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RESEARCH ARTICLE

Marketing Behaviour and Economics Vechur Cattle Farming in Kerala

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ABSTRACT

The investigation was conducted to assess the situation of Vechur cattle farming in Kerala state with the objectives to study the marketing behaviour of Vechur cattle farmers and the economics of Vechur cattle farming. The research work was carried out in three districts of the state namely Kottayam, Thrissur and Palakkad. By chain referral sampling a total of 60 Vechur cattle farmers were selected as the respondents of the study. Data were collected using a structured pretested interview schedule. The results of the study revealed that out of 60 farmers studied only 23 were marketing the milk in that only six of them doing it on a commercial basis. By engaging in Vechur cattle farming the different sources of income were the sale of milk, sale of value-added products, sale of heifers, sale of manure, sale of urine and sale of male calves. It could be concluded from the economic analysis that the farm with the highest number of productive animals got the highest profit but even though the size was less by engaging all the income-generating activities income per animal was highest for the farm with two animals.

Keywords: Vechur, behavior, Kottayam, animal, farm, farmers.

INTRODUCTION

The dairy sector in India, despite many constraints, has made significant progress in the last decade. India is the largest milk producer in the world and contributing 22 per cent of global milk production. During 2018-19 the total milk production in India was 187.7 Million Tonnes with a Per capita availability of 394 grams/day (Animal

Husbandry Statistics, DAHD & F, GoI). Livestock in general and dairying, in particular, play a vital role in the Indian economy and also in the socio-economic development of millions of rural households. In India, about 80 million rural households are engaged in milk production, with a high proportion comprising landless, small and marginal farmers. Both commercial and small scale dairy farmers in the country playing a vital role in the total milk production and thereby in the national economy. The reason behind the high milk production in India is mainly because of the presence of a large number of milking cows present in the country and it is not because we have a large number of high yielding animals.

Most of the dairy farmers in India are raising animals in small scale traditional manner especially those farmers who rearing indigenous or indigenous non-descript animals, and these farmers are reluctant to calculate the monthly economics. They believe that it is associated with large commercial farms. Due to improper recording of the trades and analysis of data some farmers are losing their investment instead of being benefited. Organised milk procurement, processing, an efficient and effective marketing system minimizes the cost of marketing services and ensures the largest share of consumer's price to the producers. So, proper business plan, properly maintained farm economics, effective marketing system and a suitable marketing channel, can ensure maximum production and profit from dairy farming business and enable the farmers to have the better economic, social and nutritional status of living.

India has 30.70 per cent of the world's cattle population. As per the Livestock census(2019) draft, the species wise milk contribution revealed that exotic crossbred cows contributing 26 percent of the India's total milk production and 21 per cent is contributed by indigenous cows (both descript and non-descript cows). In Kerala the Vechur cattle is a dwarf breed and it is the only recognised native cattle breed of the state. The cattle are valued for the larger amount of milk it produces relative to the amount of feed it requires. The milk of Vechur cattle is believed to have medicinal properties and easily digestible due to its smaller fat globule size (Venkatachalapathy and Iype, 1997). The protein component of Vechur cattle milk has an improved antimicrobial property (Shashidharan *et al.,* 2011). Iype (2013) viewed Vechur cattle as a living reality and it provided the farmers with a viable, economical and sustainable resource. Even though Vechur cattle milk is famous for the believed medicinal values, due to the low yield of milk, the people were reluctant to do Vechur cattle farming earlier. However, the trend is changing nowadays. Even though a significant number of people are engaged in indigenous cattle rearing these days, there is a lack of proper data regarding the marketing and economics of Vechur cattle farming. Therefore, keeping in view of the above facts, the marketing and economics of Vechur cattle farming were studied.

MATERIALS AND METHODS

An ex post facto research was conducted among the Vechur cattle farmers in Kerala state to understand the marketing behaviour of Vechur cattle farmers and the economics of Vechur cattle farming. By employing the chain referral sampling technique, a total of 60 Vechur cattle farmers from three districts of the state namely Kottayam, Palakkad and Thrissur were selected. Although 60 Vechur farmers were studied only 23 were selling their milk and on analysis it is understood that only 6 farmers qualified as being engaged in commercial Vechur cattle farming *ie*, selling the products on a commercial basis so the economics of those farms were studied. The data were collected through a pre-tested structured interview schedule and the collected data regarding cost components, milk production, marketing etc. were analyzed by using simple tabular analysis, averages, percentage and ratios. The cost and returns analysis was carried out on the basis of different cost concepts as given below: -

1. **Fixed cost:** Fixed cost is the expenditure which is incurred whether or not the production is carried out. It included the cost of construction of shed, equipment and cost of purchase of animals.
2. **Variable cost:** Variable costs are those costs which are incurred on the variable factors of production and can be altered in the short run. It includes feed cost, labour cost, veterinary cost and insurance cost.

a) Feed and fodder cost- Cost on green fodder, dry fodder and concentrate were worked out by multiplying quantities of feeds and fodders consumed by animals with their respective price as described earlier.
b) Labour Cost-It included family as well as paid labour. The hired labour was calculated on the basis of actual cost incurred. In case of family labour, the imputed value obtained depending upon the time spends in dairying and wage rates as fixed by minimum wages fixed by the Government of Kerala. The labour cost was apportioned on a standard animal unit basis.
c) Veterinary cost- It included the cost incurred on artificial insemination, pregnancy diagnosis, vaccination, medicines feed supplements and fees of a veterinary doctor.
d) Insurance cost - The cost of insurance was imputed for all milch animals at a premium rate of 3 per cent per annum.
e) Electricity cost
f) Cost of production of a value-added product -It includes the cost of production of value-added products like ghee, curd, buttermilk etc.
g) Cost of production by Products-It include the cost of production of by-products like Panchagvya, Jeevamritha etc.

3. **Total cost:** It was obtained by adding fixed cost and variable costs
   i.e. Total cost = Variable cost + Fixed cost
4. **Average fixed cost:** It was obtained by dividing the fixed cost with the total number of Vechur animals reared on the farm.
5. **Average variable cost**: It was obtained by dividing the variable cost with the total number of Vechur animals reared in the farm
6. **Average total cost:** It was obtained by adding average fixed and average variable costs,
   i.e. Average total cost = Average variable cost + Average fixed cost
7. **Revenue**: Revenue were obtained by adding all the returns from the farm like sale of milk, sale of a value-added product, sale of the heifer, sale of male calf and sale of by-products Revenue = Sale of milk + sale of value-added product + sale of heifer + sale of male calf + sale of by-products
8. **Gross return:** Gross return was calculated by subtracting variable cost from revenue
   i.e. Gross returns = Revenue – Variable cost
9. **Net return:** The net return was calculated by subtracting the total cost of production from revenue
   i.e. Net returns = Revenue – Total cost of production

RESULTS AND DISCUSSION

The data in Table 1 revealed that out of 60 Vechur cattle farmers studied only 23 of them were selling their milk, in that majority (82.61%) of them sold milk to nearby households in loose as farm fresh form, only two of them pocketed and sold as farm fresh form and none of them were pocketed and sold as processed. This was in consonance with the findings of Kumar and Staal, (2010) they reported that the majority of the milk marketed still passes through the traditional channels handling raw milk and conventionally processed products. In case of indirect marketing about half of them sold their milk to the Co-operative Society and only a few of them sold milk to Hotel or Tea Shop/ other agencies. This was in consonance with the findings of Potdar *et al*. (2019), they found that 33.00 percent of the studied respondents sold milk to the cooperative dairy. Similar findings were also reported by Suhaimi *et al.* (2017) in a study on transaction cost analysis of milk marketing channel selection that only a minority of farmers chose intermediaries including restaurants, hotels or processing firms as their milk marketing channel. On further analysis, it is found that only half of the farmers were doing value addition of the milk. Farooq *et al.* (2009) reported that in Pakistan farmers studied in the desert area sold only one-fifteenth of the total milk produced and remaining was consumed as liquid milk and yoghurt or converted it into butter or desi ghee. Upon asking whether the buyers ready to pay a premium price majority of the farmers reported that the buyers were not willing to pay a premium price for Vechur milk. It could be inferred from Table 2. that Farm number 3 incurred a high total cost of

production and this was due to more number of animals reared. Jadav *et al.* (2016) opined that the average per day per animal total maintenance cost for an indigenous breed was Rs. 194, for Gir it was Rs. 213 respectively during 2014 and further he reported that the cost of maintenance of Indian buffaloes and cows were found increasing with an increase in farm size. On analysis of the income pattern, it revealed that they derived direct income from the sale of all types of products and byproducts of Vechur cattle except urine. Jadav *et al.* (2016) found that buffalo and cow milk production was remunerative for all categories of farms. Though the population of adult animals was the same in other farms the net return from the Vechur cattle farming varied significantly from Rs.62086 to Rs.116861. This could be due to factors such as the sale of heifer calf, extent of value addition, exploring marketing channels for milk to obtain premium price, negotiation skills, etc.

Farm number 3 was having the highest net income since the number of animals was more. It also revealed that the farmer had engaged labourers for the farm operations and he had diversified his farm business like value addition of Vechur cattle products in the farm. By a cursory look at the results of the economics of Vechur cattle appeared that the Farm number 3 which was having six animals provided less return per animal than those with a few animals but an in-depth analysis revealed that the farmer did not completely disposed of the offspring produced in the farm, which was an important income component of other farms since the farm was in the expansion phase. The farm with the highest number of productive animals got the highest profit but even though the size was less by engaging all the income-generating activities income per animal was highest for the farm with two animals.

CONCLUSION

Even though India is the highest milk producer in the world and well established cooperative structure, in the case of indigenous cattle farming the traditional marketing channels are still dominant. Majority of the farmers are doing direct marketing because they are not getting premium prices for the milk and hence they are reluctant to sell the milk to the co-operative society, this point to establishment of marketing facilities exclusively for indigenous cattle products so as to help the indigenous dairy animal holders to sustain in the business and conservation of local breeds. The economic analysis revealed that the farm with the highest number of productive animals got the highest profit but even though the size was less by engaging all the income-generating activities income per animal was highest for the farm with two animals. So the authorities should give training to the farmers for value addition of milk, preparation of by-products like Panchagavya and Jeevamritham from indigenous cow urine and dung. Above all people should be made aware about the importance of indigenous cattle through appropriate extension methods.

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Table 1. Details of marketing

Sl. No.	Category		Frequency (f)	Percentage (%)
1	**Vechur cattle farmers who selling the milk (n=60)**			
	Yes		23	38.33
	No		37	61.67
2	**Milk marketing pattern (n=23)**			
	Direct	Nearby households in loose as farm fresh	19	82.61
		Pocketed and sold as farm fresh	2	8.70
		Pocketed and sold as processed	0	0.00
	Indirect	Co-operative Society	6	26.08
		Hotel or Tea Shop/ other agencies	3	13.04
3	**Saleo f value-added products (n=23)**			
	Yes		6	26.08
	No		17	73.91
3	**Are buyers ready to pay a premium price (n=60)**			
	Yes		2	3.33
	No		58	96.67

Table.2. Cost and return from Vechur cattle farming

Particulars	Farms					
	Farm. 1	**Farm. 2**	**Farm. 3**	**Farm. 4**	**Farm. 5**	**Farm. 6**
Number of animals in the farm	2	2	6	2	2	3
Cost of production in Vechur Cattle Farming						
Feed Cost	8400	21000	48720	17520	6000	21600
Veterinary Aid	600	800	2000	1200	1200	1000
Cost of production of value-added products	2000	1200	4000	1000	1500	3200
Electricity Cost	2000	1440	2000	3000	0	3000
Labour cost	0	0	18000	12000	24000	3600
Miscellaneous	2400	2400	9000	6000	1800	7200
Total Cost	**15400**	**26840**	**83720**	**40720**	**34500**	**39600**
Income from Vechur Cattle Farming						
Sale of milk	33600	43560	85440	72000	41586	57600
Sale of Value added products	11001	13500	63000	12000	12000	20000
Sale of heifer	77000	80000	200000	40000	40000	60000
Sale of Manure	2400	0	8000	0	0	2000
Sale of Urine	1250	1800	0	0	0	0
Sale of Male Calves	7000	3000	10000	6000	3000	3000
Gross Return	**132251**	**141860**	**366440**	**130000**	**96586**	**142600**
Net Return	**116851**	**115020**	**282720**	**89280**	**62086**	**103000**
Net return per animal	**58426**	**57510**	**47120**	**44640**	**31043**	**34333**

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RESEARCH ARTICLE

Knowledge, Attitude and Practices of Dental Students towards Dental Management of Patients on Anti-Coagulant Therapy (Survey)

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ABSTRACT

To assess the learning, state of mind, awareness and practices of dental students toward dental management of patients on anticoagulant therapy. The study was conducted during the academic year 2017-18 among the dental house surgeons and postgraduate in Chennai. A self-administered questionnaire was questioned to 132 students. The questionnaire was designed to collect the data regarding the knowledge and awareness among dental students about anticoagulant drugs, their attitude and practices towards treating patients on anticoagulant therapy in dental management. The data from the participants were collected, statistically analysed, and results were obtained **a**bout 56% of students preferred to refer the patient to physician while treating patients under anticoagulant drugs. About 42% of them have mentioned that local haemostatics measures can control bleeding during dental extraction.

About 55% of students have stated that minor surgical procedures can be carried out safely, without stopping the anticoagulant medication. About 61% of them did not know the half-life of Warfarin. About 57.6% of them told they will advise INR test before an oral surgery procedure if the patient is on warfarin therapy. Educational programs and workshops related to the subject can increase the awareness of students to upgrade their knowledge, awareness and practice related to managing patients on anticoagulant therapy before dental treatment. The main findings from this study suggest that there is a great need to educate dental students to use evidence-based guidelines in terms of dental treatment for patients on anticoagulant therapy.

Keywords: Anticoagulant therapy, Survey, Warfarin, Bleeding, dental procedure.

INTRODUCTION

An ageing society and a continuous expansion of the eligibility criteria for primary or secondary pharmacological prevention of Cardiovascular and cerebro vascular events have led to an ongoing rise in the number of patients continued anticoagulant has to be balanced against the risk of thromboembolic events in case the protective drugs are discontinued before the procedure. The standard of care done by dental practitioner as of recently is to stop anticoagulant drugs before dental procedures involving bleeding since these drugs are known to affect coagulation and clot formation. Most current recommendations favour the performance of simple procedures such as tooth extraction under continued anticoagulant or antiplatelet therapy. Data in the literature largely indicate that in patients taking warfarin the risk of thromboembolism outweighs the risk of bleeding. As a consequence, it is usually not recommended to interrupt therapy with warfarin (anticoagulant drugs) for tooth extractions. Dental students were either not aware of the official recommendations or had difficulties in adapting these to clinical practice. Hence, this structured survey was conducted for dental students in our institution to evaluate their knowledge, attitude and practices regarding dental management of patients on anticoagulant therapy.

MATERIAL AND METHODS

The study was conducted during the academic year 2017-18 among the dental house surgeons and postgraduate in Chennai. A self-administered questionnaire was questioned to 132 dental students. The questionnaire was designed to collect the data regarding the knowledge among dental students about anticoagulant drugs, their knowledge, attitude and practices towards treating patients on anticoagulant therapy. The data from the participants were collected, statistically analysed, and results were obtained

RESULT

About 56% of students preferred to refer the patient to physician while treating patients under anticoagulant drugs. About 42% of them have mentioned that local haemostatics measures can control bleeding during dental extraction. About 55% of students have stated that minor surgical procedures can be carried out safely, without stopping the anticoagulant medication. About 61% of them did not know the half-life of Warfarin. About 57.6% of them told they will advise INR test before an oral surgery procedure if the patient is on warfarin therapy. About 33% told aspirin is anticoagulant. About 27% told they will do blood test before extraction if patient is on anti-coagulant therapy, about 45%were not aware of heparinization process.

DISCUSSION

A dentists' attitude, knowledge and practice can be determined in an effective manner by conducting a questionnaire survey. Face to face surveys have response rates higher than electronic or mailed questionnaires [18, 19]. But the major disadvantage with face to face questionnaires is interviewer bias [20]. Hence, a nurse was present during the filling up of the printed questionnaire provided to the participants. This was done to ensure better response rate and also eliminated interviewer bias as they did not offer any clarifications. In the present survey, a little more than half the dentist's answered that they are comfortable with carrying out dental procedures if blood test report investigation were within the therapeutic limits for patients on OAM. However, the same participants answered that they would prefer that the OAM be discontinued prior to procedures such as extraction and implant surgery for which current recommendations suggest proceeding without discontinuing the OAM and manage the bleeding with local haemostatic [21,22].A systematic review done by Modrid C et al. [23], concluded that there is no need to interrupt anticoagulation therapy or supplement it with bridging therapy for minor procedures like extraction or implant placement. In these cases, local haemostatic measures such as sutures or tranexamic acid solution can be employed to control the bleeding. However, for patients taking oral anticoagulant therapy requiring major oral surgical procedure, where bleeding risk is high, the dosage of anticoagulant therapy can be reduced or the drug can be stopped and bridged with low molecular weight heparin. The decision depends on the individuals risk for thromboembolism and bleeding [23].The results of survey also suggested that over 40% of the dentistswere most concerned about the risk of thromboembolism in the management of these patients.

These results could be explained on the basis that though the dentists are aware and updated about the current recommendations, they find it difficult to translate it into practice. This could be in part due to the fact that procedures such as implant surgery are increasingly being carried out by general dentists whose training in the management of excess bleeding could be limited making them apprehensive towards such situations[24]. Thus, they have a tendency to refer the patient to the physician to diminish the danger of peri-operative bleeding, by requesting them to consider discontinuation of the OAM prior to the procedure. There is a need to transfer the knowledge of the recommendations and the results of these surveys to the physicians, cardiologists and neurologists alike that many of the dental procedures don't result in significant bleeding and don't warrant the discontinuation of the drug [24]. The risk of thromboembolism also has to be reiterated by these primary physicians to the dentist to help them reconsider whether it really requires discontinuation. A similar speculation was made by Ringel R and Maas R [15] about the underestimation of therisk of thromboembolism by dentists and overestimation of the risk of bleeding by the primary physician [15].Continuing education programs in specialties such as implantology ,oral surgery, and periodontics need to include local haemostatic measures and the relevant recommendations as a part of their curriculum. It would also be beneficial if a special emphasis is placed on these areas as a part of the undergraduate dental curriculum since the proportion of the populations on these medications are showing a steep upward trend [24]. Further complicating matters are the availability of newer antiplatelet and anticoagulants.

The newer anticoagulants which come under the class of Novel Oral Anticoagulants (NOACs), such as dabigatran (direct thrombinin hibitors) and rivaroxaban (anti-factor Xa) have advantages over the traditional medications. They have less food and drug interactions, act faster and have shorter half-lives. Routine monitoring of prothrombin time and INR is not recommended while using these drugs [25]. Although current evidence on the dental managements of these patients is in the form of review articles, non dental data and opinion of experts, randomized control trials and evidence-based recommendations for these newer drugs would be published in the literature in the future [26–28]. This will require constant updates on the part of the dentist. As the switch is made to these newer drugs there will soon exist a divided population of patients on newer and older OAM's. Hence, there is an urgent need for every dentist and primary physician to update themselves on the current literature about the older OAM's before the newer OAM's are prescribed in increasing numbers. All these facts throw light on the dentists responsibility to update himself on the current evidence-based literature and weigh the risk of thromboembolic events and the

bleeding risk from the dental procedure in consultation with the primary physician of the patient(who has prescribed the OAM) before considering the proposed management. The dentist's decision should also be based on their clinical setup and the resources available for effective control of any emergency during and after the procedure. In the case of lack of such facilities, it will be wise to refer them to a setup where such facilities are available or treat them in a hospital-based care. Jeske AH et al., [7], Wahl MJ [29] and Can MM et al., [13], stated in their published surveys that the Dentists should improve their knowledge and awareness about OAMs as their survey results were similar to the current study [7,13,28]. They also emphasized the need to organize more continuing dental education programs pertaining to this topic**.**

CONCLUSION

INR values should be obtained within 24 hours before the dental procedure. For patients with INR in the therapeutic range 2-4 or below, therapy need not be modified ordis continued for simple single dental extractions [29]. Educational programs and workshops related to the subject can increase the awareness of students to upgrade their knowledge, awareness and practice related to managing patients on anticoagulant therapy before dental treatment. The main findings from this study suggest that there is a great need to educate dental students to use evidence-based guidelines in terms of dental treatment for patients on anticoagulant therapy.

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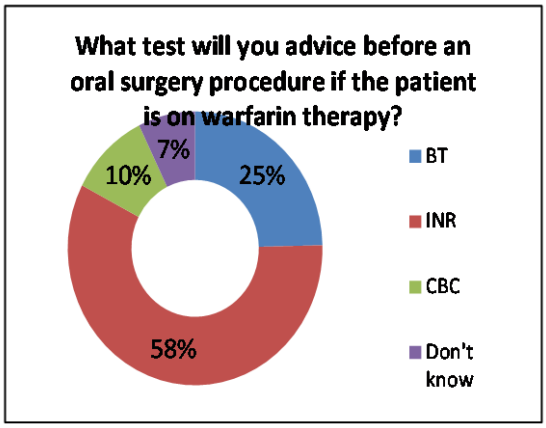

Figure 1: What test will you advice before an oral surgery procedure if the patient is on warfarin therapy.

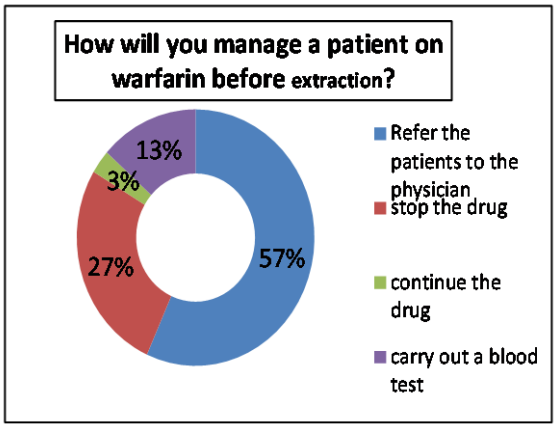

Figure2: How will you manage a patient on warfarin before extraction.

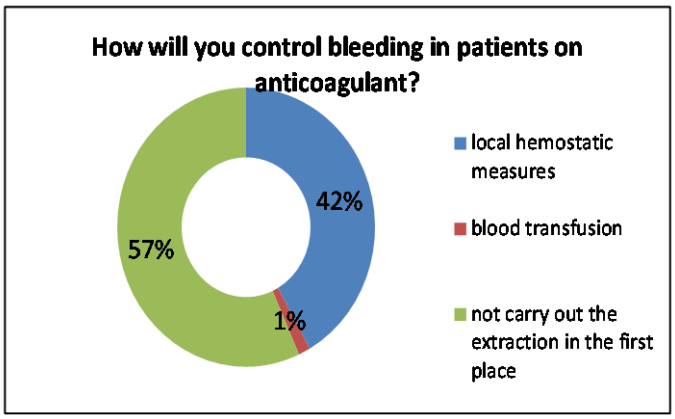

Figure 3: How will you control bleeding in patients on anticoagulant therapy.

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RESEARCH ARTICLE

Linkage between the Overall Work Life and Life Satisfaction of Nurses at Hospitals in Coimbatore District at COVID – 19

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ABSTRACT

Hospitals are a part of the Health care industry, which is taking care of the health and wellbeing of the people. The objective is to study the linkage between the overall work-life and life satisfaction of nurses at hospitals in Coimbatore district. This study has considered 20 hospitals in Coimbatore District and has used a purposive sampling design to collect the primary data. A well-structured questionnaire used to collect the data from the nurses. The researchers used descriptive analysis, canonical correlation, and t statistics. It is essential to consider the overall working life of the nurses to improve the Quality and performance in hospitals.

Keywords: Overall work-life, Quality of work life, work-life balance, career advancement, labor welfare practices, Salary and compensation, training and development, job satisfaction, Life satisfaction, Hospital.

INTRODUCTION

Quality of Work Life (QWL) defined as the extent to which an employee is satisfied with personal and working needs through participating in the workplace while achieving the goals of the organization. The Gap of personal life with professional life is a worrying factor due to globalization, stress; work time is overlapping with a lifetime, changing nature of the job (Babatunde, A. et al., 2019). According to Lee, D.J., Sirgy, M.J.(2019), nursing professionals

are continuously working 24X7 with highly committed, and sometime they were working more than 40 hours per week (Kowitlawkul, Y. et al., 2019). Siew-Yong et al. (2018) reported that job satisfaction among nurses in Malaysia is meager, due to the low pay. QWL can benefit the nursing staff as the provision of QWL attributes are on the constitution at work organization, safe and healthy working conditions, and social integration at the workplace, the social relevance of work, and work and life span. The concept of QWL is always an exciting concept for researchers and scholars (Bowling et al., 2014; Zulkarnain Amin, 2013).

Many studies regarding the poor QWL is associated with reduced Salary, heavy workload, inadequate welfare facilities, insufficient work tools unfortunate promotional aspects and job environment (Rantanen et al., 2011, Tshitangano T. G (2013), Moradi .T at el (2014), Chauhan and Patel (2014). Job satisfied employees are showing the commitment and improved productivity (Chiang and Birtch, 2011; Nayak et al., 2018; Slimane, 2017). The excellent output is the result of highly satisfied employees (Brunges and Foley-Brinza, 2014; Yuh and Choi, 2017). If the workers are dissatisfied with QWL, it affects the job as well as the output of the firm (Elizur & Shye, 2011). There is a positive relationship between job satisfaction and QWL among employees (Rochita Ganguly (2010). Macey et al. (2009) suggested that healthcare organizations had to spend money to increase the QWL through proper training, retaining skilled and committed workers. The job like nursing demands the employees always to keep calm, polite, and moving kindly with the patients. Though they have different feelings, they cannot express or show to others (Zapf, Isic, Bechtoldt, & Blau, 2003).

REVIEW OF LITERATURE

Mushfiqur et al. (2018) stated that increasing work hours, locations, changing environment, the balance between personal and work life are creating a moral obligation to each worker. Tucker et al. (2018), Subha et al. (2018); Somers et al. (2018), and Jennings (2007) opined that the relationship between superiors and subordinates must be in positive directions work time and aspirations. Kossivi et al. (2016) stated that better QWL makes better results in an organization's overall results. According to Jeya Sunitha et al. (2015), QWL dimensions such as career growth, training and development, recognition, work nature and inter-personal relationship in the hospital environment is the major influencing factors for nurse satisfaction. The variables used to study the QWL are training and development (T&D), Salary & Compensation, labor welfare practices, and career advancement. The variables used to study the salary and compensation is salary at par with the industry, compensations are adequate, Overtime allowance, Medical claim, and compensation. The variables used to study the labor welfare practices adopted in the hospitals are working conditions, relaxation facilities, free education facilities, holiday facilities, sanitation and hygiene, medical facilities, housing facilities, and personal counseling.

According to Dhawar et al. (2014), a good QWL in an organization support the employees for providing the best in their roles and motivate them towards their objectives. Parameshwari and Suresh (2015) observed that extrinsic and intrinsic motivations to the employees are having a high impact on the growth of an organization. Jayakumar & Kalaiselvi, (2012), opined that QWL focuses on the formulation of organizational policies and strategies. Better QWL is needed to attract and reduce the attrition of the employees (Ashwini, 2014, Nanjundeswaraswamy, 2013).Surienty (2013) stated that high QWL increases the attachment towards the organization. QWL is focusing on work, family life, and leisure (Chitakornkijsil, 2010). The variables used to study are career advancement is as follows. A promotion at the proper time, more career development programs, no fear of losing the job, higher studies are encouraged, leaves provided at the time of writing exams, motivated to study higher, Conveyance allowance, health allowance fixation, night shift allowance.

The variables used to study the work-life balance are flexible leave arrangements like career breaks, sabbaticals and parental leave, availability of information on possibilities, emergency childcare, supportive organizational culture, situational factors, support from employer and management, support from colleagues, policies of the

organizationThe variables used to study the job satisfaction variables are satisfaction from the wages and bonuses, satisfaction from the rewards, satisfaction from fringed benefits, satisfaction from non-financial rewards, teamwork, personal recognition, promotion opportunities, and effective communication.

RESEARCH METHODOLOGY

Researchers used Descriptive research design for the current study. Both the primary data, as well as secondary data used in the study. A structured questionnaire used for collecting the primary data. Purposive sampling design framed for the current study. In total, 400 questionnaires were distributed purposely to nurses in the selected 20 hospitals in Coimbatore. Nurses filled the structured questionnaire and reported their opinion about their overall work-life and satisfaction. The researcher decided to collect data from 20 nurses per hospital (20 nurses X 20 hospitals as samples. The number of completed questionnaires was 361. After the scrutiny, 12 questionnaires rejected due to incomplete responses. Finally, 349 completed questionnaires used for the study. Hence, the sample size of the present study comprises with 349 nurses. Statistical tools used were descriptive analysis,'t' statistics, ANOVA, regression, and canonical correlation. The data were collected from March 2020 to June 2020 at Coimbatore.

Analysis and Interpretation

Socio Economic Conditions of the Nurses

23.2 percent of the respondents are in 25-35 age groups, 91.6 percent of the respondents are female. 77.3 percent of the respondents have a nursing degree/diploma.31.2 percent of the respondents are married. 58.7 percent of the respondents are unmarried. 40.8 percent of the respondents are having a monthly income of rupees 15000-25000. Box's Test of Equality of Covariance Matrices shown the value for Box's M as 14.575; F = 1.054, df1:150, df2:4538.559 and p value is 0.312 >0.05. It indicates that the covariance matrices are not different. i.e. the observed covariance matrices of the dependent variables are equal across groups. Multivariate Tests indicates the main and possible interaction effect of the design. The intercept refers the error variance.

Levine's Test of Equality of Error Variances explains the variances of each dependent variable are the same as the variances of all other dependent variables. In this design, JSAT, WLB and EEP are significant. For each dependent variable, post hoc tests are computed. The results of Tukey test between JSAT and QWL indicates that except section 1 in section 2, section 2 in section 1, and section 3 in section 4 and section 4 in section 3 are not significant at 0.05 levels. The results of Tukey test between WLB and QWL indicates that except section 1 in section 2, section 2 in section 1, and section 3 in section 4 and section 4 in section 3 are not significant at 0.05 levels. The results of Tukey test between EEP and QWL indicates that all the section 1, 2,3,4,5 with sections 2,3,4,5 are not significant at 0.05 levels. Pillai's trace, Lawley-Hotelling's trace, and Wilk's lambda and corresponding *F*-tests and canonical correlations coefficients for all functions are zero. The above table 4.5 indicates the Eigen values, percentage, cumulative percentage, values of canonical coefficients and its squared values. Table shows the regression between individual Univariate with dependent variables. The standard error of each test is calculated as the average conditional standard error across all the variables.

Assessing Overall Model Fit

The table 5 shows that the Output for canonical correlation analysis consists of (1) the raw canonical coefficients, (2) standard errors, (3) *t*-tests, (4) *p*-values, (5) confidence intervals, and (6) the canonical correlation coefficient for each function. The "raw "canonical coefficients are maximizing the correlation between the two sets of variables. The Unstandardized canonical coefficients indicate how much each variable in each set is weighted to create the linear combinations that maximize the correlation between the two sets. From the table 4.6, the variable QWL, a one unit increase leads to a .331 increase in the job satisfaction when all of the other variables are held constant. The strength of the relationship between the pairs of covariates is reflected by the CCA coefficient. For the first function, *Rc* = .57971. For the second function, *Rc* =.20128. For the third function, *Rc* = .05215. The correlation between the

dependent variables and canonical variables factor loadings. The first dependent variable can predict up to 53.11% and the second dependent variable can predict up to 29.43%. *QWL and CAD* is most closely related to the first canonical function, and LWP is closely related to the second canonical function. In the case of covariates, JSAT is most closely related the first canonical function, and *EEP* is most closely related to the second canonical function.

DISCUSSIONS

Researchers studied the association between OWL and life satisfaction using canonical (correlation Analysis (CCA). CCA was used instead of separate linear regression models for each OWL measurement because it simultaneously models the effects of multiple independent variables on multiple dependent variables. CCA offers a more efficient approach for assessing the effects of the OWL factors on QWL, TD, SALCOM, LWP, and CAD, such as multiple linear regressions. Furthermore, in CCA, the latent variable approach, as used, helped to avoid multicollinearity. Researchers found that OWL of nurses working at hospitals in the Coimbatore district had a significant but moderate association with Life satisfaction factors. In addition to that, CCA helped in narrowing down OWL factors and outcome variables (JSAT,WLB and EEF) that might contribute to the relationship based on the variable loadings to the composite scores. Thus, CCA used as a comprehensive approach to extracting information from data to simultaneously identify both essential exposure and outcome variables so that the assessment of the relationship between a single exposure and an outcome can further proceed.

Additionally, CCA revealed a significant interaction between QWL, TD, SALCOM, and WLB through the composite scores. Because the OWL measurements are highly correlated, the combination of the indicators captures more information and, thus, as a composite variable, may better predict future outcomes more efficiently than the use of a single OWL measure. So, in addition to evaluating the association between two sets of variables, CCA can also be used as a data mining tool in that it was able to narrow down fewer exposure and outcome variables that might contribute to the relationship. The composite scores can also identify the effect of interaction between factors on life satisfaction. The effect of interaction between independent variables on the dependent variables depicted in the canonical loading 1 and 2. In this study, following the canonical correlation analysis, the multivariate analysis of variance indicated that JSAT is most closely related to the first canonical function, and *EEP* is most closely related to the second canonical function. It indicates that when job satisfaction and work-life balance is perfect, then the life satisfaction is improved. Factors such as the quality of work-life, salary, welfare practices may lead to making a work-life pleasant and smooth. Hence from the study, the canonical model analysis indicates that OWL and LISAT are interrelated, and the link is secure when QWL factors and LISAT factors are complements to each other (Al-Ahmadi, 2009).

CONCLUSIONS

The aim of the current research is to study the linkage between the overall work life and life satisfaction of nurses at hospitals in Coimbatore District at COVID – 19 period. The healthcare industry is providing essential health services to society, which is provided by doctors, nursing staff, and paramedical staff. Nurses are the core of the health sector. The health sector reported that the shortage of nursing staff in the COVID 19 period and the challenging nature of the nursing profession are the reasons for the difficulty of performing nursing jobs and retaining nursing staff. The dissatisfaction about the job can tackled by providing QWL factors at the workplace, safe and healthy working conditions, social integration at the workplace, the social relevance of work, and work and life span. Effective management of QWL can reduce the adverse effects of stress and dissatisfaction about the job. At the global level, the healthcare worker, i.e., nurses, reported experiencing work-related problems (workload, stress, work pressure, less cooperation from superiors and colleagues), which leads to job dissatisfaction. The factors of QWL can improve job satisfaction and enable the nurses to work better.

In this COVID 19, the provision of QWL, safe and healthy working conditions, and social relevance of the work-life are the most critical factors to address the issues among the nursing staff. Working conditions associated with the right work times and responsibilities within the human capacities can bring a positive impact on satisfaction towards their job.Future research needs to incorporate a longitudinal research design. Moreover, the present research utilized the QWL dimensions, which have limitations. The other dimensions of QWL for the future may include the dimensions of adequate and fair compensation, opportunity to growth and security, and the opportunity to develop human capital. Future research can consider all the QWL dimensions to explore the impacts of QWL on life satisfaction. Since the sample for this study is mostly female nurses, future research may include male respondents to explore the issue of life satisfaction.

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TABLE 1 -Box's Test of Equality of Covariance

Box's Test of Equality of Covariance Matrices[a]	
Box's M	214.575
F	1.054
df1	150
df2	4538.559
Sig.	.312
Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.	
a. Design: Intercept + QWL + SALCOM + LWP + CAD + QWL * SALCOM + QWL * LWP + QWL * CAD + SALCOM * LWP + SALCOM * CAD + LWP * CAD + QWL * SALCOM * LWP + QWL * SALCOM * CAD + QWL * LWP * CAD + SALCOM * LWP * CAD + QWL * SALCOM * LWP * CAD.	

TABLE 2 - Levene's Test of Equality of Error Variances

Levene's Test of Equality of Error Variances[a]				
	F	**df1**	**df2**	**Sig.**
JSAT	2.450	105	243	.000
WLB	2.996	105	243	.000
EEP	1.922	105	243	.000
Tests the null hypothesis that the error variance of the dependent variable is equal across groups.				
a. Design: Intercept + QWL + SALCOM + LWP + CAD + QWL * SALCOM + QWL * LWP + QWL * CAD + SALCOM * LWP + SALCOM * CAD + LWP * CAD + QWL * SALCOM * LWP + QWL * SALCOM * CAD + QWL * LWP * CAD + SALCOM * LWP * CAD + QWL * SALCOM * LWP * CAD.				

TABLE 3 -Multivariate Tests of Significance (S = 3, M = 0, N = 170)

Test Name	**Value**	**Approx. F**	**Sig. of F**
Pillai's trace	.37930	12.44700	.000
Hotelling's trace	.55113	15.64588	.000
Wilks lambda	.63530	14.1083	.000
Roys	.33607		

TABLE 4 -Eigen values and Canonical Correlations

Root No.	**Eigen values**	**Pct.**	**Cum. Pct.**	**Canon Cor.**	**Sq. Cor**
1	.50617	91.8435	91.84357	*.57971*	.33607
2	.04222	7.66157	99.50514	*.20128*	.04051
3	.00273	.49486	100.0000	*.05215*	.00272

TABLE 5 –Univariate analysis Regression analysis for WITHIN CELLS error term: Individual Univariate .95 confidence intervals

Dependent variable- QWL

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t	Lower -95%	CL- Upper
JSAT	.33162	.34191	.05453	6.081	.000	.22438	.43888
WLB	.38348	.39794	.04772	8.036	.000	.28963	.47734
EEP	.15644	.15538	04735	3.303	.001	.06331	.24959

Dependent variable- SALCOM

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t	Lower -95%	CL- Upper
JSAT	.40480	.41840	.05719	7.078	.000	.29233	.51728
WLB	.21365	.22226	.05004	4.269	.000	.11523	.31208
EEP	.23357	.23256	.04966	4.703	.000	.13591	.33125

Dependent variable- LWP

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t	Lower -95%	CL- Upper
JSAT	-.05429	-.05278	.09984	-.5438	.587	-.25067	.14208
WLB	.04644	.04544	.08737	.5315	.595	-.12540	.21828
EEP	-.10134	-.09490	.08670	-1.168	.243	-.27187	.06918

Dependent variable- CAD

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t	Lower -95%	CL- Upper
JSAT	-.03611	-.03536	.09934	-.36354	.716	-.23150	.15927
WLB	.08252	.08132	.08693	.9493	.343	-.08845	.25350
EEP	-.10406	-.09815	.08626	-1.206	.228	-.27374	.06560

TABLE 6 –Canonical correlation analysis

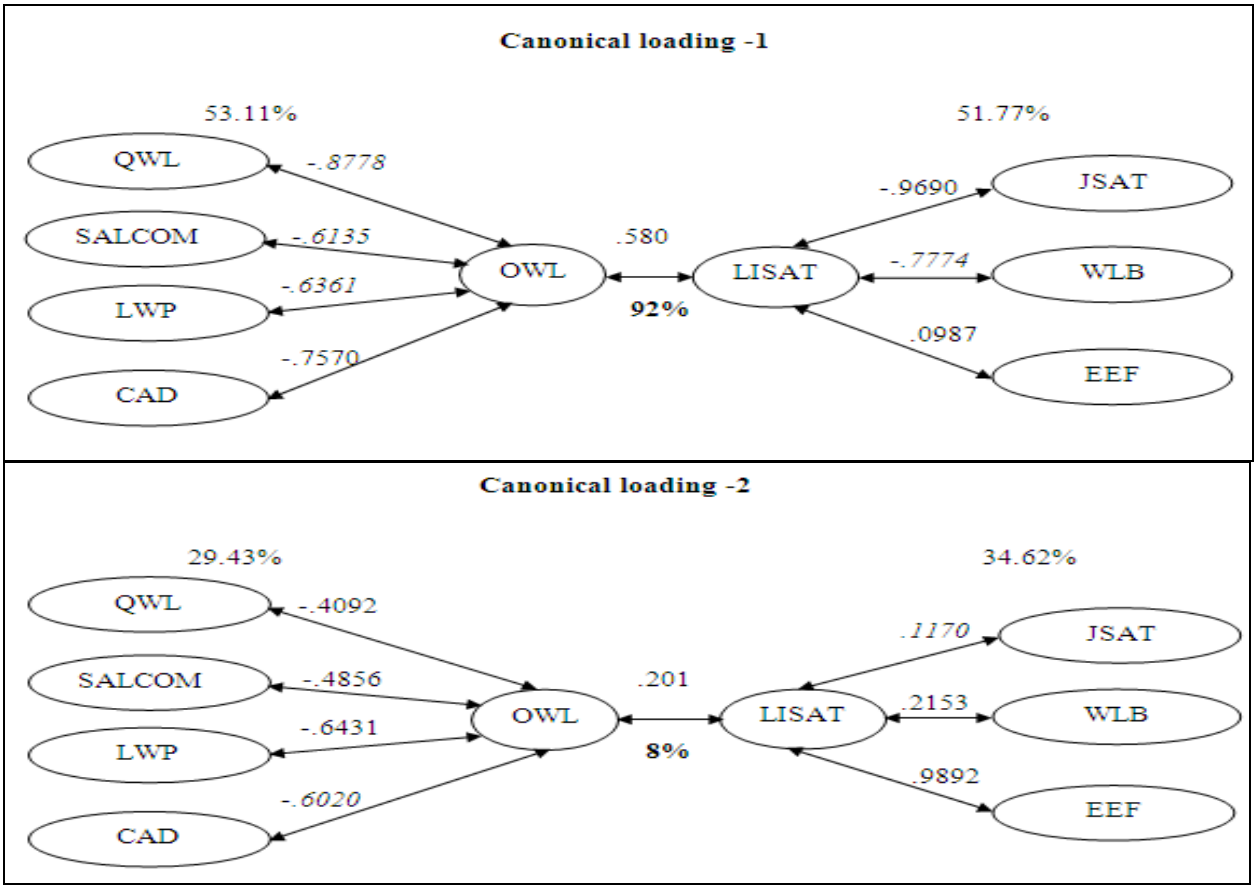
Correlations between DEPENDENT and canonical variables			
	Function No.		
Variable	1	2	3
QWL	-.87777	.40916	-.24432
SALCOM	-.61352	-.48385	-.09670
LWP	-.63608	-.68311	-.42274
CAD	-.75695	-.60197	.25134

Variance in dependent variables explained by canonical variables				
CAN. VAR	Pct Var DEP	Cum Pct DEP	Pct Var COV	Cum Pct COV
1	53.1113	53.1113	17.8489	17.8489
2	29.4374	82.5487	1.19264	19.0415
3	7.7731	90.3219	.02114	19.0627

Standardized canonical coefficients for COVARIATES: CAN. VAR			
	Function No. 1		
COVARIATE	1	2	3
JSAT	-.76605	.19455	1.07863
WLB	-.31141	-.11384	-1.32393
EEP	.15839	1.01267	.16049

Correlations between COVARIATES and canonical variables: CAN. VAR			
	Function No.2		
COVARIATE	1	2	3
JSAT	-.96894	.11702	.21785
WLB	-.77744	.21526	-.59097

EEP	.09875		.98920	-.10829
Variance in covariates explained by canonical variables				
CAN. VAR	**Pct Var DEP**	**Cum Pct DEP**	**Pct Var COV**	**Cum Pct COV**
1	17.3972	17.3972	51.7673	51.7673
2	1.4025	18.7997	34.6183	86.3856
3	.03703	18.8368	13.6143	100.0000



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RESEARCH ARTICLE

Recurrent Ameloblastoma: A Surgical Challenge and Charisma

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ABSTRACT

Ameloblastoma is locally aggressive benign odontogenic tumour with increased risk of recurrence rate. The choice of treatment depends on the histologic subtype. Radical therapy is the recommended modality for solid ameloblastomas. The possibilities of recurrence even after enbloc resection are still high. The author presents case reports of recurrent ameloblastomas post radical resection . This case describes the recurrence of ameloblastoma in the soft tissue after 1 year of segmental resection and reconstruction with Recon plate.

Keywords: ameloblastoma, tumour, plexiform, cavity, solid

INTRODUCTION

Ameloblastoma is the common locally aggressive benign epithelial odontogenic tumour of the oral cavity[1]. It was first recognized by Cusack in 1827 and named in 1930 by Ivy and Churchill [2]. According to WHO classification in 2005, there are 5 subtypes of benign ameloblastoma documented, and they are (1) solid/multicystic type, (2) desmoplastic type, (3) unicystic type, and (4) extraosseous/peripheral type[3]. Histopathologically, the 6 subtypes are follicular, plexiform, acanthomatous, basal, unicystic, and desmoplastic ameloblastoma[4]. It can be managed either by the conservative method or radical approach depending on the type, location, and size and age of the patient. A systematic review by Almaida et al. described that the 50% of recurrence is seen in follicular subtype and the recurrence rate is significantly low if a radical approach is used[5]. A number of different treatment strategies have been previously reported including local techniques (curettage, enucleation or marsupialization) or radical treatments (marginal or en-bloc segmental resection with safety margins and reconstruction of bone defect)[6]. This Case describes case of recurrence of ameloblastoma in patient who underwent segmental resection of the jaw and reconstructed with Recon plate.

Case

A 21-year-old female patient referred by a private practitioner complained of swelling in the previously operated area of the Left lower jaw since one month. She had a history of surgery in the same region. While going through the records of the patient, she had undergone segmental resection and reconstruction of the defect with a recon plate 5 years ago. Histopathology reports of the previous pathology was Ameloblastoma in records. Panoramic radiograph and CT scan revealed multilocular radiolucent lesion in the previously operated site. Clinical diagnosis at present was recurrent multicysticameloblastoma. Excision of the lesion with 1cm uninvolved soft tissue margin was performed through the previous scar. Resection of condylar head along with the coronoid process was done. Reconstruction was done with Recon Plate with Condylar head. Histopathology report of the specimen suggested follicular ameloblastoma with acanthomatous changes with tumour free margins. A 6 months-follow-up showed no recurrence. She is planned for alloplastic reconstruction of the Left hemimandible, considering the benign nature of the lesion.

DISCUSSION

Ameloblastoma is a locally aggressive, anatomically benign tumour of the oral cavity which rarely undergoes malignant transformation [7]. It is the second most common odontogenic tumour, the first being odontoma [8]. Solid/multicystic variant is the most common type, and it is highly aggressive and has a 90% recurrence after conservative management such as curettage and enucleation [9]. A Higher rate of recurrence is observed in mandibular ameloblastomas than maxillary ameloblastomas and in follicular type than in plexiform or any other type[10]. Ahlem et al. observed that the cell proliferation activity evaluated by Ki67 and CD10 was significantly higher in recurrent tumours [11]. More common area affects the mandibular posterior region. Infiltration of the tumour cells occurs more predominantly in the cancellous portion of the cortical bone. Hence, CT scan is most promising in identifying the cortical destruction and soft tissue involvement [12]. Management involves either conservative or radical approach. The conservative method involves enucleation with adjunctive procedure either chemical cauterization or peripheral ostectomy of 1–1.5cm normal margin.

Conservative approach can be utilized for unicystic type. According to Pogrel and Montes, a unicystic variant can be best managed by enucleation with an application of Carnoy's solution or cryotherapy [13]. Radical approach is indicated for large ameloblastoma involving the inferior alveolar canal or below or for more aggressive variants like intramural ameloblastoma or multicystic type [14] . It involves segmental or marginal resection with 1.5–2cm normal bony margin beyond the radiologic margin. Resection with 2-3cm clear bone margin is indicated in cases of ameloblastic carcinoma. Mandible posterior region is the common site of occurrence, and as it invades the cancellous

portion beyond radiologic margin, over a time it can cause cortical perforation [15]. Invasion of the periosteum can lead to spread of the tumour cells to the soft tissue. Inadequate resection of the hard and soft tissues beyond a tumour would cause recurrence [16] . It is the known fact that the rate of recurrence with the conservative management is high (around 60%) compared to radical treatment (13%). Reports have been suggested that there are higher possibilities of retained soft tissue tumour islands during the surgical procedure in the complex regions like infratemporal fossa. In this first case report, the resected mandibular region underwent tumorigenesis. It could be due to the remaining cells at the osteotomy site. It would be wise to wait for the histological report with the free margin before reconstruction in any case of the solid type to avoid donor site morbidities. The complication of primary reconstruction should be explained to the patient before surgery.

CONCLUSION

Our experience with this case report suggests high local aggressiveness of the solid type of ameloblastoma. Tumour free soft tissue margin in three dimensions should be considered when treating large lesions with an erosion of cortical outline. Clinical and histological study to a larger extent will provide added information in the management.

Consent

Informed consent is taken from the patient

Conflicts Of Interest

The author declare that they have no conflicts of interest

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Figure1- Facial Profile

Figure2- Intraoral pic showing proliferated growth in lower left posterior region of jaw

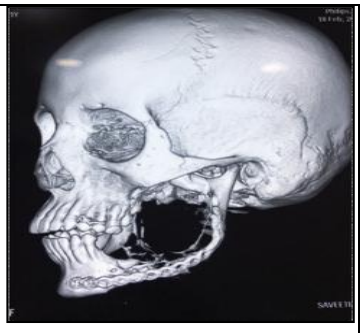

Figure3- Preoperative 3D CT scan showing recurrent tumour and remnant of coronoid process

Figure4- Preoperative 3D CT scan showing recurrent tumour and presence of Recon plate and expansion & thinning of Cortical plate

Figure5- 3D CT scan showing presence of molat tooth in Left Coronoid region

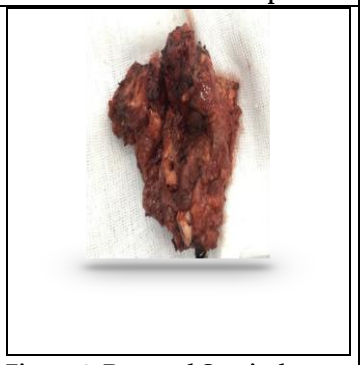

Figure 6- Resected Surgical specimen

Figure 7 - post op OPG showing Reconstruction of defect with Recon plate with condylar head.

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RESEARCH ARTICLE

Odd Powers of Triangular Numbers

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ABSTRACT

The sum of powers of natural numbers is connected with Bernoulli Numbers. They can also be calculated by several other techniques like Faulhaber's Formula, Euler – Summation Formula etc. The sums of first power of natural numbers are called Triangular Numbers. Triangular numbers appears as special class of more general numbers called Figurate numbers. Beginning from the period of Pythagoras, several mathematicians up to modern day had investigated about Figurate numbers. Recent research includes Figurate numbers in higher dimensions. The sum of squares of natural numbers for example is called Square Pyramidal numbers and they resemble the great pyramids of Egypt which are considered to be one of Seven Wonders of the World for long time. We find several interesting properties for triangular numbers. For instance, the sum of any two successive triangular numbers is a square number. However, in this paper, I propose a new formula to determine relationship between the odd powers of triangular numbers with sum of certain powers of natural numbers. This expression provides us with a new perspective to the understanding of triangular numbers as well as sum of powers of natural numbers.

Keywords: Sum of powers of natural numbers, Triangular Numbers, Bernoulli numbers, Telescopic Summation, Binomial Coefficients.

INTRODUCTION

The study of sum of powers of natural numbers has been a great deal of research right from Ancient times. Many new ideas had emerged in the last three to four centuries. In particular, mathematicians like Johann Faulhaber, Leonhard Euler, Jacob Bernoulli made significant contributions before they were treated with modern ways in connection with Integrals and other methods.

Let us denote the sum of kth powers of first n natural numbers by the expression

$$S_k(n)=1^k+2^k+3^k+\cdots+n^k \qquad (1.1)$$

Definition

The sum of first n natural numbers is defined as nth triangular number. In view of (1.1), we see that $S_1(n)=1+2+3+\cdots+n=\frac{n(n+1)}{2}=T_n \quad (2.1)$ is the nth triangular number. The first few triangular numbers are 1, 3, 6, 10, 15, 21, 28, 36, 45, 55, 66, 78, 91, 105, 120, 136, . . .

The sum of second, third, fourth, fifth and higher powers of sums of natural numbers can be computed using Bernoulli numbers which we define now.

Bernoulli Numbers

The Bernoulli numbers are the numbers which occur as coefficients of $\frac{x^n}{n!}$ in the Maclaurin's series expansion of the function $\frac{x}{e^x-1}$. In particular, the nth Bernoulli number denoted by B_n can be computed through

$$\frac{x}{e^x-1}=\sum_{n=0}^{\infty}B_n\frac{x^n}{n!} \quad (3.1)$$

There is an elegant method to compute Bernoulli numbers with the aid of Pascal's Triangle entries. Due to exponential series formula, first, we notice that the constant term in the expression $\frac{x}{e^x-1}$ is 1 and so by (3.1), we must have $B_0=1$.

From the row entries of Pascal's Triangle without their last term, we have the following set of equations concerning consecutive Bernoulli numbers.

$$B_0+2B_1=0$$

$$B_0+3B_1+3B_2=0$$

$$B_0+4B_1+6B_2+4B_3=0$$

$$B_0+5B_1+10B_2+10B_3+5B_4=0$$

$$B_0+6B_1+15B_2+20B_3+15B_4+6B_5=0$$

. . . . . .

Knowing $B_0 = 1$, from first of these equations, we get $B_1=-\frac{1}{2}$. Now knowing B_0, B_1 we can use second of above equations to find B_2. Similarly, using successive values of previously obtained Bernoulli numbers in the subsequent equation, we obtain the following Bernoulli numbers:

$$B_0=1, B_1=-\frac{1}{2}, B_2=\frac{1}{6}, B_3=0, B_4=-\frac{1}{30}, B_5=0, B_6=\frac{1}{42},$$

$$B_7=0, B_8=-\frac{1}{30}, B_9=0, B_{10}=\frac{5}{66},\ldots \quad (3.2)$$

We observe that except for B_1 all other Bernoulli numbers with odd subscripts are zero.

Enumerating Sums of Powers of Natural Numbers

In view of **[1]**, **[2]** by the corresponding author, we can express the sum of kth powers of natural numbers as a polynomial of degree $k+1$ (for $k = 1$ to 10) as listed below:

$$S_1(n) = 1+2+3+\cdots+n = \frac{n(n+1)}{2}$$

$$S_2(n) = 1^2+2^2+3^2+\cdots+n^2 = \frac{n(n+1)(2n+1)}{6}$$

$$S_3(n) = 1^3+2^3+3^3+\cdots+n^3 = \left[\frac{n(n+1)}{2}\right]^2$$

$$S_4(n) = 1^4+2^4+3^4+\cdots+n^4 = \frac{n(n+1)(2n+1)(3n^2+3n-1)}{30}$$

$$S_5(n) = 1^5+2^5+3^5+\cdots+n^5 = \frac{n^2(n+1)^2(2n^2+2n-1)}{12}$$

$$S_6(n) = 1^6+2^6+3^4+\cdots+n^6 = \frac{n(n+1)(2n+1)(3n^4+6n^3-3n+1)}{42}$$

$$S_7(n) = 1^7+2^7+3^7+\cdots+n^7 = \frac{n^2(n+1)^2(3n^4+6n^3-n^2-4n+2)}{24}$$

$$S_8(n) = 1^8+2^8+3^8+\cdots+n^8 = \frac{n^9}{9}+\frac{n^8}{2}+\frac{2n^7}{3}-\frac{7n^5}{15}+\frac{2n^3}{9}-\frac{n}{30}$$

$$S_9(n) = 1^9+2^9+3^9+\cdots+n^9 = \frac{n^{10}}{10}+\frac{n^9}{2}+\frac{3n^8}{4}-\frac{7n^6}{10}+\frac{n^4}{2}-\frac{3n^2}{20}$$

$$S_{10}(n) = 1^{10}+2^{10}+3^{10}+\cdots+n^{10} = \frac{n^{11}}{11}+\frac{n^{10}}{2}+\frac{5n^9}{6}-n^7+n^5-\frac{n^3}{2}+\frac{5n}{66}$$

As noticed in (2.1), $S_1(n) = \frac{n(n+1)}{2} = T_n$ is the nth Triangular number.

We now try to find powers of the nth Triangular number T_n.

Computing Powers of the Triangular Numbers

From the expressions for $S_1(n), S_3(n)$ mentioned above, we have $S_3(n) = \left[S_1(n)\right]^2 = T_n^2 \quad (5.1)$

Equation (5.1) is called "Nicomachus Theorem" named after ancient Greek mathematician Nicomachus.

In view of (5.1), all even powers of the triangular numbers can be computed through $T_n^{2k} = \left[S_3(n)\right]^k \quad (5.2)$

We now try to express odd powers of Triangular numbers (i.e. $S_1(n)$) as linear combinations of $S_3(n), S_5(n), S_7(n), \ldots$ In particular, we try to compute the value of $\frac{1}{4}S_3(n)+\frac{3}{4}S_5(n)$

$$\frac{1}{4}S_3(n)+\frac{3}{4}S_5(n)=\frac{1}{4}\left[\frac{n(n+1)}{2}\right]^2+\frac{3}{4}\left[\frac{n^2(n+1)^2(2n^2+2n-1)}{12}\right]$$

$$=\frac{1}{4}\left[\frac{n(n+1)}{2}\right]^2\times\left[2n^2+2n\right]=\left[\frac{n(n+1)}{2}\right]^3=\left[S_1(n)\right]^3$$

Thus, $T_n^3=\left[S_1(n)\right]^3=\frac{1}{4}S_3(n)+\frac{3}{4}S_5(n)$ (5.3)

Similarly, computing the following linear combination of $S_5(n),S_7(n),S_9(n)$ we have

$$\frac{1}{16}S_5(n)+\frac{5}{8}S_7(n)+\frac{5}{16}S_9(n)=\frac{1}{16}\left[\frac{n^6}{6}+\frac{n^5}{2}+\frac{5n^4}{12}-\frac{n^2}{12}\right]+\frac{5}{8}\left[\frac{n^8}{8}+\frac{n^7}{2}+\frac{7n^6}{12}-\frac{7n^4}{24}+\frac{n^2}{12}\right]$$

$$+\frac{5}{16}\left[\frac{n^{10}}{10}+\frac{n^9}{2}+\frac{3n^8}{4}-\frac{7n^6}{10}+\frac{n^4}{2}-\frac{3n^2}{20}\right]=\frac{n^{10}}{32}+\frac{5n^9}{32}+\frac{10n^8}{32}+\frac{10n^7}{32}+\frac{5n^6}{32}+\frac{n^5}{32}$$

$$=\left[\frac{n(n+1)}{2}\right]^5=\left[S_1(n)\right]^5=T_n^5$$

Thus, $T_n^5=\frac{1}{16}S_5(n)+\frac{5}{8}S_7(n)+\frac{5}{16}S_9(n)$ (5.4)

Similarly, we can prove that $T_n^7=\frac{1}{64}S_7(n)+\frac{21}{64}S_9(n)+\frac{35}{64}S_{11}(n)+\frac{7}{64}S_{13}(n)$ (5.5)

Noticing the coefficients in equations (5.3), (5.4) and (5.5), we have the following general equation given by

$$T_n^{2k+1}=\frac{1}{4^k}\left[\binom{2k+1}{0}S_{2k+1}(n)+\binom{2k+1}{2}S_{2k+3}(n)+\binom{2k+1}{4}S_{2k+5}(n)+\cdots+\binom{2k+1}{2k}S_{4k+1}(n)\right] \quad (5.6)$$

Equation (5.6) provides the required expression for computing odd powers of Triangular numbers. From the above computations we have the following observations:

1. The odd power of any triangular number can be written as linear combination of sum of powers of odd indices beginning with the given odd power and ending with twice that power minus one (i.e.) linear combination of $S_{2k+1}(n),S_{2k+3}(n),S_{2k+5}(n),\ldots,S_{4k+1}(n)$.

2. The sum of coefficients of all the terms in the linear combination of $S_{2k+1}(n),S_{2k+3}(n),S_{2k+5}(n),\ldots,S_{4k+1}(n)$ for any natural number *k* is always 1.

We now try to see why these observations are true indeed.

Proof of the Observations

The first observation immediately follows from the equation (5.6), where the coefficients of the linear combination so formed is $\frac{\binom{2k+1}{2r}}{4^k}$ where $r = 0, 1, 2, \ldots, k$ and $\binom{2k+1}{2r}$ are the Binomial coefficients.

For proving the second observation, we make use of the following combinatorial identity:

If m is odd positive integer then $\binom{m}{0}+\binom{m}{2}+\binom{m}{4}+\cdots+\binom{m}{m-1}=2^{m-1}$ (5.7)

Since $2k + 1$ is always odd for any positive integer k, from equation (5.7), taking $m = 2k + 1$, we get $\binom{2k+1}{0}+\binom{2k+1}{2}+\binom{2k+1}{4}+\cdots+\binom{2k+1}{2k}=2^{2k}=4^k$.

Hence the sum of coefficients of sums of powers in equation (5.6) must be 1 for any positive integer k.

CONCLUSION

Equation (5.6) provides us the relation between odd powers of Triangular numbers in terms of sum of powers of odd indices beginning with given odd power and ending with twice that power minus one. Using this fact, we may understand the fact that odd powers of triangular numbers can be written as linear combination of sum of certain odd powers of natural numbers where the coefficients of such linear combination are constructed through Binomial coefficients of the form $\binom{2k+1}{2r}$ for $r = 0, 1, 2, \ldots, k$. We notice that such a linear combination contains $k + 1$ terms.

We can also try to derive interesting relationship between even powers of Triangular numbers and the respective sum of even power indices of powers of natural numbers. The main focus of this paper is to attain equation (5.6) which occurs for the first time in the research connecting sums of powers of natural numbers.

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RESEARCH ARTICLE

Development and Validation of a Forced Degradation UPLC Method for the Simultaneous Determination of Nebivolol HCl and Valsartanin Bulk and Pharmaceutical Dosage Form

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ABSTRACT

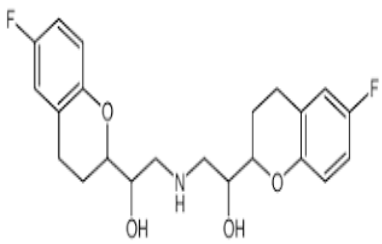
An excellent method with simple, precise was developed for Nebivolol HCl and Valsartan by using Forced degradation UPLC method. The column used was C-18 BEH _ 1.7 µm x 2.1 x 50 mm in ambient temperature. Flow rate was 0.8 ml/min, wavelength of 278nm, mobile phase used was acetonitrile : Buffer (50:50). Buffer used0.01 N Disodium hydrogen phosphate with pH 3.5 adjusted by OPA. Run time 4 min. The percentage purity and RT of Nebivolol HCl and Valsartan was found to be 99.72 and 99.30&1.193 and 1.827 respectively. The validation parameters was carried out, linearity of Nebivolol HCl was found to be (1µgm/ml to 8µgm/ml) R^2= 0.998 and Valsartan was found to be (16µgm/ml to 128.8 µgm/ml) R^2= 0.999. Intermediate precision, Robustness, LOD LOQ was within the limit as per ICH guidelines. Recovery studies taken place in 80%,100% and 120. Forced Degradation was carried out in three conditions acidic, basic and peroxide condition, degradation takes at basic and peroxide. As per literature review there is no method developed for Nebivolol HCl and Valsartan in Forced degradation UPLC method. So we made attempt to develop the Nebivolol HCl and Valsartan in UPLC method.

Keywords: UPLC, Nebivolol HCl, Valsartan, ICH guide lines, forced degradation.

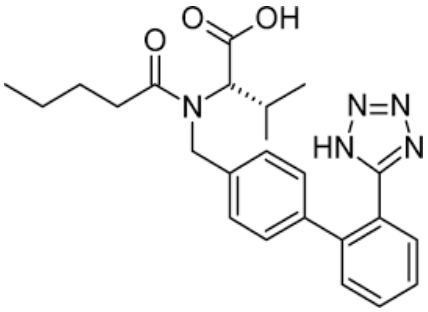
INTRODUCTION

Nebivolol hydrochloride (NEB)[1] is (±) [2R* R* R* (S *)] œ, œ [iminobis (methylene)] bis- [6- fluoro- 3, 4 - dihydro2H- 1- benzopyran- 2-methanol] β1-adrenergicblocker 1,3,4 . It is a beta blocker used to treat high blood pressure and

heart failure. It is generally less preferred than a number of other blood pressure medication. Valsartan[2] Chemically, is (2S)-3-methyl-2-[N- ({4- [2- (2H- 1, 2, 3, 4-tetrazol-5-yl)phenyl] phenyl} methyl) pentanamido] butanoic acid. By blocking the action of angiotensin, valsartan dilates blood vessels and reduces blood pressure. Valsartanis aAngiotensin II receptor antagonist medication used to treat high blood pressure, heart failure, and diabetic kidney disease.Valsartan[13] is an ARB that selectively inhibits the binding of angiotensin II to AT1, which is found in many tissues such as vascular smooth muscle and the adrenal glands. Chemical stability of pharmaceutical molecules is a matter of great concern as it affects the safety and efficacy of the drug product. The FDA and ICH guidances state the requirement of stability testing data to understand how the quality of a drug substance and drug product changes with time under the influence of various environmental factor[3,4].The drug was subjected to acid, base, oxidation, which enabled separation and detection of degradation products from basic and oxidation stress[12] .Ultra Performance Liquid Chromatography (UPLC) system is an innovative product that brought revolution in high performance liquid chromatography by outperforming conventional high performance liquid chromatography (HPLC). UPLC decreases sample run times up to a factor of 10, uses up to 95 percent less solvent and significantly improves productivity in the laboratory[5,6]. HPLC and UV methods are reported for it[(16-21)]. There is, however, no work reported on combination of these two drugs. In the present communication, we propose fast, simple and accurate spectrophotometric method for simultaneous estimation of both the drugs in tablet dosage form[15].



Structure of Nebivolol HCl



Structure of Valsartan

MATERIALS AND METHOD

HPLC Water- Milli-Q grade, Acetonitrile- Fisher scientific, Methanol- Fisher scientific, Potassium di hydrogen phosphate- Merck, Ortho phosphoric acid- Sigma, Hydrochloric acid- Merck. These solvents were throughout method development and validation. Nebivolol HCl and Valsartan are gift sample from Aurobindo Pharmaceuticals Andhra Pradesh..

Instrumentations

The UPLC method development and validation was done using Waters Acquity UPLC BEH Column. The dissolution apparatus Distek , UV-Visible spectrophotometer -Perkin elimer, Analytical balance-Sartorius.

ASSAY

Test Solution Preparation

Preparation of stock

10 tablets were weighed and powered.Powered tablets transferred equivalent toabout5mg of NebivololH C l and 8 0 mg ofValsartaninto50 mLvolumetricflask.Addabout10mLofmobilephaseandsonicatefor15min. Dilute to volume with diluent and mix well.

Preparation of standard

Pipetteout1c0 mL of the above stock solution into a100 mL volume tric flask. Dilute to volume with diluents and mix well and to get final Concentration of about100µg/mLFiltertheabovesolutionthrough0.45µmPVDF membrane filter.

Chromatographic Condition

In the present study column usedC_{18} BEH - 1.7 µm x 2.1 x 50 mm in ambient temperature. Flow rate was 0.8 ml/min, wavelength of 278nm, mobile phase used was Acetonitrile Buffer (50:50). Buffer used0.01 N Disodium hydrogen phosphate with pH 3.5 adjusted by Ortho phosphoric acid. Run time 4 min. The retention time was found to be 1.193 and 1.827 for Nebivolol HCl and Valsartan.

Validation Parameter

- System Suitability
- Specificity
- Linearity and Range
- Precision
- Ruggedness
- Accuracy
- Robustness
- Limit of Detection and Limit of Quantitation
- Solution stability

System Suitability

System suitability was performed by injecting 5 replicate of injections Nevibolol and valsartan. NevibololHCl and Valsartan was diluted by mobile phase to the final concentration of 50µgm/ml and 80µgm/ml respectively. It was performed to determine the resolution, theoretical plates, tailing factor, repeatability of retention time etc. All parameters are within the range as per the ICH guidelines.

Specificity

Specificity is the ability to assess unequivocally the analyte in the presence of components which may be expected to be present. It was performed to identify the any impurity may present, it was done by using standard, sample, placebo dilutions of both NevibololHCl and valsartan.

Calibration Curve (Linearity)

Linearity of Nevibolol HCl was found to be (1µgm/ml to 8µgm/ml), 25.1 mg of Nevibolol HCl was taken which is diluted to 50 ml from that 0.2 ml to 1.6 ml was taken and make upto 100ml. Valsartan was found to be (16µgm/ml to 128.8 µgm/ml), 40.1 mg of valsartan was taken and diluted with mobile phase to 50 ml from that 2 ml to 16 ml was taken which is diluted to 100 ml. % RSD of both Nevibolol HCl and valsartan was found to be 0.998 and 0.999 respectively. Tab 02, Fig 02,03.

Precision

Intermediate precision was carried in both Nebivolol HCl and Valsartan,Precision of Nebivolol HCl standard dilution was (50µgm/ml) and sample dilution was (20 µgm/ml) ,Valsartan standard dilution (10 µgm/ml) and sample dilution was (20 µgm/ml) to determine repeatability of method development. With the same solution precision was carried out next day also. % RSD was with in the limit as per ICH guidelines. Tab 03

Accuracy

Nebivolol HCl and Valsartan accuracy was study done in 80%, 100% and 120%. Recovery and percentage purity of Nebivolol HCl and valsartan was found in the range of 4.98 to 5.0 mg, 99.72% to 100.9% and 79.17 to 79.21 mg, 98.97 % to 99.02 % respectively. Tab 04

Robustness

Robustness study was done by changing the pH, wavelength, flow rate in both the drug. % RSD was with in the limit as per ICH guidelines. Tab

LOD and LOQ

Limit of detection was carried out in Nebivolol HCl and Valsartan the value are found to be 2.96 and 4.32 respectively.Limit of quantificationwas carried out in Nebivolol HCl and Valsartan the value are found to be 10.37 and 10.69 respectively.

Forced Degradation Study

Acid Degradation Study (2N HCL)

The sample solution of Nebivolol HCl and Valsartan50µgm/ml and 80µgm/ml respectivelyare expose to acidic condition for 30 minutes but the there is no degradation takes place.

Base Degradation Study (2N NaOH)

The sample solution of Nebivolol HCl and Valsartan50µgm/ml and 80µgm/ml respectivelyare expose to basic condition for 30 minutes there was degradation takes place, Extra peak were obtained and changes in RT.

Peroxide Degradation Study (2N H_2O_2)

The sample solution of Nebivolol HCl and Valsartan50µgm/ml and 80µgm/ml respectivelyareexpose to a peroxide condition for 30 minutes there was degradation takes place, extra peak were obtained.

CONCLUSION

The present study was method development and validation of Nebivolol HCl and Valsartan by uplc method with forced degradation study. Since no method was developed in UPLC, RT of Nebivolol HCl and Valsartan was found to be 1.193 and 1.827 respectively. In forced degradation study both Nebivolol HCl and Valsartan degradated by basic and peroxide condition. Analytical method validation plays a fundamental role in pharmaceutical industry for releasing the commercial batch and long term stability data[14]. So this study is useful for routine pharmaceutical analysis.

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TAB:1 Assay of Nevibolol HCl and Valsartan

Commercial Formulation	Drug	Standard area	Sample Area	Label Claim (mg)	Amount Present (mg)	% Purity
Byvalson	NevibololHcl	90204	88841	5mg	4.986 mg	99.72
	Valsartan	1361535	1364168	80 mg	79.174 mg	99.30

Tab 2Linearity and Range

s.no	NevibololHcl		Valsartan	
	Conc (mcg/mL)	Mean area	Conc (mcg/mL)	Mean area
1	1	16120	16.1	271190
2	2	31891	32.2	533214
3	3	50250	48.3	827780
4	4	65767	64.4	1081726
5	5	86857	80.5	1361544
6	6	102373	96.6	1639361
7	7	121200	112.7	1912479
8	8	138120	128.8	2183451

Tab 3 IntermediatePrecision Results for 5/80 mg Tablets

s.no	NebivololHcl			Valsartan		
	mg/tab	AUC	%Assay	Mg/tab	AUC	%Assay
1	4.98	88841	99.72	79.17	1364168	98.97
2	4.94	87461	99.00	79.70	1361928	99.63
3	5.00	89176	100.09	79.21	1364915	99.02
4	4.89	86504	98.00	80.14	1368279	100.18
5	4.90	86410	98.02	80.32	1369571	100.41
6	4.95	87388	99.06	80.26	1369456	100.33
Mean	4.94	87630	99.76	79.80	1366386	99.76
%RSD		0.87			0.65	

Tab 4Accuracy of Nebivolol HCl and Valsartan

% Conc	NebivololHcl				Valsartan			
	mg/tab	AUC		%Assay	Mg/tab	AUC		%Assay
		STD	SAMPLE			STD	SAMPLE	
80%	4.98	88841	66753	99.72	79.17	1364168	1064794	98.97
100%	4.94	87461	86255	99.00	79.70	1361928	1390645	99.63
120%	5.00	89176	103942	100.09	79.21	1364915	166855	99.02

Tab 5 Robustness of Nebivolol HCl and Valsartan

s.no	NebivololHcl					Valsartan				
	Std area	Sample area	content	assay	%RSD	Std area	Sample area	content	assay	%RSD
Flow rate (0.7 ml)	91622	91284	4.96	99.21	0.51	1473254	1475231	79.8	99.80	0.25
Flow rate (0.9 ml)	80974	80854	4.96	99.029	0.73	1473254	1470750	79.5	99.50	0.26
Wavelengt h276nm	79406	79650	5.003	100.06	0.61	1537073	1543867	80.1	100.22	0.16
Wavelengt h 280nm	90910	91177	5.0024	100.05	0.98	1229902	123492	79.9	99.99	0.88
pH(3.45)	85675	85777	4.99	99.99	0.73	1365133	1370167	80.03	100.5	0.24
pH (3.55)	86427	86379	4.98	99.81	0.45	137839	1378405	79.74	99.87	0.18

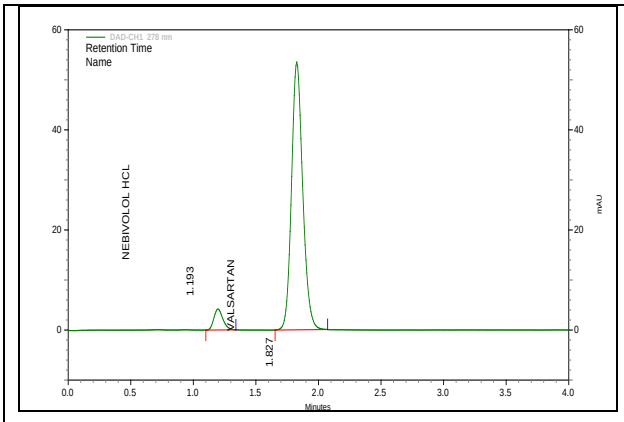

FIG: 01 Chromtagram of Nebivolol HCl and Valsartan

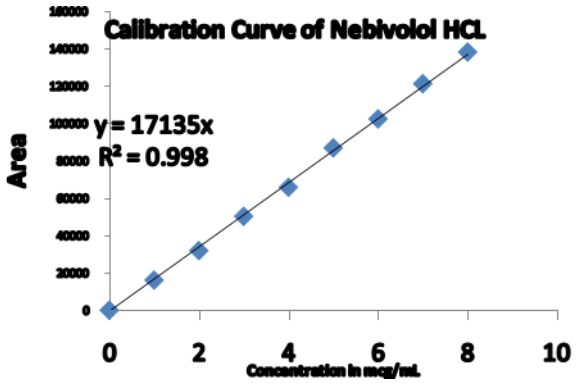

Fig 02 Linearity of Nebivolol HCl

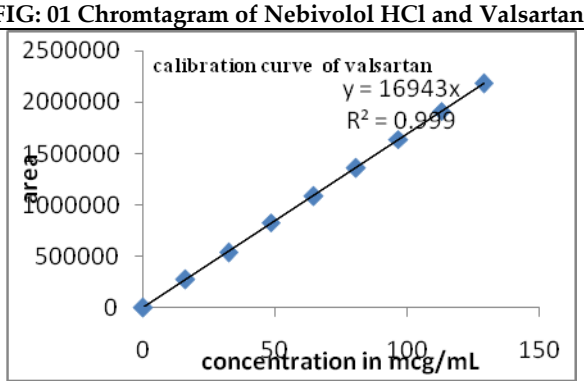

Fig 03 Linearity of Valsartan

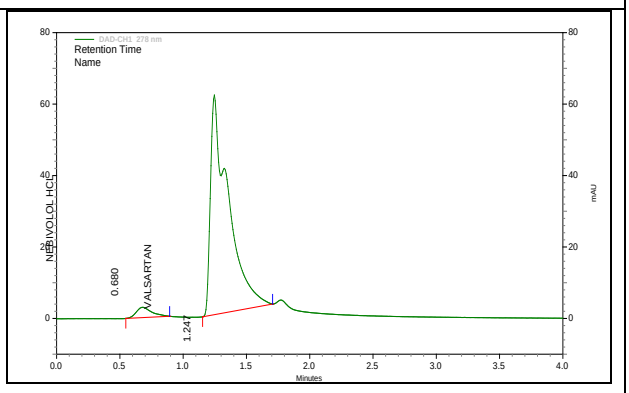

Fig 04: Base Degradation chromtogram

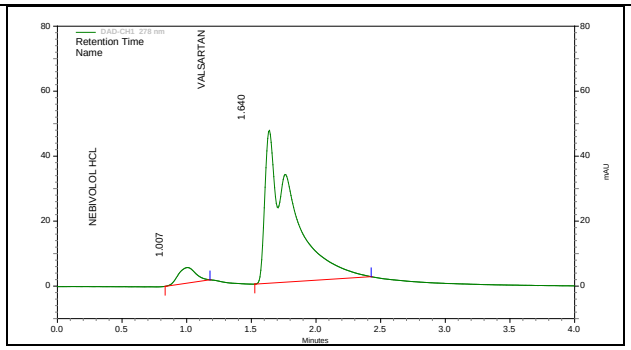

Fig 05: Peroxide Degradation chromtogram

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RESEARCH ARTICLE

Early Laparoscopic Cholecystectomy Treatment Outcomes among Patients with Acute Gallstone Pancreatitis

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ABSTRACT

Among acute gallstone pancreatitis cases, laparoscopic cholecystectomy has been considered as the treatment of choice for years to prevent further biliary complications. But there has been an ongoing debate on the timing of the procedure i.e. recommendation of early or delayed laparoscopic cholecystectomy. Our aim was to determine the outcome of early laparoscopic cholecystectomy in terms of post-operative wound infection and hospital stay among patients with acute gallstone pancreatitis. This descriptive study was conducted at one of the surgical units of Lahore General Hospital, Pakistan for 15 months. A total of 155 patients with acute mild to moderate gallstone pancreatitis were included in the study after obtaining written informed consent. Outcomes were determined in terms of post-operative wound infection and duration of hospital stay. The severity level and mortality risk were determined through Ranson's score. The collected data was statistically analyzed using SPSS Version 20.0. Of the total AP patients, 82(52.90%) were males and 73(47.10%) were females with a mean age of 39.40±13.69 years. These patients had only 5% mortality risk as per the Ranson's Criteria i.e. 46.5% patients had Ranson score 1 while 53.5% of patients had Ranson score 2. Wound infection was observed among 7.74% patients and the mean duration of hospital stay was 2.61±1.17days. We conclude that early laparoscopic cholecystectomy is associated with reduced duration of hospital stay and causes no prominent increase in the post-operative complications among patients with mild to moderate acute gallstone pancreatitis.

Keywords: Laparoscopic cholecystectomy, Early cholecystectomy, Gallstone Disease, Acute Pancreatitis, Wound Infection, Hospital stay.

INTRODUCTION

Acute Pancreatitis (AP) is a recognized complication present among cases with gallstones, and it is mostly managed conservatively in majority cases [1]. For definitive and supportive treatment, cholecystectomy is required for the complete removal of the source. But if the gallstone impaction in the papilla persists and the condition is not supported by the treatment approach, the overall prognosis of biliary pancreatitis worsens [2]. That results in adverse outcomes and the recurrence is observed in 60% cases with an overall mortality of 9% [2, 3]. Therefore, it is essential to remove the gallbladder and clear any residual calculi from the biliary system. However, there is controversy in estimating the appropriate time for the laparoscopic cholecystectomy to treat patients with acute gallstone pancreatitis [4,5].

For appropriate treatment and management, a selective approach has been incorporated to ensure safety. It emphasizes continuing the conservative treatment unless the symptoms diminish, if the symptoms do not resolve with a conservative approach then the surgical procedure is recommended within the same hospital stay i.e. Endoscopic retrograde cholangiopancreatography (ERCP) & papillotomy may be performed [1,3]. It is evident from the existing literature that early cholecystectomy effectively prevents the biliary pancreatitis recurrence rate and also averts the complications associated with the gallstone disease as compared to the interval or delayed cholecystectomy [6]. Although the consequential risk is minimum in the early days of pancreatitis but several randomized trials suggest similar morbidity and mortality risk associated with both early and delayed cholecystectomy among patients with Acute Gallstone Pancreatits [6-8].

Initially, the early laparoscopic surgery for the treatment of acute gallstone pancreatitis wasn't very preferable, as the operative duration was prolonged. Moreover, a high rate of associated complications and increased conversion rates were also a few of the significant barriers leading to strong debate [9]. Consequently, under the general practice, subsequent laparoscopic surgery is now performed after initial conservative treatment [9]. Besides the high conversion rate, the application of early laparoscopic cholecystectomy has become safe and accepted [9]. The objective of this study was to determine the outcomes of early laparoscopic cholecystectomy in terms of post-operative hospital stay and wound infection among patients with gallstone pancreatitis. We aimed to establish the safety and feasibility of the procedure, assessing the decrease in the rate of recurrent biliary pancreatitis and to lessen the overall economic burden on the patient.

METHODOLOGY

This descriptive study continued for 6 months at the Surgery Department of Lahore General Hospital. A total of 155 patients were selected with non-probability consecutive sampling, with 95% confidence interval, 5% margin of error and 11% expected frequency of wound infection in a patient undergoing early Cholecystectomy in mild gallstone pancreatitis. Both male and female patients within the age range of 18-60 years having acute gallstone pancreatitis and fit for general anesthesia as per ASA (American Society of Anesthesiologist) Grade 1 & 2 were included in the study. While pregnant females, patients who are hemodynamically unstable, or having diagnosed with decompansatory chronic liver disease, those who underwent multiple abdominal surgeries and the ones with associated choledocholithiasis were excluded from the study sample.

Laboratory investigations and ultrasonography (USG) was performed for the diagnosis and stratification of patients. The patient demographic details, the severity of pancreatitis and serum amylase level was noted. Patients were initially managed conservatively with IV antibiotics, analgesia & fluids and kept NPO (nil per os). After explaining the study procedure, written informed consent was obtained and the Laparoscopic cholecystectomy was performed under general anesthesia by a panel of skilled and experienced consultant surgeons. Ceftriaxone 2gm was injected post-operatively for two days i.e. once each day. 30 mg Ketorolac was injected intravenously twice in a day i.e. each

after 12 hours and orally 6 hours after the operation. The discharge and duration of hospital stay were decided based on the requirement of injectable antibiotics and pain intensity, patients were discharged when there is no need of IV antibiotics and analgesics and they can tolerate oral diet and medications. Post-Operative Hospital Stay was calculated from the day of operation until the day of discharge. Procedural outcomes were determined in terms of Wound Infection, which was labeled after wound examination characterized by notable erythema, raised temperature > 100_{o}F and rise in total leucocyte count > 11,000/cm_{3}. These measures were assessed post-operatively up to one week. The level of severity and mortality risk was estimated using Ranson's Criteria, where patients with score ≤ 3 had 5% mortality risk, score 3–5 (10% mortality risk) and ≥ 6 greatly increased the risk i.e. more than 60% chances of mortality or other complications [10].

The data was documented using a performa and statistically analyzed via SPSS Version 20.0. Qualitative variables like gender, the grade of physical status, Ranson Score & wound infection were presented as frequency and percentage while quantitative variables like patient's age and duration of hospital stay were presented as mean and standard deviation (SD).

RESULTS

In the present study, total of 155 patients having acute gallstone pancreatitis were enrolled having a mean age of 39.40±13.69 years. Of the total, 82(52.90%) were males and 73(47.10%) were females. the grade of physical status was also assessed using ASA grading, 64(41.3%) patients were ASA grade I and 91(58.7%) were grade II. The Ranson's score was also calculated for stratification of the risk profile. It was observed that 72(46.5%) patients had Ranson score 1 while 83(53.5%) had Ranson score 2. The hospital stay and post-operative wound infections were also monitored, 12(7.74%) patients developed wound infections after the operation while 143(92.26%) didn't had any. The mean duration of hospital stay was 2.61±1.17days.

DISCUSSION

This descriptive study was carried out to determine the outcomes of early laparoscopic cholecystectomy among patients with acute gallstone pancreatitis. The AP cases are mostly mild (80%) but when severity develops it increases the morbidity and mortality risk i.e. common in 20% patients [11]. For preventing the recurrent gallstone associated complications, it is appropriate to perform cholecystectomy as soon as the biliary pancreatitis is resolved [12,13]. But the time for application of the procedure is still debatable as both the early and delayed surgeries are associated with their consequences. Originally, due to high conversion rates and complexities associated with early laparoscopic procedures among patients with severe pancreatitis, interval or delayed cholecystectomyis recommended when the inflammatory symptoms diminish [13,14]. As per the current guidelines, early cholecystectomy is advised after conservative management among acute biliary pancreatitis patients [13,15,16].

Among the post-operative complications wound infections were assessed, 7.89% of patients suffered wound infection after early laparoscopic cholecystectomy. A similar study from Bangladesh reported post-operative complications among 16(31.4%) patients treated with early laparoscopic procedure, of these wound infection was the most significant [17]. While according to several other international studies, the complication rates associated with early cholecystectomy fall between 4% to 11% in terms of wound infection, subphrenic abscess and biliary leakage [1,3,5,18,19]. Moreover, the comparative analysis has shown a slight increase in the post-operative complication rate among the patients treated with early laparoscopic cholecystectomy as compared to those treated with delayed laparoscopic cholecystectomy [21-24]. In contrast, a meta-analysis including fifteen randomized controlled trials concluded that early laparoscopic cholecystectomy should be performed in routine practice for treating the patients of acute gallstone pancreatitis, as the early procedure is associated with lesser chances of wound infections, shorter

hospital stay and decreased treatment costs with no significant variation in the morbidity and mortality rate [6]. In this study, the mean duration of hospital stay was 2.61±1.17 days with early laparoscopic cholecystectomy. A local study from Lahore also reported similar findings i.e. in support of early cholecystectomy, the hospital stay was comparatively shorter among patients treated with early cholecystectomy 7.19±3.24 days in comparison to 11.83±5.42 days with delayed procedure [25]. A study conducted by Minutolo and colleagues on the outcomes and cost of early and delayed laparoscopic cholecystectomy among AP patients reported no significant differences in the operative time between the two procedures [7]. Although the conversion rates were high among patients treated with early laparoscopic cholecystectomy but the total hospital stay was shorter with those treated with early procedure [7]. Moreover, the overall treatment cost of the delayed laparoscopic procedure was also significantly higher as compared to the early procedure [7].

According to a Systematic Review, there is no significant indication of increased complexity risk with early laparoscopic cholecystectomy as compared to delayed [26]. Furthermore, early procedure shortens the duration of hospital stay among AP patients when provided with suitable facilities and procedural performance by experienced consultants [26]. However, the early laparoscopic cholecystectomy is highly recommended among patients with mild AP. But in the case of severe AP, there is still a lack of evidence in support or against the application of early laparoscopic cholecystectomy. Further randomized controlled trials are required in order to assess the safety and risk profile associated with early laparoscopic cholecystectomy for severe AP cases. The study assessed the post-operative complications (wound infections) and hospital stay among patients with acute gallstone pancreatitis, there were several limitations which narrowed down the scope of the study. The most prominent among them was the absence of any comparative or control group, further, no other post-operative complication was assessed other than wound infection. A more descriptive randomized trial is required in order to evaluate the comparative safety of the two procedures and also the treatment cost must also be evaluated.

CONCLUSION

It is concluded from the study results that the early cholecystectomy is safe and feasible for treating the acute gallstone pancreatitis, in terms of decreased chances of wound infection and shortens the duration of hospital stay and thus reducing the rate of future recurrent attacks of pancreatitis with gallstones. Therefore, it should be considered as the best choice of treatment for acute pancreatitis.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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Table 1: Baseline characteristics, post-operative complications & duration of hospital stay among study subjects

Baseline characteristics		(n=155)
Age (Years) (Mean ± SD)		39.4±13.69
Gender n (%)	Male	82(52.90)
	Female	73(47.10)
Grade of Physical Status n(%)	Grade I	64(41.3)
	Grade II	91(58.7)
Ranson's Scoren (%)	1	72(46.5)
	2	83(53.5)
Post-operative complications & hospital stay		
Duration of Hospital Stay (Days) (Mean ± SD)		2.61±1.17
Wound infection n (%)	Present	12(7.74)
	Absent	143(92.26)

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RESEARCH ARTICLE

Land use Land Cover Change and Mitigation Strategies adopted against Flood in Tribal Areas of Brahmaputra Flood Plain

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ABSTRACT

The main objective of the paper is to analyse changes in land use land cover of the Brahmaputra floodplains and discuss the mitigation strategies adopted by the floodplain dwellers. The area selected for the study is located in the Dhokuakhana Revenue Circle which is majorly dominated by the missing tribal community, located on the bank of the mighty Brahmaputra. To analyse the changes in land use land cover of the study area, satellite imageries of two time periods viz. 1973 and 2005 has been used and analysed in Remote Sensing platform. The analysis indicates that there is a gradual widening of river Brahmaputra over the period of time and has led to the change in land use land cover of the study area. It has washed away some portion of the land and the area primarily affected is the Matmora village. The percentage of water bodies has increased by 6 percent in the study area from 1973 to 2005. However, for the dwellers of flood-prone area, flooding is a natural event which occurs every year. They have developed their own traditional belief and alert system to mitigate flood, which is practiced since ages. Recently with the intervention of Government to mitigate annual flooding, the dweller has become more dependent on Government actions and their century-old strategy and technique to forecast weather and to mitigate flood have lost its significance. Apart from this, Government intervention has also led to the growth of some unwanted social conflicts. However, the safety and security of the area will always be determined by the strength and longevity of the embankment.

Keywords: Flood, land use land cover, mitigation strategy, Brahmaputra floodplain.

INTRODUCTION

"The Brahmaputra valley in Assam is one of the most hazard-prone regions of the country, with more than 40% of its land susceptible to flood damage" [1]. Every year Assam experiences huge losses of property, crop and human lives due to devastating floods caused by the river Brahmaputra. It is a natural hazard that annually demands substantial financial support and brings irreparable losses to the agrarian economy of the State. The Assam Government has to spend a considerable amount of money every year in either giving relief to the flood-affected victims or paying out in managing and repairing the broken/washed away embankments. This comes as a bottleneck to the development of the State. Further, it has also been recorded that the Brahmaputra River is widening in Assam, resulting in an average loss of 3900 ha over the last 34 years [2]. This widening of the river is one of the main reasons for the lack of success in flood protection, which has increased the risk of facing frequent disasters in the floodplain areas of the State. However, a section of indigenous people, viz. the Missing Community residing in the floodplains of the Brahmaputra, have been living with the floods since time immemorial and developed unique traditional techniques to survive the annual flood events. But, the age old traditional practices adopted or developed by the indigenous people of the flood-prone areas, in response to the normal climatic variations so far are gradually losing its effectiveness against the increasing scale and intensity of the changing hazards [3].

External help from the Government was impacting the masses in the sense that they have now become dependent on the Government for their survival. These floodplain areas are again mostly occupied by the destitute population who lose their belongings, especially agricultural land almost every year because of the floods. Thus they are trapped in the vicious cycle of poverty and increased vulnerability to frequent water-induced hazards like erosion, siltation and loss of cultivable land. Under such a condition, question arises about the influence of these annual floods on the lives of people living in the flood-prone area of Assam. The present paper focuses on studying the temporal changes in the land-use land cover of the river basin of Brahmaputra flood-prone areas. Further, an attempt has also been made to evaluate the strategies adopted by the local community and the Government to mitigate or reduce the effect of flood in the study area. For the study, the Matmora area of the Dhokuakhana Revenue Circle, which is annually affected by floods, is considered as the case study area. This area is mostly dominated by the tribal population of the Mising community who have a history of residing in the floodplain areas of the Brahmaputra and tactfully surviving the annual flood events. (Map No. 1).

MATERIAL AND METHODS

The methodology adopted to study the shifting course of the river and land use land cover changes of the study area is based on temporal analysis of satellite imageries of three different years. Satellite imageries of Landsat MSS-1973, TM 1990 and EMT+2005, Global Land Cover Facility, for three years viz 1973, 1990 and 2005 are analysed in Remote Sensing platform to assess the change in the course of the river and also to compare the land use land cover change dynamics in the study area, two time periods viz 1973 and 2005 is used. A modification of the Anderson Scheme Level I method is used to evaluate land use land cover changes [4] Five separate land use land cover types viz agricultural land, vegetation cover, water bodies, build-up area, and sand dunes are identified for the study. Further, focused group discussion with 20 villagers was also conducted in the study area for a better understanding of their perspective regarding flood scenario of the area and their traditional techniques as well as government initiatives to mitigate flood.

RESULT AND DISCUSSION

Physical changes observed in the study area over the years

In the Dhokuakhana sub-division annually the river Brahmaputra washes away almost 200 villages causing an estimated loss of Rs 90 crore. The map no. 2 shows the changes in the course of the river Brahmaputra in the study

area over three periods of time, i.e. 1973, 1990 and 2005 and it indicates a gradual widening of the river. The extensive riverbank erosion has led to encroachment of the villages by the river as major portions of land are washed away by the annual floods. Spatial analysis of the river shows that there has been a gradual shift in the course of the river towards its western side, and with time it is shifting further west taking away more land. The river has advanced by 10 km towards the Dhokuakhana town [5]. The village which is mostly affected is Matmora village. According to the Census data 1971 and 2011, the number of households in the Matmora area has drastically reduced from 282 households to 46 households. This is a serious case of the river Brahmaputra gradually shifting westward to have eaten up almost the whole of the Matmora village. This has led to frequent shifting of settlement by the people of the floodplain areas of the Matmora in the Brahmaputra floodplains. The analysis indicates that there is a continuous incidence of flood in the study area and over a period of time, many villages were affected by annual floods (Fig 1). The land use landcover of the study area is greatly affected by the shift in the course of the river of this region. Discussions with the villagers of the study area revealed that due to excessive erosion of the riverbank, the embankment was realigned 6-8 times in the last 20 years. Floods of 2007 affected 764 villages and 76.6% of the cropped area, causing a loss of Rs 12cr of crops. However, after 2008 the number of villages affected by floods drastically reduced (Fig. 1), which is mainly due to the initiative taken by the Assam government for the construction of the Geotube embankment. In contrary, the excessive sand casting of 2008 rendered large track of agricultural land uncultivable [3,6]. The agricultural area is covered with 4-5 feet of sand, and it will take some 8-9 years to get back their fertile lands. This led to the change in the economy of the people from purely agricultural cultivators to daily wage earners in the study area [3,7].

The change in land use land cover of the study area is evaluated using satellite images of two time periods viz. 1973 and 2005. Temporal analysis of the land use land cover change of 1973 and 2005 shows a significant change in land use land cover of the study area (Map No. 3 and Map No. 4). A drastic change in land use land cover is observed in Matmora village where almost 31 percent of the area in 2005 is covered by water bodies, which is a rise of 6 percent from 1973 to 2005. Further, changes in the vegetation, agriculture and build-up area were also observed. A study indicated that Matmora village was situated far to the east about eight kilometres away from its present location and the current location of the Matmora village is its fifth transit location in the last 50 years [3]. Further, a gradual decrease in the build-up areas was observed in the eastern part of the district, however the increase in the built-up area in the northern and southern part of the district is evident. Every time the river took away the land, the villagers had to shift to other suitable locations [8].

In this process of shifting and resettlement, many new villages were formed adjacent to one another and the population also gradually increased. Discussions with the villagers reveal that earlier the natural landscape in the southern part of the study area had some water bodies with less population, but in the process of river meandering, it has at times deposited rich alluvium and silt in the wetlands and made fertile areas available for cultivation. New occupants and also those affected by floods came and settled in these newly created areas leading to the increase in the percent of built-up area in the southern part of the study area. An increase of 2 percent of settlement between 1973-2005 is observed (Fig No. 2). Further, it is also interesting to see that the area under agriculture has reduced, whereas the area under vegetation has increased. Six percent loss in the land under agriculture was found in the study vegetation has increased. The loss of agricultural land in the study area could be attributed to the westward shift of the river and heavy river bank erosion [9]. Another reason for this is the annual deposition of sand in the agricultural fields making it uncultivable [3,10]. Further, one percent increase in the vegetation cover could be due to an effort made by the Government for the promotion of social forestry in many places of the study area.

Mitigation strategies adopted against flood

Non-structural measures: The river-centric culture and floodplain dwelling of these tribal people have led to the development of some traditional beliefs and alert systems practised through ages. As such, they have developed some forecasting techniques which are purely based on their traditional beliefs. Their long association with the floods have made them experienced in the timings of the occurrence of floods. They can now understand the nature

of floods and how heavy rains in the distant hills are sure to cause flash floods in the downstream villages. They have learnt to predict the approach of a flood by observing the natural phenomenon occurring around them. Similarly, just before the floods it is said that the cows and other animals behave erratically and go out of control. It is a common belief in Assam that uninterrupted frog calls foretell heavy rains [3,5]. Again if there are no or few fish in the early rainy season, there will surely be floods. Apart from this, river watching is a favourite past time of the villagers during the rainy season. For this, specific representatives are chosen from the villages and appointed to watch the condition of the embankment and also the water level throughout the night. The representatives from 10 different villages gather together near the embankment to monitor the weak portions the whole night. If they find anything critical, they immediately raise alarms to the people. The Mishing tribal community in the Matmora area in their grandparent's days used two interesting instruments called Le-Long and Mabong which sounds like cymbals to warn people within 3-4 km about the advancing floods [5]. But under today's changing climatic conditions and anthropogenic interventions to control and regulate natural happenings, some of these traditional beliefs and alert systems in practice throughout ages have now lost their effectiveness. They are no longer practiced. It is also reported that, with the recent construction of the hydel power project in Arunachal Pradesh, floods have become all the more unpredictable as flow of the Brahmaputra River is now controlled by the National Hydle Power Corporation. They may hold or release the water as and when needed. The dwellers of flood-prone area reported that now the floods have become unpredictable and uncertain.

Structural measures: Like the rest part of India, the strategy of flood control adopted in Assam, has mainly comprised the construction of embankments to protect the floodplains [11]. Apart from the construction of embankments, other structural measures adopted by the Government are the construction of porcupine spurs, dykes, laying of sandbags along the embankments and stone walls. In the study area, the construction of porcupine spurs is of great significance. Here the bamboos are tied together in a triangular fashion to check the currents of the river and thus reduce riverbank erosion. To increase the longevity of the structure and make them more resistant to water currents, these porcupine spurs are covered with grass or branches of trees. Another common practice, especially seen in the study area is the use of sandbags along the edge of the embankment facing the river. This strengthens the embankment by checking erosion. Sometimes instead of sandbags, bamboo fences are also used in a similar fashion. It works great in holding the soil tightly and checking bank erosion. In the Matmora area, social forestry has also been introduced in some places. This has increased the forest cover of the region and goes a long distance in dealing with the future impacts of floods under the changing climatic conditions.

One of the important structural initiatives undertaken by the State Government to mitigate the annual flooding scenario of the Matmora region was that of the construction of the Geotube embankment. It is first of its kind to be constructed in the State. In this area, the Government, in collaboration with a Malaysian Company named Emaskiara, constructed a Geotube embankment to check the flow of the river Brahmaputra. Altogether they laid 146 geotubes in the area to build the retirement dyke for a stretch of 5 km in which the original embankment was annually breached by the Brahmaputra [8]. Along with these geotubes, synthetic carpets filled with locally available sand are also laid on the slopes. In due course of times it is expected that local breed of grass and small plants will grow up on these carpets filled with sand and water and it will become part and parcel of the surrounding natural environment. This type of arrangement is considered to be environment friendly and long-lasting as it is made from locally available materials. At the same time, they do not require any maintenance from time to time. Since the construction of this Geotube embankment the region experienced moderate floods. For the time being they are free from the ravages of annual flooding and related impacts. However, it was also seen that the construction of the embankment has led to the growth of some unwanted social conflicts arising between the Government and the local beneficiaries. During group discussion with the villagers of the study area, some people strongly held that they were never consulted before going for such a massive project. Most of them reported having had only partial participation, especially in the implementation phase of the project, such as voluntary contribution of physical labour in the construction works. The wages paid to the construction labourers were only Rs 2,600 for 15 days which was much lower than the market rates. Most of the people also reported that after the construction of the embankment

the ground water level of the region has drastically reduced. It appeared that villagers strongly prefer consultations and interactions with development authority not only in project implementation phase, but from the very start of its design and development. Most of the focus group participants believed that participation of villagers in development project could be initiated only through consultations and interactions with the development authority. Any organisations, be it Government, international or local, who is interested in helping them, has to come to them with interesting activities that can create reciprocal conversations such as group discussions between themselves and the organization. Such attempts are helpful in building confidence among people.

Analysis of the impact of embankments on the life of the floodplain dwellers shows that the condition of the embankment determines most of their socio-economic decision. This dependence on the embankment will continue to remain the same and for future generations to come it will act as the immediate shelter during floods. The safety and security of the area along with the future increase in population will always be determined by the strength and longevity of the embankment.

CONCLUSION

The mighty Brahmaputra river has changed its course many times over the year and in the process of its natural shifting of river channel, erosion, transportation and depositional activities, new fertile lands for habitation are created at some places while existing inhabited lands are totally devoured by the river at other locations. The indigenous floodplain dwellers of Assam have lived with these natural phenomenon and developed traditional techniques to survive them. The Government is also leaving no stone unturned to improve the situation and mitigate flood by constructing embankments, spurs and dams. However, with the involvement of Government and changing climatic conditions, the age-old strategy to mitigate flood has gradually lost its prior significance.

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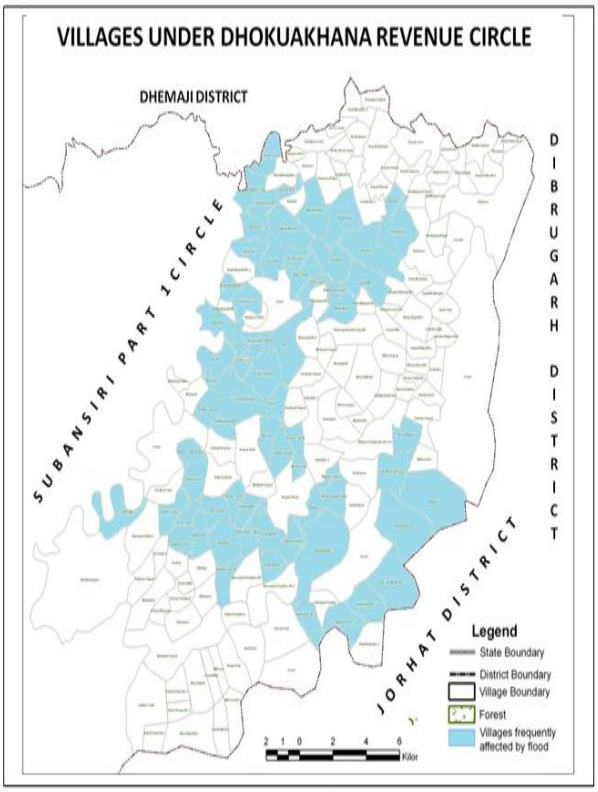
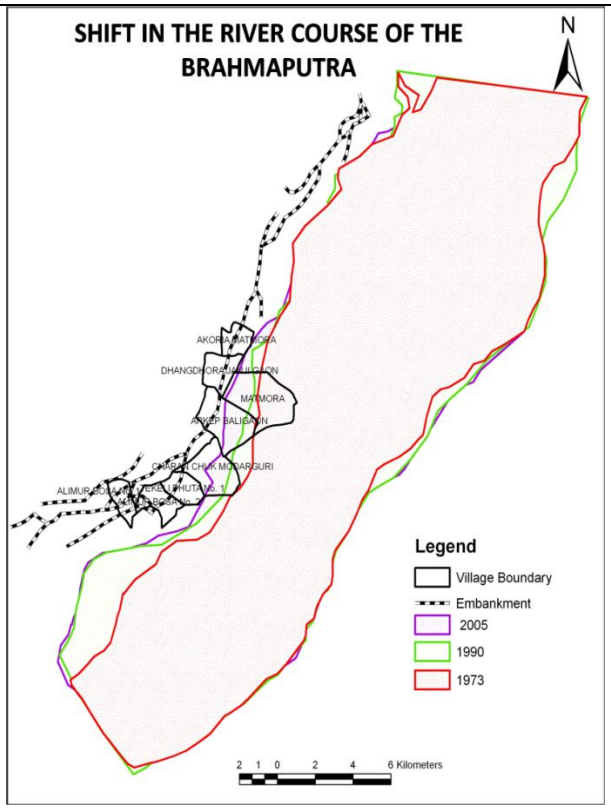


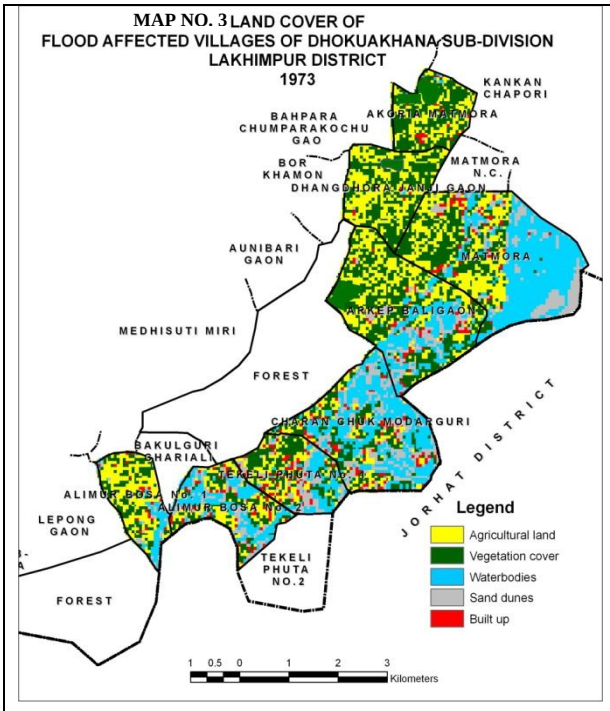
Source: Disaster Management Report, Assam, 2009

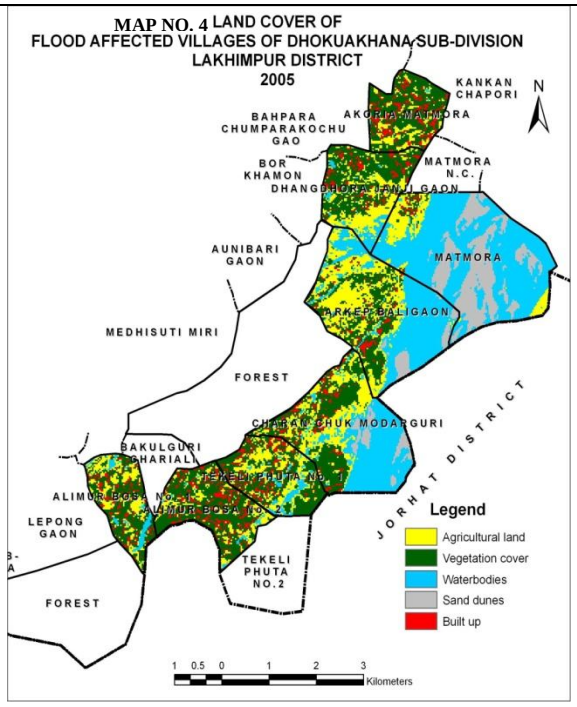
Map No. 1 Villages under Dhokuakhana Revenue Circle



Source: Global Land Cover Facility, Landsat MSS-1973, TM 1990, EMT+2005

Map No. 2. Shift in the river course of the Brahmaputra





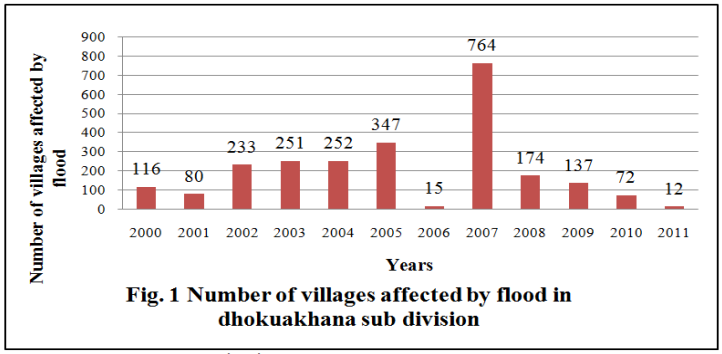


Fig. 1 Number of villages affected by flood in dhokuakhana sub division

Source: Flood Assessment Report, 2000-2011

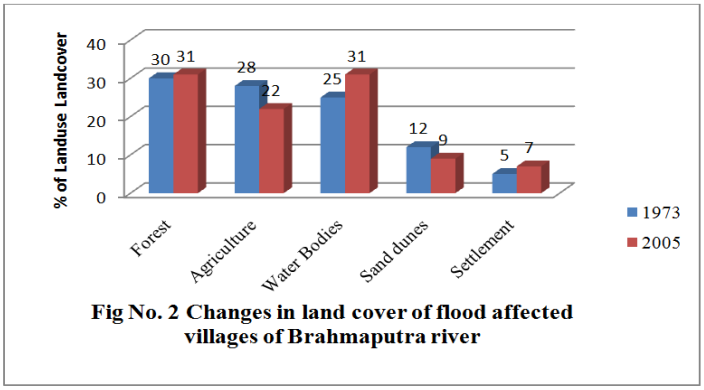


Fig No. 2 Changes in land cover of flood affected villages of Brahmaputra river

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RESEARCH ARTICLE

Analysis of Water Parameter and Its Impact in Abandoned Open Cast Coal Mine Pit: Special Reference to Damalia OCP, Raniganj, West Bengal

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ABSTRACT

Abandoned OCP can put its vital liabilities at mine closure. However, depending upon significant characteristics of which water quality is key factor. OCP may also represent scopes to provide valuable regional benefit and denotes residual closure risks and even offset the environmental costs of mining by creating new opportunities to uses. These possibilities are widely interdependent on water quality and safety issues. Unfortunately, some of these OCP have continued to be abandoned without sustainable use. This present study was undertaken in the Damalia Abandoned Open Cast Mine Pit, Raniganj Block, under Eastern Coal Field Limited (ECL), West Bengal state of India to assess surface water quality for fishery, agriculture, drinking and domestic purposes. TSS (Total Suspended Solid) concentrations were higher in the monsoon season than in the pre and post monsoon season, irrespective of location, but significant seasonal variations were more occurred in the abandoned opencast mine pit water than in the underground mine water bodies. The quality of the surface water as well as the groundwater in the region may be adversely affected by the high pollutants concentrations in this mine water. It is also reveal that hardness of surface water due to $CaCo_3$ is 117.43mg/lt. but alkalinity is minimum i.e. 182 mg/lt. in monsoon season. Due to fresh water discharge from surrounding sewage, Dissolved Oxygen (DO) become higher (6.22 mg/lt.) in monsoon time in comparison to other two seasons. As results of this inter dependent physical parameters, ecosystem becomes more enriched and natural fishing is being

done extensively. Findings of this investigation would help to apply proper management perspectives to the stakeholders for improving the surface water quality of the study area.

Keywords: Abandoned open cast coal mine pit, Dissolved Oxygen (DO), sustainable use, TSS (Total Suspended Solid), water quality

INTRODUCTION

Coal mining is a significant industrial activity as well as important source of soil heavy metal (HM) pollution in our country. It is reflected in all studies regarding the effects of mining activities on soil environmental quality have needed field monitoring and investigation in the small regions or bibliometric analysis (Prasad, B., et al 2019). Coal mining is commonly done by both opencast and underground capturing process. It is one of the major industries which contributes to the economic development and growth of our country but environmental depletion is occurred in certain ways. In the mining field, huge amounts of underground water are discharged on surface to facilitate the overall mining process. Over the past few decades, Indian coal mining industry has witnessed a magnificent growth in term of production of coal; though it has been invariably witnessed with a number of environmental problems and issues including the proper disposal management of the mine water (Cravotta 2008; Singh et al. 2010, 2012; Tiwari et al. 2017). During the mining operations, huge quantities of underground mine water are pumped out from underground sumps and surface mining pits (Singh et al. 2011). Mine water encompasses all natural water emanating from mining site including mine pit, waste rock piles and tailing dam leachates (Sarkar et al. 2007). All natural runoff from the surrounding mining site including mine pit, abandoned rock piles and nearby percolated dam water are mixing with the mine water (Sarkar et al. 2007). The discharged water often contains high load of TSS, TDS, hard and heavy metals, which contaminate the surface and ground water. Sometimes it is acidic in nature and pollutes the water regime. The water of the opening is mainly rain water and mine discharged. Due to lack of proper water management plan in this area, major volume of the water is discharged through the open channels without any beneficial use and the remaining areas are facing a terrible water deficit throughout the year (Tiwary and Dhar 1994). Mining water is contaminated with various heavy metals (Younger and Wolkersdorfer 2004; Singh et al. 2010, 2012). Soil and rock beds above the coal layers (overloaded compounds) are removed during mining and which commonly contain traces of iron, manganese and aluminum and can also contain different heavy metals. In the mining sites, the action of leachates and sediment deposition process, these metals can be dissolved in water (Singh 1998). It is also observed that industrial discharges from coal washeries and mining activities are the causing factor of heavy metals contamination in mine water with a certain magnitudes (Keishiro 2006). It is experiencing that major people of Raniganj Block are basically depends on this mine water for the purpose of their domestic, agricultural and fisheries sector. So this is an alarming issue for the shake off local people. On the other hand the mining pit is very deep, as it is too difficult to collect samples especially during monsoon season. This abandoned pit is not an easy accessible for us as it is very difficult to communicate with this area or to collect data from this study site.

STUDY AREA

Raniganj Coalfield is geographically spread in stretch of the Damodar river bank in the Asansol and Durgapur Subdivision of West Bengal. Whereas Satgram area is located around 23.674889^0-23.782563^0 N and 87.456231^0-87.082754^0E it extends into the coal mining area in Bankura district across the Damodar. It is bound by Sripur area and kanustoria area on the North, Kajora area/ Andal CD Block on the East, rural area of Bankura district on the South and neighbourhoods of Asansol on the west. Our present study site, Damalia OCP near South of Harabanga Village, is an abandoned open cast coal opening is located in Satgram area (Eastern Coalfields Limited), under Raniganj Block of Paschim Bardhaman. The geographical location of this OCP is $23^0$36' 32'' N Lat and 87^0 04' 00'' E

Long. The altitude of this site is 88.45 mt. from MSL. The length of this reverse "L" shaped OCP is 650 mt. where the width of this OCP is 710 mt. The average depth of this OCP is 220 mt. It is 5 km away from Raniganj Railway Station and located at the north edge of Damodar River.

METHODOLOGY

Sampling was carried out for three consecutive seasonal phases, these are pre monsoon, monsoon and post monsoon season. Surface water was collected from five points of said OCP and mixed it thoroughly. After that it was brought to the laboratory for analysis by using APHA 23rd Edition, 1060. Parameters like temperature, pH, Total Suspended Solid (TSS) i.e. pollutants, Dissolved Oxygen (DO), BOD, COD, Total Hardness as $CaCO_3$, Total Alkalinity as $CaCO_3$ were taken into observation. Standard protocols and methodologies were maintained during sampling and analyses of the mine water (BIS 1987). Whereas Correlation statistics was performed by using SPSS statistical software version 16.0 for analysing the data set and get better result. ANOVA (single factor) was also applied for analyse the impact of different variances. Distribution analysis methods like histogram, pie chart, bar, line graph were also used.In the present study, the sampling seasons were selected according to the hydrological background. Hydrological status of an area basically depends on the seasonal variations due to rainfall distribution. The most influencing factor for the hydrological regime of the study area is depends on south-west monsoon, while the whole sampling procedure was undertaken during pre-monsoon, monsoon and post-monsoon season.

DATA ANALYSIS

The study has been done in different climatic condition like, pre monsoon, monsoon and post monsoon. Different physical properties are taken into consideration to analyse the total water quality. To examine the data we have used few statistical methodologies and voting technique. We have putted the data in tabular form to represents the bar diagram. We have computing ANOVA to determine the views and dependency of variables between the groups. We have also using voting techniques to determine or understanding the ground reality from local inhabitants. We were preparing an ideal questioner on the basis of associated issues and problems, like pollution, biodiversity, water quality and its associated diseases, fishing etc. After that we were putting this question to the respondents, like local people, policy makers, researchers, environmentalists, and mining workers. Each response is equals to 5 in this test and in respondent group consist of 20 people. After getting the response, a response percentage (issue or problem wise) has been taken into consideration and plotted in pie chart.

DISCUSSION

We have collected water sample from the different surface portions of Damalia OCP for analysis the physical properties of water. Samples were collected during three seasons, i.e. pre monsoon, monsoon and post monsoon for getting seasonal variation of data and to find out the correlations between the variables. Fig. 4 denotes that the air temperature in pre monsoon season is 36^0C, 28^0C in monsoon and 29^0C in post monsoon season. As we know that in post monsoon season, winter months are coming in order and therefore, the temperature is decreased at that time.In rainy season, basically at the advent of monsoon, fresh water cames into the pit through surface drainage. Therefore, the temperature at that time is moderate in nature. The average temperature observed is 31^0C at that time. On the other hand, in pre monsoon season, summer months are coming as per order and the atmospheric temperature became higher in respect of other two seasons. The average air temperature is 36^0C at the time. We were also measured the water surface temperature (Tab 1) during three seasons. It has been observed that water surface temperature directly depends on air temperature as it is directly contact with air temperature. As a result it is found that surface water temperature relatively were 33^0C, 29^0C and 27^0C in pre monsoon, monsoon and post monsoon respectively. In monsoon time, fresh water is coming into pond as surface run-off. That is why pH value has decreased and it became 5.74, while in post monsoon season, its value became higher (6.96) and in pre monsoon

season it's become moderate, i.e. 6.32. It has been observed that Total Suspended Solid (TSS) pollutants were higher in monsoon season (4.5 mg/l) in compared to pre (1.8 mg/l) and post monsoon (3.0mg/l) season in this OCP Due to fresh water supply during rainy season, DO has been increased, and reached at 6.22 mg/l. It was higher than other two seasons. Biological Oxygen Demand (BOD) was minimise (8mg/l) during rainy season, due to rich bio-diversity in OCP ecosystem and fresh water supply. But in the other two seasons the BOD value was almost the same (10 mg/l). Like as BOD, COD may also vary as per the condition prevailing in these three seasons. COD has reached lower mark (49.48 mg/l) at the advent of monsoon season, whereas, reached in the highest mark in the post monsoon season (59.52 mg/l). Total hardness as $CaCO_3$ (mg/l) was became higher in rainy season as the huge amount of leached materials were coming through surrounding surface run off. Its value, has reached lower mark at pre monsoon (summer dominant) as their lower precipitation occurs. Due to discharge of fresh water in rainy season and medium nature of evaporation, the rate of alkalinity was decreased i.e. 182 mg/l. On the other hand, alkalinity has reached its maximum mark in post monsoon season i.e. 204 mg/l. From the ANOVA (Tab 2), we have found that F value is less then F critical value. That means, there is no significant difference between the groups or properties. We also argued that, the season wise data, in accordance with prosperities directly influence on the other factors. All the parameters are directly interlinked with each other and as a result of fresh water mixing during rainy season, temperature may vary during different monsoon time. All other parameters are also changed as it is. From using VOTING technique (Fig 5), through respondents by using the issues related questionnaires, we can analyse, the probable impact due to water quality of that area. We here selected few questions related to the specified issues like biodiversity, pollution, water quality and fishing activity. These questions are:

- What are the major pollutions operating in this region?
- Which are the most vulnerable pollution and pollutants in this area?
- Are you directly or indirectly affected by this pollution and how?
- Are you experiencing rich biodiversity? If yes, then why?
- What types of phytoplanktons and zooplanktons are you found in this OCP and these are harmful or not?
- When are these biodiversity become rich and why?
- Is this OCP water drinkable or not? If not, then why?
- Is it useable for domestic or agricultural or other purposes?
- Is this water can create any skin or any other diseases to you?
- What kind of fishes are there?
- When the fishing activity is become maximum?
- If any artificial breeding/ cultures are implement in that OCP ? If yes then, when and how?

On the basis of these questionnaires we have got that fishing rate was much higher in this area and there was only naturally breaded fishes and by which local inhabitants can able to get proper nutrients as well as money from it. On the other hand, bio-diversity is not very significant as per the response received.

CONCLUSION

The study area is fall under tropical climatic condition and experiences three main categories which are pre monsoon, monsoon and post monsoon. Average annual rainfall is about 1100± 100 to 1250± 100 mm and the monsoon generally lasts from June to September. Mid week of March to 1st week of June is dry summer intervened by tropical cyclones i.e. pre monsoon season. While from October to early January is under post monsoon season. It has been studied that there was greater seasonal disparity in the abandoned opencast coal mine pit water in respect of the underground mine water, but generally contaminant concentrations were higher in the monsoon season than in the pre and post monsoon season, irrespective of location. This is attributed to high evaporation and more intense anthropogenic activities (high degree of mining) in pre monsoon (Olias et al. 2004; Tiwari et al. 2015; Vega et al. 1998), and dilution in the post-monsoon season, since 85% of the annual precipitation falls in the monsoon season. In monsoon time, the rate of surface runoff was higher and due to this, huge amount of pollutants contaminate with pit

water. Therefore, it resulting the change of physical condition of this water bodies and creating several changes in biotic diversity. In abandoned Damalia OCP, all the parameters regarding physical features of water were examined and computed through ANOVA, where the results shows that F value is 0.006416 and F critical value is 3.402826. So, now we can argue that all the variables in the data set are relatively depended to each other. Besides this, from voting technique analysis, we can say that water quality directly influenced and varied in different season, especially highest in monsoon season.

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Tab 1: Water Parameter in Damalia OCP

PROPERTISE	PRE MONSOON	MONSOON	POST MONSOON	Limit as per MoEF Schedule-VI Standard
Air Temperature	36^{0}C	31^{0}C	29^{0}C	–
Water Surface Temperature	33^{0}C	29^{0}C	27^{0}C	–
pH (at 25^{0}C)	6.32	5.74	6.96	5.5-9.0
Total Suspended Solid (TSS) i.e. pollutants (mg/lt.)	1.8	4.5	3	100.0
Dissolved Oxygen (DO) (mg/lt.)	5.5	6.22	5.18	–
BOD (mg/lt.)	10	8	10	30.0
COD (mg/lt.)	52.57	49.48	59.52	250.0
Total Hardness as $CaCO_3$ (mg/lt.)	109.43	117.43	110.43	–
Total Alkalinity as $CaCO_3$ (mg/lt.)	198	182	204	–

Tab 2: ANOVA ON WATER QUALITY

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	53.74762222	2	26.87381111	0.006416	0.993606	3.402826
Within Groups	100529.5358	24	4188.73066			
Total	100583.2835	26				

Tab 3: Voting through respondent using issues or problem related questioner

	POLLUTION	BIODIVERSITY	WATER QUALITY	FISHING
LOCAL INHABITANT	1	1	5	5
MINNING WORKER	1	1	1	5
ENVIRONMENTOLIGT	5	2	4	3
POLICY MAKER	3	3	3	3
RESEARCHER	5	4	4	3
TOTAL RESPONSE	15	11	17	19
(%)	24%	18%	27%	31%

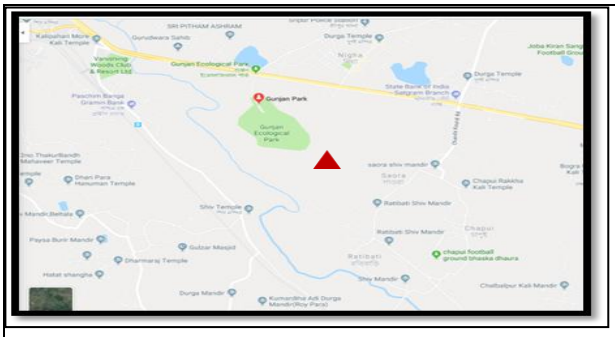

Fig 1: Location of Damalia Abandoned OCP

Fig 2 Damalia Abondoned OCP

Fig 3: During sample collection from study site

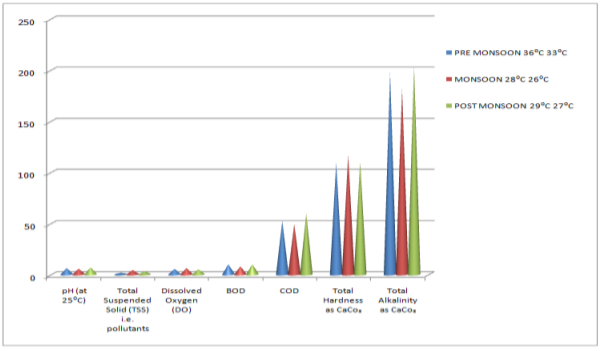

Fig 4: Season wise deviation in water quality

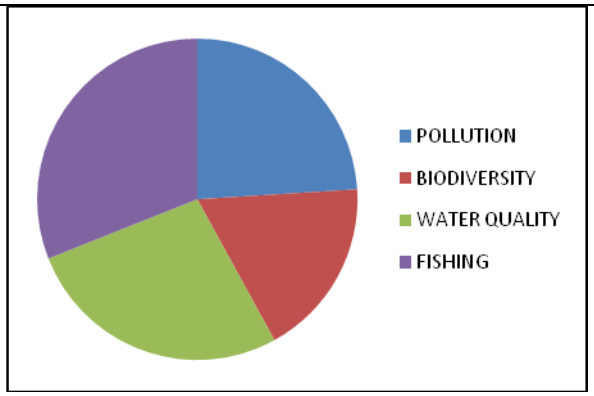

Fig 5: Response from respondents regarding OCP issues or problems

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RESEARCH ARTICLE

COVID – 2019 and Indian Medicine Sources : Drug Discovery Attempt

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ABSTRACT

COVID-19 the pan global pandemic is efficient contagion. A swift mass killer. Its pathophysiology is still evolving in the academic arena. No specific therapy exists in any school of medicine. Family physicians need an oral urgently. 12 indo\tropical med anti-virus herbs; composition; formulation & drug dose regimen suggested. Natural or extract use; practices; possible label & off label use as integrative effort for therapeutics & prophylaxis & historical usage. Active pharmaceutical ingredients (APIs) identified. Key moiety being Ellagic acid & Ellagi Tannins (hydroxyls & phenolic gr). Nicotine (related compounds) is theorised as a potent virion neutraliser in the fossa-through to alveoli levels. The natural viz, fruits; leafs etc., and ayurvedic similar have been focused upon & presented, with prior art, history, heritage & present day applied opportunity. Jhoona + copra smoke and Sri Karpura burning as room steriliser; cow dung thin film spray for floor treatment. All have efficacy against RNA viruses; broad spectrum; non toxic and safe. Sour, bitter & harsh items posits beneficial. Sweet &\or glutonic not. Multi-disciplinary integrative approach. Evidence based. Vedic literature discussed. Work initiation 2004. Multi-disciplinary report.

Keywords: Ellagic acid; Punica; Diospyros melanoxylon; Andrographis paniculata; Phylanthus; Jhoona; Karpura; Copra; Madhuca; Neem; A Vulgaris; Viricide; Integrative Medicine; Covid-19.

INTRODUCTION

Mankind's Heritage

Hippocrates of Kos, Greece, (DoB 460A.D.) said "Let food be thy medicine and medicine be thy food", i.e., 'functional food' be our guiding light [1 – 3]. "A physician who fails to enter the body of a patient with the lamp of knowledge and understanding can never treat diseases. He should first study all the factors, including environment, which influence a patient's disease, and then prescribe treatment. It is more important to prevent the occurrence of disease than to seek a cure'. Charak (*Samhita* : compendium) Date, 300BC-200BC, Meulenbeld [4,5]. The celebrated Iranian, Muhammad ibn Zakariya al-Razi (c.854 925 AD) and propounder of Arabian medicine opined 'The doctor's aim is to do good, even to our enemies, so much more to our friends...' [6]. In most of the countries clinical practitioners of conventional medicine look down, ignore and feign upon traditional schools (genetic beds & foundation of the modern). The roots of inter\intra school rancidity can apparently be traced to the Surgeon Barber Associations [7]. Ultra contagious pandemic covid-19 has indicated that a bottom up model is the sole economic versatile route for any therapy for the global masses (overwhelming majority being non affluent). That, drug discovery (marching on brains) related and or professional guild based self set restriction (stans & style) can await. Service to mankind has to march on its heart. The ailing has to be served (by the 1st clinician – at report) with all wherewithal. There are no alternatives. We are reminded of our heritage. We therefore adopt an integrative approach in this communication. The allopathic (conventional medicine) aspects including historiography have been reported elsewhere [8].

Clinical Aspects of Covid-19

The species of COVID-19 is caused by the virus SARS-CoV-2 [9] and is a RnA particle (virus). Although S-CoV-2 be large in size and varied in architecture it is a non CMV is extremely infectious and has sharp affinity for the pulmonary parynchema. Prognosis being seriously grave. At presentation and until discharge/demise fever be 37.5°C (99-100^0 F; i.e. low pyrexia); Pneumonia; pulmonary crisis; acutely down-turned thoracic cage mechanics [10]. Contact transmitted, the virus first settles in the fossa. The epiglottis acts as the 1st physical barrier. Only 1/10th can pass in (1-3hrs). Preferred location being far lower end (not bronchial tree). In far deep gets less oxygen depleted air (more N2 & WBCs for pleural walls release most) and the outcome is bilateral fibrosis. As response pathology the human body pumps in fluid into the lungs – this is pleurisies – it is preceded by pneumonia pseudo symptom; cytokine storm from the pleural parynchema. By the time the patient starts coughing 50% of the Bilateral fields are effected by fibrosis (in X-ray plate 'ground glass' (12-16th day) [11,14]. Saline infusion via gravity route fails by 10th day. Pain killers & steroids & O2 are all contra indicated. Too Late. Most difficulty arising out of phagocytosis failure + fibrosis. A member of large joint family getting infected and not being quarantined leads to all member infection and almost all member demise (supporting info from China). This is the most unique aspect of this virus sub spp. COVID-19 is not a self limiting virus. It is a swift killer if counter is not effective. There is no counter (medicine). Reports suggests that herbs may contain the panacea. There being no (allopathic/ conventional) drug that is specific. In this transaction we present a few natural source(s) and chemical moieties as having specificity for virulent RNA viruses. We search the Indian *alias* Hindu traditional medicinal sources which world wide is otherwise known as Ayurveda (plural life sciences) having umbilical with Sanatan texts (perennial literature) and Vedic Vigyan (plural sciences) for leads and or direct references; based on our current abilities (occidental included); discuss select ingredients as source for prevention and therapy against COVID-19 and more specifically for any viruses in general. Ours are safe. Until some very proven and equally safe prophylactic conventional medicine is arrived at our current integrative approach (holistic anti-virus source exploration & data mining) is the best way forward. Nascent effort. 1st time report.

MATERIAL AND METHODS

A Quick, brief review of Drug discovery literature pertaining to conventional school and Ayurveda (India's National School of Medicine). Co-relationing the Therapeutics of the Conventional medicine with the known and the established aspects of the fruit & herb members of Ayurved (Classical included); co-relationing modern averments of the viral pathology with averments in the Vedic and Sanskrit literary sources. Stemmatics & discussion of Sanskrit technical phones. Connecting our fruit & herbal members with viral pathology & vice-versa. Tabulation; Statistical studies. Compare & contrast. Critical considerations. Member varieties as a whole have been physically examined and their drug moieties have been elucidated post water or ethanol via soak-efflux-harvest.

Back Ground

Bhattacharya [15] had in 2004 reported that the Ayurvedic Dalimba's (*punica granatum*) rind contains anti-malarial and also broad spectrum anti-viral property. The Ayurvedic *punica granatum* is unique. Subsequently Bhattacharya [16-18] enlarged the list of his 1st time finds as in Table – 1; which all have been availed by apex experts & institutes worldwide (collateral info); also opined upon by NIV-ICMR Pune [19] and a subsequent MOU with NIH-USA [20]. That in 2010, a multi-lateral team headed by Dell Agli et.al., [21] cited Bhattacharya's work in their seminal work (EU funded research). Table- 2 (30yr period histography) in brief indicates the various authorities; groups & their finds vis-a-vis our caption and beyond. We stand advantaged and inspired. Discussion of Table 1 : Indian Ayurvedic dalim is different from the other species (world wide) as such that the indo spp., is purely medicinal member. There is no juice. Pluck pre ripe (choloroplast stage). Cut the fruit, discord the seed. Take the carp and even aril (only in case of the Kendu) and sun dry it to bone hard. Grind, sieve, weigh & fill in capsules or to make in tablet/suspension form. Wt & Vol measures can vary as per clinical requirements.

A herbal/ayurvedic formulation can be made by taking any one row or any combination or all the rows together, in cap or tablet or suspension form. Cap 400-500mg. 1 cap OD as prophylaxis. Jointly & severally to make various types of formulations of different potencies & Supplements; shall also create employment & sustainable ecology friendly afforestation. The above combination is suitable for diabetes also. Item No. 4 – to – 9 (& specially member No 4 & 8) when taken individually or in any combination as a bitter chocolate neutralises the virions that have settled in the fossa. Most effective barrier of virus that afflict the respiratory tracts. Suspensions appear as brown-amber (depending upon the formulation). The Lucknow \indian Hookaa is very good in defeating the URTI viruses. It uses member No. 7. The indo country side has many a regional repositories [22] of medicinal & therapeutic treaties of great antiquity and authority which all need to be studies and we do plan to proceed to do that under some scheme. In view of national emergency and societal exigencies this is a swift brief communication with diffuse uncenates for topical levity and reference value.

Punica Historiography : Table-2

The Punica granatum has two primary varieties. {i} indo ayurvedic – that has no juice; small Fig-1 {ii} the juicy fruit is large and is pan global available [23,24]. The dried rind of member of the indo ayurvedic variety (member-i) has been exclusively used by The Indian National School of Medicine since few millennia before present and is an extraordinary medicine member. The Sino school of medicine do not offer any such comparable [25,26]. Member ii in its screened sweet juice form has been the cynosure for centuries including 4 (supposed) mentions in the Bible [27]. The large/juice variety is also a natural member all over the Mediterranean rim; the Asia minor; has been studied extensively world over and India even has a (dedicated) National Level Institute [Table-3, Sl. No. 11]. We try to throw some light in brief in such direction for topical levity Table-2.

Discussion of Table – 2

Indicates the prior-art associated with Punica as anti-viricide and as a versatile member in numerous drug discovery matters. However, the indo ayurvedic members (Fig-1 & 2) has not been used until Sl No 7 & 8 (2003-04). The moot

point is that the indo member has no juice, no other confounding and or confabulating and or any other extra moiety. And whereas, the commercial punica is well known to have other compounds. The prior-art aspects of the other members as are in Table-1 can also be tabulated like wise. Our Ref No.26 presents a select list of indo ayurvedic treatises in Palm Leaf form of great antiquity & authority, published by the Indian National Science Academy [see ref 22]. The classical indo ayurvedic punica is noted to be used in 'n' number of formulations; clinic-patho indications and ways and means save & except fever and or swasa-kassa (COPD). It may concurrently be considered

Ayurved Drug Members

Vedic Method Of Room And Work Place Sterilisation

Room Air Sterilisation

Covid spp architecture being varied with a length dimension can clump for atmospheric column conditions and surface air to play upon; Bernoulli coming it play thus can waft i.e., be air borne. Individually not. Normally lies still on surface –gets picked by human touch during normal chore (clumps in nails). In pharma industry and in allopathic hospital & clinics fumigation is done with Formaldehyde + Potassium permanganate. It has been well known that such fumigation does not effectively reduce virus from the atmosphere. Rather there is a heightened chance of morphosis and mutation (because virion is biogenic charge particle). Therefore, herein below we give the Vedic method (it is also indo Tribal practice).

Damar Batu i.e., Sal resin alias Benzoin Resin from the Saal Tree (*shorea robusta*) exudate. Pia saal resinous exudates is the best. It is called Jhunaa and is a natural resin. It is to be burnt with copra (best being coconut copra) for maximum anti-virus efficacy. Dry copra has long ambering property with maximum conversion of mass into smoke (white particles). Copra is comprised of natural semi cellulose threads (musagenous) that are full of vacuoles. Musagenous matter & jhunaa on getting hot sublimates with a time lag and fill up the vacuoles variously and act as fuel. The twine (smoke particles & resin particles) be of variable size and architecture yet complement as a grooved\fused pair get air borne as smoke particles of the size less than 10-nano meters (nm). All the particles combindly comprise the dry smoke and are moderately aerodynamic efficient (near ground). Traps therm better Inefficient in radiating. Remains suspended in near surface level. Does not escape into higher altitudes nor precipitously descend down (waft for long). Popularly known as *Jhunaa dhooan*. Benzoin is an enantiomer (approx. 5nm scale). The viruses are mostly enantiomers (COVID-appears a bit different). Jhoona smoke is PhCH(OH)C(O)Ph; $C_{14}H_{12}O_2$ MASS - 212. A near polymer with semi-conductor type property at nano & pico scale which on contact with any other non-polymer viruses because agglutination (lysis). COVID virus diameter is minimum 40-50nm; and are charge potentiated. The mechanism of viremia is that a virion attaches to any cell and enters it. In the case of the Jhunaa it is reverse. The jhunaa enantiomer is a ketone hence retains ability to reform as per stimulus. They are also non-charges. Are antagonistic to most other free floating/settled particle enantiomers. Most corona group RNAs are enantiomers & particles and pH neutral. Jhunaa (Bezoin enantiomer) is antagonist to COVID enantiomer. Jhunaa smoke has long duration floatation ability. While fumigating indoors the shutters are left open because the Jhunaa smoke has greater horizontal thrust and pushes out all other floating particles (out of the rooms).

Table – 3 discusses the Vedic practice of air & room sterilisation in open & shut conditions. The sources are also discussed on the platform of Current Best Modern Sciences. A multi-disciplinary approach is taken. Integrative & holistic from concept to delivery. The well established fact being that the health care and health science experts from Greek and Sino-Nippon countries/societies came to india to imbibe related knowledge [28]. The Sanatani health science expert never went to Greece nor ever to the Sino-Nippon countries/societies to learn anything. The Sanatanis also had a very well developed sense of anatomy [29,] and health science [30]. Therefore, long period multi-disciplinary effort is needed (read with Ref 4). Intensive search of the extensively diffused repositories of the Sanatan Vigyan (perennial sciences) needs to be mined from caption domain. This work is a quick brief (exploratory) study towards such national and societal goal. Also youth ennobling is our objective.

Discussion : Table – 3

The Hindus practice raw & cooked meat offering during rituals and large vessel servings of gruel gravy/s (risk of virus from fungi) &/or release from sacrificial flesh & body fluids. Jhunaa keeps the envira free of virus and or floating pathogens. The Jhoona has no bad effect on the Caterpillar, butterfly, bees or on the pollination cycle. Therefore, it is thought to be pregnancy safe. The jhunaa is also neither an insecticide nor a pesticide. It is extensively used inside the womb rooms of the Hindu shrines ritually daily. Jhoonaa smoke & karpura non smoke are 2 very contrasting members having very different mechanics of getting air borne and retaining the space. Yet either are enantiomers and are RnA specific viricide.

Open floor Treatment

All floating particles eventually fall to the ground. The Hindus also do Gobar lep (cow dung thin film brushings) of the neighbourhood & even walls. The cow dung films comprise of cellulose in undigested state in particulate size (macro meters scale) and have high Ph (above 8). On drying the alkali matter leaches to the top and forms a binding layer. The bacterial pathogens are all mostly acidic. On touch/contact they experience ionic shock and loose the potency of virulence. The pH neutral virus particles get stuck. No more air-borne ability. No more mitosis (Vans vridhi stop).

Dusk Time de-gassing

The Hindus further burn cow dung in the evenings (dusk time). These also are anti-pathogenic. However mostly anti-insecticide & de-odorant. Dung which is manure and culture bed for worms acquires insecticide property on being admixed with charcoal & being burnt (ambering) and also gains aerodynamic property. In the case of Jhunaa the copra restricts any in-process toxicity development. Bovine\ruminant dung burning/smoke is technically de-gassing and agro-met wise causes inversion so that (also) morning dew can form and heighten the dawn's freshness (24hrs scale). It is also considered as anti-locust. It does not down turn rain episodes (good CCNs).

RESULTS

The Hindus \ Sanatanis (adivasi included) have been living in sub-continent India at least since 5000 yrs before present (sans migration). They have the holistic cum integrative health care system called Ayurveda (plural life). Ayurveda makes no mention of Vootaanoo (non-bodied) i.e., virus.; Although 'vootaanoo" is a member in the literary Lexicons and or in theatrics. The term phone vootaanoo is not indicated as a fatality causing member. No direct mention of medicine/cure/treatment either are noted in the texts vis-a-vis vootaanoo. Even the Indian repositories and practice of the Arabic-Persian School of medicine make no mention [30b]. The texts are studied and a list of herbs are extrited and cited that have been in wide use for various indications. The texts are indicated. We identify our listed members as anti-virus. First time. Ayurveda needs to be mined from caption domain. Green field opportunity. In view of extreme human health emergency we hoisted this mss., for pan global glare by critical scholars and having received a thumping positive response conclude it [31].

CONCULSION

Non of the schools of medicine have any drug/therapy for COVID. The current allopathic usages are all 'off label' or 're-purposed' usages (hence social distancing & Lock Down). No usage (of any of our members) is indicated vis-à-vis the now known symptoms of the COVID-19 (which is still evolving) and or the SARS type virus pathology. For the formulating pharmacists; the Family physician; and the home maker we have provided a gamut. Experience, usages and studies (of our candidate members) against pre covid viruses indicates significant anti-viral efficacy. Effective contra free therapeutics. Clinical (conventional assessment cum diagnostic based) measurable results within 6hrs to 24hrs. Feel good factor. Stand alone efficacy. Swift uptake; in blood life; metabol & excretion

mechanics to some extent studied/known. Safe and event less holistic-comprehensive efficacy as variable groups/ formulations\ compositions. Complementing & synergistic role with allopathic; No likely confabulation with allopathy medicaments is envisaged. Direct label use. Eco; labour & employment friendly. Room Floor and interior air and exterior air anti-virus steriliser and mechanics have been briefly presented. 1st time on pan global basis. Therefore, ours is an original and first time ground breaking work. Continuously working further. Non prior to us have done anything alike. We do not propose any supremacy concepts/ideas; any revisionist theory. Our objective is throwing some light on the Sanatan haversack faced with existential crisis from a pan global pandemic.

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TABLE – 1Vedic internal medicine ingredients (herbs) – viricide.

Sl No	Herbs	Component	w/w or v/v	A P I	Comments	Mechanics
1	*Punica Granatum* (Dalimba)	Carp Figure – 1&2	400-1200mg Sun dried, slow ground whole herb. Chew-swallow or tablet/capsule.	Ellagic Acid Figure - 3	Anti corona	Mid gut; Urolithin pathway
2	As above	As above		Punicalin-s group Hydroxylic/carboxyli. Figure - 3	Antivirus broad spectrum. Re- enabler ofphagocytosis (peerless)	As above & (Incubation period efficacy).
3	*Diospyros melanoxylon* (Kendu)	Whole fruit peel included, Sans seed, specially the aril, unripe & Beedi Leafs		Work is on Figure - 4	Broad spectrum; anti-corona; Adipose tissue enlargement arrester	As above
4	*Andrographis paniculata*	Twigs & leafs, sans roots		As above	Adjunct & adjuvant anti-virus; Fossa cleansing.	Oral to Anus – elementary canal. Therapeutic
5	*Phyllanthus niruri*	Whole plant, sans roots	200-400mg Chew & swallow	As above	Gastric; Liver & Small bowl	Viricide.
6	*Azadirachta indica* (Neem)	Leafs/flower		6 compounds (sulphur free)	Anti bact & viricide	Hepato-lower small bowl – anal phase.

7	*Nicotiana & Solanaceae* Tobacco (also Beedi)	Dried Leaf	300–500 mg Chew. Smoke 1-3mg	Nicotine	Reduces N availability in lungs & Upper Res Tracts for the Virion's incubation period	Prophylaxis Incubation failure.
8	*Madhuca Indica* (Mohula)	Fruits/flower	10-5gm	Natural Alcohol & Polymeric fructose.	Oral Slow Chew	-Do- & Binds with the virions & neutralizes in the fossa
9	*Syzygium aromaticum* (Clove)	Flower	In mcg	Allyl Benzens, Eguenol Loaded in Clove	Sublingual-slow	Prophylactic & Therapeutic. Potent Viricide

Sl No	Year	Conveniently extrited Relevant References. Select. 3 Decades	Remarks
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2	1998	Antiviral or antifungal composition comprising an extract of pomegranate rind or other plants and method of use. US Patent . 5,840,308	USA
3	1990	*Compendium of Indian Medicinal Plants* : Central Drug Research Laboratory , CSIR, Lucknow, [1999 – 95] , Vol – 1 , 1990 , p. 335 , Vol – 2 , 1993 , p. 573 , Vol – IV , p. 611 , Vol –5 , p. 709 . (preceded by Glossary AND more by RRL Bhubaneswar publication – 3 Vols)	India
4	2000	Why a pomegranate ? British Medical *Journal* 2000; 321 doi: https://doi.org/10.1136/bmj.321.7269.1153	London
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www : Our search indicates an interesting histology about the scholarly efforts using the Punica fruit & its dermis only. Numerous studies commences post Sl. No.7.			
Note : Indian ayurvedic Punica is quite different on pan global basis. It is entirely medicinal (only for medicine moiety). Indian Ayurveda uses only the rind of such atypical (only for medicine). Others use the juice.			
Reuters News Media Inc., 1996. Pomegranates could help in battle against AIDS. March 10th, http://www.aegis.com/news/re/1996/RE960310.html NOT AVAILABLE			

TABLE – 3 Air & Room Anti Virus Steriliser. Vedic Methods.

1	Sri KarpuraCamphor	Crystal-white Latex Camphor tree exudates. Non resin	1-10gm 1000ft^3	Burn Open room. Shutters closed	Versatile keton; Enantiomer; Efficient aerodynamic; volatile.	Viricide & high reflex smooth muscle relaxer; mucus hardener also air clarifier
2	Jhoonaa+Dry copra	Saal Tree resinous exudate	1-10gm 1000ft^3	Burn Open room On Copra. Shutters open	Versatile keton; Enantiomer; Non volatile; less aerodynamic	Viricide &de-odorant. Non clarifier.

Table – 4 in brief presents the outcome of the ongoing work & cultural Heritage inspiration based 4 natural sources.

Ongoing	
Ficus Religiosa	Leafs; sap; bark are viricide. Smoke is mosquitoes repellent; anti allergen. Hence possibly Lord Buddha selected this tree to sit for his nirvana attainment mediations; 6th B.C.
Ficus Bengalensi	Leaf & sap & all parts are viricide. Associated with Siva Mahadev & Sri Ganesa of the Hindu Pantheon; since 2nd B.C. Sri Jagannath Temple Sri Mandir at Puri has albino member (does not have hanging roots); is associated with the Hindu Elephant headed God Sri Ganesa.
Artocarpus heterophyllus	All parts & sap are viricide. Fruit green is myard builder. Yet non teratogenic.
Artemisia Vulgaris	Flower is up-regulator of WBC & CD4 expression. Rest plant is potent viricide – nasal- route efficacy. Mild chemo. Used by Sri Jagannath Dev, at Sri Mandir, Puri. Tribal knowledge.

Fig – 1 : The classical indo ayurvedic punica on scale. Best for wt/% yield of drug moiety.

Fig-2 : the same fruit is cut; thickness of the rind is shown

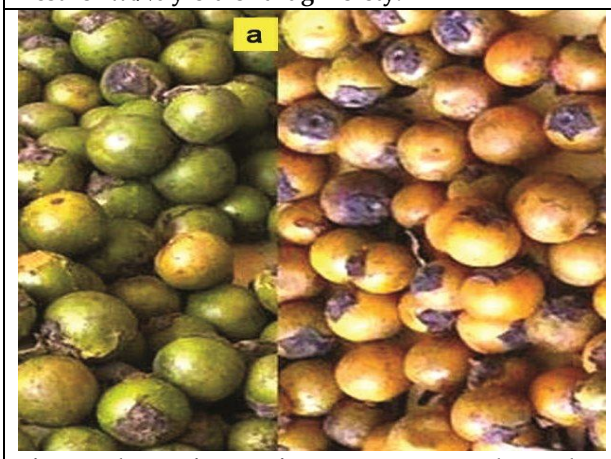

Fig-3 : The Unripe & Ripe Dyospyrous melanoxylon are shown side by side. Either are suitable. Green is more harsh. It is tribal fruit-food cum medicine member.

Fig-4a – Size reduction of the punica rind, bone dried-stone hard; excellent keeping quality at room temp (tropical humid).

Fig-4b – Appearance of the material whence filled in translucent capsules, size 00 @ 450-500mg per capsule.

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RESEARCH ARTICLE

Morphology Based Genetic Divergence and Relationship Assessment of Productivity Traits in Early Maturing *Brassica rapa* Genotypes

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ABSTRACT

Genetic divergence may be considered as heart of a hybridization program as it helps to choose appropriate parents and increase long term genetic gain. Moreover, in Bangladesh aspect, short duration high yielding mustard and rapeseed varieties are necessary to increase cropping intensity by fitting well in the rice based cropping pattern. For this reason, an investigation was carried out with 46 early maturing *Brassica rapa* genotypes following RCBD design with three replicates to assess genetic diversity and association between yield and its components with a view to marking most priority yield components. The genotypes were significantly different from each other for all the studied attributes explored from ANOVA (Analysis of variance). Among the studied genotypes, OTBC-15002 and OTBC-15015 performed well and were identified as high yielding (5.69 g and 4.74 g, respectively) as well as short duration (78 days and 77 days, respectively) genotypes. The higher values of PCV (phenotypic coefficient of variation) compared to the corresponding GCV (genotypic coefficient of variation) for most of the traits and the slight difference between them indicated that the expression of the traits was little influenced by the environment. Estimated heritability ranges from 55.23% (siliqua length) to 96.16% (siliqua / plant). High heritability together with high genetic advance in percentage of mean and higher PCV and GCV was observed for branches/plant, siliqua /plant, seeds/ siliqua and yield/plant which suggests that giving preference on these characters would be rewarding for amelioration of yield. Plant height, siliqua /plant, 1000 seed weight were the first priority yield components marked from correlation and path coefficient analysis due to having significant positive correlation along with higher positive direct effects on seed yield. Cluster analysis categorized the genotypes into seven clusters denoting cluster III as the largest cluster accommodating 11 genotypes. Cluster V was the best group in terms of

yield and earliness followed by cluster III. The outcome of the present study could be exploited in future rapeseed breeding programs for developing early maturing high yielding varieties.

Keywords: Morphology, genetic divergence, early maturing, heritability, correlation, cluster analysis

INTRODUCTION

Rapeseed and mustard, belonging to the family Cruciferae (*Brassicaceae*), are the most important source of edible vegetable oil in Bangladesh and the second most important oilseed crop in the world after soybean [1]. The seeds of mustard contain 42% edible oil which serves as solvent of vitamin A, D, E and K, and 25% protein [2]. It is also used as green manure and fodder crop, and leaf is used as vegetable in various mustard growing countries of the world. In Bangladesh, rapeseed and mustard occupy the first position in respect of area and production among the oil crops grown. In the year of 2018-19, rapeseed and mustard were cultivated in 270 thousand hectares of land with the total production of 312 thousand MT [3]. The yield of rapeseed and mustard is generally low in Bangladesh which results in acute shortage of edible oil. As a result, a large amount of foreign currency is expended to meet the oil demand. In Bangladesh, most of the released varieties of mustard are usually late varieties (90-110 days) and thus cannot fit well as a gap filling crop in rice based cropping pattern (T.aman rice- mustard- Boro rice). As a result, the land remains fallow during rabi season. If late varieties are cultivated during this season, the transplanting of boro rice may be pushed later which increases the risk of exposure to flood. So, development of short duration (75- 80 days) high yielding varieties might be appropriate solution to be cultivated after aman and prior to boro rice to increase cropping intensity as well as save the foreign currency without affecting this popular cropping pattern. Genetic variability is a prerequisite for initiating appropriate breeding procedures in crop improvement programs. The response to selection is determined by heritability estimates as it indicates the extent of transmissibility of a character to next generations [4]. Moreover, high heritability coupled with high genetic advance offer the most efficacious condition for selection for a particular trait [5]. Inter-relationship between yield contributing traits is of great importance for a breeder to prioritize the most effective yield components [6]. Traits having significant effect on yield can be determined by path analysis [7]. According to Sharma and Jana [8], assessment of genetic variation is a prerequisite for initiating an efficient breeding program and improvement of crop plant, as it provides the foundation to pick out desirable genotypes. Greater divergence of the parents renders broad spectrum of variability in the segregating generations [9]. Knowledge on genetic diversity could help breeders and geneticists to understand the structure of germplasm and predict which combinations would produce the best offsprings [10]. Convincing the aforesaid ideas, the study was undertaken in order to assess nature and magnitude of genetic diversity in early maturing rapeseed genotypes which will serve as potent genotypes to develop short duration high yielding varieties in future breeding programme.

MATERIALS AND METHODS

Plant Materials and Experimental Design

The experiment was conducted with 46 *Brassica rapa* genotypes including three checks namely BARI Sarisha-14, BARI Sarisha-15, and Tori-7 collected from Bangladesh Agricultural Research Institute (BARI) following Randomized Complete Block Design (RCBD) with three replicates. The plot size was 3m × 2.1 m. The distance between replication to replication was 1m. Plant to plant and row to row distances were 10 cm and 30 cm respectively. The names of the 46 *Brassica rapa* genotypes are presented in the Table 1.

Data Collection and Statistical Analysis

Data on nine agro-morphological traits (days to 50% flowering, days to maturity, plant height (cm), branches/plant, siliqua /plant, siliqua length (cm), seeds/siliqua, 1000 seed weight (g), and yield/plant (g)) were recorded on ten randomly selected plants from each plot in each replication. The data for each of the characters was averaged to obtain mean plot data and analysis of variance (ANOVA) was performed using the mean values. Duncan's Multiple Range Test (DMRT) [11] was performed for all the characters to test the differences between mean of the genotypes. Genotypic variances, phenotypic variances, heritability in broad sense, genetic advance were estimated according to the formulae given by Johnson *et al.* [12]. Genotypic and phenotypic coefficient of variation, and genetic advance in percentage of mean were worked out following to formulae suggested by Burton [13] and Comstock and Robinson [14], respectively.

Genotypic Variances (σ^2_g) and Phenotypic Variances (σ^2_p)

$\sigma^2_g = \frac{GMS - EMS}{r}$ and $\sigma^2_p = \sigma^2_g + EMS$

Here, GMS= genotypic mean square; EMS= error mean square, and r = number of replication

Heritability in Broad Sense (h^2_b)

$$h^2_b = \frac{\sigma^2_g}{\sigma^2_p} \times 100$$

Heritability was classified as low (<30%), medium (30- 60%), and high (>60%) [12].

Genotypic Coefficient of variation (GCV) and Phenotypic Coefficient of Variation (PCV) : $GCV = \frac{\sqrt{\sigma^2_g}}{\bar{X}} \times 100$ and $PCV = \frac{\sqrt{\sigma^2_p}}{\bar{X}} \times 100$; where, $\bar{X}$= Population mean

GCV and PCV were categorized as low (<10%), moderate (10-20%) and high (>20%) [15].

Genetic Advance (GA)

GA = $h^2_b.K.\sigma_p$; Where, K (Selection differential) = 2.06 at 5% selection intensity;
σ_p = Phenotypic standard deviation

Genetic Advance in Percentage of Mean, GA (%): $GA\ (\%) = \frac{GA}{\bar{X}} \times 100$

GA (%) was categorized as low (0-10%), moderate (10-20%), and high (≥20%) [12, 16]. Simple correlation coefficients at both genotypic and phenotypic levels for different attributes were estimated following the formula suggested by Singh and Chaudhury [17]. Path co-efficient analysis was done according to the procedure employed by Dewey and Lu [18], also quoted by Singh and Chaudhury [17], using simple correlation values. D^2 values [19] were calculated from transformed uncorrelated means of characters for grouping of the genotypes into different clusters [20, 17]. Average intra and inter-cluster distances were estimated according to Rao [20]. Dendrogram was prepared based on Ward's method of grouping.

RESULTS AND DISCUSSION

Estimation of Variability and Genetic Parameters

Analysis of variance (ANOVA) showed that significant variation ($P \leq 0.01$) prevailed among the genotypes for all the nine characters studied (Table 2). Significant genotypic variations in different *Brassica* spp. have also been reported earlier by Afrin *et al.* [21] and Shaukat *et al.* [22] for various morphological traits. Genetic parameters for all the studied attributes are shown in Table 3. PCV was higher than the corresponding GCV for all the traits revealing the presence of environmental influence on these traits to some extent. The highest PCV and GCV were observed for

siliqua/plant (28.06% and 27.51%, respectively) followed by yield/plant (g) (27.37% and 26.10%), seeds/siliqua (21.74% and 21.03%), and branches/plant (21.63% and 19.34%). The lowest PCV and GCV were recorded for days to maturity (4.84% and 3.70 %, respectively)(Table 3). Similar reports for siliqua/plant and days to maturity have been made by Helal *et al.* [23] and Aktar *et al.* [24], respectively thus satisfying our results. All the characters studied exhibited high heritability except siliqua length (55.23%) and days to maturity (58.49%). The highest heritability was found in siliqua/plant (96.16%) followed by seeds/siliqua (93.56%), yield/plant (90.89%), 1000 seed weight (g) (82.49%). Merely heritability estimate often fails to appropriately forecast the rewarding yield components, but estimation of genetic advance together with heritability would be more conducive in predicting yield [12]. Genetic advance estimated the highest for the siliqua/plant (34.63) followed by plant height (13.88), seeds/siliqua (7.62) and the lowest for the siliqua length (0.79) among the traits. The genetic advance in percent of mean (GA %) ranged from 5.83% (days to maturity) to 55.57% (siliqua/plant). Siliqua/plant showed the highest heritability (96.16%) along with the highest GA (34.63) and (GA %) (55.67) which was in conformity with results reported by Choudhary *et al.* [25], and Ghosh and Gulati [26] indicating preponderance of additive gene action. To sum up, siliqua/plant, seeds/siliqua, yield/plant, branches/plant, and 1000 seed weight might be considered as important selection criteria in rapeseed breeding program (Table 3).

Performance of the Genotypes under Study

Mean performances of the genotypes for different morphological traits are shown in Table 4. The most early blooming genotypes were OTBC-15011, OTBC-15015, and OTBC-15022 (27 days) and late flowering ones were OTBC-15044 and OTBC-15047 (37 days). The most short duration genotypes were OTBC-0830, OTBC-0835, OTBC-14010, OTBC-15015-1, OTBC-15061, and BARI-14 (75 days) followed by OTBC-15009, OTBC-15016, OTBC-15020, OTBC-15023, and OTBC-15024 (76 days). The highest days to maturity was taken by OTBC-15050 (87 days) followed by OTBC-15034 and OTBC-15043 (86 days) (Table 4). The tallest genotype was OTBC-15051 (108 cm) followed by OTBC-15049 (104.7 cm) and OTBC-15052 (102.5 cm) whereas the shortest one was OTBC-15010 (76.6 cm). The highest number of branches/plant and number of siliqua/plant were found in OTBC-15033 (6.8 and 107.2, respectively) and the lowest values for both characters were in OTBC-15007 (2.2 and 29.6, respectively). The highest siliqua length was observed in OTBC-0835 (5.95) followed by OTBC-15048 (5.77) and OTBC-15022 (5.76). OTBC-15044 had the highest number of seeds/siliqua (26.80) followed by OTBC-15051 (26.40) and OTBC-15028 (25.50). 1000 seed weight was found maximum in OTBC-15002 (3.91 g) and minimum in OTBC-14001 (2.17 g). OTBC-15002, OTBC-15052, and OTBC-15015 produced greater yield/plant (5.69 g, 4.86 g, and 4.74 g, respectively) whereas the minimum yield was observed in OTBC-15047 (2.00 g). Crop duration is an important consideration in mustard breeding. Usually short duration cultivars are more preferable in Bangladesh to suit well in the popular rice based cropping pattern. On the contrary, the farmers will not adopt the early but low yielding varieties. So, considering crop duration and yield, OTBC-15002 and OTBC-15015 were the best performers as they produced high yield (5.69 g and 4.74 g, respectively) within shortest crop duration (78 days and 77 days, respectively)(Table 4).

Association among the Traits

Inter-relation was studied among the yield and its components at both genotypic and phenotypic levels (Table 5) followed by path coefficient analysis to split the correlation coefficients into direct and indirect effects (Table 6; Figure 1). Genotypic correlation coefficients were higher than phenotypic correlation coefficients for most of the traits except days to maturity, seeds/siliqua, and 1000 seed weight (g) (Table 5). Weber and Moorthy [27] also reported that low phenotypic correlation is resulted due to the masking or modifying effect of environment. Plant height, siliqua/plant, and 1000 seed weight showed significant positive correlations with yield/plant both at genotypic and at phenotypic levels which is in agreement with the results of Kumar *et al.* [28]. The result unveiled that these characters were controlled by additive genes and less affected by the environmental fluctuation. Days to 50% flowering and days to maturity was negatively inter-related with grain yield which is in line with the findings of Onyia *et al.* [29] and the result suggests that grain yield can be ameliorated by selecting early flowering and early

maturing genotypes. Plant height was significantly positively correlated with days to 50% flowering and days to maturity which hints that tall genotypes tend to have longer crop duration. Significant positive correlation of plant height with seeds/siliqua, 1000 seed weight, and yield/plant suggests that these characters can be ameliorated through increased plant height. Halder *et al.* [30] and Khan *et al.* [31] found that plant height showed highest positive significant association with yield. Branches/plant showed positive correlation with siliqua/plant (significantly) and yield/plant which revealed that higher number of branches helps to produce more leaves and siliqua and ultimately cause increased yield through boosting photosynthesis (Table 5). Sana *et al.* [32] also found the same result in case of *Brassica napus* cultivars. Results of path coefficient analysis at both genotypic and phenotypic levels revealed that plant height exerted the highest direct positive effect on yield/plant followed by 1000 seed weight, seeds/siliqua, siliqua/plant, branches/plant and suggests that choosing of these traits is directly helpful for raising of yield (Table 6; Figure 1). Afroz *et al.* [33] reported maximum direct positive effect of plant height on yield followed by siliqua/plant, number of primary branches/plant, and 1000-seed weight thus assuring our results. In this study, days to 50% flowering, days to maturity, and siliqua length exhibited direct negative effect on yield/plant (Table 6; Figure 1). Similar findings were earlier reported for days to 50% flowering by Zahan [34]; for siliqua length by Iqbal *et al.* [35] in mustard. Long growth duration of the genotypes may adversely affect the yield/plant due to shattering of the siliqua. Residual effect was 0.27 and 0.29 at genotypic and phenotypic levels, respectively (Table 6). Residual effect (0.27) denotes that the selected characters in this study contributed 73% to the yield. Very low and non-significant correlation of some traits with yield as well as some other factors like sampling error, personal error and geographical position need to be included in the study to explain completely for the variation in yield. From the association study it was clear that plant height, siliqua/plant, and 1000 seed weight were the first priority yield components influencing greatly to the yield due to having strong associations as well as high positive direct effects. Thus emphasizing of these characters during selection will be advantageous for getting high yield in rapeseed breeding.

Nature and Magnitude of Diversity

The success of any crop improvement program depends on genetic divergence. Based on the Mahalanobis [19] D^2 value, the genotypes were grouped into seven clusters (Table 7; Figure 2). Formation of variable numbers of clusters based on morphological traits was previously reported by a number of scientists [35, 24]. The largest cluster was cluster III (11 genotypes) followed by clusters (IV and VII) and clusters (I and V) accommodating 7 and 6 genotypes, respectively. Cluster II and cluster VI housed 5 and 4 genotypes, respectively (Table 7). The presence of wider genetic diversity among the genotypes is explored from the higher values of inter-cluster distances compared to intra-cluster distances except cluster III (Table 8). The highest intra cluster distance (243.70) was possessed by Cluster III and the lowest one by cluster I (20.91) explaining the presence of heterogenous nature of the genotypes in cluster III but relatively homogenous in cluster I. The highest inter cluster distance was observed between the cluster IV and V (713.25) followed by the cluster III and IV (622.59), and the lowest one was found between cluster I and II (60.22) (Table 8). The crossing between the genotypes drawn from the distant clusters may yield wide ranges of recombinants showing higher heterosis. Table 9 shows that cluster I had the lowest mean values of days to 50% flowering, days to maturity, plant height and the highest average value for siliqua length reflecting that genotypes of early, dwarf and longer siliqua constituted that cluster. Cluster VII ranked first for days to 50% flowering, plant height, seeds/siliqua, and 1000 seed weight whereas was second topper for days to maturity and yield/plant indicating that this cluster was made up of late, taller and high yielding genotypes with larger seeds. All high yielding genotypes were placed in cluster V whereas cluster II accommodated low yielders indicating maximum contribution of this trait towards the divergence between the aforesaid clusters. Crosses involving genotypes from cluster II and cluster V may produce high heterosis for yield. Considering duration and yield, more emphasis should be given on cluster V for choosing parents in hybridization program for achieving novel high yielding and short duration genotypes. All the characters did not contribute equally to the total diversity. Some characters were more important than others. Yield/plant contributed maximum (22.71%) to the total diversity followed by 1000 seed weight (19.03%), seeds/siliqua (17.20%), siliqua/plant (13.33%)(Table 9). Above-mentioned 4 characters contributed

72.27% towards the divergence, thus, considered as the important traits. Bardhan and Thangavel [36] also reported that the higher contribution of characters toward divergence determines the right choice of parents.

CONCLUSION

The present study has disclosed that the studied genotypes were genetically diverse enough which may be used as starting breeding material for developing early maturing high yielding rapeseed varieties. OTBC-15002 and OTBC-15015 performed the best in respect of higher yield as well as earliness. Estimation of genetic parameters and association study recommends that plant height, siliqua/plant, seeds/siliqua, yield/plant, branches/plant, and 1000 seed weight might be considered as important selection criteria and emphasis of these traits during selection would be milestone to develop improved genotypes with higher yield as well as earliness. Forty six studied genotypes were grouped into 7 clusters. Short duration genotypes with higher yield were grouped into cluster V followed by cluster VII and cluster III. It is recommended that further molecular based diversity analysis needs to be studied for the comparison of the present result.

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Table 1. The list of the 46 *Brassica rapa* genotypes

SL No.	Genotype (code name)	SL No.	Genotype (code name)	SL No.	Genotype (code name)	SL No.	Genotype (code name)
G1	OTBC-0828	G13	OTBC-15005	G25	OTBC-15024	G37	OTBC-15048
G2	OTBC-0830	G14	OTBC-15007	G26	OTBC-15027	G38	OTBC-15049
G3	OTBC-0835	G15	OTBC-15009	G27	OTBC-15028	G39	OTBC-15050
G4	OTBC-14001	G16	OTBC-15010	G28	OTBC-15031	G40	OTBC-15051
G5	OTBC-14003	G17	OTBC-15011	G29	OTBC-15032	G41	OTBC-15052
G6	OTBC-14004	G18	OTBC-15015	G30	OTBC-15033	G42	OTBC-15055
G7	OTBC-14010	G19	OTBC-15015-1	G31	OTBC-15034	G43	OTBC-15061
G8	OTBC-14017	G20	OTBC-15016	G32	OTBC-15035	G44	BARI Sarisha-14
G9	OTBC-14018	G21	OTBC-15020	G33	OTBC-15043	G45	BARI Sarisha -15
G10	OTBC-14027	G22	OTBC-15021	G34	OTBC-15044	G46	Tori-7
G11	OTBC-15002	G23	OTBC-15022	G35	OTBC-15046		
G12	OTBC-15003	G24	OTBC-15023	G36	OTBC-15047		
NB: OTBC= Observation Trial *Brassica campestris* / *rapa*							

Table 2. Analysis of variance (ANOVA) of yield and its components of 46 genotypes of *Brassica rapa*

Source of variation	Df	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches / plant	Siliqua / plant	Siliqua length (cm)	Seeds / siliqua	1000 seed weight (g)	Yield/ plant (g)
Replication	2	0.783	0.551	1.35	0.976	0.03	0.036	3.874	0.023	0.001
Genotypes	45	28.958**	31.920**	183.03**	2.506**	893.53**	1.020**	44.859**	0.590**	2.164**
Error	90	3.894	6.106	13.73	0.193	11.74	0.217	1.006	0.039	0.070

** = Significant at 1% level of probability

Table 3. Estimation of genetic parameters of 46 genotypes of *Brassica rapa*

Genetic parameters	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches/ plant	Siliqua/ plant	Siliqua length (cm)	Seeds/ siliqua	1000 seed weight (g)	Yield/ plant (g)
δ^2p	12.25	14.71	70.16	0.96	305.68	0.48	15.62	0.22	0.77
δ^2g	8.35	8.60	56.43	0.77	293.93	0.27	14.62	0.18	0.70
PCV (%)	10.86	4.84	9.24	21.63	28.06	14.08	21.74	15.00	27.37
GCV (%)	8.97	3.70	8.28	19.34	27.51	10.46	21.03	13.63	26.10
h^2b (%)	68.21	58.49	80.43	79.98	96.16	55.23	93.56	82.49	90.89
GA	4.92	4.62	13.88	1.62	34.63	0.79	7.62	0.80	1.64
GA (%)	15.25	5.83	15.30	35.63	55.57	16.02	41.90	25.49	51.25

Here, δ^2p= Phenotypic variance; δ^2g= Genotypic variance; PCV and GCV= Phenotypic and genotypic coefficient of variation, respectively; h^2b = Heritability in broad sense; GA= Genetic advance; GA (%) = Genetic advance in percentage of mean

Table 4. Mean performance of 46 genotypes of *Brassica rapa*

SL No.	Genotypes	DF	DM	PH (cm)	Branches/ plant	Siliqua / plant	SL (cm)	Seeds/ siliqua	1000 Seed weight (g)	Yield/plant (g)
1	OTBC-0828	28.00 ef	78.00 ef	83.80 n-s	3.20 op	60.13 i-l	5.72 ab	17.80 i-l	2.67 o-r	3.14 j-n
2	OTBC-0830	28.00 ef	75.00 f	84.00 n-s	3.47 m-p	43.27 q	4.23 h-l	14.10 q-t	2.61 p-r	2.74 n-p
3	OTBC-0835	28.00 ef	75.00 f	79.40 r-t	4.60 f-k	59.13 i-n	5.95 a	17.10 k-m	3.05 i-n	3.00 k-o
4	OTBC-14001	31.00 de	79.00 d-f	84.20 m-r	4.60 f-k	57.40 j-n	4.94 b-j	15.60 m-r	2.17 s	2.02 r
5	OTBC-14003	31.00 de	79.00 d-f	87.20 j-q	4.00 j-o	52.80 n-p	5.16 a-h	13.80 r-t	2.34 rs	2.07 r
6	OTBC-14004	32.00 cd	79.00 d-f	87.07 j-q	5.20 c-g	59.80 i-m	5.38 a-e	15.60 m-r	3.42 b-i	2.20 qr
7	OTBC-14010	32.00 d	75.00 f	77.00 st	5.60 b-d	72.60 ef	4.66 d-l	10.80 u	3.62 a-d	3.40 h-l
8	OTBC-14017	35.00 b-d	78.00 ef	89.00 i-o	5.60 b-d	53.00 n-p	4.70 d-l	22.00 de	3.20 e-k	2.80 m-p
9	OTBC-14018	35.00 b-d	79.00 d-f	86.60 k-r	4.80 d-j	49.00 o-q	5.34 a-f	23.60 cd	2.67 o-r	2.20 qr
10	OTBC-14027	34.00 b-d	80.00 c-f	91.60 g-l	6.00 bc	99.60 b	3.92 l	15.40 m-s	3.58 a-e	3.80 e-h
11	OTBC-15002	34.00 b-d	78.00 ef	98.73 b-g	4.13 i-n	75.47 e	4.27 g-l	15.50 m-r	3.91 a	5.69 a
12	OTBC-15003	33.00 cd	77.00 ef	90.33 i-o	5.00 d-i	63.73 h-j	4.68 d-l	18.40 h-k	2.81 l-q	3.74 f-i
13	OTBC-15005	31.00 de	79.00 d-f	88.33 j-p	5.53 b-e	56.47 k-n	4.25 h-l	15.90 l-q	3.16 f-m	3.46 h-k
14	OTBC-15007	36.00 bc	78.00 ef	87.80 j-q	2.20 q	29.60 s	4.58 e-l	25.20 a-c	2.65 o-r	2.20 qr
15	OTBC-15009	31.00 de	76.00 ef	92.67 f-k	5.40 b-f	71.67 ef	5.46 a-e	16.80 k-n	3.53 a-g	4.06 d-g
16	OTBC-15010	33.00 cd	85.00 ab	76.60 t	5.40 b-f	73.40 ef	4.88 b-k	16.00 l-q	2.78 m-q	2.20 qr
17	OTBC-15011	27.00 f	77.00 ef	86.13 k-r	3.60 l-p	85.33 d	4.00 kl	17.10 k-m	3.43 b-i	3.60 g-j
18	OTBC-15015	27.00 f	77.00 ef	94.00 d-j	5.00 d-i	82.87 d	5.44 a-e	13.60 st	3.65 a-c	4.74 ab
19	OTBC-15015-1	32.00 d	75.00 f	97.60 b-h	4.40 g-l	65.60 g-i	5.56 a-d	16.40 l-o	3.21 e-k	3.60 g-j
20	OTBC-15016	28.00 ef	76.00 ef	83.87 n-s	3.87 k-p	56.20 k-n	5.54 a-d	16.00 l-q	3.01 j-o	2.74 n-p
21	OTBC-15020	33.00 cd	76.00 ef	80.80 q-t	4.80 d-j	54.20 l-o	4.04 j-l	17.80 i-l	2.67 o-r	3.14 j-n
22	OTBC-15021	34.00 b-d	78.00 ef	91.40 h-m	4.20 h-n	46.20 q	4.16 i-l	14.10 q-t	2.61 p-r	2.74 n-p
23	OTBC-15022	27.00 f	77.00 ef	87.00 j-q	5.53 b-e	85.27 d	5.76 ab	17.10 k-m	3.05 i-n	3.00 k-o
24	OTBC-15023	28.00 ef	76.00 ef	81.47 p-t	3.93 j-p	57.67 j-n	5.27 a-f	15.60 m-r	2.17 s	2.02 r
25	OTBC-15024	28.00 ef	76.00 ef	81.60 p-t	5.06 d-h	63.53 h-j	5.74 ab	13.80 r-t	2.34 rs	2.07 r
26	OTBC-15027	33.00 cd	77.00 ef	97.80 b-h	3.40 n-p	60.20 i-l	4.58 e-l	15.60 m-r	3.42 b-i	2.20 qr
27	OTBC-15028	34.00 b-d	79.00 d-f	98.70 b-g	4.33 h-m	49.80 o-q	5.33 a-f	10.80 u	3.62 a-d	3.40 h-l

Table 4. Mean performance of 46 genotypes of *Brassica rapa* (continued)

SL No.	Genotypes	DF	DM	PH (cm)	Branches/ plant	Siliqua / plant	SL (cm)	Seeds/ siliqua	1000 Seed weight (g)	Yield/plant (g)
28	OTBC-15031	28.00 ef	78.00 ef	84.53 l-r	4.06 j-n	62.27 i-k	5.69 a-c	22.00 de	3.20 e-k	2.80 m-p
29	OTBC-15032	32.00 d	78.00 ef	95.60 c-i	4.67 e-k	74.47 ef	4.89 b-k	23.60 cd	2.67 o-r	2.20 qr
30	OTBC-15033	34.00 b-d	84.00 a-c	100.8 b-d	6.80 a	107.2 a	4.44 f-l	15.40 m-s	3.58 a-e	3.80 e-h
31	OTBC-15034	34.00 b-d	86.00 a	92.40 f-k	3.60 l-p	93.00 c	5.46 a-e	15.50 m-r	3.91 a	5.69 a
32	OTBC-15035	32.00 d	79.00 d-f	89.80 i-o	4.27 h-m	45.80 q	4.76 c-l	18.40 h-k	2.81 l-q	3.74 f-i
33	OTBC-15043	35.00 b-d	86.00 a	91.00 h-n	5.00 d-i	49.20 o-q	5.60 a-d	15.90 l-q	3.16 f-m	3.46 h-k
34	OTBC-15044	37.00 ab	79.33 c-f	98.00 b-h	5.20 c-g	35.47 r	5.16 a-h	25.20 a-c	2.65 o-r	2.20 qr
35	OTBC-15046	35.00 b-d	84.00 a-c	99.50 b-f	4.13 j-n	53.13 n-p	4.26 h-l	16.80 k-n	3.53 a-g	4.06 d-g
36	OTBC-15047	37.00 ab	81.00 b-e	86.60 k-r	4.00 j-o	70.50 e-g	5.20 a-g	16.00 l-q	2.78 m-q	2.20 qr
37	OTBC-15048	35.00 b-d	83.00 a-d	100.50 b-d	3.87 k-p	46.20 q	5.77 ab	17.10 k-m	3.43 b-i	3.60 g-j
38	OTBC-15049	34.00 b-d	83.00 a-d	104.70 ab	3.60 l-p	46.87 pq	4.95 b-j	13.60 st	3.65 a-c	4.74 ab
39	OTBC-15050	34.00 b-d	87.00 a	92.60 f-k	6.20 ab	68.80 f-h	5.58 a-d	16.40 l-o	3.21 e-k	3.60 g-j
40	OTBC-15051	34.00 b-d	84.00 a-c	108.0 a	4.66 e-k	48.40 o-q	5.05 a-i	16.00 l-q	3.01 j-o	2.74 n-p
41	OTBC-15052	33.00 cd	81.00 b-e	102.5 a-c	4.33 g-m	49.13 o-q	4.92 b-k	24.60 bc	3.88 a	4.86 b
42	OTBC-15055	28.00 ef	78.00 ef	83.80 n-s	3.20 op	53.60 m-o	4.17 i-l	21.30 ef	3.26 d-k	2.94 l-o
43	OTBC-15061	28.00 ef	75.00 f	84.00 n-s	5.20 c-g	95.60 bc	4.94 b-j	16.80 k-n	3.02 j-o	3.40 h-l
44	BARI-14	28.00 ef	75.00 f	79.40 r-t	3.13 p	36.33 r	3.92 l	21.70 e	3.54 a-f	3.66 g-i
45	BARI-15	31.00 de	79.00 d-f	84.20 m-r	4.73 d-k	63.67 h-j	4.43 f-l	20.90 e-g	3.45 b-h	3.74 f-i
46	Tori-7	31.00 de	79.00 d-f	87.20 j-q	5.33 c-f	83.00 d	4.69 d-l	16.50 k-o	2.31 rs	4.26 b-e
	Mean	32.24	79.27	90.69	4.54	62.32	4.94	18.18	3.15	3.20
	Minimum	27.00	75.00	76.60	2.20	29.60	3.92	10.80	2.17	2.00
	Maximum	40.00	87.00	108.00	6.80	107.20	5.95	26.80	3.91	5.69
	CV (%)	6.12	3.12	4.09	9.68	5.50	9.43	5.52	6.31	8.24
	SE (±)	0.46	0.48	1.15	0.13	2.54	0.09	0.57	0.07	0.13
	SD	3.11	3.26	7.81	0.91	17.26	0.58	3.87	0.44	0.85
	LSD (0.05)	3.19	4.01	6.01	0.71	5.56	0.76	1.63	0.32	0.43

Legend, DF= Days to 50% flowering; DM= Days to maturity; PH= Plant height; SL= Siliqua length

Note: Genotypes with the different letter(s) are statistically different

Table 5.Genotypic (G) and phenotypic (P) correlation coefficients among different yield and yield contributing characters of 46 genotypes of *Brassica rapa*

Characters		Days to maturity	Plant height (cm)	Branches / plant	Siliqua / plant	Siliqua length (cm)	Seeds/ siliqua	1000 seed weight (g)	Yield /plant (g)
Days to 50% flowering	G	0.591**	0.573**	-0.007	-0.220	-0.248	0.452**	0.086	-0.239
	P	0.550**	0.527**	0.038	-0.220	-0.257	0.441**	0.057	-0.240
Days to maturity	G		0.485**	0.189	0.084	0.025	0.293	-0.077	-0.082
	P		0.424**	0.168	0.072	0.028	0.276	-0.072	-0.077
Plant height (cm)	G			0.023	0.022	-0.072	0.455**	0.351*	0.411**
	P			0.025	0.021	-0.054	0.443**	0.343*	0.394**
Branches/plant	G				0.526**	0.107	-0.245	0.152	0.186
	P				0.516**	0.086	-0.241	0.129	0.179
Siliqua/plant	G					-0.004	-0.473**	0.095	0.339*
	P					-0.001	-0.468**	0.091	0.338*
Siliqua length (cm)	G						0.084	-0.122	-0.030
	P						0.058	-0.118	-0.040
Seeds/siliqua	G							0.113	0.109
	P							0.133	0.128
1000 seed weight (g)	G								0.594**
	P								0.612**

*= significant at 5% level of probability; **= significant at 1% level of probability

Table 6. Genotypic (G) and phenotypic (P) path coefficient analysis showing direct and indirect effects of different characters on yield of *Brassica rapa* genotypes (diagonal bolded number indicates direct effect)

Characters		Days to 50% flowering	Days to maturity	Plant height (cm)	Branches/ plant	Siliqua/ plant	Siliqua length (cm)	Seeds/ siliqua	1000 seed weight (g)	Yield/ plant (g)
Days to 50% flowering	G	**-0.665**	-0.0162	0.303	-0.0005	-0.0525	0.0346	0.125	0.0327	-0.239
	P	**-0.602**	-0.0064	0.225	0.0037	-0.0556	0.0383	0.134	0.0231	-0.240
Days to maturity	G	-0.393	**-0.0275**	0.256	0.0139	0.0201	-0.0035	0.0811	-0.0293	-0.082
	P	-0.331	**-0.0117**	0.181	0.0162	0.0182	-0.0042	0.0839	-0.0292	-0.077
Plant height (cm)	G	-0.381	-0.0133	**0.528**	0.0017	0.0053	0.0100	0.125	0.134	0.411**
	P	-0.317	-0.0049	**0.427**	0.0024	0.0053	0.0081	0.135	0.139	0.394**
Branches / plant	G	0.0047	-0.0052	0.0121	**0.0736**	0.125	-0.0149	-0.0678	0.0579	0.186
	P	-0.023	-0.0019	0.011	**0.0964**	0.131	-0.0128	-0.073	0.0523	0.179
Siliqua / plant	G	0.146	-0.0023	0.0116	0.0387	**0.238**	0.0006	-0.131	0.0362	0.339*
	P	0.132	-0.00085	0.0089	0.0497	**0.253**	0.00015	-0.142	0.0369	0.338*
Siliqua length (cm)	G	0.165	-0.0007	-0.038	0.0079	-0.0010	**-0.139**	0.0232	-0.0465	-0.030
	P	0.155	-0.00033	-0.0230	0.0083	-0.00025	**-0.149**	0.0176	-0.048	-0.040
Seeds/ siliqua	G	-0.301	-0.008	0.241	-0.0180	-0.113	-0.012	**0.277**	0.043	0.109
	P	-0.265	-0.0033	0.189	-0.023	-0.118	-0.0086	**0.304**	0.054	0.128

1000 seed weight (g)	G	-0.0572	0.00211	0.186	0.0112	0.0227	0.0171	0.0312	**0.381**	0.594**
	P	-0.0343	0.0008	0.146	0.0124	0.0240	0.0176	0.0404	**0.406**	0.612**

* and ** indicate significant at 5% and 1% level of probability, respectively.
Residual effect= 0.27 and 0.29 at genotypic and phenotypic levels, respectively

Table 7. Distribution of genotypes in different clusters

Cluster number	Number of genotypes	Code name of genotypes
I	6	OTBC-0828, OTBC-0835, OTBC-15016, OTBC-15023, OTBC-15024 and TBC-15031
II	5	OTBC-0830, OTBC-14001, OTBC-14003, OTBC-15021 and OTBC-15027
III	11	OTBC-14004, OTBC-14010, OTBC-14017, OTBC-14027, OTBC-15002, OTBC-15003, OTBC-15005, OTBC-15011, OTBC-15020, OTBC-15033 and Tori - 7
IV	7	OTBC-14018, OTBC-15007, OTBC-15035, OTBC-15044, OTBC-15047, OTBC-15055 and BARI-14
V	6	OTBC-15009, OTBC-15015, OTBC-15015-1, OTBC-15022, OTBC-15032 and OTBC-15061
VI	4	OTBC-15010, OTBC-15034, OTBC-15043 and OTBC-15050
VII	7	OTBC-15028, OTBC-15046, OTBC-15048, OTBC-15049, OTBC-15051, OTBC-15052 and BARI-15

Table 8. Intra (diagonally bold) and inter cluster distance (D^2 and $\sqrt{D^2}$ = D (in parenthesis)) among the 46 genotypes

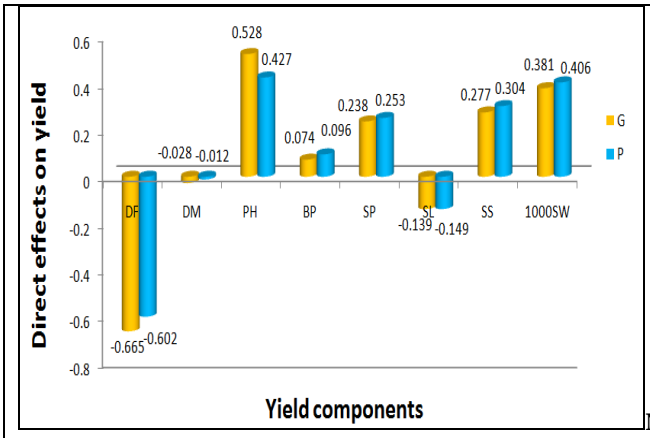
Cluster	I	II	III	IV	V	VI	VII
I	**20.91** (4.57)	60.22 (7.76)	219.08 (14.80)	276.82 (16.64)	227.61 (15.09)	127.24 (11.28)	207.15 (14.39)
II		**54.04** (7.35)	258.02 (16.06)	271.44 (16.48)	286.40 (16.92)	146.79 (12.12)	209.70 (14.48)
III			**243.70** (15.61)	622.59 (24.95)	180.19 (13.42)	232.71 (15.25)	389.19 (19.73)
IV				**193.80** (13.92)	713.25 (26.71)	335.25 (18.31)	247.14 (15.72)
V					**98.41** (9.92)	250.45 (15.83)	379.64 (19.48)
VI						**105.40** (10.27)	225.55 (15.02)
VII							**105.10** (10.25)

Table 9. Cluster mean and contribution of yield and yield components of 46 genotypes towards divergence

Traits	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V	Cluster VI	Cluster VII	Times ranked 1st	% contribution towards divergence
DF	28.00	31.40	32.00	34.71	30.33	34.00	35.00	27	2.61
DM	76.50	77.60	78.45	79.19	76.67	86.00	82.57	20	1.93
PH	82.45	88.92	88.44	88.99	94.48	88.15	102.43	33	3.19
BP	4.12	3.93	5.24	3.83	5.03	5.05	4.24	109	10.53

SP	59.82	51.97	73.67	45.76	79.25	71.10	51.03	138	13.33
SL	5.65	4.61	4.46	4.73	5.34	5.38	4.96	98	9.47
SS	16.97	14.70	16.05	22.86	16.32	16.30	23.06	178	17.20
1000SW	3.04	2.54	3.27	3.07	3.45	2.73	3.54	197	19.03
YP	3.05	2.27	3.37	2.63	4.14	2.30	4.02	235	22.71

Note: DF= Days to 50% flowering, DM= Days to maturity, PH= Plant height (cm), BP= Branches/plant, SP=Siliqua/plant, SL= Siliqua length (cm), SS= Seeds/siliqua, 1000SW= 1000 seed weight (g), YP= Yield/plant (g)



ote: DF= Days to 50% flowering, DM= Days to maturity, PH= Plant height (cm), BP= Branches/plant, SP=Siliqua/plant, SL= Siliqua length (cm), SS= Seeds/siliqua, 1000SW= 1000 seed weight (g),

Figure 1. Partitioning of genotypic (G) and phenotypic (P) correlations into direct effects of different yield components with seed yield/plant

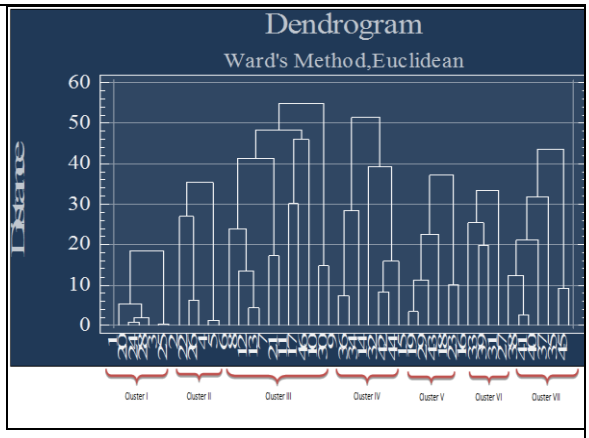


Figure 2. Based on the Mahalanobis D^2 value, the genotypes were grouped into seven clusters

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RESEARCH ARTICLE

Weather Modification Science: Indian Heritage

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ABSTRACT

Indian sub-continent as alike many a large geography domains have contrasting weather pattern ranging between excess to acute deficient rainfall. India has a very large census depending upon rain fed agriculture. Rain making using modern science is vital. Her heritage indicates that since time yore the resident minds have focused upon weather modification with focus for rain making. Cultural & rituals exists in robust practice mode. All these have not been discussed. Details thereof are presented with textual reference (Classical & commentaries included ranging 2000+yrs) and co-relationing with modern best known sciences. Even Lord Sri Krishna has enjoined upon the sovereign power to ensure rain making. Nexus between Deepavali & rains in the Deccan -&- clear sky in the indo-gangetic & coastal plains. Eco-friendly. 1st time. Original. Multi-disciplinary. Heuristic & Pedagogic. Pan global family welfare. Construe as 'Critical Technology' in the words of Bharat Ratna Dr. A.P.J. Abdul Kalam.

Keywords : Weather Modification Heritage; Vedic Literature & Rain making; Vedic Vigyaan; Good CCNs; Deepavali & Rains.

INTRODUCTION

Annually, various agro-meteorological regions of India experience severe cyclones, floods, draughts, heat wave, etc. Such contrasting severe weather events occur often at the same time in different regions, inflicting wanton loss at the family level and throws State plan implementation out of gear. Hence, weather modification is assuming high significance in state planning to ameliorate human and ecological stress. Author during the last two decades has been focusing upon and pursuing the caption objectives in various forums ~ DST [1]; TROPMET-2007 [2]; International Tropical Metorology Conf.-INTROMET [3]; Asia-Pacific region forum [4]; Asia-Ocenia region forum [5]; International Conf. on Weather Modification [6]; National Conf. on Climate change[7]; related National [8] and International symposia [9] Hydrology Conferences, and among professional bodies of Geologists [10]; Engineers [11-

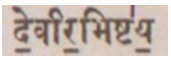
13]; Social Scientist [14]; Geographers [15]; policy advocacy to public and GOI [16]. Also, large tracts of the Indian sub-continent annually experiences severe human, veterinary and ecological stress due to Heat wave and Sun Stroke [17a] Global warming, etc., [**17b**]. Rain fall and raised humidity are the sole anti-dotes. Author's concurrent objective (thus far) being to elicit information about Indian heritage in intellectual property practices; etc., in the caption domain. Our objective (this transaction) is to lead the reader towards the heart of the matter. In view of Global climate change being an "hypothesis" and getting embroiled in intense acrimony alongside an erratic monsoon phenomena and agriculture failure, necessitates consciousness about weather modification heritage and related home grown sciences. This communication is a nascent attempt to discuss few select aspects of Indian heritage in the domain of aerosol science and weather modification practices which have not been discussed pre to this report. Therefore, these presents are made in popular language for the benefit of the multi-disciplinary readers, policy initiators and makers. We hope our report will lead to in- depth study and more reports with societal good. This communication is original. Inspiration lies in our own related work [17c] and the cue in collinear Vedic Vigyan works [17d].

India is the land of heritage. Scholars like Ravi Prakash Arya [18] have indicated that Sri Dayanand Saraswati (1824-83), the founder of Āṛya Samāj -India, have dealt upon extensively about 'rain making', who (see Ref. No.34) drew inference from the *Satpatha Bṛahṁaña*, and further indicates that Shri Ram Narayan Arya [19] as an applied rain maker who used Vedic principles and practices to cause precipitation. His method was *yagña* (fire exercise/event), using an exotic blend of *āhūti* i.e.,upwardly invitation{s} (*note-**i***). The Ārya duo mention two forms of *yagña* (applied exercise) having opposite purposes (i) rain making (ii) rain thwarting/terminating. They even mention the constituents of the *āhūti* in brief. The Āṛya Śamāj-Bhubaneswar, Odisa, India, also has a group of rain making applied scientist led by Anādi Veda Sevaka [20], who conducts such exercises on call. From among the Āṛya Śamāj's collections, he forwarded to the present author a booklet titled *Vṛisṭi-yagña Padhati* (Principles and Practices of Rain making), authored by Vidyāṇaṇda '*videha'* of Ajmer, Rajasthan [21]. Śṛi Videha mentions the constituents of the *āhūti* (oblation material) at length [see Mechanics-1 Ref.No.21], enumerates the operation, and cites his primary sources the *Vedas* (***note-ii***) with collinear transliteration and translations in Hindi verse. The Āṛya Śamāj-Bhubaneswar branch officials also inform, that, in the vernacular, such collections go by the nomenclature '*parjaña śūktas*' (precipitation hymns), credited to Biṛeṇḍṛa Kaṛa and Dūṛgā Caṛaṇ Māhāṇti, etc., severally [22]. Śṛi Videha, in his introduction, emphatically announces that, among all the sciences, weather modification is the highest (read with Ref.No.41). We take our cue from all these inputs, take a swift-brief fresh look at select Hindu scriptures and attempt a Kaleidoscopic connection in relation to caption. The topic has great historical depth, wide literary-cultural spectrum and real time scientific value. This domain is therefore loaded with opportunities and assumes high relevance.

The Vedas & Satellite Works

With the *Rik* starts the *Vedas.*

D. Bhattacharya and P.C. Naik [23a] have earlier emphatically opined in the *IJHS* [23b] and elsewhere variously and numerously, that, the *Rik* is an ode to the Cosmos in abstract terms and that it is bereft of mysticism (religion is not mentioned in the Rik). The couple *Rik Veda* denotes 'elemental/basic plurality' i.e., that and those which all for the ancient mind constituted nature and not that and those of the modern period. Hence, the *Rik* is a technical treatise. Fig. 1 is a scanned copy from the *Rik Veda* (10.9.4) [24]. The very same canto is also noted in the *Sāṁ* (33), the *Yajūr* (36.12), and in the *Athaṛva* (1.6.1) *Vedas* respectively. G.K. Dash [25] has provided us with the following holistic translation. "(let) The copious rain may quench our requirements. (let) the rains usher in peace all around us". In other words, in the Rik Vedic periods rain fed food crop production was the sole crop pattern. Deficient rain led to insufficiency in food crop production which in turn led to un-peaceful conditions ! Hence, the rain-drill (more-Fig10).

The very relevant term 'copious rain'  (*deviṛviśtāye*) has been used conjunctly with the term '*devi'* as a poly-syllabic mono phone. The rest parts of the canto qualifies *deviṛviśtāye* with '*apa'* (pristine water) being supplicated by the then erudite minds as the harbinger of ecological inflorence cum all round prosperity for all

societies in continuum ! The Rik → the Sāṁ →the Yajūr → the Athaṛva Vedas constitute a historical series. This is internal evidence.

Let us consider few more internal evidences (not done pre to this communication in relation to caption). In such paramount Hindu (so called) theistic literature, rain has been alluded to with numerous synonyms as do the modern meteorological science journals. We know, synonyms convey similar meanings, and often stand distinguished from each other as masculine/feminine/non gender by virtue of verse/phrase construction, usage, etc. In modern technical literature the evolution track of each and every term is discussed and debated via the usage of the *stemma* (stemmatics). Eventually, certain terms get to be more relevant. All this is very significant in any model. In our context, the term 'devi', is a feminine phone that imparts numerous connotations viz. (i) mother (ii) goddess (iii) Earth (iv) deliverer/giver. This is attested to by cognate period linguists and grammarians (see *Śabdakalpadṛūṁa* / *Bhasakośa*, alphabetically). Our considered view is that the use of the term '*devir*' in the Rik has been used to connote 'deliverer/giver'. In other words, for the ancient mind, the cloud does not manufacture rain, it only bears, to deliver. A (tactical) feminine usage. The corresponding (present day) scientific parlance of equal order would be 'vector stage II'. Not as 'conceiver', because, in the *Athaṛva Veda* (AV).4.15.5 (Fig.4,5A, 5B) cloud conception mechanics has been apportioned to an interaction involving solar energy and the sea in the germination of moisture, while मरुद्भिः(wind) has been clearly indicated as the vector, albeit of stage-I, (AV 4.15.7). Such cloud genetics and not rain initiation mechanics is comprehendible in the Rik's cantos. Should we take '*Devi*' as the stemma of *deviṛviśtāya*, it then denotes '*medini/pṛithvi*' (Earth). Thence, copious/quenching pristine rain is the member in focus. The '*devir*' part of the polysyllable cum mono-phone *deviṛviśtāya* is a noun in present-continuous form, while '(a)*viśtāya*' (copious precipitation) is its implication enhancing ad-verb and verb; further qualified by the adjective *pitaye* (quenching). Whatever be the grammar, the Rik's couplets are in *dohada* (dual bodied) format. Are deducements of abstracts (of millenniums of dialectics) in techno-jargon acronyms with absolute brevity, perfect diction & flawless grammar for application often as Odes; peerless polysyllables and enticing syntax mandating complex helical movement of the tongue essentially participated with many a musculatures of the face, all the musculatures of mouth, fossa & vocal chords resulting in intonation misinterpreted as verse. Factually, is abrasive prose for professorial sonorous rendition. Also as style statement. The modus continued with corroborating exfoliations in the Hindu apex texts that followed. Let us examine further.

The *Śām veda* follows the *Rik* on the historical time line. It repeats all that is said in the *Rik* with musical intonation. The syllable *Śā* = *Rik* = basic/elements; and *aṁ* = musical intonation. In other words the Rik is severe and abrupt, while the Śām is *lāsya* (harmonic). Therefore, there is scant need to consider it separately. However, from the *Śām* transpires the *Chāṇḍogya Ūpaniśada*, which we have considered (see Ref.No.37).

The *Yajūr veda* follows the *Śām* on the historical time line. Its opening canto is dedicated to wind and cool conditions (YV 1.1) [26]. B.V.K.Sastry (27) provides the following enhanced translation and summary, "Let the sacred wind energy (blow) which gives life; for sustaining power, for welfare, for wealth. Let these be deployed for best acts. Oh God, we submit these to you; please guide us accordingly. Please keep us green and cool. We follow the path of the elders who lived a noble life following such maxim(s). We offer this sacred ritual to Indra (i.e. *yagña* to rain God). (may) This offering ensure that we are not afflicted by diseases, or thieves. May we be bestowed with best of Cow-wealth (milching). May such wealth increase and be protected". Mention of rain is conspicuous by absence. Here wind is the member in focus and it is conceptualized as energy, a element of nature that bestows wealth and 'green & cool' living conditions. We may note human, floral and faunal wellbeing are inter-connected with cool breeze. *Inter-alia* it suggests that the human mind of the *Yajūr Veda* period did not approve breezelss pouring rain. That such knowledge has been passed (to the *Yajūr Veda* people) by their predecessors. All this suggest a proto concept cum inherited awareness about biosphere. YV.36.10 may also be referenced (not produced).

We go back to the Rik. Phone *Vṛiśṭi* (rain) is feminine. So too is mother Nature and her processes, which all exhibit *śakti* (energy). We may note that rain is energy in the *Rik* and wind is so in the *Yajūr*. In other words, the cantos detail and emphasize a supplication to Nature and to the natural processes and not to any divine entity. Rain for the past mind was a (physical) matter called *apa* (pristine water, not even any non specific fluid. Rain is also not portrayed as Goddess. Even rain bearing cloud is not mentioned directly (only anecdotally). Term '*apa*' is used as *napuṇsaka liñga* (non gender). Evolution of easy to use durable writing medium being due, all this had to be memorized and retained forever. Therefore, the cantos as a whole are power packed jargons, in absolute brevity, in the then perfect diction. They are not for the non-initiated.An absolute aspect of the nature was observed and rendered dispassionately, being conscientiously conserved, improved and expanded upon in all the four treaties, which followed each other spanning few millennia (c.3000B.C -1000A.D?) of the Indo historical period (28,29).

This canto (Fig.3) from the *Athaṛva Veda* (4.15.1) describes overcast conditions followed by copious precipitation, all around to quench the earth. So, for the ancient minds, overcast condition (allude to rainable clouds) was a pre requisite for copious precipitation. Clouds come in the *Athaṛva* period. These canto trio (Fig.4) have been taken (along with Fig.3) from William Dwight Whitney's work [30]. We can see the transliteration as well. We may focus on No.5 (top canto, AV-4.15.5) as a case study – for it is very important to our context.

Fig. 5A is its transliteration provided by *Vidheha* – the Indian native Vedic scholar cum rain maker. While, Fig. 5B comprise its clone in Hindi verse (*Devanagari* script) done by *Vidheha*. He translates the comprehensive meaning as ~: 'Moisture is vectored (updrafted ?) by breeze upon its release from the sea due to the heat of the Sun. Bring the clouds here, (to) straddle the sky ('Oktas' in meteorological science), precipitate, along with thunder, great rain causing cloud do quench the earth'. We can see there is much contrast between Whitney's and Vidheha's renditions. We are inclined to follow Vidheha. The moot point is about (i) sun caused sea based evaporation (ii) astronomical gravity (iii) sea as the source of rainable cloud forming moisture (iv) cloud comprises of moisture (v) wind as the sole vector (vi) the supplication is to such an process for quenching the earth (*Pṛithvi*). It is not limited by geography, historical period, religion, kingship or any other purpose other than wetting of the soil (all types-every where). The internal evidence also suggest that in the *Athaṛva Veda* period the Indian sub-continent (annually) had a long dry spell and one rainy season, as alike in the present centuries. Hence quenching was necessary. This settles well with IMD's 30 year data also [31a].

This canto (Fig.7a) is again from the *Athaṛva Veda* (1.6.4). The overall contextual-compact meaning has been provided by B.V.K. Sastry (see Ref. No. 27), 'May the Divine waters be auspicious for all of us; Let there be no land without water which becomes barren because of lack of rain or non-tillable or marshy by excess of water (viz : kachar kachar of Assam & Flushing meadows of UK); (may) our tiling implements be auspicious; so be it with the water storage vessels; (may) the annual rains be auspicious for all of us'. Significance of hydrological cycle is traceable with a social link. Now water storage in nature means 'swaths of water' in turn alludes to hydraulic devices; water table; springs (*bāṁphee*); et.al.

Our Fig.7b is a canto again from the *Athaṛva Veda* (4.15.8). B.V.K. Sastry provides the gross total meaning as ~: 'Let all direction be lighteed with the bright lightening/arching. (let) The winds blow from every direction to directions, all across. (let) The water bearing clouds vectored by the good and auspicious wind approach the earth'. Thus we see, arching→thunder→wind→rain and →parching Earth are again put in a cascade cum kaleidoscopic series. Meteorologically when the wind blows uni-directionally rain does not occur (due frontal stratification; absence of vortex). That, poly-directional blow augers rain fall (vortical).

Rain physicists consider rain as the end product of a cascade. Across rural India arching (cloud-to-ground in particular) is considered as a signature of enhanced down-pour. We know, arching leads to lysis of electro-static borders between two cloud mass→alteration the Bulk mass modulus → conjugation → buoyancy failure →load

shedding→ to regain equilibrium/buoyancy→ precipitation seizes. With conjugation and or excessive collation cloud mass gain weight; gravity aspected; loose elevation rapidly causing pedal effect [**31b**] felt as wind & gusts.

Of modern evidence based learning, we further know, precipitation phenomena is 'load shedding' post convection (up-draft), which has to be induced by application of energy in form of heat. For the shed load to reach the surface and quench the ground there has to be adequate shedding i.e., a down-draft (the other half of the convection) of significant order or else there can be rain fall only to evaporate in mid air and not reach the ground. In free atmosphere (compressible fluids) convection, expand and compresses atmospheric fluids sectorally as waves. Wind being the signature.

Veda=plurals. The *Śaṁhitās* (vedic compendiums) followed in the order of *Śmṛitis* → *Bṛahṁaṇas*→*Arañyakas*→*Ūpaniśadas*→ *Sūtṛas*→*Kathās* and → *Āgamas / Pūrāṇas*. Puranas = ancient lore/s. The caption *Śmṛiti* means 'memoirs'; *Bṛahṁaṇas* denotes 'scholarly works'; *Arañyaka* denotes works by scholars who had detached self from family and collegiums; Vedanta = distillates; *Ūpaniśada* = Conclusion; *Sūtṛa* = 'axioms', *Kathā* denotes story telling or discussion (e.g., Māhāvāṛat kathā or Geetā Katthāṁṛtya) and *Āgamas/Pūrāṇas* denote (sectoral) advanced /branching works on ideas / concepts from preceding works. We herein consider canto No. 5.35.19 of the *Śatpatha Bṛahṁaṇas* ; canto No. 6.2.10 of the *Vṛihad-Arañyaka Ūpaniśada*; canto No. VI.ii.3 & 4 of *Chāṇḍogya Ūpaniśada* (metrical conclusion\advisories); and canto No. 3.14 of the BhÁgavat GeetÁ. B.C. Chowhan [32] has his sight on few other texts (not considered herein).

Our Fig.8 is that of *Śatpatha Bṛahṁaña* (5.3.5.19) [33]. Śri Dyanand Sarwasti (34) was the first to give the couplet's comprehensive meaning (in *Śaṇskṛit lingua-Devanagari* script) and propound the close correlation that it had with cloud formation and rain mechanics. He was the pioneer scholar to opine that, rain could be induced by *yagna* (exercise/drill). Interestingly, the canto is from the Vth Chapter, section *Madhyañadina Rājśūyagña* (state sponsored noon exercises). Meteorology tells us that natural updraft is robust at noon. So for the *Śatpatha Bṛahṁaña* weather modification drill leading to precipitation was a noon time activity on the official agenda of the state of the cognate period. A mass exercise is also suggested by the usage *Rājśūyagña.* Ravi Prakash Arya (35) has provided the rendition (Fig.9) in Anglo-Saxon script with diacritical. The phrase *Śatpatha Bṛahṁaña* means 'True Path Scholar'.

Fig.10. [36] is from the *Vṛihad Aṛaṇyaka Ūpaniśada* (VI.ii.10). It says, rain is possible due to the *āhūti* (oblation) and also suggests a subtle connection between the luni waxing phase and *yagña.* We know, the full selenic phase inflicts heightened buoyancy to atmospheric and to terrestrial fluids. So the *Aṛaṇyakas* brings in the luni astronomical gravity aspect. There is no mention of 'gravity'. The phrase *Vṛihad Aṛaṇyaka Ūpaniśada* may work out as 'Expanded advisories repository by Forest Dwelling Scholar's'. The *Bṛahṁaña* and the *Aṛaṇyaka* clearly connects 'Rain drill', with rain. Phone *Aṛaṇyaka* are super-specialties and subtly hints as 'bachelor' while *Bṛahṁaña* hints at rest types by scholars having non-bachelor life style combinations (supporting averment).

Apart from Sea, Sun, Earth, Wind, Moon, what else does the ancient mind tell us about the natural nexus between fire, water, air in relation to rain, in brief ? Fig.11 and Fig.12 are from the *Chāṇḍogya Ūpaniśada* (VI.ii.3 & 4) respectively. The canto duo suggests that at genesis (of the Universe/*Bṛahṁā*), fire preceded water, which was born out of fractionation of fire and (which) precipitation in turn resulted in bountiful food on the Earth. The phrase *Chāṇḍogya Ūpaniśada* [37] means 'metrical metaphor-advisories'. Who brought all these to our notice ? It was the master of dialectics, the *Ādi Guroo Śṛi Śaṇkarācārya* (the self reforming albino cum fountain teacher), dt. to between c.700-850A.D., (disagreement accepted about his *datum*) in his *Desideratum* cum *Magnum Opus*, "*Bṛahṁa Śūtṛa Vasya*" ~ A Commentary On The Axioms Of The Cosmos [38]. This book of axioms is based on a well known forerunner termed '*Bṛahṁa Śūtṛa*' by Bādrāyaña (cotton like nut-shell-vehicle) *alias* Vāsya (commentator!). At 2.iii.8-12, The Śaṇkara additionally sites the *Taitariya Ūpaniśada* (II.i.2), [39] and numerous others. In style, he does it brilliantly and in an inter-corroborating manner (inter-disciplinary). The *Chāṇḍogya* has umbilical connections with the *Śām Veda* (***note-iii***). At 2.iii.14 he unambiguously drives home the point, that the order of dissolution proceeds in the reverse

manner ! Evolution being the obverse (logically). In modern day parlance Śaṇkara's maxims indicate that reversal of the hydrological process proceeds with onset of aridification mechanics. In spite of his didactic cum heuristic method he errs not an fraction to even make a chance mention of any nation or society or geo-spatial domain. The universality concept is retained. Hence vedic vigyan = plural science. Down the time line Hindu texts as a thumb rule state collated matters in collective noun in a continuous tense with polysyllables – which all can also be fractalised and grappled with.

Did the author(s) of the *Śatpatha Bṛahṁaña* discover cloud formation and precipitation mechanics (or were the first observer or commentator) ? On examination it is noted that the *Śatpatha Bṛahṁaña* makes numerous mention of the *Yagña-Valka Śmṛiti* (as a resource). The caption phrase '*Yagña-Valka Śmṛiti'* [40] denotes 'memoirs of the emitted exercises of (a saint called) *YogiÐvara* Yagña-Valka'. The Yogiśvara (godly-saint) was a known scholar of the *Yajūr Veda* group/guild of the Vaisaṁpāyana order. Modern Śaṇskṛitists and Indologists inform us that *Taitiriya Aṛaṇyaka* in turn drew upon the *Yagña-Valka Śmṛiti*. So, in relation to our caption, we find and report that there existed diffuse inter-connection between the various theistic Hindu literature pre-dateable to Śaṇkara. He followed suit. He did not invent. Among the hoard that we have select discussed, the *Yagña-Valka Śmṛiti* is attributed to a definite scholar, yet is not Śṛi Yogiśvara's very own creation. In the case of the *Bṛahṁa Śūtṛa Vāsya* a definite scholar (namely Śaṇkara) makes a 'commentary' on a previous work, the root covenance of which remains again un-demarcated. Therefore, at this point of our discussion to non (in particular) are we able to apportion the credit of *Vṛiśṭi Yagña*, because non claim authorship. Our moot point is that from every perspective vis-a-vis our caption great antiquity is suggested, along with poly modal investments.

Again, it is also something like this :~ Nature and Natural laws do form the subject matter of the *Bṛahṁa Śūtṛa*(s). Wisdom of undermined periods and regions were collated by Bādrāyaña on which the ÏaÆkara made a commentary. This formed the foundation of *Ādwaita* (Non-Duality) on which around c.12th A.D., Rāmānuja further made a *Viśisṭādwita* (Special Non-Duality). Similarly, in modern period we find "Special Theories" and "General Theories" in the domain of Laws of Physics (nature) and Philosophy (mind). Heart ? is absent. Rather often matters of the heart are jested about (in the Hindu texts).

Furthermore, the four primal *Vedas* are compendiums containing nature observations; record; comments and commentaries; parables; application corrective measures and relief. Details about their covenances apart, even their locus posits as universal. The *Śmṛitis* and *Bṛahṁanas* are treaties that emanate from household system (family based scholars). The *Araṇyakas* emanate from the *Vānapṛaśthis* (they who have relinquished family and urbane life style and have settled in forests yet remain within the world of scholarship). The *Vāsyas, Śūtras, Ūpaniśadas* and *Kathāś* are products of *Gurūkūl* system (teacher & taught practice alias *Guroo-Siśya paraṁparā*). Since we are attempting an multi-disciplinary model to evaluate internal evidences *vis-a-vis* our caption the crux is that in spite of such variety in etiology we note that the ancient societies were always seized of the matter as in our caption. It was individual, and oligarchy driven. In that case, these 'works' were not 'donor driven'. The mater and the materials thereof can easily be considered as 'Research Works' of great antiquity. All this posits as *paraṁparā* (tradition). We stand humbled.

The Geetā

In the Hiṇdū way of life, nothing is done if not done with the *Bhāgavat Geetā*. The Śabdakalpadṛūṁa gives the meaning of the term 'nationale' for *Bhāgavat* and 'recitation' for *Geetā* i.e. *Bhāgavat Geetā* = *Faithful Recitation*. The *Vedas*, we have noted use the feminine phone *Vṛiśṭi*. The *Geetā* uses the term *Paṛjana* (precipitation) which is of *napuṇsaka liṇga* (i.e., neither masculine, nor feminine). There are no *devi* or *vṛisṭi* terms, which suggests a collinear phonetic evolution. We may further note that while the *Śaṁhitās* dealt with observation and supplication. The *Bṛahṁaṇas, Arañyakas* and *Ūpaniśadas* deal the same for intervention (of various orders) in the natural process with an applied science perspective.

Fig.13. [41] is that of the *śloka* (canto) from the *Bhāgavat Geetā* (3.14). It says 'food crops on the surface is possible due to precipitation which in turn is possible by *Yagña'*. The epic uses the words *paṛjaña-yagña* (exercise/drill/ human effort induced precipitation) and cites it as a metaphor. It may be relevant to relate for the benefit of the non initiated and the non Hindu scholars world wide, that every erudite scholar of Indology and of Indian literature accept the *Geetā* as a gem of a masterpiece (the *Māhāvārata* epic being the master piece). Every erudite scholar of Hindu theology and specially of philosophy accept the character of Kṛśna as that of the genius. For every Hindu, Lord Kṛśna is the peerless-supreme. In our candidate *śloka* (Fig.13) the gem, the genius and the supreme come together. The back ground being, Lord KªÐna on battle field, is extolling a unwilling yet immensely capable general to take to arms to solve the paramount problems of nation-society (unspecified) by blood and steel. To do so, the Lord selectively uses man made weather modification exercise / technique (*yagña*) as his choice metaphor. Readers may co-relate with Introduction, last para, and Ref. No.19~ Vidheha's opinion about the status of weather modification science (see Mechanics-I and also revisit Otto Von Bismarck's State policy – Ref. No.42).

India Country Wide Annual Practices

Fig. 14 is that of a satellite picture of the moisture field over India on 14-10-2009 which is 4 days pre to *Deepāvali*. We can see a sub-continent wide mild film of moisture loaded stream (gray colour) descending towards the southern India (towards the magnetic equator ?). It is coming in from across the Himalayas from the agro-industrial heart land of China. Dark zones represent clear sky regions. We know aerosols are particle nuclei (~0.2◎ m size)around which moisture collate. Over the Deccan the thin film of moisture/aerosol overall is an placid phenomena. Even an untrained mind and eye can observe that the fluid bed is virtually non-discernable along the Himalayas. This is due to heightened speed {Reynolds}of fluid flow from highland Tibet across the Himalyan barrier which acts as a weir. The Indo-Sutlej-Ganga being low lands. The gradient is high of the order 4mts of elevation for every 1mt of lateral traverse, which is why the satellite camera is unable to trap (not designed). Whereas, the fluid bed is not sufficient dense over the Deccan. This neither portends rain fall nor aridity. It is an typical equinotical phenomena (bi-annual *alias* inter-annual). However, precisely during the inter-annual periods, the farmers in the plains needs high soil moisture and atmospheric relative humidity and not rain, for this is period of flowering, budding, sap filling (critical crop period). Any interdiction leads to ecological stress, to production failure, and to socio-economic stress among the human kind (crop failure is only a part). Moreover, cold moisture inflows triggers snow fall in the Himalayas (during this period) which is vital for the mountain's fragile environment. The cold moisture warms up in the Indian plains and posits as good candidate to cause rain fall if further engineered. However, precipitation (load shedding) can happen only when adequate cloud condensation nuclei (CCN) are present for the floating moisture to collate around (see Mechanics II-A).

Fig. 15 is that of the satellite picture post *Deepāvali*, which was on 18-10-2009. We can see, that our domain of interest has much less moisture and that rainable cloud is located around south peninsular India. Both the images are exposed at about 00 UTC, in the IR range of 10-13◎ m (provided by m/s Dundee Satellite, for academic purposes). It is further relevant to relate that due to the geostrophic rotation of the earth Coriolis law [43a] comes into play which states that 'fluids in the northern hemisphere will be thrown anti-clock wise in a circular manner i.e., towards the Indian mainland (Fig.14). The north-east monsoon that brings bountiful rain fall for the rain fed subsistence farmer (and all) is a clock wise flow. The north east monsoon flows originates in the north west of India (to a great measure from around $+30^0$ latitude), wherefrom due to *Deepāvali* moisture is repelled out. It flows out into the Bay of Bengal and swerves backwards towards Nellore-Karikal coast after having crossed the $+18^0$ latitude to cause bountiful precipitation over a large tract of the Deccan. This happens counter to Coriolis theory. During the same period, Indians to the south of $+15^0$ lat. burn incendiaries. The southern Indian practice of celebrating *Deepāvali* with incendiaries (in place oil lamps) assists north east monsoon phenomena and its mechanics. On the entire globe such an meteorological phenomena is singular. (see Mechanics II-B).◎

This apart, our decadal observation is that in the provinces, the farmers and the villagers (*Adivāśi*-to- *Brahmaña*) burn leafs, hay, bamboo, cow dung, dry twigs, shrubs, baggasy, etc., pre-monsoon, in the open fields, to cause pre-monsoon showers. In Kashmir, stacks of Chinar leafs are preserved and burnt through the winter, which down regulates snow fall (killer episodes) and up-regulates rain fall kinematics. Rain drops releases trapped latent energy (while snow does not). Rain also depletes the energy basket of the system(s); also desiccates the non rain regions leading to intermittent episodes of clear sky conditions and down regulation of searing chilled winds (same period opposite example of Kashmir is Tibet). This in turn helps the flora and the fauna to survive the long and intense winter. Sans rain, Kashmir and even mid Himalayan range regions would develop Tundra type of climate. At present they are loaded with flora.

Down in the plains, rural India use fuel wood and coal in the hearths. This injects hygroscopic and carbonous (H_2O and ion adsorbing) black bodies, gray bodies (large aerosols), causes turbulence → condensation and→rain. So, the gradually warming dry-cold inflows from Tibet, Middle –East and the Thar gets impregnated with hygroscopic CCNs. Thus we see that the various regional Indian societies have evolved unique eco-friendly methods to inflict local (macro) and regional weather modification which leads to significant up- regulation of rain fall or dew with collinear down-regulation of aerosols with other benefits (viz. process scavenger) on a synoptic scale, precisely during the inter-annual periods. Such precipitation is used for field preparations, intercrops, podding or ripening (overcome moisture stress periods), augmenting surface water for the rain fed subsistence farming [43b-to-43d]. Not for anything else.

India Modern Operations

From the above discussion it becomes apparent that, India has a deep history of weather modification. The above also *prima-facie* appears to be moored to material as are in the Indo primary literature. However, officially, (Govt.-establishment) the Vedic technique(s) have not been considered. The administration of India in all its wisdom and altruistic attitude through its various agencies has attempted modifying weather (using air-crafts, NaCl, Silver iodide and pyrogenic sparkler candles) in Delhi [44], Karnataka[45], Maharastra [46] and Andhra Pradesh [47] with an aim to cause rain fall in rain shadow regions using non vedic concepts, techniques and aerosols (hardware & software). Before to India's independence the advanced nations have been developing such technology and also applying elsewhere in the world [48]. Snow fall [49,50] and fog dispersion has also been man-engineered. Official recognisation to *Vṛiṣṭi-yagṇa* is yet due. Sarasvati's-Arya's-Ajmeri's *alias* Vedic principle was indirectly mimicked by J.V.M. Naidu [51] of the IMD, in Aug.2006. He did cause significant rainfall over north Andhra districts (a rain shadow region). In place of *yagña* Naidu had used hand made indigenous incendiaries and ground based generators. The underlying principle of Naidu's mechanics was 'bottom seeding', which is same as is in *yagña.* The *Indra-Meghamadhanamu* (undivided Andhra Pradesh, 2007) operations used specially fitted aircrafts, imported and indigenous, air-borne, modern pyrogenic sparkler-candles over south-west Andhra (internal & side seeding). On few occasions during that operation the author used Satellite pictures to advice the operation centre about the time and place of the seeding. When done so, it did rain even in Kadapa district which is considered as rain less [52]. Author used principles of fluid mechanics (applied) to cause boundary lyses cum shoring of moisture banks resulting in rain fall. All these are modern techniques based on modern science of non Indian iteology and invariably is hyper-expensive, more often unsustainable and disregards the knowledge platform offered by heritage and history. However, they come within the ambit of our caption. In 2008 using the above knowledge and principles of Fluid mechanics author had advised Prof. Murlaikrishna of *Indirameghadhanumu* Andhra Pradesh, weather modification exercises. He had got good results using our on line advisories. In 2010, we informed the central Govt of India (idea killed).

DISCUSSION

These presents stand co-linearly on the shoulders of the pioneering European scholars (starting with Orientalists viz., Sir William Jones {c.1746-94} accelerated by Sir Monier Williams KCIE {c.1819-99}; Friedrich Max Müller {c.1823–1900}, Andrew Sterling {c.1846}, et.al.,, till date), who in-spite of language, climate, lodge cum board, and distance barriers have attempted translations of Indogenic literature igniting our latent imaginations; to the Āṛya Śamāj; to the Vedāṇta scholars of the Śṛi Rām Krishna Mission; and to many more (about whom we know not) who all have pre alluded to much what we have discussed herein. If a focused, narrow angle caption, discussion cum scientific co-relationing (thereof) as alike the present communication was missed, it indeed seems to have been by chance. We stand further humbled and pat ourselves, 'good-luck'. Anything extra mural of the establishment = not science; not feasible; not permissible (2020 too).

The Vedic verses relating to precipitation (*parjana śūṭras*) are as alike modern 'definitions', to laws of physics/nature. Again alike Algebra they do allow step-by-step back tracking (from the problem to the solution and reverse). The supplication is for quenching the earth (*Pṛithvi*) with subsequent floral inflorence and bountiful food crops (not for flowers to romance with nor for timber to make weapons to combat with)! The emphasis on inflorence and bountiful food crops appears as internal evidence of the society progressing from hunting and gathering/shifting cultivation to that of settled agriculture stage. It is this stage that is meant by the phone 'Hindu', which is of Lama/Tibetan etiology. Which rings in a feel of great antiquity. In such antique literature we note *jigyñāśā* (enquiry) as alike in our caption. The call for rain in the *vedas* is a universal one, for universal purposes. The *veda* (plural) aspects have been observed, narrated, debated and an attempt to modify weather is clearly noted. They constitute, peerless documents of History of sciences. Most of the texts have no specific author, nor a group. Only schools/collegiums. Simply put, the primal texts are compendiums (*Śaṁhitās*) wherein mention(s) are about that and those peer reviewed and accepted inputs which were dwelled upon further (for memoirs, explanation, amendments, appendixes, et.al.,) as *Brahṁañas*, *Śmṛitis & Śūṭras* as discussions, *Ūpaniśadas* as advisories, *Vāsyas* as commentaries, and finally as *Bhāgavat-Geetā* (Faithful\General Recitation) by the scholastic minds of cognate *collegiums* of cognate periods. No signature, no thumb (*note-iv*). Thus, the erudite among the ancient mind was dispassionately and collectively were seized of the underlying ethos (objective) of the matter as in our caption. They have even used internal evidence based dialectics to thrash out the correct path.

Our model has yielded a very interesting and relevant results. We may note that the ancient erudite mind even uses the supreme God head to tacitly inform and instruct the posterity in perpetuity, that (limited and eco-friendly) weather modification is as important as waging war for own nation-society's well being and fundamental rights. Interestingly, in the *Geetā* too, the scribe is a nameless, faceless character called *vāśya mūni* (apex commentator). In our select cited material there is God, but, he is not supreme! It is nature and human enterprise. There is also nature observation; their physical cum mechanical properties; action and reaction i.e., naked eye observation based correlated mechanics & kinematics; the then science cum application, supplication for conservation cum awareness and heurism! Science and Technology related aspects have carefully been embedded innocuously amidst the large bed volume of theistic rendition with literary flourish to fail the evil eye. To selectively enable the initiated, the informed and the inquesting. The verses also posits as information/data bank as a *process continuum*. Indeed pedagogic ! This indeed is *Bṛaṁhanatwa* (scholarship). *Bṛaṁhanatwa* is not hereditary. It is acquired academics basis opined The Adi Sankara (supporting info).

Climate is a complex phenomena of continuous tripartite robust inter-exchange involving boundary less, friction less Newtonian fluids of ocean-atmosphere, land-atmosphere and land-sea-atmosphere, coupled processes. Such process are vectored by geomorphology and orography. Weather is a short period component of the climate in relation to a grossly reduced geographical domain. Weather modification amounts to variability on macro-meso scale and are transient phenomena, climate changes are planetary in scale and are long term phenomena. The ancient mind

seemed to have sense of this very important aspect. Hence, this communication gets more loaded. The IPCC may have to take fresh look at all these-as well (read with Photo jor, Ref No. 17b).

Mechanics – I

For clouds to form adequate moisture should be available. Moisture has to collate in free atmosphere. For initiation of collation kinematics, cloud condensation nuclei (CCN) is essential. CCNs are particles. There are good CCNs (non isotopic carbon, anything hygroscopic). Tail pipe exhausts from hydro-carbons driven vehicles are bad CCNs. They do form cloud yet are efficient rain failers [53]. The *Āhūti* (in a *vṛiṣṭi yagña*-as per Vidheha) constitutes of ingrates of 24 herb and plant products/parts. The total is weighed in 80 fractions wt/wt. of which clarified butter (*Ghee*) comprises 14 parts. Of the 14, 5 parts are to be mixed with the ingrate and rest 9 parts are to be used as *āhūti* (for combustion in continuum). *Ghee* has relative low melting point and a high smoke point; low fire spread property (slow burning); is rich in fat, loaded with 98% glycerols (hydrophilic). Hot *ghee* quick soaks into the cellulose matrix of the ingrate (capillary and osmosis path way) and trigger sublimation (proceeding from the edges of the fire line); the whole burns at low temperature with deep soak action (not so with high octane or swift spread or high temperature generating burners). Sublimation thwarts generation of wood gas which is noxious (good CCN nevertheless yet not as efficient). Sublimation is the signature of the process of conversion of solid matter into gas phase (particles); assists better release of alkaloids and flavinoids (compounds), which are nature loaded in the ingrate and are also large particles. When *ghee* is mixed with the ingrate and *ÁhÚti* is offered into a small fire, the particles from solid matter (ingrate) and the *ghee* are liberated simultaneously and rise together. This is different from western sparkler technique. The couple is more effective in triggering collation in low relative humidity conditions. Alkaloids are crystalline and react easily with acids to form gygroscopic salts in free atmosphere. Flavinoids are aromatic compounds. Jointly they form a very large component of the ingrate release, are water-soluble pigments, antioxidant, hygroscopic and unstable (vehicle tail pipe exhausts are stable). These fail dioxide, peroxide and other stable compound particle formation (rain failers). Large particles exhibit efficient updraft (higher buoyancy) property in the convective fluid bed of evaporated *Ghee* which due to its eminent Partial coalescence property (Rhealogy) assists updraft (without lateral dispersion) towards cooler region. Particles are vectored by the rising warm air [54]. The *Ghee* burns completely leaving no residue. In turn it efficiently turns all other natural compounds that are in the *āhūti materia* into activated carbon, hydrophilic and hygroscopic black and gray bodies (i.e. large surface area particulates). *Ghee* fat is also a large molecule (0.1 to 22 ◎ m, to 15 ◎ m in diameter) circular/globular covered by a thin membrane of phospholipids ~8-10 ◎ m which melts, burns and converts to pure carbon almost instantaneously with fire contact (*āhūti*) and also thwarts degeneration of glycerols (Tri-glycerides/Glyserols are hydrophilic and large rain friendly compounds). *Ghee* is a non Newtonian fluid, has a high partial coalescence which fails on heating (temporarily attains Newtonian property) and regains post evaporation (**Rheological property is low**). Heat and flame treatment initially improves spreadability of *ghee* on ingrate and cellulose matter and again during updraft of the molecules (due to convective aeration). *Ghee* condenses efficiently by releasing trapped latent energy amidst a Newtonian fluid bed (free atmosphere). This also up-regulates convection. Subsequent regain (due coalescence, non-Newtonian character and hydrophilic property) leads to formation of large rain drops. Hence select wood (Chandan & Bel – *Santalum album & Aegle marmelous* are used for erecting the *yagña* pyre), and the herb ingrate on burning provide eco-friendly CCNs while *Ghee* is the vector cum efficient coalescence inducing candidate. In a rain making *yagña* the gamut of released particles are eco-friendly and efficient poly phasic rainable cloud collation CCNs. They (*suo-motto*) rise upwards, which in meteorological science is known as bottom seeding. Best results are got by performing *yagñas* for long duration and or in numerous locations latitudinally or meridonially simultaneously-mid day period ~*madhyañ-dina-yagña*, Ref.33). There can be no more economic a technique.

In Odisa, a ritual is held through the night to the full moon of *Falgun* (Feb-March), which is also known as Dola Poornima. Across Odisa, it is known as Agni Poornimaa. This event ensures a night long burning of logs. Now, we can easily co-relate it with the inter-annual period meso scale events of rain storms associated with lightning. It helps

the crops and also washes the flora, charges the top soil with ions, which in turn helps in nutrient fixing in the ensuing crop season. This too is another aspect of eco-friendly, limited, modification.

Mechanics II-A

A - Regarding Indo-Gangetic *Ākāś deep dāṇ* event, what then is the underlying theory ? Post the south west monsoon, Indians to north of 15^0 latitude burn oil by celebrating *Ākāś deep dān* for the entire period of *Kārtik*, terminating with instantaneous large scale burning of organic oil (non volatiles viz. Castor/*Ricinus communis* and *Sesamum***)** by celebrating *Dipāvali* (6 hrs). These oils are cold pressed organic oils (*Ghee* is not cold pressed) are Newtonian fluids – spreads out with reduction of atmospheric density/centrifugal force due to geostrophic rotation effect. With gain in elevation these hydrophobic particles exerts a thrust on the hydrophilic CCNs and on the yet to collate moisture because they have high dispersion property. They also exhibit low partial collation and are non precipitating in character, also have surfactant property; resists conglomeration and condensation, post evaporation. They have opposite physical and behavioral properties to that of the *Ghee.* The particles of these compounds also adsorb other CCNs, absorb radiant energy, have higher therm indexes, viscosity, surface tension, buoyancy, rate of decent, are semi-conductors, non-polarised, act as Fermions. They occupy greater cross section of the atmospheric column. In turn down-regulate turbulence, induce frontal stratification, thwart physical pathways of convective cloud condensation. All this results in cooling and lowering of the adiabatic zone (non Green house effect !), followed by reversal of wind flow direction (land breeze), laminar flow, which is very extraordinary. The released particles get injected into the atmosphere from the bottom and induces lower atmosphere cooling to ensure smooth withdrawal of the monsoon (clearing of the sky)**.** *Ghee* does the reverse**.** These aspects are also underscored by India Meteorology Dept's T –Π diagrams (available across met stations of India – 30 yrs basis [see Ref.31]~popularly known as single station module, never utilized for purposes as we have done). Clearing of the sky permits penetration of wider spectrum of the solar radiation at greater intensity (shortening day light hours due Dec Solstice). It results in normal photo-synthesis and crop cycle (critical for flora & fauna) in the various tropical species which makes the north Indian plains so very (agro-veterinary) special on pan global basis. During the same period all along the same latitude elsewhere in Asia-Africa-S America-Australia, crops and flora wilt and fail, even the veterinary populations are thin and are of smaller in size (N America & Europe do not have any comparable historical civilization in the yore). A month long festival of light (*DeepÁvali*) requires a robust earthen lamp making industry. No wonder the *khullar* industry is exclusive all along the Ganga-Jamuna belt and is peerless.

B - Regarding the Krishna-Kaveri *Ātasbāzi* events (incendiary festival) what then is the underlying theory ? During the same period, the native Indian incendiary industry (Krishna-Kaveri region) use charcoal as the carbon in the chemistry. *Ātasbāzi* (incendiaries) and low temperature burning (ground level fire works) generates CCNs in a solid to solid process with rapid sublimation in a near conforming orders, which in turn expresses CCNs (elements↔aerosols) in a narrow spectrum of the periodic table, while widening the spectra of size and architecture (mass). For example an high temp instantaneous explosion sieves Sodium Percholorate into Sodium and Potassium and thwarts formation of any compound (same with Sulphor). The intensity of the explosion(s) determines the CCN size characteristics. Interestingly, Sodium and Potassium severally are rain friendly CCNs, but as a compound Sodium Percholorate is not as efficient a rain inducing CCN, nor as eco-friendly. All these released particles excite ions, intensify electro static conditions, para magnetic pathways, efficiently condense and collate moisture, express latent energy, react to radiant and irradiated energy, (i.e. warming = Green house effect- CCN), induce atmospheric turbulence and convective processes. "Bosons pack together", goes the famous axiom [55]. All these act as Bosons. Thus, when adequate amounts of rain friendly CCNs are injected into the lower atmosphere electro-static boundary layers of the atmospheric stream flow lyses and collapse inflicting swerve, even reverse flow [56]. Boundary layers collapse as in fluid mechanics. The nocturnal-diurnal temp swing in the Deccan being very large the meteorological boundary layer remains in a flux (moist & non vertical). Nocturnally subsidence occur. *Ātaśbāzi* is done post Sun set. This helps in more efficient bottom seeding. Hence, the Sivakasi region of Tamil Nadu is the mother bed of incendiary industry of the sub-continent and is considered as peerless. Whence half of the Indian peninsula ushers

in clear sky, the other half at the same time induces overcast conditions (well considered civilisational aspects). Thence, the sun is in the south as well (read with AV 4.15.5) All this is region specific, eco-friendly, limited modification. So the wisdom that is noted in Indogenic literature seems also to have been applied on very large scale under the guise of religio-cultural events for social and ecological good [57-60]. Covid-19 raged across the globe as we final edited this mss., we found precious lot in Vedic Vigyan vrs virus which we correlated with covid [61-62]

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Notes

i : Opposite of *aviseka* (rill flow - down drafts). Liquid is the vehicle; presumes cooling. In *Ahuti* combustion \fire is the vehicle; presumes radiative therm & vortical updrafts.
ii : *Vedas* means 'plurals'. Sanskrit means 'self gelling'. Sanatan means 'perennial'. 'Hindu' means 'riparian settlers/people' (Tibetan-Lama phone; c.700-1000 A.D., Vajrayana Lit).
iii : *Śām, Yajur* & the Rik are identical. The Rik is resonant & cryptic prose; The Yajur is expanded verse; *Śām* is verse– is sung (is for the masses – popular rendition). The *Taitariya Ūpaniśada* = staged i.e., 'logic\dedactive advisories' quite metaphoric; technical jargon loaded.
iv : No religion; no nation; no individual; no sovereign; no subservience; no group; no guild. Completely borderless; frictionless; relentless *vāsya* (in continuum commentary) i.e., = vedic (plural) alias sanatan (perennial) vigyaan. Co-ordinates : star & trajectories. Distillate : time in space & season on Earth; planets & satellites ? discounted !

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49. J.Hallet & S.C.Mosop, *Nature*, 174, Vol.14, pp.26-28.
50. D.L.Mitchell, R. Zhang & R.L. Pitter, *Jor. Of Applied Meteorology*, 1990, Vol.29. 153-63.
51. Dr.J.V.M.Naidu, as the Director of Cyclone Forecast Centre, Vishakhapatna, had conducted weather modification during south west monsoon. He had succeeded in diverting heavy rain bearing clouds from Orissa to over north Andhra (a rain shadow region). His experiment was considered as gymnastics, and let into ignominy. Establishment disapproved this unique effort.
52. E. Mail correspondence dt. 1st week of Oct.2008, received by author from Andhra Seeding Operations Centre, confirmed adherence to our model (as given on daily basis) and reported an avg. rain fall of ~ 15-20mm per rain gauge, in October in Kadapa dist., which is an acute rain shadow area of Telengana. Data available. Not produced.
53. Proceedings of *TROPMET*-2006, National Symposium on Role of Meteorology in National Development, Proceedings of the Silver Jubilee India Meteorology Society & IMD, Pune, Vol-II, pp. f1-114. AND also Op.Cit. No. 49.
54. It may be relevant to relate that released particles being ultra small, get super charged with energy due to burning process. Post release they start expressing into the atmosphere. Such phenomena acts as propulsion. The particle rises. Meteorological updraft carries it to relevant altitude. Terrestrial gravity does not effect particles.
55. S.N. Bose, 1894-1974, Refer, Bose-Einstein Statistics, Bose-Einstein Condensates.
56. Bhattacharya, Deepak, "Proceedings of The Orography of Orissa & Andhra Act as Hydraulic Devices *vis-à-vis* Monsoon Drafts : A Theory", *National Workshop on Mesoscale Modelling of Atmospheric Process*, DST, Andhra University, Jan. 2007.
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Disclaimer

The paper was submitted to *Indian Jour of History of Sciences*-INSA (03-2010). It was returned without comments. It has since been submitted to *International Jour of Meteorology* (USA) –in May=2010. The learned editor has informed that it will take around a year if not more for the entire process to complete. Few Govt. officiandos have also availed copies and have yet not acknowledged. Public lecturing at lot many places

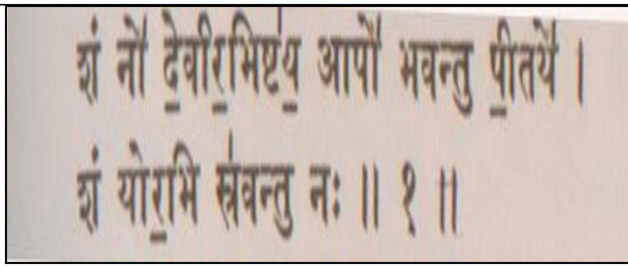

शं नो देवीरभिष्टय आपो भवन्तु पीतये ।
शं योरभि स्रवन्तु नः ॥ १ ॥

Figure 1.

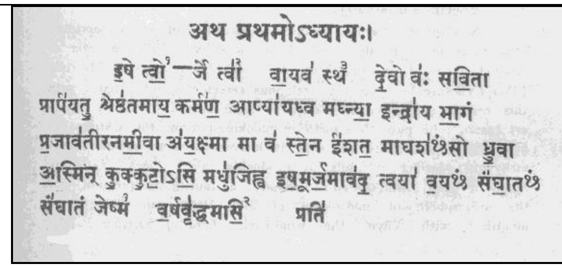

अथ प्रथमोऽध्यायः।
इषे त्वो—र्जे त्वा वायवं स्थ देवो वः सविता
प्रापंयतु श्रेष्ठतमाय कर्मण आप्यायध्व मघ्न्या इन्द्राय भागं
प्रजावतीरनमीवा अंयक्ष्मा मा वं स्तेन ईशत माघशंसो ध्रुवा
अस्मिन् कुक्कुटोऽसि मधुजिह्व इषमूर्जमावंद त्वया वयं संघातं
संघातं जेष्म वर्षवृद्धमसि प्रति

Figure 2.

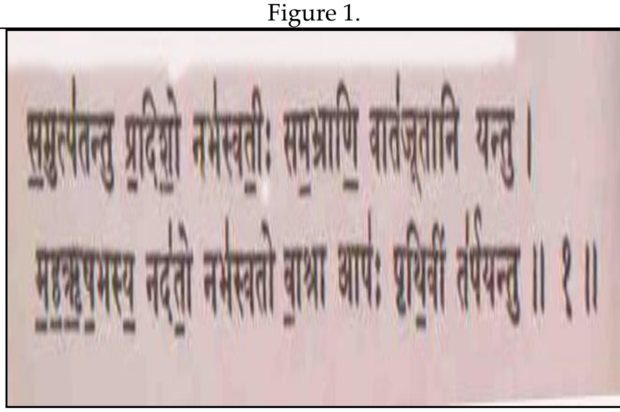
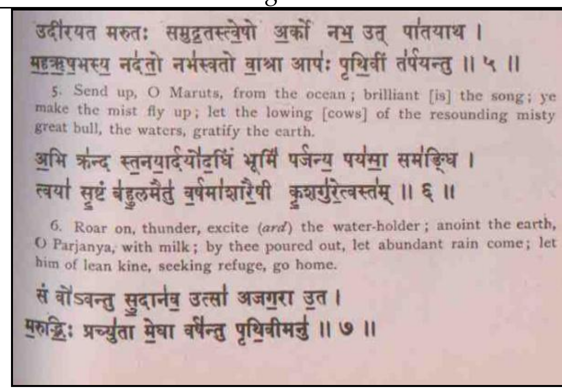

समुत्पतन्तु प्रदिशो नभस्वतीः समभ्राणि वातजूतानि यन्तु ।
महऋषभस्य नदतो नभस्वतो वाश्रा आपः पृथिवीं तर्पयन्तु ॥ १ ॥

Figure 3.


उदीरयत मरुतः समुद्रतस्त्वेषो अर्को नभ उत् पातयाथ ।
महऋषभस्य नदतो नभस्वतो वाश्रा आपः पृथिवीं तर्पयन्तु ॥ ५ ॥

5. Send up, O Maruts, from the ocean; brilliant [is] the song; ye make the mist fly up; let the lowing [cows] of the resounding misty great bull, the waters, gratify the earth.

अभि क्रन्द स्तनयार्दयोदधिं भूमिं पर्जन्य पयसा समङ्ग्धि ।
त्वया सृष्टं बहुलमैतु वर्षमाशारैषी कृशगुरेत्वस्तम् ॥ ६ ॥

6. Roar on, thunder, excite (*ard*) the water-holder; anoint the earth, O Parjanya, with milk; by thee poured out, let abundant rain come; let him of lean kine, seeking refuge, go home.

सं वोऽवन्तु सुदानव उत्सा अजगरा उत ।
मरुद्भिः प्रच्युता मेघा वर्षन्तु पृथिवीमनु ॥ ७ ॥

Figure 4.

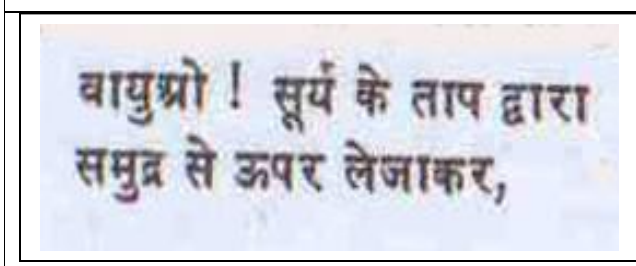

वायुओ ! सूर्य के ताप द्वारा
समुद्र से ऊपर लेजाकर,

Figure 5A.

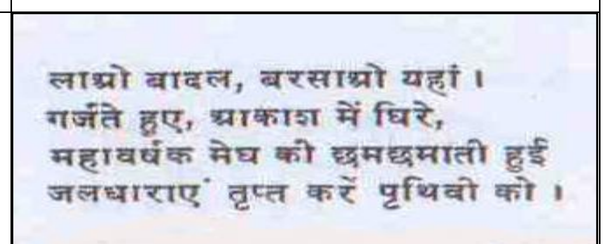

लाओ बादल, बरसाओ यहां ।
गर्जते हुए, आकाश में घिरे,
महावर्षक मेघ की छमछमाती हुई
जलधाराएं तृप्त करें पृथिवी को ।

Figure 5B.

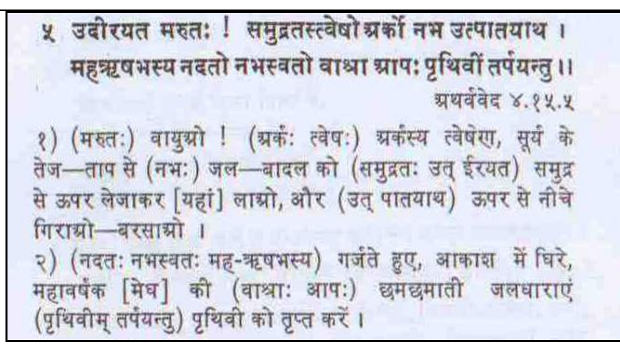

५ उदीरयत मरुतः ! समुद्रतस्त्वेषो अर्को नभ उत्पातयाथ ।
महऋषभस्य नदतो नभस्वतो वाश्रा आपः पृथिवीं तर्पयन्तु ॥
अथर्ववेद ४.१५.५
१) (मरुतः) वायुओ ! (अर्कः त्वेषः) अर्कस्य त्वेषेण, सूर्य के तेज—ताप से (नभः) जल—बादल को (समुद्रतः उत् ईरयत) समुद्र से ऊपर लेजाकर [यहां] लाओ, और (उत् पातयाथ) ऊपर से नीचे गिराओ—बरसाओ ।
२) (नदतः नभस्वतः मह-ऋषभस्य) गर्जते हुए, आकाश में घिरे, महावर्षक [मेघ] की (वाश्राः आपः) छमछमाती जलधाराएं (पृथिवीम् तर्पयन्तु) पृथिवी को तृप्त करें ।

Figure 6.

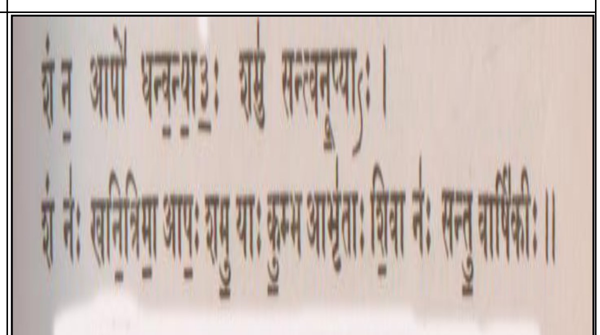

शं न आपो धन्वन्याः शमु सन्त्वनूप्याः ।
शं नः खनित्रिमा आपः शमु याः कुम्भ आभृताः शिवा नः सन्तु वार्षिकीः ॥

Figure 7a.

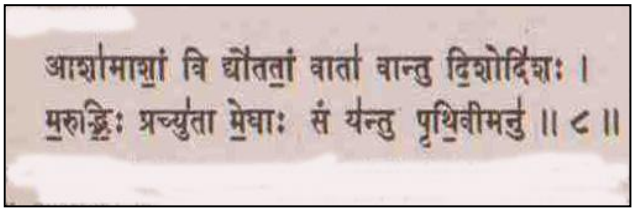

आशामाशां वि द्योततां वाता वान्तु दिशोदिशः ।
मरुद्भिः प्रच्युता मेघाः सं यन्तु पृथिवीमनु ॥ ८ ॥

Figure 7b.

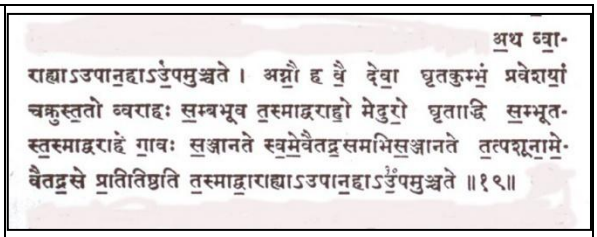

अथ ब्वा-
राह्याऽउपानहाऽउँपमुञ्चते । अग्नौ ह वै देवा घृतकुम्भं प्रवेशयां
चक्रुस्ततो व्वराहः सम्बभूव तस्माद्वराहो मेदुरो घृताद्धि सम्भूत-
स्तस्माद्वराहे गावः सञ्जानते स्वमेवैतद्रूसमभिसञ्जानते तत्पशूनामे-
वैतद्रूसे प्रातितिष्ठति तस्माद्वाराह्याऽउपानहाऽउँपमुञ्चते ॥१९॥

Figure 8.

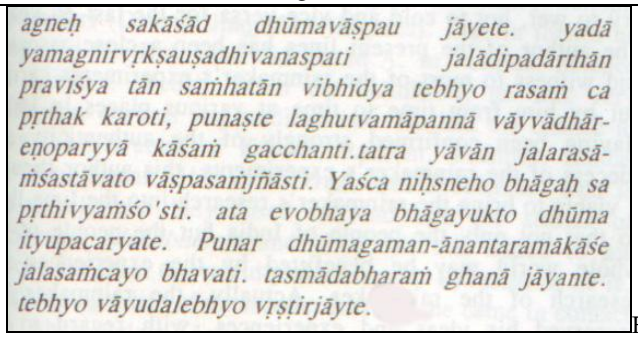

agneḥ sakāśād dhūmavāṣpau jāyete. yadā yamagnirvṛkṣauṣadhivanaspati jalādipadārthān praviśya tān saṁhatān vibhidya tebhyo rasaṁ ca pṛthak karoti, punaste laghutvamāpannā vāyvādhār-eṇoparyyā kāśaṁ gacchanti.tatra yāvān jalarasā-ṁśastāvato vāṣpasaṁjñāsti. Yaśca niḥsneho bhāgaḥ sa pṛthivyaṁśo'sti. ata evobhaya bhāgayukto dhūma ityupacaryate. Punar dhūmagaman-ānantaramākāśe jalasaṁcayo bhavati. tasmādabharaṁ ghanā jāyante. tebhyo vāyudalebhyo vṛṣṭirjāyte.

Figure 9.

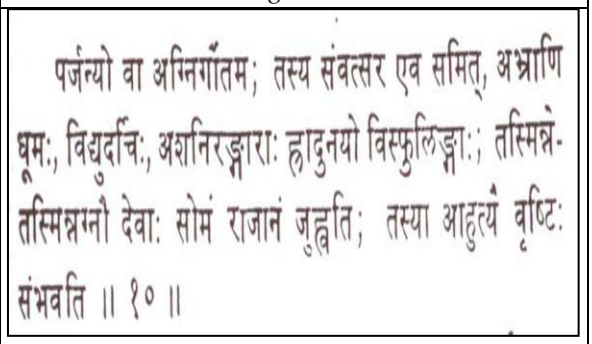

पर्जन्यो वा अग्निर्गौतम; तस्य संवत्सर एव समित्, अभ्राणि
धूमः, विद्युदर्चिः, अशनिरङ्गाराः ह्रादुनयो विस्फुलिङ्गाः; तस्मिन्ने-
तस्मिन्नग्नौ देवाः सोमं राजानं जुह्वति; तस्या आहुत्यै वृष्टिः
संभवति ॥ १० ॥

Figure 10.

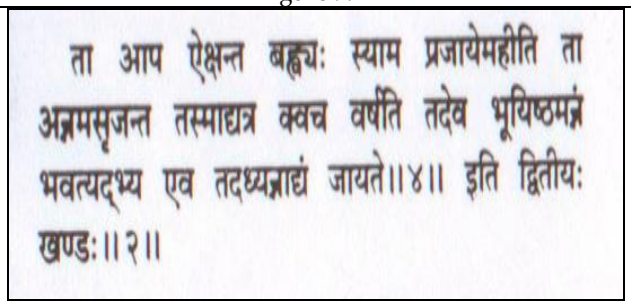

ता आप ऐक्षन्त बह्व्यः स्याम प्रजायेमहीति ता
अन्नमसृजन्त तस्माद्यत्र क्वच वर्षति तदेव भूयिष्ठमन्नं
भवत्यद्भ्य एव तदध्यन्नाद्यं जायते॥४॥ इति द्वितीयः
खण्डः॥२॥

Figure 11.

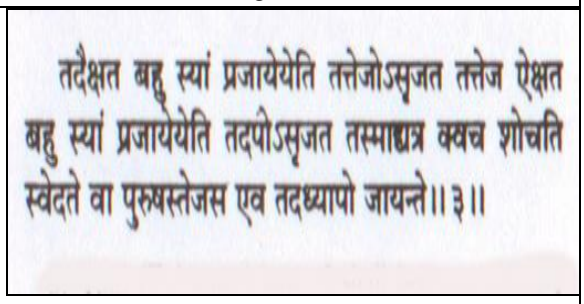

तदैक्षत बहु स्यां प्रजायेयेति तत्तेजोऽसृजत तत्तेज ऐक्षत
बहु स्यां प्रजायेयेति तदपोऽसृजत तस्माद्यत्र क्वच शोचति
स्वेदते वा पुरुषस्तेजस एव तदध्यापो जायन्ते॥३॥

Figure 12.

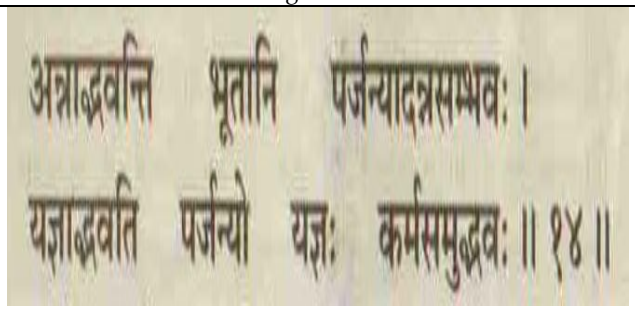

अन्नाद्भवन्ति भूतानि पर्जन्यादन्नसम्भवः ।
यज्ञाद्भवति पर्जन्यो यज्ञः कर्मसमुद्भवः ॥ १४ ॥

Figure 13.

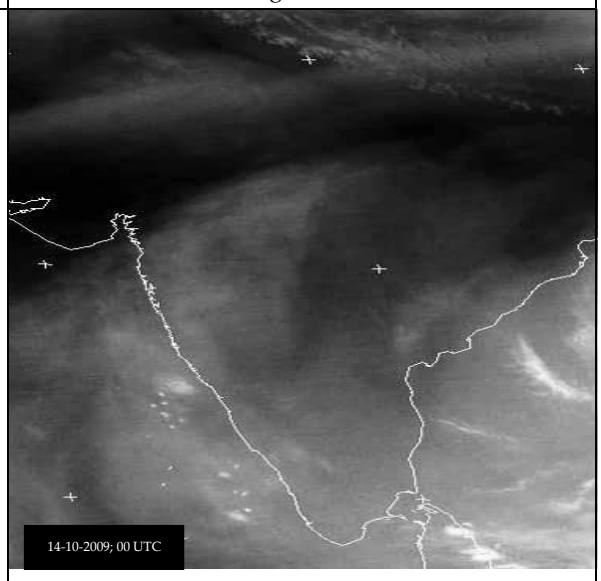


Figure 14.

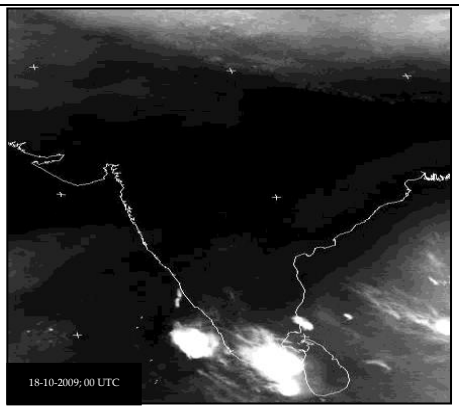


Figure 15. Satellite picture post *Deepāvali,* which was on 18-10-2009.

KEY TO TRANSLITERATION

		Sounds like			*Sounds like*
अ	a	o in *son*	ड	ḍ	d
आ	ā	a in *master*	ढ	ḍh	dh in *godhood*
इ	i	i in *if*	ण	ṇ	n in *under*
ई	i	ee in *feel*	त	t	French t
उ	u	u in *full*	थ	th	th in *thumb*
ऊ	ū	oo in *boot*	द	d	th in *then*
ऋ	ṛ	somewhat between r and ri	ध	dh	theh in *breathe here*
			न	n	n
ए	e	a in *evade*	प	p	p
ऐ	ai	y in *my*	फ	ph	ph in *loop-hole*
ओ	o	o in *oh*	ब	b	b
औ	au	ow in *now*	भ	bh	bh in *abhor*
क	k	k	म	m	m
ख	kh	ckh in *blockhead*	य	y	y
ग	g	g (hard)	र	r	r
घ	gh	gh in *log-hut*	ल	l	l
ङ	ṅ	ng	व	v	v in *avert*
च	c	ch (not k)	श	ś	sh
छ	ch	chh in *catch him*	ष	ṣ	sh in *show*
ज	j	j	स	s	s
झ	jh	dgeh in *hedgehog*	ह	h	h
ञ	ñ	n (somewhat)	ं	ṁ	ng
ट	ṭ	t	ः	ḥ	half h
ठ	ṭh	th in *ant-hill*			

Figure 16. Where-so-ever diritic marks have been used they are as in Sankaracharya's, *Brahma Sutra Bhasya*, Translated by Swami Gambhirananda, Advaita Ashram, Kolkata–14, India, January 2000, Opposite to p.1

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RESEARCH ARTICLE

Optimization of Potential Bacterial Consortium for Bioremediation in Crude Oil Contaminated Sites

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ABSTRACT

The selected bacterial consortium able to degrade crude oil was isolated from petroleum contaminated soil at automobile workshops and petrol pumps in Chennai, Tamil Nadu, India. Bacterial analysis of the samples revealed the presence of crude oil degrading bacteria belonging to the genera *Pseudomonas*, *Enterobacteriaceae, Moraxella, Bacillus and Micrococcus* sp. The microbial consortium consists of (*Pseudomonas aeruginosa* and *Bacillus pumilus*) is having higher degradation. The biodegradation rate of crude oil concentration in Bushnell Haas (BH) broth, but addition of carbon and nitrogen source had a substantial impact on the biodegradation of crude oil, which suggested that carbon might provide a factor that was necessary for its crude oil biodegradation. Influence of various effects of pH, temperature, carbon sources, nitrogen sources and on crude oil degradation from BH broth also studied. The results showed a rapid and efficient process of crude oil degradation 90%in BH broth supplemented with 1% cellulose and 1% peptone inoculated by bacterial consortium at incubation temperature of 35 °C at pH 7. This study suggests that isolated *Pseudomonas aeruginosa* and *Bacillus pumilus* may play an important role for biodegradation of crude oil in the contaminated soil.

Key words: Crude oil, Biodegrdation, Bacterial consortium, *Pseudomonas aeruginosa* and *Bacillus pumilus*.

INTRODUCTION

In recent years, petroleum and its byproducts pollution has been increasing concern both nationally and internationally. These pollutants are removed by biotechnological process using microorganisms (Agarry *et al*. 2012). Bioremediation process is used to remove environmental pollutants such as organic and inorganic substances from

soils, water and sediments. It has countless advantages when compared to other processes employed to remove pollution such as extraction with solvents addition of chemical oxidizers (Nano *et al*., 2003). The presence of hydrocarbon contamination in the environment has influenced the biodiversity of the region. The petroleum hydrocarbon degradation from environment is limited by large number of factors. An important factors in the biodegradation of contaminated soils is low bioavailability and solubility of the hydrocarbon (Latha and Kalaivani 2012). The degradation of petroleum hydrocarbons and its byproducts using environmental microorganisms have been recognized as an efficient, versatile, economic and environmental friendly treatment. The research for effective and efficient methods of petroleum hydrocarbons from contaminated sites has intensified in recent years, because biodegradation is responsible for cleaning of the environment pollutants (Grangemard *et al*., 2001).

Bioremediation is also environmentally friendly; it does not produce waste products and is cost effective. Microorganisms with potentials for oil degradation are widespread in nature. It can be combined with other technologies and naturally occurring process when the conditions are suitable for the growth of microorganisms (Roy *et al*., 2014).In general, bioremediation process optimization may be incomplete by the lack of studies showing the simultaneous effect of different environmental factors). Hence, our study focused was to set up the optimum values of five abiotic factors: pH, temperature, carbon source, nitrogen source and salt concentration for the biodegradation of crude oil. In order to achieve the efficient biodegradation of the above factors on the microbial growth and the biotic degradation was studied (Amass *et al*., 1998). Generally, microbial communities present in crude oil contaminated soils are enriched by microorganisms able to use as a carbon and nitrogen source (Gallego *et al*., 2007).The present study focused on to isolate, identify and screen the efficient oil degrading bacterial strains, bacterial consortium and optimization of bacteria consortium with different carbon source, pH and temperature oil under different concentration.

MATERIALS METHODS

Sample collection

Petroleum hydrocarbon contaminated soil samples were collected from motor vehicle workshops, water service stations and vehicle parking areas located in and around Chennai, Tamil Nadu. Soil samples were collected randomly 5-10 cm beneath the surface using spatula and packed in sterile container. The samples were transported to the laboratory in an ice box and stored at 4^{o}C for analysis. The collected soil samples were serially diluted from 10^{-1} to10^{-6}, spreaded on nutrient agar plates and incubated at 37^{o}C for 24 hours. The obtained cultures were purified by quadrant streaking on sterile nutrient agar plates (Khan and Rizvi, 2011).

Primary screening of crude oil degrading bacteria

Bushnell Hass media (BHM) along with redox indicator 2, 6-dichlorophenol indophenol was prepared, 1% of crude oil was added. The isolated strains were inoculated into broth and incubated at 37°C for 7 days (Ibrahim *et al*., 2013). Ten ml of broth was taken, centrifuged and the supernatant was used to measure the optical density at 640nm for degradation ability of the isolates. About 0.1ml of each 7 days old BH broth culture was spread over to the nutrient agar plates to count bacterial population.

Secondary screening by gravimetric analysis

The bacterial strains (15 nos) showed more efficiency on crude oil degradation and increased growth in primary screening was selected for secondary screening. About 100ml of Bushnell Hass broth media was prepared with this one gram of crude oil was added in the broth. Oil degrading isolates were aseptically added as an inoculums. The flask was incubated at 37°Cfor 7 days in a rotary shaker at 120rpm. After incubation, the flask was added with diethyl ether solvent and transferred to the separating flask. The estimation of residual oil left after degradation was made by the amount of oil in a preweighed plate (Anupama *et al*., 2009).

Degradation by Bacterial Consortium

Bacteria were grouped for consortium such as A + B, A + C, A + D, B + C, C + D, A + B + C, A + B + D, A + C + D, B + C + D and A + B + C + D. Ten milliliter of the above isolates were taken and mixed. The suspension was taken as seed inoculums and 1 ml of inoculum of above consortium was inoculated in BH medium with 100 ppm of crude oil and kept in a shaker at 37 °C for 7 days.

Effect of pH on crude oil degradation

The BH broth was prepared with various pH (3, 5, 7, 9 and 11). 100 ppm of crude oil was prepared and one ml of one OD bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) was inoculated to the broth and kept in a shaker (120 rpm) at 37°C. The samples were drawn aseptically at regular intervals. The bacterial growth was checked by standard plate count method and concentration of crude oil in the medium was determined by using UV visible spectrophotometer (Singh and Chandra, 2014).

Effect of temperature on crude oil degradation

The sterile BH Medium at pH 7 with 100 ppm of crude oil was prepared and one ml of one OD bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) was inoculated to the medium and kept in a shaker (120 rpm) at different temperature (15, 30, 35, 40 and 45°C). The bacterial growth was checked by standard plate count method and crude oil concentration in the medium was determined using UV visible spectrophotometer method (Sarkar *et al*., 2017).

Effect of carbon sources on crude oil degradation

The sterile BH medium at pH 7 with 100 ppm of crude oil and 100 mg/l various carbon substrates such as dextrose, sucrose, cellouse, starch and glucose was prepared and one ml of 1 OD bacterial consortium *(Pseudomonas aeruginosa* and *Bacillus pumilus)* was inoculated and kept in a shaker (120 rpm) at 35°C. The samples were drawn aseptically at regular intervals, analyzed the bacterial growth was checked by stranded plate count method and concentration of crude oil using UV-Vis spectrophotometer (Teng *et al*., 2010).

Effect of nitrogen sources on crude oil degradation

The BH broth at pH 7 with 100 ppm of crude oil and 100 mg/l various nitrogen sources peptone, beef extract, yeast extract, soya bean and casein acid hydrolysate was prepared and one ml of one OD bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) was inoculated to the broth with added 1% cellouse and kept in a shaker (120 rpm) at 35°C. The samples were drawn aseptically at regular intervals. The bacterial growth was checked by stranded plate count method and concentration of crude oil in broth was determined by using UV visible spectrophotometer (Teng, *et al*., 2010).The best nitrogen sources was selected and used for further the crude oil degradation studies.

RESULTS

Sample collection and isolation of bacteria from soil sample

There are 14 crude oil contaminated soil samples were collected for obtaining efficient crude oil degrading bacteria isolates from in and around Chennai. Totally 135 bacterial strains were isolated from crude oil contaminated samples and identified by various biochemical tests according to the Bergey's manual of determinative bacteriology. Among the 135 bacterial strains the major genera present in petroleum contaminated sites were *Micrococcus*, *Pseudomonas*, *Bacillus*, *Moraella* and *Enterobacteriaceae* sp.(Fig 1).

Primary screening of by DCPIP test

Among the 135 bacterial isolates, 15 isolates were screened for degradation of petroleum hydrocarbons by primary screening method using DCPIP test. Ability of the isolates to degrade the hydrocarbon was confirmed by the color change from blue to colourless.

Secondary screening by gravimetric analysis

The rate of degradation was confirmed by gravimetric method. Among the 15 bacterial isolates only two bacterial genera namely *Bacillus* sp. 18 and *Pseudomaonas* sp. 35 showed higher degradation ability was confirmed in secondary screening. The bacterium *Bacillus* sp 18 degraded 37% and *Pseudomaonas* sp 35 degraded 38% within 7 days (Fig 2).

Efficient microbial consortium

In this study, the two combination of bacterial consortium was used to check the efficient microbial consortium (Fig.3). The results showed that consortium B+C was more efficient in crude oil degradation. Hence, this consortium was used for further degradation study. The selected two bacterial consortium were subjected to morphological and biochemical character studies and identified as*Pseudomonas aeruginosa* and *Bacillus pumilus*.

Effect of pH on crude oil degradation

The effect of pH on the bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) with various pH like 3, 5, 7, 9 and 11. The pH in the broth is directly proportional to the degradation of crude oil. Periodically the bacterial growth was determined by standard plate count. The maximum growth of (85×10^6 CFU mL^{-1}) was observed in pH 7, at 35°C in 7 days followed by pH 3 (75×10^6 CFU mL^{-1}). In pH 5, pH 9 and pH 11 growth showed about 69×10^6 CFU mL^{-1}, 66×10^6 CFU mL^{-1} and 60×10^6 CFU mL^{-1} respectively (Fig.4). The result showed that pH 7 was ideal for the growth of the bacterial consortium.

The maximum crude oil degradation 95% (100 to 5 ppm) was observed in BH broth at pH 7 during 7 days. At pH 3, 5, 7, 9 and 11 the degradation of crude oil was 70, 85, 95, 88 and 78% respectively. The complete degradation was obtained in pH 7 indicated that the neutral pH 7 was the suitable for degradation of crude oil (Fig. 5).

Effect of temperatures on crude oil degradation

Crude oil degradation was studied at different temperatures like 15, 30, 35, 40 and 45°C the broth was containing bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) with 100ppm of crude oil concentration at pH 7. The maximum growth was observed in 35°C (75×10^6 CFU mL^{-1}) in 7 days followed by 15, 30, 45 and 40°C (71×10^6 CFU mL^{-1}, 68×10^6 CFU mL^{-1}, 64×10^6 CFU mL^{-1} and 60×10^6 CFU mL^{-1}) respectively (Fig.6). The result showed that 35°C was ideal for the growth of the bacterial consortium.

The maximum crude oil degradation 95% was observed in pH 7, at 35°C in 7 days by the bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) with 1% cellouse in pH 7 at 35°C in 7 days incubation. At the temperatures 15, 30, 40 and 45°C degradation was observed 49, 75, 95, 90 and 88% respectively (Fig .7). At the 35°C for the higher of degradation (95%) was observed 7 days incubation. This indicates that 35°C was finest temperature for crude oil degradation study.

Effect of carbon sources on crude oil degradation

BH medium with various carbon sources and bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) was studied. Totally five different analytical grade carbon sources namely dextrose, sucrose, glucose, starch and cellulose were used. The maximum growth was observed cellulose (80×10^6 CFU mL^{-1}) in pH 7, at 35°C in 7 days followed by dextrose (75×10^6 CFU mL^{-1}), starch (66×10^6 CFU mL^{-1}), sucrose (60×10^6 CFU mL^{-1}) and glucose (58×10^6 CFU mL^{-1}) respectively (Fig.8). The result showed that cellulose was ideal carbon growth of the bacterial consortium. The

maximum 96% (100 to 4ppm) degradation of crude oil was observed in BH broth with supplemented cellulose as a carbon source in pH 7 at 35°C in 7 days. In order to other carbon sources degradation was observed in starch 95% (100 to 5ppm), glucose 92% (100 to 8ppm), sucrose 90% (100 to 10ppm) and dextrose 85% (100 to 15ppm) respectively (Fig. 9). The cellouse showed best degradation and selected for the further studies. Cellouse used as co substrate to enhance the metabolic activity of bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*).

Effect of nitrogen sources on crude oil degradation

BH medium with various nitrogen sources and bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) was studied. Nitrogen sources, namely peptone, beef extract, yeast extract, soya bean powder and casein acid hydrolysate were used. The maximum growth was observed in peptone (85×10^6 CFU mL^{-1}) in the pH 7 with 1% cellouse, at 35°C for 7 days followed by soya bean powder (80×10^6 CFU mL^{-1}), yeast extract (76×10^6 CFU mL^{-1}), casein acid hydrolysate (70×10^6 CFU mL^{-1} and beef extract (62×10^6 CFU mL^{-1}) respectively (Fig.10).

The result showed that peptone was ideal for the growth of the bacterial consortium. In this study, the maximum crude oil degradation was observed in nitrogen sources peptone amended with 1% cellouse in pH 7 at 35°C during the experimental days. The degradation was observed 93% (100 to 7ppm) in beef extract, 92% (100 to 8ppm) soya bean powder, 91% (100 to 9ppm) yeast extract and 89% (100 to 12ppm) casein acid hydrolysate respectively (Fig. 11).

DISCUSSION

Presently the toxic, mutagenic and carcinogenic properties of polycyclic aromatic hydrocarbons (PAHs) have been concerned by the Unites States Environmental Protection. (Luning Prak and Pritchard, 2002) Microbial bioremediation removes or immobilizes the pollutants reducing toxicity with a very low environmental impact. Environmental pollution acts on the indigenous biota of the ecosystem to eliminating or selecting microorganisms in accordance sensitivity in the presence of the toxic agent. There are several reports on bioremediation of pollutants by the action of different bacterial strains have been capable of degrading hydrocarbons (Rahman *et al.,* 2002;Varjani*et al.,* 2015) have been reported on the roles of *Bacillus* sp. And *Pseudomonas* sp. in hydrocarbon bioremediation. Rapid primary screening procedure was performed to assess the indicator dye (2, 6-DCPIP) decolourization efficiency of selected strains for confirmation of crude oil biodegradation. To ascertain microbial ability to utilize hydrocarbon substrate by simple observing the color change of DCPIP in which the quickest decolourization time represents the best oil biodegradation is a major breakthrough in biodegradation studies. Total bacterial count was determined by standard plate count method (Selvakumar *et al*., 2014).

Secondary screening of purified culture is also done by recovering oil from the flask and the estimated amount of oil is left after degradation. Increase in oil degradation is directly proportional to an increase in cell count indicating that bacterial isolates were capable for oil degradation (Rahman *et al*., 2002). *Pseudomonas* sp. is an outstanding and natural crude oil degrader reported in the literature which is wide spread in nature and can degrade wide range of xenobiotics. It has been postulated that *Bacillus* sp. are predominant and more tolerant to high level of crude oil contaminated soil due to their ability of the resistant endospore which may protect them from the toxic effect of the hydrocarbon (Usman *et al*., 2012). The present study was undertaken to determine the optimum condition and efficient bacterial isolate to attain the maximum degradation possible in soil contaminated samples. Among different combinations of bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) used a maximum of growth was recorded in the combination B+ C at 7 days. Similarly, Rajakumar *et al*. (2008) reported that bacterial consortium of *Pseudomonas* sp. KW1 and Bacillus sp. YW4 from nitrate contaminated soil were found to be the most efficient in terms of nitrate reduction was recorded in the two bacterial consortium combination. Prabhakaran *et al*. (2014) studied crude oil degradation and showed that mixed bacterial consortia degraded maximum level of 93.85% of crude oil.

The effect of various pH on bacterial growth was studied in BH broth containing 100ppm of crude oil. The maximum growth (85 × 10^6 CFU mL^{-1}) was observed in pH 7, at 35°C in 7 days followed by pH 3 (75× 10^6 CFU mL^{-1}), pH 5 (69 × 10^6 CFU mL^{-1}), pH 9 (66 × 10^6 CFU mL^{-}) and pH (60 × 10^6 CFU mL^{-1}) respectively. In the current study, bacterial growth was maximum at pH 7, though the process was active from pH 7 to 9. Similarly, Hambrick *et al*. (1980) found increased growth rates of microbial mineralization of octadecane when pH was increased from 6.5 to 8.0.

The effect of various pH on bacterial growth was studied in BH broth containing 100ppm of crude oil. The maximum level of bacterial growth was observed in pH 7 at 7 days. The maximum 95% degradation was observed. Pawar (2015) suggests that pH 7.5 was most suitable for the degradation of all PAHs as 50% degradation was also observed for all in soil pH 7.5 within the first seven days. The effect of various temperature on bacterial growth was studied in BH broth containing 100ppm of crude oil pH 7. The maximum growth was observed in 35°C (75 × 10^6 CFU mL^{-1}) followed by 15, 30, 45 and 40°C (71× 10^6 CFU mL^{-1}, 68 × 10^6 CFU mL^{-1}, 64 × 10^6 CFU mL^{-1} and 60 × 10^6 CFU mL^{-1}) respectively. The bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) degraded crude oil from 100 to 5ppm (95%) at the temperature 35 °C. At the temperatures of 15, 25, 45 and 55°C, the crude oil degradation was 49, 75, 90 and 88% respectively. Most of the reports revealed that, the best biodegradation efficiency of crude oil was achieved at the highest temperatures (35-40°C). Husain and Ahmad, (2013) also reported 35°C temperature showed higher efficiency of oil degradation.

The effect of various carbon source on bacterial growth was studied in BH broth containing 100ppm of crude oil. The maximum growth was observed in cellulose (80 × 10^6 CFU mL^{-1}) in pH 7, at 35°C in 7 days followed by dextrose (75× 10^6 CFU mL^{-1}), starch (66× 10^6 CFU mL^{-1}), sucrose (60 × 10^6 CFU mL^{-1}) and glucose (58 × 10^6 CFU mL^{-1}) respectively. The bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) degraded crude oil from 100 to 4ppm (96%) in the broth amended with 1% cellulose. The carbon sources of dextrose, sucrose, lactose and starch the crude oil degradation was 95, 92, 90 and 85% respectively. The above results showed that 1% of cellulose as carbon source was found to be optimum for crude oil degradation by the bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*). Rajakumar *et al*., (2008) also reported that carbon sources enhance the nitrate degradation percentage.

The effect of various nitrogen source on bacterial growth was studied in BH broth containing 100ppm of crude oil. The maximum growth was observed peptone (85 × 10^6 CFU mL^{-1}) was observed in pH 7 with 1% cellouse, at 35°C in 7 days followed by soya bean powder (80 × 10^6 CFU mL^{-1}), yeast extract (76 × 10^6 CFU mL^{-1}), casein acid hydrolysate (70 × 10^6 CFU mL^{-1} and beef extract (62 × 10^6 CFU mL^{-1}) respectively. The bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) degraded crude oil degraded from 100 to 5ppm (95%) in BH broth containing peptone as a nitrogen source. The nitrogen sources of beef extract, yeast extract, soya bean powder and casein acid hydrolysate the crude oil degradation was 93, 92, 91, and 89 % respectively. The above results showed that 1% of peptone, as nitrogen source was found to be optimum for crude oil degradation by the bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*). Ashok *et al*., (2016) also reported that nitrogen sources enhance the ethylbenzene degradation. In the nutrient enhancement, the effect of the nitrogen form on biodegradation is well documented in the literature (Shewfelt *et al*., 2005). The microbes found in soil, groundwater and superficial waters can break down hydrocarbons which will be utilized as carbon and energy source, thereby eliminating them from polluted environments (Mazzeo *et al*., 2010).

CONCLUSION

In this study, hydrocarbon utilizing *Pseudomaonas* sp. and *Bacillus* sp. bacteria was isolated from contaminated soil. Screening of crude oil degrading bacteria was performed by DCPIP redox indicator spectrophotometric technique. *Pseudomonas aeruginosa* and *Bacillus pumilus*. both are predominant bacterial strains have more ability to degrade the petroleum oil contamination was proved. Bacterial consortium used for crude oil degradation process and obtained better results for oil degradation. It was further investigated for degradation of hydrocarbon by gravimetric analysis

revealed 78% of degradation. Using microbial consortium process is successful and safe way to enhance environment health in particular with low cost, technique and high public acceptance to cleaning up aquatic ecosystems from oil spills.

In this optimization study, *Pseudomonas aeruginosa* and *Bacillus pumilus* were found to be the most efficient in terms of crude oil degradation. The above results revealed that crude oil degradation by *Pseudomonas aeruginosa* and *Bacillus pumilus* were influenced by various pH, temperature carbon sources and nitrogen sources. The rate of bacterial growth and crude oil degradation was high with 1% cellulose and 1% peptone as the sole carbon source and nitrogen source under optimum conditions at an optimum temperature of 35°C and pH 7. The cellulose and peptone is a successive nutrient source for the bacterial growth and could be useful to remediate containing crude oil. The maximum degradation was recorded up to 90% for a period of 7 days in optimization study. In the study carried out with bacterial consortium as inoculum. The bacterial consortia showed a superior crude oil degrading ability.

Many factors were studied such as pH, temperature, carbon and nitrogen sources were optimized and enhanced the bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) to use crude oil as a substrate, degrade and detoxify. The bacterial growth with biocarrier materials was high with 1% cellulose and 1% peptone as the sole carbon source and nitrogen source under optimum conditions at an optimum temperature of 35°C and pH 7 at 7 days. Therefore, information derived from metabolites during the process was effective and defined important factors interference on efficient clean-up of pollutants. Based on the observation, it could be concluded that the bacterial consortium (*Pseudomonas aeruginosa* and *Bacillus pumilus*) by bacterium is a potential biological resource and can be used for remediation of oil contaminated environment sites.

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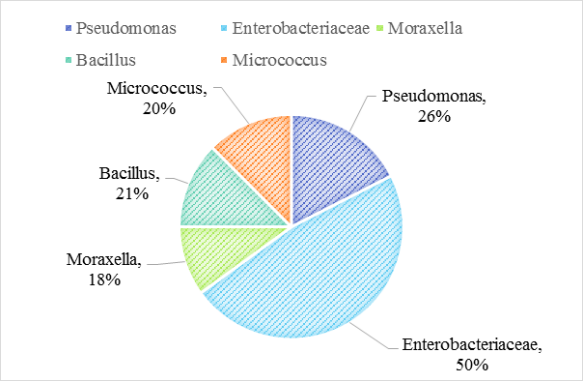

Figure 1. Major microbial genera in oil contaminated soil

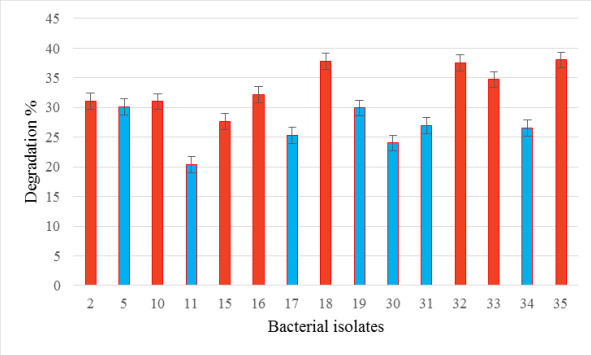

Figure 2. Secondary screening of bacteria in crude oil degradation

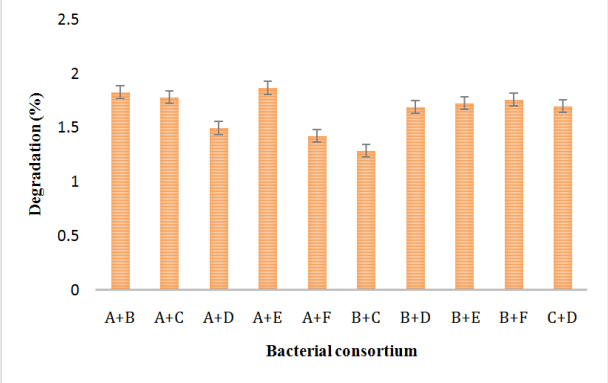

Figure 3. Efficient bacterial consortium

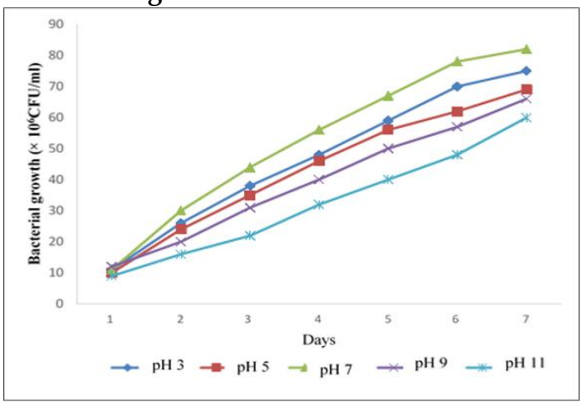

Figure 4. Effect of various pH on the growth of bacterial consortium

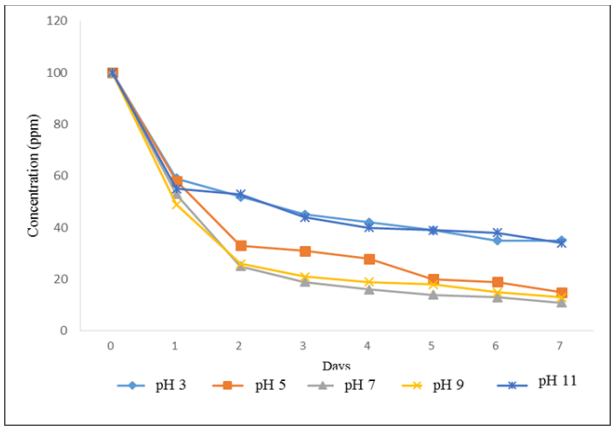

Figure 5. Effect of various pH during crude oil degradation

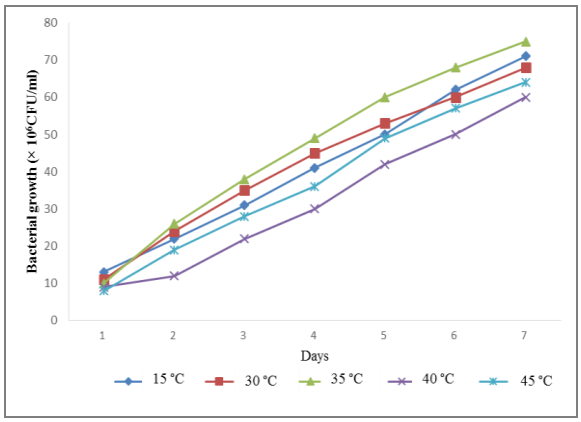

Figure 6. Effect of various temperature on the growth of bacterial consortium

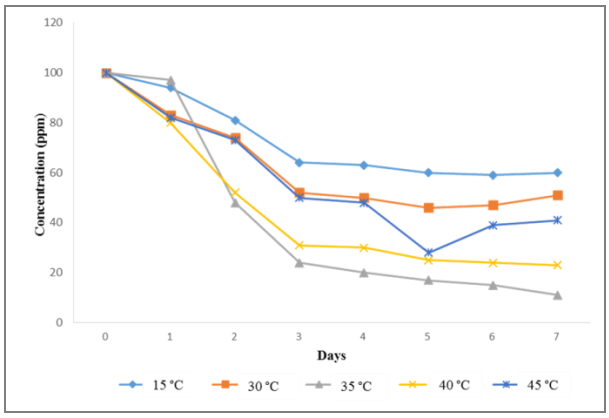

Figure 7. Effect of various temperature during crude oil degradation

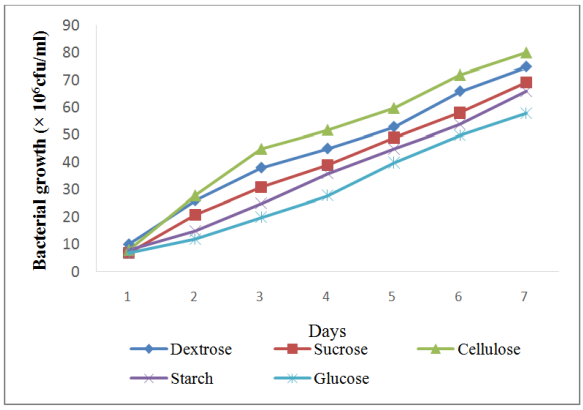

Figure 8. Effect of various carbon source on the growth of bacterial consortium

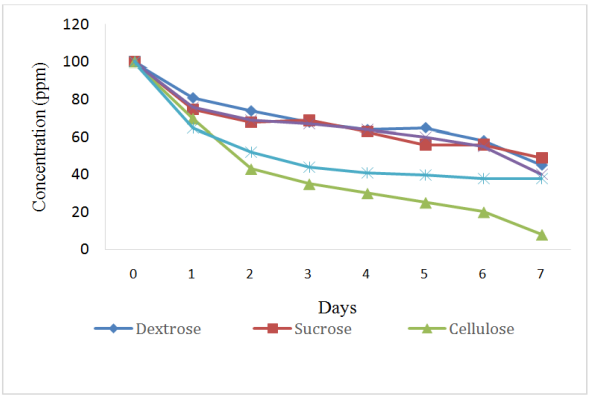

Figure 9. Effect of various carbon source during crude oil degradation

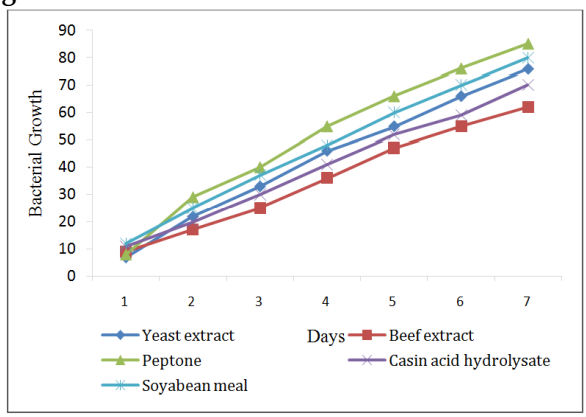

Figure 10. Effect of various nitrogen source on growth of bacterial consortium

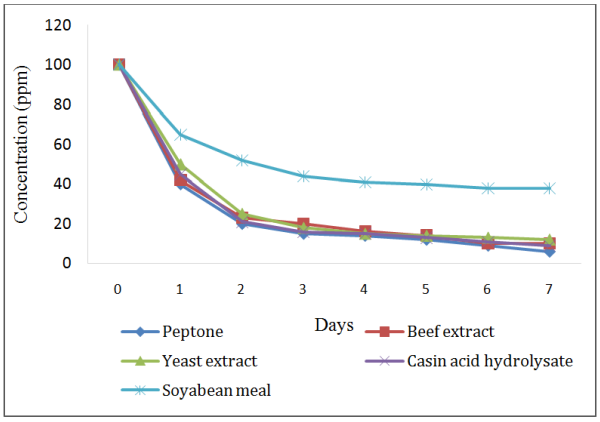

Figure 11. Effect of various nitrogen source during crude oil degradation

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REVIEW ARTICLE

Analysis of Thin Films by Infrared Spectroscopy: Review

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ABSTRACT

Binary, ternary and quaternary thin films have been prepared by using different deposition methods. The obtained films were used for many applications such as solar cell, opto-electronic device, laser device, sensor, electro luminescent device and light emitting diode. So far, several analysis tools such as X-ray diffraction, atomic force microcopy, scanning electron microscopy, energy dispersive X-ray analysis, UV-visible spectrophotometer, Raman spectroscopy, photoluminescence spectroscopy technique and X-ray photoelectron spectroscopy technique have been used for thin film characterization. In this work, various types of thin films were prepared via physical and chemical deposition techniques. The Fourier transform infrared spectroscopy (FTIR) was used to identify functional groups in sample. FTIR spectra confirmed that characteristic peaks are affected by the changes in experimental conditions such as temperature, heating process, pH value, presence of complexing agent, concentration of solution, deposition time, and deposition cycle.

Keywords: thin films, solar cells, Fourier transform infrared spectroscopy, deposition.

INTRODUCTION

Recently, many researchers have investigated binary, ternary and quaternary semiconductors. These materials have been employed in many applications including solar cell [Julia et al., 2020; Ho and Anand, 2015], cathodic ray tube, sensor, laser device, optoelectronic devices, light emitting diode, infrared window, and biologic application. Thin films can be produced through various deposition techniques such as chemical bath deposition [Tan et al., 2013], electro deposition method [Kassim et al., 2009; Abdul et al., 2010], thermal evaporation technique [Nafiseh et al., 2017], spray pyrolysis [Offor et al., 2018], magnetron sputtering [Li et al., 2018], metal organic chemical vapor

deposition [Ju et al., 2007], molecular beam epitaxy [Martin et al., 2003], sol gel spin coating method [Lee and Park, 2008], pulsed laser deposition [Gao et al., 2017], and successive ionic layer adsorption and reaction technique [Guzeldir et al., 2012], and e-beam evaporation method [Tatiana et al., 2020].

Properties and characterization of obtained thin films through various tools have been reported by many researchers. X-ray diffraction [Ho, 2015; Yilmaz et al., 2020] was used to determine the structure of films. Atomic force microcopy [Lim et al., 2013; Anuar et al., 2011] and scanning electron microscopy [Kumari and Vipin, 2020; Ho et al., 2019; Shariff et al., 2011] were employed to study the morphology of sample. Energy dispersive X-ray analysis [Derya et al., 2020; Ho, 2016] was utilized to investigate the elemental composition of materials. UV-visible spectrophotometer was used to study the optical properties of films including band gap and absorption behavior [Chaik et al., 2020; Alkesh et al., 2020]. Raman spectroscopy could be used to determine chemical composition and structure of sample [Nadarajah et al., 2020; Olgar, 2020]. Photoluminescence spectra were used to study the electronic structure and properties of sample [Audrius et al., 2020; Hassen et al., 2020]. X-ray photoelectron spectroscopy technique was employed to measure elemental composition, chemical state and electronic state of the element [Avilez et al., 2020]. In this work, thin films were prepared by using different deposition techniques. The Fourier transform infrared spectroscopy (FTIR) was used to identify functional groups in sample. The advantages and limitations of this technique were briefly described also.

Literature survey

Fourier transform infrared spectroscopy (FTIR) is a non-destructive method [Andrei, 2018], which provides information related to the functional groups of sample. Generally, three components such as radiation source, interferometer and detector could be observed in spectrometer. The source produces radiation which passes the sample through interferometer. Several examples of common sources such as silicon carbide, tungsten halogen lamp, and mercury discharge lamp. The FTIR spectrometer uses an interferometer to modulate the wavelength from a broadband infrared source [George, 2012] and the signal was measured in a very short time [James et al., 2004]. A detector measures the intensity of transmitted or reflected light as a function of its wavelength. The infrared spectrum indicated fingerprint of thin films with absorption peaks attributed to frequencies of vibrations between the bonds of atoms [Larkin, 2011]. Researchers highlighted that no two compounds form the exact same infrared spectrum due to each different material is a unique combination of atoms. There is a reason why infrared spectrum could be used in qualitative analysis. The advantages and limitations of FTIR as listed in Table 1.

Infrared analysis of binary thin films

CdS films have been prepared via micro emulsion mediated sonochemical route [Aurobinda et al., 2010]. There are three strong peaks at 635.54 cm^{-1} (stretching frequency of CdS bond), 3429 cm^{-1} (OH stretching) and 1629 cm^{-1} (OH bending mode) could be seen. Cadmium selenide thin films were produced through wet chemical synthesis [Aurobinda et al., 2010]. Based on the FTIR spectra, several peaks could be found in 624 cm^{-1} (stretching frequency of CdSe bond), 3432 cm^{-1} (OH stretching) and 1628 cm^{-1} (OH bending mode). Chemical bath deposition of zinc selenide thin films was carried out in acidic condition, at 80 C and various deposition times (60, 120, 180 and 240 minutes). FTIR analysis showed some peaks such as 637 & 1148 cm^{-1} (ZnSe stretching vibration mode), 877 cm^{-1} (CH bending mode), 1412 cm^{-1} (bending vibration of CH_2), 1587, 3261 & 3473 cm^{-1} (stretching mode of OH) in all samples [Khalfi et al., 2020].

Chemical spray pyrolysis deposition technique has been used to prepared zinc sulfide thin films. ZnS films showed large band gap [more than 3.5 eV] and wide direct band gap. FTIR analysis showed that the presence of several weak vibrational peaks such as 611.45 cm^{-1} and 680 cm^{-1} for the films prepared at 350 °C and 400 °C [Djelloul et al., 2015].

The SnS films have been prepared on corning glass by using chemical bath deposition method. Experiment indicated that different film thicknesses were obtained by varying the number of deposition cycles such as 2 (374 nm), 3 (440 nm), 4 (528 nm), 5 (672 nm) and 6 cycle (723 nm). FTIR analysis indicated that there are two regions could be found. If wave number range more than 1500 cm^{-1}, represented detail of functional group in thin film. While wave number range less than 1500 cm^{-1} indicated the information related to the nature of material. FTIR spectra showed the presence of some peaks such as 865-880 cm^{-1}, 732-747 cm^{-1} and 569-583 cm^{-1} in all samples, represented SnS bond stretching vibration [Javed et al., 2020]. The Fe-doped tin sulfide thin films were prepared via chemical bath deposition method onto glass substrate. FTIR spectra confirmed that the band at 2434 cm^{-1} (SnS bond stretching), 2854 cm^{-1}(O-H bond stretching), and 2605 cm^{-1} (O-H bond stretching), when the 4%, 6% and 10% Fe in SnS films, respectively (Javed et al., 2018). SnS films were deposited synthesized onto soda lime (as glass substrate) by using chemical spray pyrolysis method. The as-deposited SnS films (Sn:S molar ratios of 1:1) showed peaks at 3460-3590 cm^{-1} and 1630-1670 cm^{-1}, attributed to O-H group in samples [Polivtseva et al., 2017]. FTIR analysis also indicated that the formation of tin oxide was not observed for the annealed films and films (Sn:S molar ratios of 1:8).

The uniform deposition of CdTe thin films (thickness=1.05 mμ) was produced at room temperature under evaporation rate (8 to 10 Å/s) through electron beam vacuum evaporation technique [Subhash and Dhaka, 2018]. The obtained thin films were treated with various concentrations of $CdCl_2$ (0.15M, 0.2M and 0.25 M). The FTIR investigation confirmed that the IR transmittance was increased with $CdCl_2$ treatment.

Infrared analysis of ternary thin films

Ternary compound such as Cu-S-Se films were prepared onto fluorine doped tin oxide glass substrate via electrodeposition method. FTIR study revealed that the presence of two peaks at 1110 cm^{-1} (vibration of stretching mode of CuSe) and 615 cm^{-1} (vibration of stretching mode of CuS) in all samples. The FTIR spectra highlighted that the peak intensity was vary with change in composition of selenium and sulfur ions [Yewale et al., 2018]. The $CuInSe_2$ thin films were synthesized by using electro deposition method in pH 2.1, deposition potential of -500 or -600 mV versus saturated calomel electrode under various temperatures such as 25 and 40 °C [Kashyout et al., 2014]. The films prepared at 25 °C and deposition potential of -500 mV showed several peaks at 2345 $^{-1}$ (corresponded to $CuInSe_2$), 3650 $^{-1}$ and 3844 cm^{-1} (corresponded to CuInSe). Meanwhile, the films deposited at 40 °C and -600 mV indicated distinct absorption peaks at 2857 cm^{-1}, 3295 cm^{-1} (corresponded to $CuInSe_2$). The growth of excellent crystalline quality of Cu_2SnSe_3 thin films onto fluorine doped tin oxide glass substrate was reported. As-deposited thin films displayed very strong peaks 3300-2800 cm^{-1} corresponded to vibration of C-H and vibration of N-H stretching bands, indicating the presence of organic species in the obtained sample. However, intensity of these peaks was reduced under a thermal treatment at 370 °C [Feng et al., 2015].

The copper indium disulfide thin films thin films have been synthesized onto fluorine doped tin oxide glass, at pH 1.5, deposition potential of -0.75 V versus Ag/AgCl by using electro deposition method, followed by sulfurization process. The films prepared using Cu(Salen) complexes showed several peaks at 1630 cm^{-1} (C=N vibration), 1448 cm^{-1} (C=C stretching mode), 736 cm^{-1} (bonding mode of phenyl group =C-H), 1125 cm^{-1} and 1192 cm^{-1} (phenolic CO bond). On the other hand, the sharp peaks could be seen at 1415 cm^{-1} (C=C stretching mode), 782 cm^{-1} (bonding mode of phenyl group =C-H), 454 to 616 cm^{-1} (CuO bond) for the films prepared in the presence of $Cu(acac)_2$ complexes [Mahdiyeh and Mohsen, 2020]. The chemical bath deposition technique has been used to synthesis highly crystalline Cu_2SnS_3 films onto conducting stainless steel at pH 4 for 2 hours [Harshad et al., 2020]. Several peaks in FTIR spectra indicated the presence of CuS & Cu_2S (619 cm^{-1}) and SnS (1397 cm^{-1}) & SnS_2 in sample. On the other hand, Cu_2SnS_3 films were deposited onto fluorine doped tin oxide glass substrate at 80 °C, pH about 1.5, for 2 hours in the presence of complexing agent such as ethylenediamine tetra acetic acid disodium salt [Suryawanshi et al., 2020]. The FTIR study was carried out for the films prepared under various deposition times such as 60, 75 and 90 minutes. The FTIR spectra showed that four characteristic peaks could be observed at 619, 1122, 1397 and 1619 cm^{-1}, corresponded to Cu-S bond vibration, asymmetric stretching of carbonyl group, vibration of SnS bond and OH bending of water,

respectively. Spin coating technique was used to produce Sn-Sb-S films onto fluorine doped tin oxide glass substrate [Warunee et al., 2020]. The tin antimony sulfide films have been prepared under various pH values such as 1.56, 1.6, 1.67, 1.73, and 1.80. FTIR spectra revealed that the presence of several peaks at 455 cm^{-1} (symmetric Sn-O-Sn stretching mode), 538 cm^{-1} (SbS bond), 1030 to 1070 cm^{-1} (CO symmetric stretching mode), 1400 to 1430 cm^{-1} (symmetry stretching vibration mode of O-C-O bond)), 1607 cm^{-1} (asymmetry stretching vibration mode of O-C-O bond), 2835 cm^{-1} (symmetry and asymmetry CH stretching vibration mode of adsorbed hydrogen from methylene group), 3000 to 3600 cm^{-1} (asymmetry stretching vibration of OH), and 3800 cm^{-1} (symmetry stretching vibration of OH) in all samples.

Infrared analysis of quaternary thin films

Hydrothermal technique was employed to prepare Cu_2ZnSnS_4 (CZTS) films [Indubala et al., 2019]. The films were treated at 650 °C for 3 hours showed several peaks including 3433 (hydroxyl group), 1638 (symmetrical stretching vibration C-O band), 1366 (antisymmetric stretching vibration of CO), 1123 (C-O symmetric stretching frequency) and 616 cm-1 (ZnS band). The copper zinc tin sulfide thin films could be used in solar cell application due to high absorption coefficient, direct band gap value and multilayer structure. The films were prepared by using equal amount of zinc, tin and copper under excess sulfur (in the ratio of 1:3), at various temperatures (350 to 650 °C) for three hours. The FTIR spectra were recorded and showed 5 peaks for the films synthesized at 350 °C (3434, 1626, 1366, 1119, and 619 cm^{-1}), 450 °C (3432, 1621, 1366, 1113, and 618 cm^{-1}), 550 °C (3438, 1639, 1385, 1117 and 618 cm^{-1}) and 650 °C (3433, 1638, 1366, 1123 and 616 cm^{-1}), respectively [Indubala et al., 2018]. The quality of obtained CZTS films was strongly depended on the metal ratios. The films were prepared under different reaction time and Cu:Sn with ratio of 1.7 & 1.8 by using acetonitrile. However, FTIR analysis confirmed that no organic residue (acetonitrile) can be seen in obtained sample after washing and overnight drying [Rein et al., 2019]. Quaternary thin films such as Cu_2ZnSnS_4 films have been deposited onto soda lime glass at 320 °C without additional sulfurization [Patel et al., 2012]. The presence of different peaks at 630 cm^{-1} (ZnS), 1129 & 1651 cm^{-1} (metal thiourea complexes), 2369 cm^{-1}& 2938 cm^{-1} (SH thiol) and 3460 cm^{-1} (thiourea) could be observed in FTIR spectra. Oleylamine was used during the deposition of CZTS films via hot injection technique. Oleylamine acted as the electron donor at elevated temperature in addition to the role of a solvent [Mary et al., 2017]. The functional group adsorbed over the CZTS film surface was investigated by using FTIR technique. The obtained FTIR spectra highlighted the capping property of oleyamine on the formation of thin films.

CONCLUSION

In this study, different types of thin films were synthesized by using physical and chemical deposition method. The characteristics of obtained films were studied by using Fourier transform infrared spectroscopy (FTIR) technique. The FTIR spectra highlighted chemical bonding states and functional group of these films. FTIR analysis confirmed that the characteristic peaks are affected by the changes in experimental conditions.

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Table 1: Advantages and limitations of FTIR

Advantages	Limitations
• Precise wavenumber measurement [Brian, 1995]	• Cannot detect atoms or monoatomic ions [Brian, 1995]
• Simple mechanical design [Griffiths and James, 2007]	• Cannot detect molecules such as nitrogen, oxygen
• Easy and universal method	• Aqueous solution is very hard to analyze
• Inexpensive method	• Complex mixtures produced complex spectra
• Internally calibrated	• Example of artifacts such as water vapor and carbon dioxide [Smith, 2011]
• All the frequencies are recorded simultaneously	
• Better sensitivity and brightness [Sun, 2009]	

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RESEARCH ARTICLE

Antimicrobial Activity of Green Seaweed *Ulva* sp against Pathogenic Microorganisms

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ABSTRACT

The biodiversity of the marine ecosystem provides an important source of chemical compounds which have many therapeutic applications. In the present work, the seaweeds were collected from Manapadu coastal region, Tamil Nadu, India to evaluate the antimicrobial properties against pathogenic bacteria. Crude solvent extracts of collected weeds were obtained by using the solvents like acetone, methanol ethanol and chloroform. These different extracts were tested against different bacterial pathogens such as *Pseudomonas* sp., *Escherichia coli*, *Micrococcus* sp., *Citrobacter* sp., *Klebsiella* sp., *P.aeruginosa*, *Staphylococcus* sp. and *Bacillus* sp. The results revealed that the *Ulva* sp. is highly potential producers of antimicrobial activity against *Staphylococcus*sp compared to the other seven pathogens. The present investigation suggests that the phytochemical constituent of the seaweed might be suitable agents for the control of human deadly diseases.

Keywords: Marine, Seaweed, Phytochemical, Crude extract, Antibacterial activity, Pathogenic microbes.

INTRODUCTION

Seaweeds refer to any large marine benthic algae that are multicellular, macrothallic and thus different from most algae that are microscopic [1]. These plants form an important renewable resource in the marine environment and have been a part of human civilization from time immemorial. The seaweed flora of India is highly diversified and comprises mostly tropical species, but boreal, temperate and subtropical elements have also been reported. The Indian subcontinent has one of the longest uninterrupted coastal ecosystems in the world which support rich

seaweeds diversity with a coastline of about 7500km, 271 genera and 1153 species of marine algae, including forms and varieties have been numerated till date form the Indian waters. They form one of the important living resources grouped under three divisions namely, Chlorophyceae (green algae), Phaeophyceae (brown algae), Rhodophyceae (red algae) and abundant on hard substrates and comely extending to a depth of 30-40m. About 624 species have been reported in India with a potential of 77,000 tonnes (wet weight) per annum. The red seaweeds contribution 27.0% brown 0.2% and others 72.8% about species of algae have been reported from the mangrove environment. Many of the rocky beaches, mudflats, estuaries, coral reefs and lagoons along the Indian coast provide ideal habitats for the growth of seaweeds. Reported on the uses of seaweeds have been cited early as 2500 years ago in chins literature [2].

There are numerous reports concerning several pathogen inhibitory compounds from marine macroalgae against human viral, microbial, fungi and yeast pathogens. The extracts of various marine algae have been shown to exhibit antibacterial activity against Gram-positive and Gram-negative bacteria. Brown algae are a large group of mostly marine multicellular algae possessing a wide range of bioactive secondary metabolites. They play an important role in marine environments, both as food and for the habitats they form. Various bioactivities of compounds from brown algae have been extensively reported [3]. Phenolic compounds which play a major role in antibacterial and antifungal activities are found abundantly in brown seaweeds when compared with the green and red seaweeds. Compounds derived from the seaweeds are having a broad range of biological activities such as antibacterial activity. Acrylic acid halogenated aliphatic compounds, chlorella derivatives phenolic inhibitors, more recently guaiane sesquiterpenes and labdane diterpenoids were also antimicrobial agents detected from seaweeds [4]. Methanol is a suitable solvent to extract bioactive components were the greatest inhibition diameters against Gram-Positive and Gram-Negative bacterial isolates [5].

MATERIALS AND METHODS

Collection of seaweed

The seaweed *Ulva* sp. was collected in bulk quantity from Manapadu coastal area, Tamil Nadu, India. The collected samples were cleaned with seawater until unwanted impurities, adhering sand particles and extraneous matter like epiphytes, pebbles and shells were removed to avoid the other algal contamination and it was immediately brought to the laboratory in sterile plastic bags containing seawater to prevent evaporation. It was washed thoroughly in the laboratory with tap water and distilled water to remove the surface salty materials. Further, it was air-dried for 1 week and ground in an electric mixer. The powdered samples were subsequently stored in the refrigerator for further experiment. In the laboratory, the species of the seaweeds were identified by Macroalgae fact-sheet prepared by Edwards et al [6] and seaweeds- field manual [7].

Biochemical Characterization

Protein

The presence of protein in the dried algal powder was tested using Lowry'stest method [8]. The dried powder of 0.0005g was taken in the boiling test tube with 5ml of 1N NaOH (sodium hydroxide) and incubates at room temperature for 24h. After 1ml of sample was taken in test tubes, 3ml of mixed solution was added (99 ml of solution A: NaOH 4g in 800 ml of DH_2O + 20g$Na_2CO_3$and make up to 1000ml, 0.5 ml of solution B: 2% $CuSO_4.5H_2O$ 2g in 100ml DH_2O, 0.5 ml of solution C**:** 2g of sodium-potassium tartrate in 100ml DH_2O) and mixed thoroughly and allowed to stand for 10 min. After added 0.3 ml of solution E (2ml of Folin and 2 ml ofDH_2O) (Folin reagent is a solution of sodium tungstate and sodium molybdate in phosphoric and hydrochloric acids), incubated the tube for

60 min. The formation of blue colour indicates the presence of peptide linkage in dried algal powder and the density of protein was measured by UV visible spectrophotometer (Thermo) at 660 nm.

Carbohydrate

The presence of carbohydrate in the seaweeds was tested using the Anthrone test method [9]. One ml of the test sample solution and 5ml of the cold anthrone reagent (0.2g of anthrone in 5ml of ethanol, slowly added 75% sulphuric acid till reaches 100 ml) was added, mixed properly and kept in boiling water bath for 10 min. The formation of green colour indicates the density of carbohydrate was measured by UV visible spectrophotometer (Thermo) at 620 nm.

Lipid

The presence of lipid in the algal powder was tested using the Sulphosphovanillin test method [10]. The algal powder 50 mg was taken in a screw-capped test and add 10ml of 2:1chloroform: methanol ($CHCl_3$: CH_3OH) solvent mixture [11] was added. The tubes were loosely closed and kept in a boiling water bath at 60°C for 30 min. After the test tubes were allowed to cool, the volume made up to 10ml with the solvent mixture and added 0.4 ml of the extract, pipetted in a separate test tube and allowed to dry completely digested with 0.4 ml of concentrated $H_2SO_4$by boiling water bath for 10 min. After cooling the tube, 5ml ofPhosphovanilln reagent was added and allowed to stand for 30 min for colour development. The colour change indicates and indicates the density of carbohydrate was measured by UV visible spectrophotometer (Thermo) at 520 nm.

Extraction of compounds from seaweed

The chemical extraction was done by the method proposed by Becerro*et al.* [12]. Five gram of dried algal powder was soaked in various organic solvents like methanol, ethanol, acetone and ethanol: chloroform (1:1). After 72 hours, the sample dissolved in each solvent was filtered using Whatman No. 1 filter paper. The isolated compounds were tested forthe antibacterial property.

Antimicrobial assay

The antibacterial activity of the algal powder was studied by well diffusion method [13]. Seaweed extract was tested against eight bacterial strains such as *Pseudomonas* sp., *Escherichia coli*, *Micrococcus* sp., *Citrobacter* sp., *Klebsiella* sp., *P.aeruginosa*, *Staphylococcus* sp., and *Bacillus* sp. Organisms to be tested was inoculated overnight nutrient broth medium. A sterile swab was dipped into the inoculum tube of nutrient broth and rotates the swab against the side of the tube to remove excess fluid. The organisms were spread over the entire MH media agar surface by streaking the swab three times in 60° angles of dimension. After 3-5 min of interval about 3 wells of 5mm diameter were made in each plate with the help of a sterile cork borer, the extracted solvents were poured into the wells each with three different doses (60µl, 80µl and 100µl) on the agar plate. Standard antibiotic discs also used as the control. The plates were incubated at 37°C for 16-18h. After incubation, the diameters of the zones were measured with a metric ruler to the nearest whole millimeters [14].

RESULTS AND DISCUSSION

Collection and identification of marine green algae

The marine green algae samples were collected from Manappadu, Coastal region of Tamil Nadu. The samples were transported to the laboratory and it identified that the algae belong to the genus *Ulva*. The taxonomy of this *Ulva* sp. is as follows.

Taxonomy

Empire:	Eukaryotes
Kingdom:	Plantae
Subphylum:	Chlorophytina
Class:	Ulvophyceae
Order:	Ulvales
Family:	Ulvaceae
Genus:	*Ulva.*

Biochemical characterization

It is better to screen the phytochemical constituents for its antibacterial characteristics. The biochemical characterization of seaweed is rich in carbohydrates, lipids and protein. These values were compared with the standards notably bovine serum albumin (BSA) for protein, glucose for carbohydrate, cholesterol for lipid. The *Ulva* sp. used in this study contains the high level of carbohydrate, protein and lipid when compared to the standards. The molecular constituents of *Ulva* sp. in comparison with standards was graphically represented in (figures 2-4). The maximum carbohydrate level obtained was 2.77, which is higher than the standard glucose, the maximum protein level was 2.289, which is higher than the standard BSA and the maximum lipid level observed was 1.77, which is also higher than that of the standard cholesterol. These results revealed that the *Ulva* sp. used in the present study is rich in nutrients and can be used in edible products.

Antibacterial activity

The green algae *Ulva* sp. exhibited a broad spectrum of antibacterial activity and its extract inhibited all the tested bacteria in different activity ranges. All four extracts from *Ulva* sp. showed activity against all tested bacteria. In the present study, it was observed that ethanol and ethanol: chloroform was the best organic solution for extracting the effective antibacterial material from the algae species used in the experiment. The result exhibited by acetone and methanol were lesser than that exhibited by ethanol and ethanol: chloroform. *Escherichia coli* shown very sensitivity in four concentrations of *Ulva* sp. extracts obtained by three organic solvents acetone, ethanol, methanol and ethanol: chloroform. The best zone produced was in the extract of ethanol: chloroform. The marine algae sample belonging to the family *Ulva* sp was tested, the table shown its maximum zone of inhibitory activityresultfor ethanol, methanol, Acetone and ethanol: chloroform extracts against *Ulva* sp (Table 1).

The investigation made on ethanol extract highest activity against *Citrobacter* sp. (13mm), *Pseudomonas* sp. (13mm), *Staphylococcus* sp. (12mm), *Micrococcus* sp. (12mm), *Escherichia coli* (12mm), *Klebsiella* sp. (10mm) *and* very low activity against *Pseudomonas aeruginosa* (9mm) and *Bacillus* sp. (7mm). Methanol extract obtained the highest activity against *Pseudomonas* sp. (10mm), *Klebsiella* sp. (7mm) *and Pseudomonas aeruginosa* (7mm) and the lowest activity against *Citrobacter* sp. (6mm), *Bacillus* sp. (5mm), *Escherichia coli* (4mm) and *Micrococcus* sp. (4mm). The extracts using acetone showed maximum activity against *Escherichia coli* (13mm), *Pseudomonas aeruginosa* (10mm) and followed by *Micrococcus* sp. (8mm), *Citrobacter* sp. (8mm), *Bacillus* sp. (6mm) and *Klebsiella* sp. (4mm). There was no activity against pathogen like *Staphylococcus* sp.

The extracts of mixed solvents of ethanol and chloroform have observed as the maximum activity against *Staphylococcus* sp. (15mm), *Klebsiella* sp. (14mm), *Pseudomonas* sp. (13mm) and the minimum activity against *Pseudomonas aeruginosa*. (13mm), *Escherichia coli* (12mm), *Citrobacter* sp. (7mm), *Bacillus* sp. (12mm) and *Micrococcus* sp. (11mm). The diameter of the zone formation is graphically represented in (figures 5-8).

The results revealed that seaweeds have a higher amount of biochemical constituents. Also, the seaweeds are considered as a source of bioactive compounds as they can produce a great variety of secondary metabolites characterized by a broad spectrum of biological activity. Rebecca *et al*. (15) had investigated the antibacterial activity against some selected human pathogens and reported that the *Ulva* sp. in the study has no activity against *Pseudomonas aeruginosa*. Rao *et al*. (16) compared the marine algae against antibacterial activity and reported *Ulva fasciata* to have low activity against gram-positive bacteria *Staphylococcus aureus*. Vallinayagam *et al*. (17) was investigated the antibacterial activity against selected pathogens and also reported the *Ulva lactuca* to have no activity against all tested pathogens. Notably, in the present study, it was observed that *Ulva* sp. have high activity against *Staphylococcus* sp. Among the solvents which were used to extract antibacterial compound, the best solvents identified were ethanol and ethanol: chloroform. The ethanol and mixture of the ethanol and chloroform were showed the zone of inhibition with a greater diameter.

CONCLUSION

The seaweeds are the rich source of nutrients and are naturally available bioactive compounds against pathogenic bacteria. In this study, *Ulva* sp. was collected from Manapadu coastal area, Tamil Nadu and tested the biochemical and antibacterial characteristics. The marine macroalgae contain more nutritious compounds, so it can be used in food industries and also food and feed supplements. The entire test microorganism has shown a different level of sensitivity towards the algal extracts in different organic solvents. This supports that the marine macroalgae contain biologically active compounds which are effective in resisting the growth of the pathogens both gram-positive and gram-negative bacteria. Though many studies were reported the presence of antibacterial activity of marine macroalgae, the species used in this study exhibit more antibacterial activity than the earlier reports. In conclusion, the *Ulva* sp. used in the present study is highly potential producers of antibacterial activity against the *Pseudomonas aeruginosa, Escherichia coli, Bacillus* sp., *Micrococcus* sp., *Citrobacter* sp., *Staphylococcus* sp., and *Pseudomonas* sp. As *Ulva* sp. are the naturally available seaweeds in coastal areas, it is economic to use it as an energy source and as an antibiotic. In the current study Ulva sp extracts showed antimicrobial activity against all organisms excepting *Staphylococcus* spand *Klebsiella* sp. All the four solvent extraction systems had responded quite well. The results indicate the presence of bioactive compounds in Ulva sp which is to be studied in feature.

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Table 1: Zone of inhibition of ethanol, methanol, Acetone and ethanol: chloroform extracts for *Ulva* sp

S.No	Name of the pathogenic microorganism	Zone of inhibition (mm)			
		Ethanol 60 µg/ml	Methanol 80 µg/ml	Acetone 100 µg/ml	Ethanol: chloroform 200µg/ml
1.	*Escherichia coli*	12	4	13	12
2.	*Bacillus* sp.	7	5	6	10
3.	*Pseudomonas* sp.	13	10	6	13
4.	*Pseudomonas aeruginosa*	9	7	10	13
5.	*Citrobacter* sp.	13	6	8	7
6.	*Micrococcus* sp.	12	4	8	11
7.	*Staphylococcus* sp.	12	-	-	15
8.	*Klebsiella* sp.	10	7	4	14

Figure 1: The seaweed *Ulva* sp

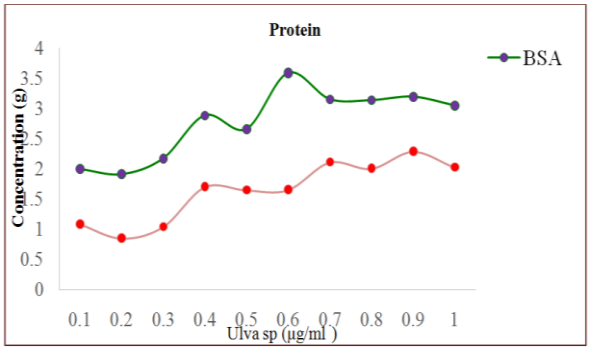

Figure 2: Comparison of protein concentration in algae and standard

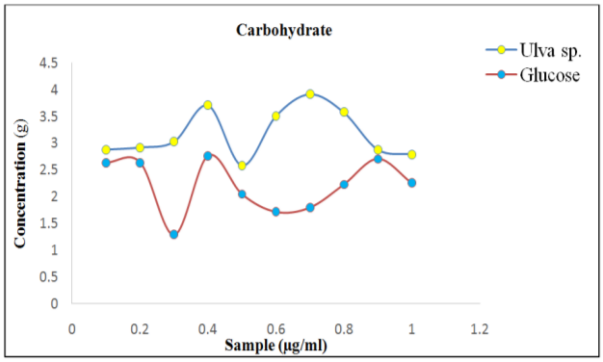

Figure 3: Comparison of carbohydrate concentration in algae and standard

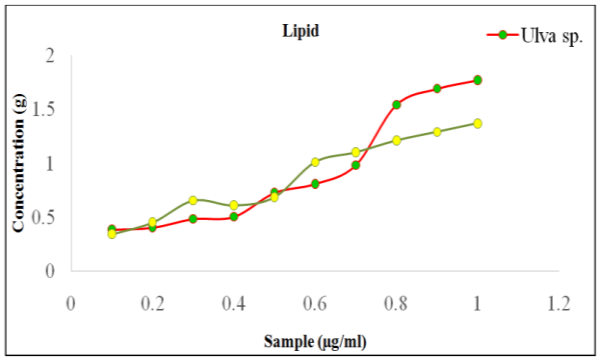

Figure 4: Comparison of lipid concentration in algae and standard

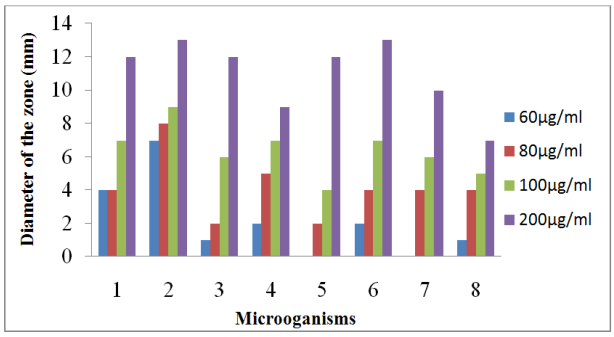

Figure 5: Antibacterial activity of *Ulva* sp. extract by ethanol

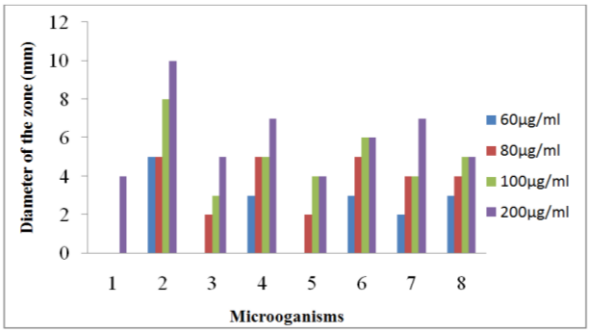

Figure 6: Antibacterial activity of *Ulva* sp. extract by Methanol

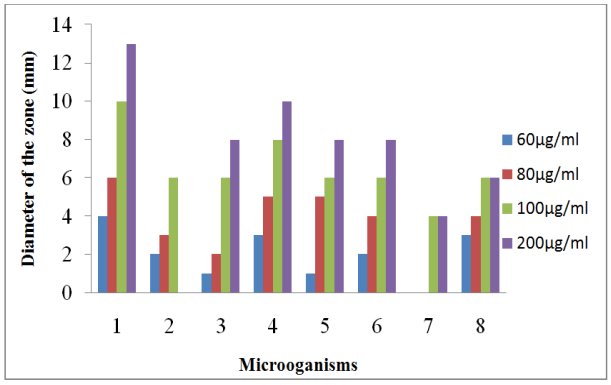

Figure 7: Antibacterial activity of *Ulva* sp. extract by Acetone

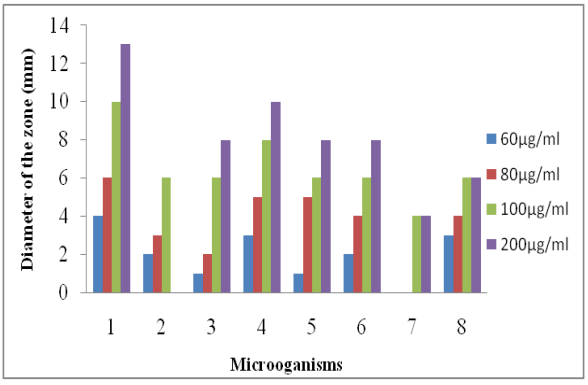

Figure 8: Antibacterial activity of *Ulva* sp. extract by Ethanol: chloroform

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RESEARCH ARTICLE

LEARNWISE, An Integrated Learning Platform for Employability Skills

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ABSTRACT

This paper delineate the implication of the learning society, and analyses the significance of the online digitized education resource in the learning society. Acute competitive pressure and natural as well as artificial menace acts as an influencer for the students as well as educational organization to progress towards adopting forward-looking and trend setting uses of online education. As the creation of learning platform put forward new requirements for online digitized education, where Centurion University of Technology and Management explores a resource-sharing device that meets the assorted learning needs of different category of people, which is more applicable to build path of independent learning system by incorporating innovative teaching target, teaching resources and also a change in the teaching mode. The ground work showcase the transformation that online education has now become a practice rather than being a hypothetical structure which escorts towards the skill development with a story of successful journey.

Keywords: education, influencer, students, learning, skill, successful .

INTRODUCTION

Where digitalization is spreading its arm rapidly for expansion in all sectors in this dynamic world, education has become more indispensable. A desire to get self-spaced, relevant and individualized education has become possible only with the online mode of learning in the present day's scenario. The world has experienced the traditional method of learning, which was practiced from kindergartens to college & universities and still existing, but the importance of traditional method of teaching and learning is losing the value due to the same old method of class room studies with blackboard, chalk and duster[1]. In traditional method of learning, specially in colleges and universities, the rigidity in the schedule create problems for students, compelling or forcing them to attend classes. At most of the time students get bored by long lectures leading to lack of attention and retention of what has been taught in the classroom. The students break down to be productive and don't get a chance to prove and exhibit their skills. No newness in the course offered is another reason for the drop in the demand for traditional method of

learning. The same old courses are offered to the students which has no realistic value, lowers the interest and productivity of the students as well as teachers. Students don't get a chance to learn new skills and which may later prove to be more fatal at the time of proving their skills and competencies leading to unemployability. It has been observed that most of the students lack their attention after twenty or twenty five minutes in an ongoing class. The one sided teaching is another drawback or the challenges faced by the students in traditional method of learning, which leads to poor concentration. Crises which are unplanned phenomenon which occur without any prior intimation and cause serious disturbances with bringing a full stop in all fields. Education is one of the major organization which gets affected by the breaks and crises by bringing a pause to the entire system by shattering and destroying the flow and consistency in the academic curriculum and performance of the students. Taking into account the natural calamities and disasters like cyclone and pandemic like COVID19[7], steps are required, not to stop the flow of learning and imparting education but to find out ways that can bring no full stop in the learning process.

As a solution to all the aforesaid challenges, online digital learning method is the best answer to it. In this technologically advanced world, it is the most wisest method to implement in the field of education. Before digital learning was treated as a sophistication means in the elite educational organisations which was also in passive form. But in this constantly changing world, with all diversified challenges, it has become compelling for students as well as trainers and lecturers to enhance desired qualification , learn new skills and broaden their knowledge that are very much in demand in present days technologically advanced glove. This is only possible by adopting online digital learning platform to secure the talents by creating jobs and competitions [6]. Flexibility of online education has made it more convenient and approachable. It is the alternative way of learning, where classes are conducted through different online platforms. Now most of the educational organisations are adopting this online method of teaching, where teaching and learning go hand in hand irrespective of time and distance. This is the greatest boon of the technological advancement and whose importance has increased to the sky high with the present day's scenario all over the world.

Setting the context: Centurion University as an instigation of integrated learning platform

Centurion University of Technology and Management, enacted by the State Legislature of Odisha, is one such university, always in the pathways to approach and adopt new initiatives for 'shaping lives and empowering communities'.Focusing on the needs of the younger generation especially for the tenth and twelve pass out, about their teaching and learning methods, their development and further leading to generate employability skill within them.It is very important for an educational organization to understand the need of the young pupils and demand of the current situation and to adopt majors accordingly and conquer. Centurion University always remain step ahead to overcome all the challenges by adopting and providing opportunities which always proved to be beneficial not only for students but at the same time for the entire team members of the organization to learn and work on new alternatives and methodologies with new learning platform which throw light on different types of core skill development, that not only aim at the growth and fame of the university but also for the well being of the society by developing the skill for self employability by boosting the entrepreneurial mind set which further helps in resolving the unemployment problem.

Why digital learning?

Any type of learning accompanied with continuous development in the field of technology is known as digital learning. Gone are those days where traditional learning method was only considered as a tool which aimed development of every individual, nation and world. 21st century is considered to be the digital era, bringing fundamental changes in the life of people by enhancing their skills with the help of digital learning. Due to the change in learning pattern all over the glove, it has become a pre-requisite to accept the transformation to survive in this digital world. The best part of this learning is that now it has become possible both trainers and lecturers can engage with the learners leading to a positive mindset without any superiority or inferiority feelings from both the sides. It is considered to be one of the best option for the trainers as well as lecturers to impart or share the learning

that are up with latest information's. Digital learning is considered to be a web based learning used for imparting knowledge to students all over the world. Survey says, digital revolution has made a remarkable impact in the online method of learning. It develops the skill which gives benefit to all, especially to students in long term. Digital learning opens up the door of possibilities for new ideas and facts. In response to cater the need in the workplace in today's world, students must be acquainted with digital learning so that they can use the digital platform efficiently and effectively. Digital learning acts as a solution and remedy for all problems in the education sector [2][6]. It has rightly been said by our prime minister, "Shri Narendra Modi – I dream of a digital India where quality education reaches the most inaccessible corners driven by digital learning".

There are different components which enable a digital platform to work. Some of the components allow digital platforms to talk to other software, and tools that observe, check the executable compliance [3]. We can say that APIs have changed the vision towards the digital learning platform. API stands for "Application Programming Interface". It is a software mediator allowing two software to talk to each other [4]. This interface is being used for learning and development process especially in an educational organization. APIs acts as a host that deliver the requirements [4]. APIs has the ability to capture data of an individual or groups performing different activities like learning, relating to courses and also societies and different other experiences and offer useful data for personalized learning for all may be students or employees [5]. APIs have the ability to lay out the contents smoothly in an honest and open manner. Thus it helps in getting or displaying resources from different relevant sources in a learning app, which act as an aid for digital learners. APIs run and deliver data from the applications we use over the internet and allow transmission of data or information from system to system, creating connectivity. APIs furnish qualitative measures to access any application data or device by accessing cloud application or any other from mobile phones which can be used by all. Thus it can be considered that it depends upon the need to choose an API for online digital learning that is able to cater the requirements.

Benefits of digital learning

Online digital method of learning has become a powerful tool worldwide [8]. In this 21st century, traditional method of learning is swiftly and steadily being replaced by digital learning method [11]. Teaching and learning mechanism are two most important elements which sets the foundation of the students and is accepted worldwide. Definitely students are benefited with the change in learning pattern i.e., by adopting digital learning method. Some significant points add an essence to the benefits of digital learning method in comparison to traditional learning method and adds a "Wow" factor in the learning process.

Increases efficiency and productivity

The efficiency of the students increases by adopting digital learning method, which leads to save valuable time and make them more productive [11]. They get influenced and develop innovative thought process to the information they receive and preserve and employ them in a better output oriented job. Involvement of both teacher and student through digital learning process make them more creative and productive as it creates more interest in the process of teaching and learning which lacks in traditional method of learning. Thus efficiency and productivity are the two components build up in the students through digital learning platform.

Collaborative learning

Digital learning supports collaborative learning. It helps in enhancing solving real world problems, satisfaction and competency level of the students. Collaborative learning acts as a basement for inputs by both teacher and student to build up the capacity to gain an accurate and deep understanding of related topics in the training session[10][14]. This type of collaborative learning is not found in the traditional learning method, where teachers only make things compulsory and the students have to follow. In collaborative learning the pupil develop the quality of paying respect to the abilities and the contribution made by their peers. It is not just like accepting the knowledge from teacher or

from curriculum but it emphasizes the students to add on and construct or structure something new leading to talent and competency development supported by teachers.

Extensive learning opportunity

Online digital learning is playing a major role in changing the educational system. It has become one of the most powerful tool in the field of education. Not only students but also faculty members get the opportunity to develop their skills in digital platform, by working with cloud based documents. As online digital learning is expanding worldwide, it has become quite easy to access deep knowledge related to a specific topic and enhance the skill and utilize it for further more productive purposes[12].

Competency based learning

Digital learning develops the competency level of the students by increasing the skill, regardless of the course offered [12]. This helps in rising the confidence and making more competent in different skills within the students. Ultimately online digital learning helps in individual progress. Digital competency increase the knowledge of an individual, which is of great demand in this 21st century. The competency based learning helps an individual to improve communication as well as access, create, store, and retrieve information as well as creating the ability of problem solving for further usage.

Develops self-motivation and accountability

Students get more attracted towards digital learning and find it more interesting, interactive and memorable in comparison to traditional learning method where they have to attend one sided lectures as well as to go through voluminous text books. More over students get involved in digital learning and their ability to remember and to recall increases leading to score or perform better [9]. When students track their own performances and involvement, the rate of self-motivation and accountability also increase[10]. It has been observed that students who were not provided the facility of online digital learning, lack the ability of self-motivation and accountability[11][12]. They fail in self -esteem and self-efficacy. Thus in this era online digital platform has significant importance in every individual life.

Increase employability

Online digital learning has a positive impact in increasing employability. It is quit flexible and interactive in nature, which not only helps in career advancement but also helps in increasing employability for students[12]. The level of employability skill can be developed by using the updated digital learning technology by the students. The 21st century digital learning technology not only provide benefits to the students to gain knowledge but also paves the pathway for employment. If we are digital literate then we can save ourselves from the unemployment problem and utilize the advantages of our digital literacy to get rid from the fear of unemployment. The digital learning platform helps in creating own jobs as well as job for others.

Learn wise, a digital learning platform

Development of skill is very much essential for each and every students as well as faculty members of an organization. Centurion University has always been a step ahead in adopting and implementing platforms which are skill oriented and up-to-date. Learn wise, a digital learning platform is one of its kind which is led by Wadhwani Foundation and has been adopted by Centurion University for its diploma and ITI level students. It is a mobile friendly cloud based platform, having the flexibility to meet the needs of global audience and provide education anywhere at any time. This digitized learning platform is meant for students to connect, learn, organize and build-up their skills competency from any part of the world. The design of this digital platform is user friendly and works as an assistant for ITI students basically belonging to rural areas having educational background up to matriculation and also for students pursuing diploma ,as they have different educational background like some of the students are tenth pass, some undergraduate and some graduate.

Taking into account the present day's scenario i.e., the increase in population leading to unemployment problem ,the content of learnwise is very much acceptable and appropriate for the ITI and diploma students. Learnwise provides the employability skill, which is the core skill required in every job at time of recruitment by the employers especially for the vocational students. This digital platform is also quit interesting consisting of modules having different units which not only provide skills based on communication basic and workplace communication but also cater modules like attitudes and behavioral skills, teamwork, customer centricity, problem solving, digital literacy both basic & workplace, workplace awareness and entrepreneurial mindset and many more. These contents are very much helpful to enlighten the matriculate and undergraduate vocational students not only to learn basic communication process with business communication but also illuminate the students to gain skill in how to perform well in teamwork and also how to analyze and solve problems. This platform is decked with "student guide", which acts as an escort to navigate suitably. Through this learnwise platform students learn and get an idea about workplace awareness and those students having a desire to be entrepreneurs also gain knowledge in this particular field while working in the entrepreneurial mind set module. The best part of this platform is that students cannot skip a single section or unit of the module assigned to them. Unless and until they complete the whole unit their completion percentage score will not increase and which appears on the dashboard of the concerned faculty. Thus this platform helps the faculty to track the registered students participating actively or not. Another important part of this learnwise platform is that, students have to appear a "pre-assessment" test and the scores they obtain, acts as a benchmark for them before working on any of the modules. After completion of all the modules assigned, again the student has to appear "quiz" and are rewarded with scores which demonstrate the degree of improvement in them. This assessment process pitch-in the students to be more competitive and also work as an assistant for the concerned faculties to find out the weakness of the students as well as to find a path to bridge the loopholes for the up-gradation of the students.

RESULTS AND FINDINGS

Attitude and Behavioral change

When something new is adopted, definitely certain behavioral changes take place with all. Exactly the same thing was observed among the students as being a part of this learnwise platform. Learnwise is a platform which motivates the students of different background. The observation speaks out the behavioral transformation of the students enrolled in this platform. Yes, it will not be wrong to say that ability to learn, accept, understand and further more utilize the learning is not the same for every student. Students who were new to this digital learning, at first found this online platform to be very challenging. It was surprising that even in this contemporary society some of the students from low income families were not introduced to smart phone and its usage. As they were new to this smart world of digitalization, they were hesitant and were quit nervous to adopt this method of learning. They were reserved and afraid of this electronic media. But gradually things changed, those students who were completely new to this digital platform found it quite interesting and participated actively. A positive attitude is all what required to adjust and adopt into the new environment of learning. They opened up themselves to the online digital world the rise in students' positive attitude toward digital learning brought positive changes in their behaviour.

Dipti Ranjan, Diploma (Mechanical Engineering) states, "Online learning platform was completely a new thing for me I was really very excited and interested. As I am completely from rural area, therefore had never thought of online learning. But after being a part of this university, I came to know about this online educational platform, that brought lots of positive attitude and behavioral changes within me, which I had never thought will ever happen". Md Ashraf says,"First I was not at all acquainted with this online learning stuff, but now I feel it is more interesting to have online learning because, here we don't have to write long answers. A simple click is all that is required to learn and to excel."

Academic achievement

The online digital platform has become an important component which leads to improvement in academic performance and paves a path to a story of success journey. Online platform support the engagement of students continuously and spontaneously both in classroom as well as out of it. This platform acted as an interactive learning medium and furnished the benefits of employability skills among the vocational students. The academic performance of the students disclose an integrity between their abilities and attitude towards digital learning. The students from low income families build in the abilities to avoid poverty through this academic achievement and develop competitive employability skills through this learnwise online digital platform. Sibadatta, Diploma (Computer Science Engineering) says, "Learnwise, is a good online learning platform. It helped me a lot in developing my communication skills with attitudes and behavioral skills. It also helped in acquiring different employability skills, about which I had no idea before. The pre and post assessment was of great help to find out my skill level and further helped me to achieve the goal. I would like to pay my gratitude to our mentor for guiding and encouraging us in this new online platform". Biswaranjan Parida, Final year (Diploma, Mechanical Engineering) say, "The students of 2018 & 2019 batch, are quit lucky to have this learnwise platform, which was not available in our time. It would have been beneficial to us in the skill development through this platform."

Inducement for online learning platform

Students are considered to be the backbone of an academic organization. Motivating students is crucial in the world with the changing online learning environment. Academic motivation regulate the students to be highly motivated. Motivation helps in developing self-efficacy in a student and make him/her believe in the capability of performing a particular task successfully. Motivating students for online learning platform helps them to build up self-confidence [15]. Centurion University is always prepared and stands ready in adopting new method of online learning platform. This skilled university not only motivate students but also the whole organizational team members both teaching and non-teaching, to empower themselves technologically and analytically strong.

CONCLUSION

World is changing with the change in advanced technology paving path for updated digital learning platforms. Utilization of online platform to prove the skill is considered to be one of the best way to step on to the ladder of success.The transformation in online digital learning has now become the ultimate path for the success of the students as well as trainers and lecturers in this era by improving skills, competencies and developing career opportunities in the present world for themselves and for others in providing jobs. It is one of the best platform to continue the flow of career development even at the crises and breaks. The support from educational organization for online digital learning motivates students for developing self-esteem, self-efficacy to perform and score well in the academic performance and have a safe and bright future.

ACKNOWLEDGEMENT

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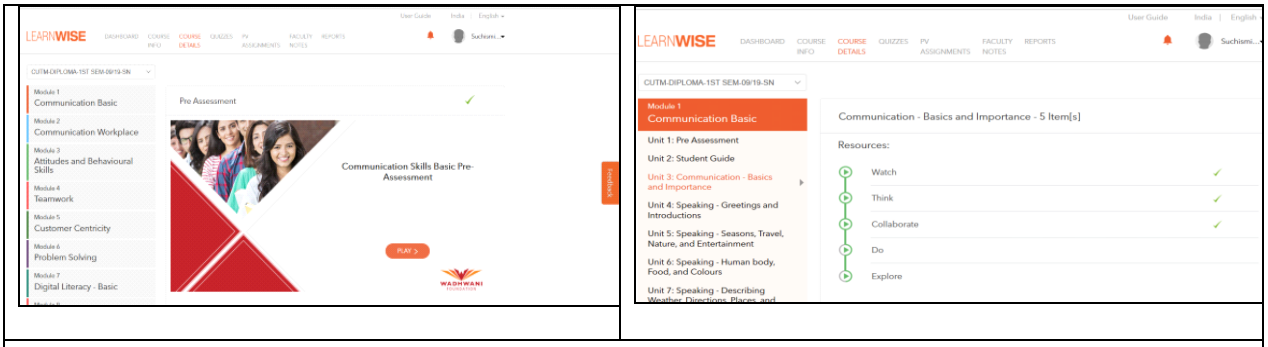
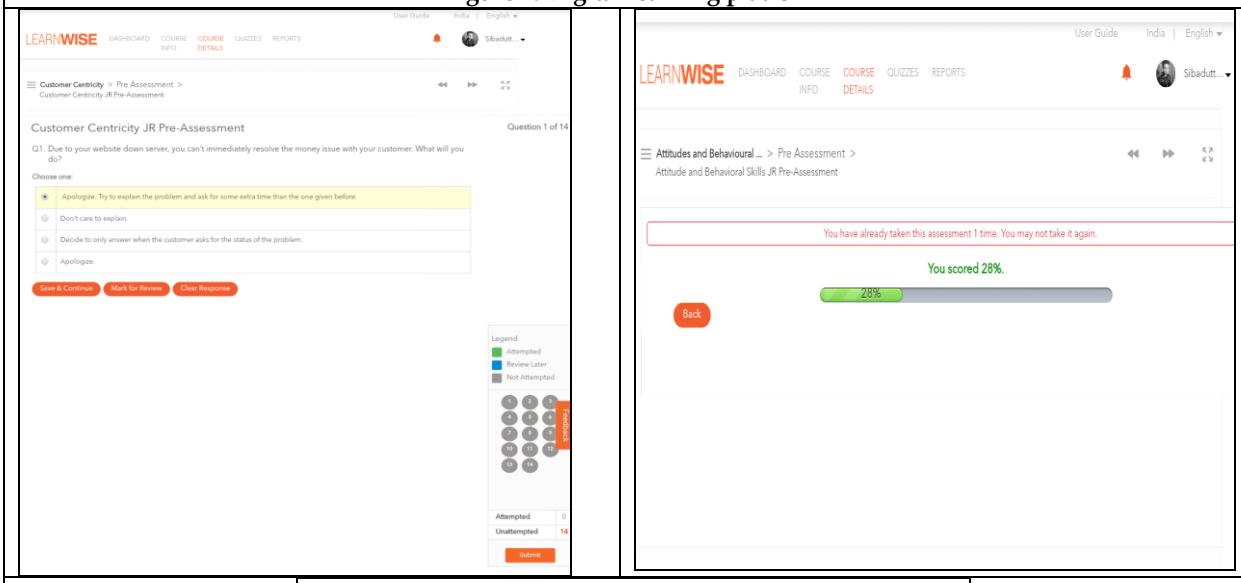


Figure 1. Digital learning platform



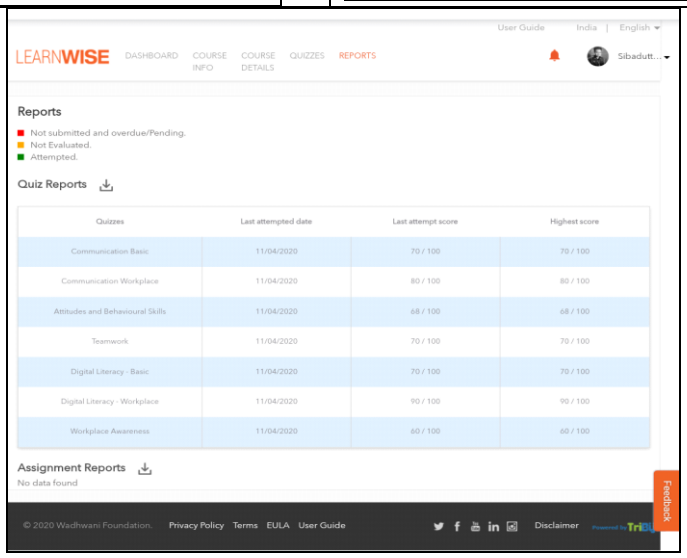


Figure 2. Post Assessment Report

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RESEARCH ARTICLE

Exploring Factors Affecting Communication Environment in the Elderly Hearing Impaired: A Study in Indian Context

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ABSTRACT

Communication is the most important aspect of social living in humans. Factors like listener attitude, environment, need and motivation play a significant role during communication. Onset of hearing loss results in communication breakdown affecting a person's psychological wellbeing. This breakdown has more significant psychological impact on older adults with hearing loss. This study explored the environmental factors affecting communication in elderly hearing impaired using the Communication Profile for the Hearing-Impaired questionnaire. Results indicated factors such as background noise, listener's adjustment and adaptation to be predominant factors affecting communication in elderly hearing-impaired males as compared to elderly females. Similar results were also obtained in participants having moderate degree of hearing loss in comparison to the participants having severe degree of hearing loss.

Keywords: Communication environment, CPHI, elderly hearing impaired.

INTRODUCTION

Communication is the most important aspect of human existence. In humans, communication generally involves the task of speaking and listening. Social interaction involving verbal communication in day to day life is dependent on a myriad of factors ranging from body language to clear speech. The onset of hearing loss in an individual has a drastic impact on communication which further gives rise to various psychosocial and socioemotional problems. This impairment in communication has a more profound effect on elderly hearing-impaired owing to co-occurrence and interference of other age-related health conditions (Yorkston, Bourgeois, & Baylor, 2010). As the ability to communicate is important for social interaction and maintenance of other life goals (Heine & Browning, 2002), older adults with hearing loss attempt to significantly improve communication so as to adjust and adapt better with the aging process (Lubinski & Welland, 1997). This results in purchase of advanced amplification and assistive listening devices. But listening outcomes depend not only on the acoustic quality of sounds but also on other environmental factors. These environmental factors can be classified as interpersonal, intrapersonal and physical factors such as

attitude and perception of the normally listening communicative partner, listening environment, coping behaviour of the hearing-impaired listener, background noise etc.

According to Demorest and Erdman (1987), the personal attitude and behaviour demonstrated by hearing impaired and normal hearing persons is crucial for maintaining interaction in communicative situations. The normal hearing persons generally have a negative image of elderly hearing impaired who are deemed to be impatient, irritable and frustrated. This often results in normal hearing persons to often overlook the communication needs of the elderly hearing-impaired person and fail to modify their speaking style to suit the listening needs of the hearing-impaired listener. The elderly hearing impaired also often exhibit low self-confidence, disassociation and a negative self-image which restricts their participation in a communicative event adequately. Studies related to communication in elderly hearing impaired have shown that the occurrence of hearing loss has a profound impact on every area of social interaction in day to day life including work, career, social life and family life etc (Leigh, 1996). Numerous studies (Garstecki and Erler, 1999; Palmer et. al., 2019; Joanovic et. al., 2019) have also cited gender and severity of loss related differences in the communication related demands and behaviours in elderly hearing impaired.

In a culturally and linguistically diverse country like India having a multi-layered social functioning, various factors can have significant effect on the verbal interaction between a hearing-impaired person and a normal hearing listener. Hence, it is important to identify such factors and study their effect on the communication process. Moreover, it is also imperative to study the effect of such environmental factors across the gender and degree of hearing loss. As patient healthcare has become more consumer driven, it has become essential to know the psychosocial and socio emotional aspects associated with hearing loss and to address those issues before planning intervention as non-red ressal of these issues will hinder maximising the benefits of intervention. As issues related to communication has embedded psychosocial and socioemotional factors, use of subjective scales especially those addressing quality of life is highly recommended. The aim of the study is to compare the performance of 60 elderly hearing-impaired persons (30 male and 30 female) on the communication environment scale of the Communication Profile for the Hearing Impaired (CPHI) questionnaire (Demorest and Erdman, 1987). The focus is on two parameters, gender and degree of hearing loss.

The specific objectives were to:

1. Assess if there was a significant difference between the performance scores of male and female participants across the communication environment scale of the CPHI questionnaire.
2. Assess if there was a significant difference between the performance scores of male and female participants across two degrees of hearing loss (moderate and severe) on items of the communication environment scale of CPHI questionnaire.

The hypotheses was: There will be a significant difference between the performance scores of male and female participants and between the participants scores having moderate and severe degree of hearing loss.

METHODOLOGY

A quasi-experimental study design with purposive sampling was used for the study. A total of 60 elderly hearing-impaired persons (30 male and 30 female) availing hearing rehabilitative services at Swami Vivekan and National Institute of Rehabilitation Training & Research, Olatpur participated in the study. Table 1 indicaes the subjects selected across two degrees of hearing loss i.e. moderate and severe and of both genders. The participants were selected on the basis of the following criteria: Chronological age greater than 60 years, Moderate to severe degree of permanent hearing loss in both ears, Speech identification scores of a minimum of 60% in quiet (in aided condition), Age appropriate cognitive function, Minimum education of up to matriculation level, Fluent speakers of Odia, No history of hearing aid usage, Ability to read and understand English, and Adequate visual acuity and/or corrected vision. Participants having known history of neurological, cognitive and psychiatric illness or unilateral/ asymmetric hearing loss were excluded from participation in the study.

Description of the instrument

The Communication Profile for the Hearing-Impaired (CPHI) scale developed by Demorest and Erdman (1987) was used in the study. The scale consists of 145 items which measure different communication related variables. The items are subdivided into 22 subscales, which assess five areas - communication performance, communication importance, communication environment, communication strategies and personal adjustment. Only the communication environment scale was used in the present study. The communication environment scale consists of four subscales - communication need, physical characteristics, attitude of others, and behaviour of others. The communication need subscale contains 06 questions, physical characteristics subscale contains 05 questions, attitude of others subscale contains 10 questions, and the behaviour of others subscale contain 10 questions. Table 2 provides the individual items in each of the subscale of the Communication Environment Scale.

Procedure

The questionnaire was administered in a one to one setting in a quiet environment. The participants were asked to read each item of the questionnaire and rate the response accordingly. All the participants consented for participation in the study.

Data analysis

The responses of the participants were analysed across the communication environment with its 04 subscales and as a function of gender and degree of hearing loss. Statistical Package for Social Sciences (SPSS) version 21.0 and Windows 10 Excel software was used for data analysis. Descriptive statistics was used to compare the responses of the participants. As the data was randomly distributed, non-parametric test of significance (Chi-Square test) was used for comparing responses.

RESULTS

The mean age of the participants was found to be 70.3 years with SD of 3.2. The mean age of the male participants was found to be 70.7 years with SD of 3.6. The mean age of the female participants was found to be 69.9 years with SD of 3.5. The mean age of the male participants with moderate degree of hearing loss was found to be 70.3 years with SD of 3.4. The mean age of male participants with severe degree of hearing loss was found to be 70.4 years with SD of 3.2. The mean age of female participants with moderate degree of hearing loss was found to be 70.1 years with SD of 3.4. The mean age of female participants with severe degree of hearing loss was found to be 70 years with SD of 3.2. Figure 1 presents the distribution of respondents by age and level of hearing loss. The first objective was to assess if there was a significant difference between the performance scores of male and female participants across the items of the communication environment scale of the CPHI questionnaire.

Table 3 notes the performance score of male and female participants. Results indicated statistically significant differences ($p<0.05$) to be present between the performance scores of male and female participants across the communication environment scale and the subscales of communication need, physical characteristics, and attitude of others. No significant difference ($p>0.05$) was obtained between the performance scores of male and female participants across the behaviour of others subscale. The second objective was to assess whether there was a significant difference between the performance scores of the participants across two degrees of hearing loss (moderate and severe) on items of the communication environment scale of CPHI questionnaire. Results indicated no statistically significant differences ($p>0.05$) between the performance scores of participants across the, attitude of others and behaviour of others subscale. However, significant difference ($p<0.05$) was obtained across the communication need and physical characteristics subscale.

Intragroup comparison was also done between the male and female participants with moderate and severe degree of hearing loss across the scales to measure the homogeneity of responses and the results are presented in Table 4. Results indicated female participants having moderate degree of hearing loss had significant intra group differences ($p<0.05$; $p=0.08$) in comparison to the participants with severe degree of hearing loss. Similarly, male participants with moderate degree of hearing loss had statistically significant differences ($p<0.5$; $p=0.06$) between them in

comparison to the participants with severe degree of hearing loss who indicated no significant differences between them. These results were observed across all the subscales.

DISCUSSION

Comparison was drawn between the responses of the participants across the Communication Environment items of the CPHI. The results indicated statistically significant differences ($p<0.05$) between the male and female participants with the female participants scoring significantly higher than the male participants across the subscales of Communication Environment except the behaviour of others subscale. The results are in line with the evidence from studies of Espmark et al. (2002) and Helvik et al. (2006) in which they reported female participants to be exhibiting more significant psychosocial and socioemotional problems in comparison to age matched male participants. Comparison between the scores of communication need subscale indicated statistically significant differences between the male and female participants with the female participants scoring significantly lower than the male participants. The communication need subscale of the CPHI questionnaire assesses communication demands faced by a hearing-impaired listener during communication at home, at workplace, and during day to day interaction with other people. The lower scores by female participants indicate that they experience less barriers during communication in comparison to male participants. But contradicting evidence could be cited from the study of Garstecki and Erler (1999) in which they stated no significant gender differences between the performance scores assessing communication need of CPHI. This contradicting finding could be attributed to be due to the societal norms of the Indian society. As compared to the western societies, females in the Indian society have experienced discrimination and less participation in education, workforce and in various other social spheres. This discrimination and restriction is more profound in the rural population owing to lack of awareness, poverty, illiteracy and stringent and orthodox societal norms. As the sampled population was drawn amongst the hearing-impaired population who reported for rehabilitative services at SVNIRTAR, Olatpur, the bias in results could be due to the female participants reduced quality of life and low assertiveness. However, the lower scores could also be attributed to the better speech discrimination scores and audiometric thresholds which has been documented to be present in elderly females as compared to elderly males (Gates et. al., 1990, Jerger et. al., 1993).

Statistically significant differences were obtained across the physical characteristics' subscale with the female participants exhibiting better communication in presence of noise and to be less affected by the talker's physical appearance. The physical characteristics subscale of the CPHI questionnaire assesses the impact of environmental factors such as background noise and the physical characteristics of the talker during verbal interaction. The findings derive support from the study of Erler and Garstecki (2002) in which they reported older female adults to be showing less difficulty related to the physical characteristics of the environment or other speakers. Their subjects reported absence of negative attitudes, opinions, or beliefs among normally hearing communication partners nor did they sense an unwillingness among normal hearing listeners to accommodate their hearing loss-related needs. This difference could be attributed to the fact that 46% of the respondents in Garstecki and Erler's (2002) study used hearing aids out of which 51% had access to binaural amplification. But in the present study none of the participants had a history of hearing aid usage. The modern hearing aids utilize noise reduction strategies which reduce the background noise and amplify speech. The sampled population without access to an amplification device thus demonstrated difficulty in communication due to changes in the physical characteristics of the environment and the talker. The lower scores of female participants could be explained on the basis of the studies of Harford et. al. (1982), Moscicki, et. al. (1985), Pearson et. al. (1995) and Gates et. al. (1990) in which the researchers reported significantly better hearing health in older females as compared to males.

Significant differences were obtained between the performance scores of male and female participants across the attitude of others subscale with the female participants citing significantly higher scores in comparison to the male participants. The attitudes of others subscale describe how a hearing-impaired person perceives the behaviours which are shown by a normal listener during a communicative event. In general, questions pertaining to mostly negative behavioural traits shown by normal hearing listeners have been cited in the CPHI questionnaire under the

attitude of others subscale. The results of the present study are in line with the results from Espmark et al. (2002), Helvik et al. (2006), Hallberg et al. (2008) studies in which they reported significant psychosocial and socioemotional problems in elderly females with negative perception of annoyance, frustration and disinterest during communicative situations.

The items of the Behaviors of Others subscale represent the normal hearing person's ability to understand the communication needs of the hearing-impaired partner as well as the adaptations that they make to overcome the communication barriers while conversing with an elderly hearing-impaired person. No statistically significant differences were obtained between the elderly male and female participants across the behaviour of others subscale with both male and female participants scoring equally. However, both male and female participants cited higher scores which indicate that they are more affected by the unwillingness of the normal hearing listener to make adaptations in their conversation style during communication. The results are in contradiction with the studies of Erler and Garstecki (2002), Sharashenidze et. al. (2007) and Demorest and Erdman (1987) in which they reported older adults to be less significantly affected by the lack of communicative adeptness on part of the normal hearing listener. However, the results of the present study could be attributed to the fact that none of the elderly hearing impaired in the present study had access to amplification devices unlike the sampled population in the western studies.

Intra group analysis across the degree of hearing loss and gender indicated significant differences ($p<0.05$) between the elderly female across the two types of hearing loss. The contention of the support for these findings comes from the various studies in which it was reported females having greater degrees of hearing loss associated with chronic diseases, and not using hearing aids to be experiencing greater social isolation (Pronk et al., 2011; Mick, Kawachi, & Lin, 2014; Weinstein, Sirow, & Moser, 2016). Results of statistical analyses comparing the performance scores of the participants having moderate and severe degree of hearing loss indicate significant difference ($p<0.05$) between the performance scores on the overall communication environment scale. Statistically significant difference was observed between the scores of older adults on the communication need and physical characteristics subscale across the two degrees of hearing loss. The results of the study are however not in line with the research evidence from other studies (Garstecki and Erler, 1999, Kim et. al., 2010, Chia et. al.,2007, Cruishanks et. al., 1998). This can be justified on the basis that none of the participants were hearing aid users. Without use of amplification, it becomes difficult for an elderly hearing impaired person to communicate with a normally hearing personas he/she has to exercise effort to get the message across. This effort becomes more profound as the degree of hearing loss increases. Unlike younger hearing-impaired individuals, elderly hearing impaired persons have to overcome not only the listening barrier but also mental load resulting from cognitive decline and other declining sensory processes. Thus, for a normal hearing person it becomes more challenging to communicate which results in greater social isolation for the hearing impaired individual. As the degree of hearing loss increases, social isolation also increases. This increase in feelings of social isolation could be attributed to the low scores given by elderly persons with severe degree of hearing loss as increased social isolation eventually develops lesser psychological need for communication. Occurrence of hearing loss gives rise to different psychological feelings. While some aggressively seek help to ameliorate the loss, others demonstrate indifference towards it. The hearing help-seeking personality trait is more positive in individuals living in developed countries. In India, social stigma attached with hearing loss, often results in lack of help seeking ability and reduced acceptability towards hearing aids (Manchaiah et. al., 2014). Unlike older individuals in developed nations, elderly hearing impaired in India face financial constraints, social stigmatization, and lack of awareness regarding hearing health care. The elderly hearing impaired in India usually do not seek rehabilitation until hearing loss significantly affects verbal communication. With increase in duration of untreated hearing loss, the auditory system undergoes reorganization which results in reduced hearing outcomes later (Trahiotis, 1992).

No statistically significant differences were obtained between the performance scores of older adults with moderate and severe degree of hearing loss on the attitude of others and behaviour of others subscale. Older adults reported significantly fewer problems relating to demand for communication in the course of everyday activities, in work

settings and at home, even though communication in these settings was often regarded as being important. Although the demand for communication was high among older adults across both the degrees of hearing loss, it was perceived to be higher by those with severe degrees of hearing loss. Older adults with severe hearing loss reported less difficulty related to the physical characteristics of the environment or other speakers. They reported not to be significantly observing negative attitudes, opinions, or beliefs among communication partners. They also were not likely to sense an unwillingness among others to accommodate their hearing loss-related needs. These findings do not support clinical observations of Garstecki and Erler's (1999) study. Unlike the findings of Garstecki and Erler's (1999) study, older hearing-impaired adults compared across both the degrees of hearing loss indicated that physical characteristics of the communication environment affect communication effectiveness less than half the time. This finding may reflect avoidance of difficult communication situations or manipulation of the communication environment. This observation also requires further analysis on a case-by-case basis. Older adult participants in this study infrequently perceived negative attitudes expressed by others because of their hearing loss. They did not experience negative reactions from their communication partners either. In all, they seemed motivated to maintain their communication skills and remained undaunted by physical barriers, impressions they made on others, or the reactions of others. These findings, particularly in regard to communication partners, are interesting in light of anecdotal reports that many older adults consider the behaviour of others to be a significant problem. Clinical experience suggests that responsibility for communication problems is often assigned to others who speak softly, mumble, or speak from another room. It is important, therefore, for clinicians to analyse responses to individual items in order to identify people for whom the attitudes or behaviours of others may be a greater issue. Furthermore, this may be important reason to involve significant others during planning for audiological rehabilitation.

SUMMARY AND CONCLUSIONS

Retirement from the work or from active life does not eliminate the need for communication. Rather, it shifts the focus of the communication environment from being more vibrant to more soothing at home and changes communication partners from co-workers to an emphasis on family and friends. However, with occurrence of hearing loss in advancing age, it becomes difficult both for the normal hearing listener and the elderly hearing-impaired person to maintain the effectiveness of communication. These socially mediated hindrances are more profoundly present in Indian societies. The results of this study show that the environmental factors influencing communication in elderly hearing impaired in India are not in the domains traditionally assumed to be the province of such domains, namely, hearing for speech, and especially hearing for speech in noisy conditions. Consistent with finding it was found that gender related differences accounted more compared to the severity of hearing loss while explaining the communication related environment. It is in domains of adaptiveness on part of the normal hearing listener and acceptance on part of the elderly hearing impaired that communication can take place effectively.

It is hoped that research in this area will delineate new insights regarding the communication related factors that intrinsically and extrinsically affect communication in Indian context. In addition, this line of research may help us to determine whether communication related environmental factors can affect benefit of amplification.

Conflict of Interest

There is no conflict of interest associated with this study. This research is a part of doctoral thesis undertaken by the principal investigator.

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Table 1: Sample distribution

	Moderate	Severe
Male	15	15
Female	15	15

Table 2: Communication Environment Scale

Communication Need	Physical Characteristics	Attitude of Others	Behaviour of Others
Q27. Conversations with others at home	Q21. Have to talk with lots of background noise	Q23. Family gets annoyed when I don't hear	Q33. Family members speak when not facing
Q43. Job requires use of telephone	Q29. Have to communicate in group situation	Q25. Others think I'm ignoring them	Q35. People accuse me of hearing what I want to
Q50. During day, have to communicate with others	Q40. Have to talk in noisy areas	Q28. People think I'm not paying attention	Q52. Family leave me out of conversations
Q62. Job involves communicating with others	Q51. Job involves talking to people who speak quietly	Q46. People treat me as if I'm stupid	Q55. Family members refuse repeat more than once
Q87. Communicating important daily activities	Q93. There's a lot of background noise at work	Q49. People get annoyed when asked to repeat	Q56. Family members talk to me from another room
Q115. Communicating important part of job		Q54. Others become impatient	Q60. People don't speak clearly enough
		Q59. People act frustrated	Q61. People don't get my attention before speaking
		Q75. Others think I'm not interested	Q66. People don't speak up
		Q86. Others feel I use hearing loss as an excuse	Q68. People say "never mind" or "forget it"
		Q111. Family doesn't understand strain and stress	Q73. People mumble

Table 3: Performance scores of male and female participants

	%age of Lower Scores		%age of Higher Scores		Degrees of freedom	p value
	Male	Female	Male	Female		
Communication Environment	44	52.7	56	47.3	1	0.03
Communication Need	38.3	76.7	61.7	23.3	1	0.01
Physical Characteristics	21.7	63.3	78.3	36.7	1	0.02
Attitude of Others	62	28.3	38	71.7	1	0.03
Behaviour of Others	46	41.7	54	58.3	1	0.08

Table 4: Performance scores across degree of hearing loss

	%age of Lower Scores		%age of Higher Scores		Degrees of freedom	p value
	Moderate	Severe	Moderate	Severe		
Communication Environment	28.3	58.3	71.7	41.7	1	0.03
Communication Need	36.7	47.4	63.3	52.6	1	0.04
Physical Characteristics	38.7	57.3	61.3	42.7	1	0.03
Attitude of Others	43.3	35.0	56.7	65.0	1	0.06
Behaviour of Others	47.7	45.0	52.3	55.0	1	0.50

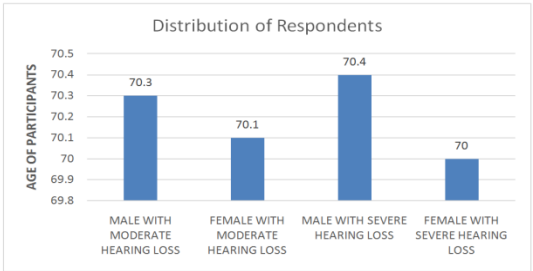

Figure 1: Distribution of mean age of participants across gender and degree of hearing loss.

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RESEARCH ARTICLE

Microwave Assisted Synthesis, Spectral, Redox, Bio-Potential and Molecular Docking Studies of Ethyl-p-aminobenzoate and its Co(II) and Ni(II) Complexes

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ABSTRACT

Mononuclear Co(II) and Ni(II) complexes with ethyl-p-aminobenzoate and oxalate ion have been synthesized using microwave irradiation method. The synthesized complexes have been characterized by analytical, conductivity, magnetic, cyclic voltammetry and spectral methods. Molecular formula, neutral nature and octahedral geometry of the complexes were confirmed by elemental analysis, metal estimation, molar conductance, magnetic moment and UV-visible spectral studies. The complex formation, metal ligating ability, probable geometry and magnetic behavior also investigated by its IR and Far-IR spectral studies. The redox properties of complex were found out and confirming the oxidation and reduction and also reversibility of the reactions. The molecular docking of BRCA 1&EGFR breast cancer target proteins using Auto Dock Vina to identify accurate binding geometries and to analyze protein-ligand interactions was carried out and confirmed by the anticancer activity of ligand.

Keywords: Ethyl-p-aminobenzoate, Oxalate ion, Microwave irradiation, Co(II) complex, Ni(II) complex, Molecular docking.

INTRODUCTION

Ethyl-p-aminobenzoate is an ethyl ester of para aminobenzoic acid. It was first synthesized by Edward Ritsert in 1890 by Fisher esterification using ethanol and para aminobenzoic acid. It has one hydrogen bond donor and three acceptor sites [1]. The formal charge is zero so it is used as a neutral ligand in coordination chemistry. This compound have variety of applications in pharmaceutical drug in the form of ear drops, dental sprays, skin gels and powders, it is poorly soluble in water but it has good inhibition character in growth so that they can be used as an antibacterial agent against gram-negative and gram positive bacteria [2-5] with this huge level of applications ethyl-p-aminobenzoate used as the primary ligand and oxalate ion used as mixed anionic ligand in the present study. Microwave assisted reactions are reducing time and organic solvent and also minimize the production of hazardous

substances [6-8]. This is safe, sustainable and the process is simple and easy in handling manner, with this the present study aims to microwave irradiated synthesis, spectral and biological characterization of metal complexes using organic and anionic mixed ligands.

MATERIALS AND METHODS

All the chemicals viz., Vanadylsulphate, solvents and reagents were of AnalaR grade (99% pure) used as such without further purification. Ethyl-p-aminobenzoate was purchased from Alfa Aesar Company.

Synthesis of metal complexes

The Co(II) complex were prepared by mixing ethyl-p-aminobenzoate 2.27g (13.74 mmol) in ethanol, oxalate ion 0.464 g (3.46 mmol) in water to 1g of $Co(NO_3)_2.6H_2O$ (3.43 mmol) in methanol. The mixture was irradiated on a microwave oven (CATA-R, model). The precipitated pink color complex was filtered, washed, dried in a desicator and kept in an air-tight glass container. The complex is stable under ordinary conditions. The Ni(II) complex were prepared by mixing ethyl-p-aminobenzoate 2.27g (13.75 mmol) in ethanol, oxalate ion 0.460 g (3.43 mmol) in water to 1 g of $Ni(NO_3)_2.9H_2O$ g (3.45 mmol) in methanol. The mixture was irradiated on a microwave oven (CATA-R, model). The precipitated green color complex was filtered, washed, dried in a desicator and kept in an air-tight glass container. The complex is stable under ordinary conditions.

Elemental analysis was carried out using elemental Vario make EL-III model instrument at 950-1200°C temperature. The metal ions were estimated after decomposing a known weight of complex in acids by gravimetric/ colorimetric methods. Molar conductance of complex solution at 10^{-3}M concentration was measured using Systronic Conductivity Bridge. The Cyclic voltammogram of the complexes was recorded in DMSO solution at room temperature on Versa Stat (Princeton Applied Research-Make) electrochemical analyzer. The magnetic moment of Cr(III) complex was measured using a Lake Shore 7410 Vibrating Sample Magnetometer (VSM) at room temperature. The solid state diffused reflectance spectral (DRS) methods of UV-Visible spectra of the complex were recorded by using Varian make, CARY-5000 model, UV-VIS-NIR Spectrophotometer. Using Schimadzu, FT-IR, 8400 S Model IR spectrometer, IR spectra of ligands and its metal complex were recorded. The Far IR spectra of the complex were recorded in a Bruker, Germany make, 3000 Hyperion Microscope with Vertex 80 FTIR system model instruments.

Protein Structure Preparation

The 3D structures of BRCA 1 ((PDB ID:1T15), & EGFR (PDB ID: 2J6 M) have been accessed from the Protein Data Bank (RCSB PDB) in pdb format. Protein macromolecules were isolated from solvents and non-standard ligands or residues using Autodock tools and deposited in a.pdb format. Macromolecules have been optimised by incorporating hydrogen atoms tools and saved in pdbqt format.

Ligand Molecules

Using the Chemsketch method, 2D ligand structure of the synthesized compound (SMTL1) was drawn. And it was translated to a.pdb file format by using online smile translator. In addition to further enhance the research, ligands have been optimised and translated to PDBQT format using the PyRx Virtual Screening Tool (python prescription 0.8) graphical user interface edition.

Protein-Ligand Interaction Using Autodock vina PyRx

Newly synthesized compounds have indeed been docked into chosen BRCA 1&EGFR breast cancer target proteins using Auto Dock Vina to identify accurate binding geometries and to analyze protein-ligand interactions [9**].** The docking of both protein ligand complexes was directly aimed at the predicted active site only. The chosen receptor residues were defined as part of the binding site. Upon docking, the docked protein (protein-ligand complex) was examined through Pymol software to investigate the type of interactions. The docking positions saved by the

compound were classified as per their dock score and the best compound pose was determined on the basis of score and interaction parameters.

RESULTS AND DISCUSSION

Micro analytical data

The elemental analysis and metal estimation of the synthesized complexes was found to be good agreement with the confirmation of molecular formula of the complexes. All the prepared complexes are non-electrolyte (1:0 type) [10]. They are stable under ordinary condition and the yields are high (Co(II) 72.50% and Ni(II) 75.33%) due to efficient synthetic method (microwave irradiation).

Voltammogram of Co(II) and Ni(II) complexes

The cyclic voltammogram of Co(II) complex shows a reduction peak Ep_c at -0.999V and oxidation anodic peak Ep_a at -0.269 V. The ΔEp is at 0.730 V and ip_a/ip_c is at 0.789 A indicating the quasi-reversible one electron transfer redox reaction with Co(II)/Co(I) couple. The Ni(II) voltammogram shows redox process with one-electron transfer quasi reversible process with the reduction peak Ep_c at -0.045V, oxidation anodic peak Ep_a at 0.503 V, peak to peak separation ΔEp is at 0.548 V and ip_a/ip_c is at 0.875 A. The standard electrode potential E^0 of this couple exhibit at 0.229V also confirmed by the quasi reversibility of Ni(II)/Ni(I) couple[11].

Electronic Absorption Spectra of Co(II) and Ni(II) complexes

The Co(II) complex exhibited three bands at 580 nm (ν_1); 493 nm (ν_2) and 269 nm (ν_3) which are assigned to $^4T_{2g} \leftarrow {}^4T_{1g}$, $^4A_{2g} \leftarrow {}^4T_{1g}$ and $^4T_{1g}(P) \leftarrow {}^4T_{1g}$ transitions respectively. These transitions suggest octahedral geometry around Co(II) ion. The magnetic moment (μ_{eff}) of the Co(II) complex is 3.54 BM and ν_2/ν_1 value is 1.18 cm^{-1}. The Ni(II) complex shows three peaks at 656 nm (ν_1); 370 nm (ν_2); 264 nm (ν_3) corresponding to $^3T_{2g}(F) \leftarrow {}^3A_{2g}$, $^3T_{1g}(F) \leftarrow {}^3A_{2g}$ and $^3T_{1g}(P) \leftarrow {}^3A_{2g}$ transitions confirming octahedral geometry. The effective magnetic moment of nickel(II) complex is at 3.25BM shows octahedral environment [12].

IR and Far-IR Spectra of Co(II) and Ni(II) complexes

The IR and Far-IR spectral studies confirmed the coordination mode of the metal complexes. The complexes shows different frequencies viz., symmetric NH_2 at 3429(s), 3418(s), asymmetric NH_2 3357(s), 3346(s), Aromatic C-C 3072(w), 2984(w), aromatic C-H 3226(s), 3225(s), carboxylic ester C=O, 1673(s) and 1674(s). The mixed ligand oxalate ion gives the stretching frequencies of Asymmetric (O=C-O), symmetric (O=C-O), oxalate (C-C) and plane deformation (O-C-O) at 1442(m), 1369(s), 1024(m) and 773(s) respectively indicating the entry of the ligands into the coordination sphere through nitrogen atom of 4-EAB and oxygen atom of oxalate ion which ie further confirmed by Far-IR spectral data gives 511 and 504 cm^{-1} for M-N bond coordination of ethyl-4-aminobenzoate and 383 and 376 cm^{-1} for M-O coordinate bond of oxalate ion, this fact confirming the coordination of metal ion through nitrogen atom of ethyl-4-aminobenzoate and oxygen atom of oxalate ion [13].

Molecular Docking

Centuries of study in molecular oncology have resulted in innovative new therapies intended to identify particular molecules that promote tumour growth and survival. The epidermal growth factor receptor (EGFR) is one of the first major targets discovered for these novel antitumor agents. About half of the cases of triple-negative breast cancer (TNBC) and inflammatory breast cancer (IBC) are over expressed with EGFR. Over expression of EGFR in breast cancer is associated with significant tumour size, poor differentiation and poor clinical outcomes [14]. While EGFR over expression is found in all subtypes of breast cancer, EGFR is more commonly expressed in Triple-negative Breast Cancer (TNBC) and Inflammatory Breast Cancer (IBC), that are particularly aggressive [15].

Another essential protein in breast cancer is BRCA1 (Breast-Cancer susceptibility gene1) the tumour suppressor genes, the mutant phenotypes that predispose to breast and ovarian cancers. Detailed study has shown that BRCA

proteins are involved in a variety of key cell processes. In general, this gene contributors to DNA repair and transcription regulation in response to DNA damage. Recent studies have indicated that BRCA protein is needed to preserve chromosomal stability, therefore shielding the genome from damage. New data also show that BRCA transcriptional controls certain genes involved in DNA repair, cell cycle and apoptosis. Hence in the present study EGFR and BRCA1 was selected as potential target for identification anti breast cancer activity of newly synthesized compound ethyl-4-aminobenzoate through molecular docking studies [16].

In molecular modeling, ligand docking at the protein active site is one of the most frequently used technique for determining the desired orientation of of entity that forms the complex (ligand and receptor) while connected together. Auto Dock Vina has been used via the PyRX interface to conduct molecular docking, providing partial receptor versatility to provide high efficiency and results accuracy. Figure-6 shows the docked EGFR complex with ethyl-4-aminobenzoate and Figure-7 shows the docked BRCA1 complex with ethyl-4-aminobenzoate. This has been performed to verify the orientation of the docked ligand at the active receptor site. The docking result shows that the ethyl-4-aminobenzoate displayed a strong binding affinity −5.7 kcal mol^{-1} with EGFR compared to BRCA1 with a binding affinity of-4.7 kcal mol−1In addition, SMTL1 developed two hydrogen bond interactions with EGFR through amino acid, namely LEU-788 & ASP-855 with hydrogen bonds at a distance of 2.6 A ° and 2.7 A °, while BRCA1 also formed two hydrogen bond interactions via amino acid interactions, namely ILE-1680&GLN-1779 with hydrogen bonds at a distance of 2.2 A ° and 2.8 A ° separately.

CONCLUSION

The Co(II) and Ni(II) complexes was synthesized using ethyl-p-aminobenzoate and oxalate ion as ligands with microwave irradiation. The complexes are non-electrolyte, biologically active and the probable geometry of the complexes are octahedral mononuclear. Effective coordination of both ligands through the 'N' atom of 4-EAB and 'O' atom of oxalate ion are also confirmed from its IR and Far-IR spectral studies. Molecular docking confirmed the ligand as potent anticancer agent.

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Table: 1.Molecular docking results obtained from Autodock

Protein Name	Binding Energy kcal/mol	Interacting amino acids	Hydrogen bond distance A°
2J6M	5.7	LEU-788 ASP-855	2.6 2.6
1T15	4.7	ILE-1680 GLN-1779	.2.2 2.8

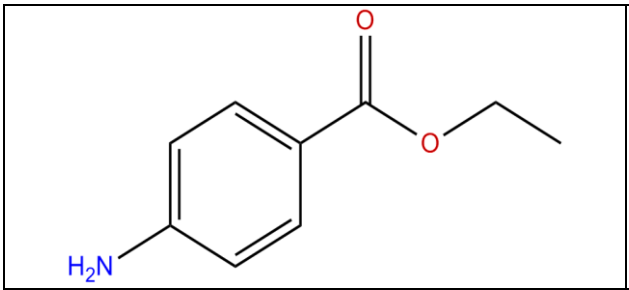

Figure-1: Structure of ethyl-p-aminobenzoate

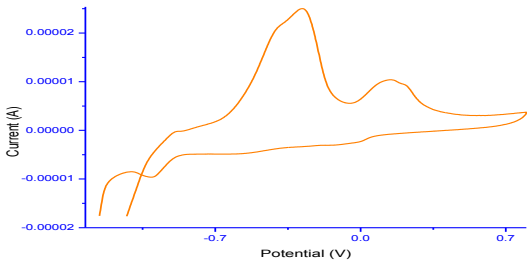

Figure-2: Cyclic voltammogram of Co(II) complex

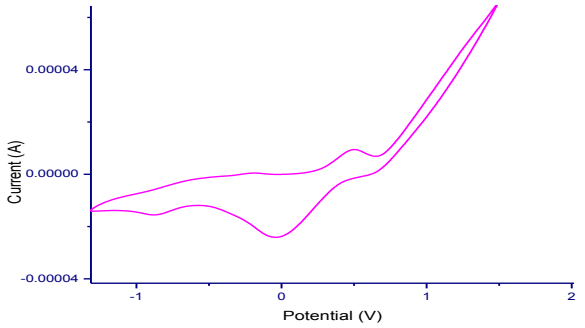

Figure-3: Cyclic voltammogram of Ni(II) complex

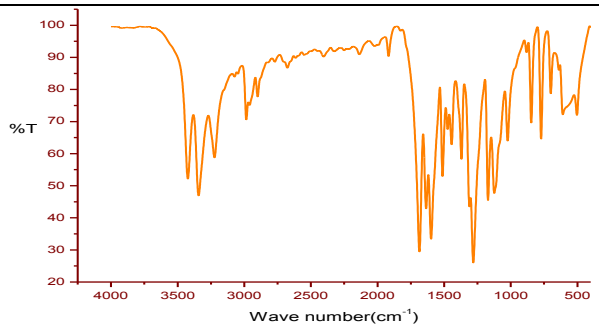

Figure-4: IR-Spectrum of ethyl-4-aminobenzoate

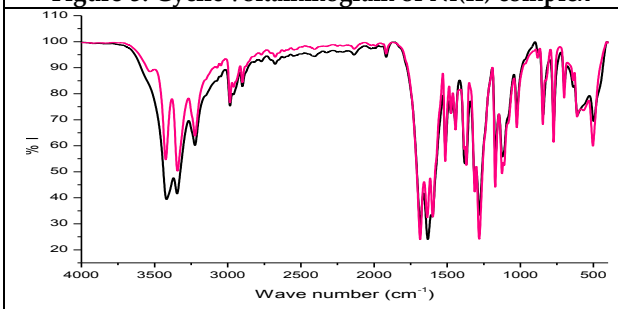

Figure-5: IR-Spectra of Co(II) and Ni(II) complexes

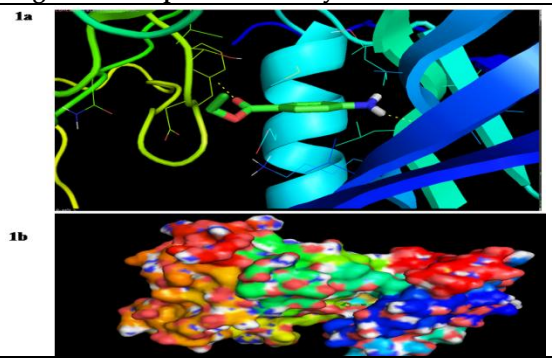

Figure-6: molecular docking of EGFR with ethyl-4-aminobenzoate

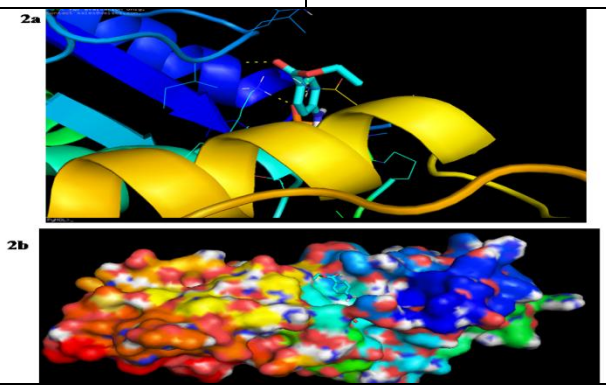

Figure-7: molecular docking of BRCA1 with ethyl-4-aminobenzoate

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REVIEW ARTICLE

Identity Crisis in Pamuk's the Black Book

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ABSTRACT

Individual and Cultural identity is one of the main themes in the works of Orhan Pamuk. Pamuk has dealt with the characters who find themselves at the crossroads of East-West conflict. The Black Book deals with the themes of identity crisis and love. It is usually found that people try to imitate someone else's self and forget their own. People try to become someone else that they are not. The main characters in the novel show their dissatisfactions with their existing identities and try to switch into others. They fall into an identity crisis after losing the present one, and search for new identity probably an idealistic one. Question of identity is a prominent theme in the post-modern literature. As a postmodern novelist, Pamuk skillfully handles the identity issue in his novels. The technique of imitation is used to create cultural and religious identity.

Keywords: The Black Book, Identity Crisis, Imitation, Postmodern.

INTRODUCTION

Quest of Identity in the Black Book

Everyone wants to become someone else whom they think can be ideal. Everyone chases for a new identity and adopt it but they fail. The Black Book also deals with themes of identity crisis and love which was published in 1990. The main contention is whether people are happy with their existing self-identities. It is a general truth found among people that they try to imitate someone else's self and forget their own. In other words, people try to become someone else that they are not. The reasons may be different for this mindset as depicted in the novel The Black Book. The characters show their dissatisfactions with their existing identities. Galip, Ruya and Celal are the main characters who try to switch their identities with others. The three characters are close cousins in relation. Ruya, Galip's wife and also his cousin one day disappears from the home and the latter starts a journey in the city to find out her. He doubts that she must be living with her step-brother, Celal who is also a famous columnist writing for Milliyet. The novel delineates man's search for new identity and missing the present one. When people lose their

identities, they fall into an identity crisis or confusion. This results in search of a new identity probably an idealistic one.

Galip's Search for New Identity

Galip is the central character in Orhan Pamuk's novel The Black Book. The novel mainly deals with the theme of identity crises in the lives of major characters Galip, Ruya, Celal, and other minor characters. Galip Bey, a lawyer by profession one day returns home and finds his wife leaving the home with little information behind. He embarks on a search of his beloved wife, Ruya. While searching his wife, he falls into the self-identity crisis and struggles to find his own identity. He doubts his wife living with her step-brother, Celal Bey who is a successful columnist. It is obvious that he is not happy with his existing identity as a lawyer. He tries to forget his own identity and hold Celal's. He desires to occupy Celal's identity because of his successful career as a writer and Ruya's longing for him. In his own words: 'how much better it hold world be if he could live this world behind forever and live in Celal's world instead (Pamuk, BB, 95). Galip represents those people in the society who complain on their existing being and try to imitate others. He deliberately wants to lose his own identity and hold Celal's, because he thinks the latter's life more successful and full of joys comparing to his own monotonous world. Galip hurt by his wife's leaving him and suspiciously living with Celal makes him doubt his own ability and status in the society. When a person thinks others better than him, he tries to become like the other one. Galip too wants to bear Celal's identity to live a happy life forever.

Galip, obsessed by Celal's self and also missing of his wife Ruya, wanders on the streets, in the coffeehouses, on the bridges and all other places in the Istanbul city. He wants to discover Celal who is also missing, because he believes that Celal and Ruya must be living together. His search is not only for Ruya and Celal, but he is in quest of his own identity which seems shattereddue to his wife's disappearance. He looks into the faces of people passing on the streets to read them He sees the people coming out of a movie theatre had forgotten their own sadness by immersing their 'selves' in the movie story. Galip too longs to watch the movie to lose him in the same story and become someone else, so that he can forget his present mental tortures. He wants to forget his past identity and run away from the harsh realities of life. Galip desires to be someone else so that he can find newness of life. This someone else that he wants to become is Celal, his cousin. Galip is suspicious that Ruya and Celal are hidden in the attic flat of City-of-Hearts Apartment which is also their ancestral house. He somehow gets the keys, cheating the janitor and his wife and enters the attic flat with his heart beats increased. He expects that Ruya and Celal must be there in the flat. But when he opens the doors, finds no presence of them. It is here that Galip spends some of the days and nights holding the identity of Celal Bey, the columnist. He completely loses his own self and bears the identity of Celal. Galip occupies Celal's flat in his absence and becomes Celal for some days. As soon as he enters the house, he hears the phone ringing so many times. Finally, he takes the phone call and talks to the person at other end.

Galip speaks to the caller person pretending to be Celal Bey. He talks to some reader of Celal Bey's column who seems to have read most of the columns written by Celal. The reader wants Celal's address to meet him. Galip in disguise of Celal pretends to have forgotten the past events and suffering from memory loss.Galip wears Celal's clothes, tries to behave like him to assume his identity. He goes through the old columns written by Celal, so that he can act accordingly. After going through several past columns written by Celal, Galip decides to write columns on the name of Celal Bey. He begins his first column with the words which show his excitement to become Celal: "I gazed into the mirror and read my face. I dreamed that I had at last become the person I've always longed to become" (Pamuk, BB, 326).Galip writes a column and signs it with Celal's signature. Finally, Galip sheds his identity as a lawyer and takes the identity of Celal Bey who he always wanted to become like. Galip visits to the pudding shop where Celal often takes his breakfast. He orders what Celal likes to eat in the breakfast. He sees the city Istanbul from a different sight of Celal, not his own. Galip is completely changed into Celal and tries to do everything like him. Nobody except Galip knows that he has become Celal and lost his own self in the process. He observes the city from the self of other's i.e. Celal's. This is the sign of loss of one's identity and looking at the world from a different sight.

At Celal's flat, Galip regularly answers phone calls from one of the Celal's readers who wants Celal's address. Galip talks to the person and seeks every detail of the past columns of the writer. He collects the information given by the caller which he uses to play the role of Celal Bey. Galip in disguise of Celal's identity answers to the caller. He also answers to the phone call of woman who calls herself Celal's beloved twenty years back. While being Celal, Galip has dissemblance to have forgotten his past.

Ruya's Identity Crisis in The Black Book

Loving Ruya the beautiful wife of Galip struggles with her existing identity and wants to become someone else. The readers know about her through Galip's descriptions and memories. It is her second marriage with Galip since her first one failed. She has got a habit of reading detective novels during night while smoking in chain and she sleeps during the day. It may be reasoned that she too is not happy with her existing identity, and being Galip's wife. She lives a life of neurotic, reading only detective novels perhaps in search of a new identity in the novels. One day, she disappears leaving her husband's home leaving no particular clues behind. She lives with her step-brother Celal, a famous columnist, in his new apartment unknown to anyone. She is found dead in Alaadin's shop a day after Celal's murder. It is clear that she too was shot and tried to save her life going into the shop but ignorant of this, the shopkeeper shut the doors only to find her dead the next day. Ruya is a vast reader of novels in which she searches her longing identity. She shows dislike of her existing identity and tries to discover a new one either by reading the novels or leaving her husband's home abruptly.

Celal's Search for a New Identity

Celal Bey, a famous columnist who writes for Milliyet makes his presence in the novel through his columns and through the description of Gailp as what he thinks of him. Celal is struggling with insomnia and loss of memory. Through his columns, the readers come to know that he too suffers from identity crisis and confusion. In one of the columns, The Eye which is the tenth chapter of the novel The Black Book, he feels the presence of an eye on him. In fact this eye is the creation of Celal himself. It follows him whenever he goes. The eye and Celal are one, but no doubles. He transfers himself into that eyes and watches himself from outside. He comes to know that it was his habit since a long time.

In other words his hope was that one day he might become someone other than himself- become the other self. Celal watches himself from outside and he watches his self from inside, but finally gets surprised to see that his person is none other than his self. This shows the crisis of identity within his mind. He struggles to know his own self i.e. self-identity, but finally comes to know that the person he wants to become is none but his self itself. Here, the novelist obviously focuses on the crisis of individual identity, people sometimes are not happy with their existing state of identity, so they long to become someone else or at least they try to make imitation of those they want to become like. In Celal's case, he tries to become like other or his imaginary ideal self, but finally comes to know that it is his self which he has been searching for. Celal represents those people who try to become better and better in their identity. He has his identity as a columnist which well is set in the Turkish society, but apart from this, he quests for a new one.

Belkis' Identity Crisis in The Black Book

Belkis is a childhood companion of Galip and Ruya whom Galip accidentally meets. She reminds their childhood memories to Galip who hardly remembers her. She informs him that she always tried to become Ruya, forgetting her own identity, because she wanted to win Galip's love. She used to imagine herself in Ruya's place even after their marriage. She followed Ruya and Galip everywhere at the theatre, in the shop on the streets, in restaurants. She imagined that she was taking Ruya's place at his side. She tells Galip how she tried to forget her 'self' and become Ruya's self. She even saw Galip in her husband, Nihat. In Belkis' opinion, it is very hard for a person to become himself. She wanted to become other person and began a new life. She can't understand why a person wants to live someone else's life and not his own. She discloses that she always wanted to bear Ruya's identity. Her life was not

real but an imitation of Ruya's in which she deliberately forgot her 'self'. She tried at her best to be faithful with her true self-identity and live her own life accordingly but she failed. She was haunted by Ruya's self and couldn't get rid of it. She used to spend hours after hours thinking only on how to become like Ruya and win Galip's heart. Belkis thought it to be an illness to desire for other's identity but after her husband's death, she got used to this habit. She finally accepts that no one in this world can ever hope to be himself or herself. People spend their most of the life time to become other's self or to imitate other people whom they feel to be their dream. In this quest of a new identity, they completely lose their true identity. Finally, the time comes when they live the life of no world, without any self-identity. As Belkis puts her thoughts in the words: "I had not been myself during the first half of my life because I wanted to be someone else, and now I was going to spend the second half of my life being someone else who regretted all those year's she had spent not being herself" (Pamuk, BB, 204).

The novelist obviously shows that every person in the world has craving for another identity. In other words, people are not happy with their inborn self and search for yet another of some other person's. A person throughout his life tries to bear other better person's identity, and forget to be his self. The people are haunted day and night by the ghosts of the 'true selves' they long to become. In short, through Belkis chapter it can be said that no one is living with his/her own true self identity. The person endlessly strives to become someone else who according to him is better one. In this identity crisis, he loses original inborn self-identity and lives with a fake identity; unfortunately he never comes to know.

CONCLUSION

Question of identity is a prominent theme in the post-modern literature. Being a postmodern novelist, Pamuk dexterously handles identity issue in his novels. Identity is studied from individual, collective or national points of view. The issue of female identity is much discussed by the feminists from the sexual point of view. Female as a gender has sexual identity in the human society in general and Turkish society in particular. The female identity is discussed from a different angle in Pamukan novels. The female is more identified from the sexual point of view.

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RESEARCH ARTICLE

Community Action Learning Program: A Pilot Experiment to Integrate Academics to Community Problems Solving

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ABSTRACT

This article enlighten about the Community action learning program (CALP) initiated in Centurion university of technology and management (CUTM) ,Odisha, who invigorate the students to develop interpersonal skill and contribute to the community. This article highlights about the piloting of CALP at CUTM as a unique way to facilitate interaction of community and academic system. The experiment design of the pilot and outcome in terms of benefitting the community and students have been discussed. The outcome of this 10 days experiment has been quite awakening in terms of substantial improvement in the skills required for a student to meet the 21st century social and professional life.

Keywords: Community, Education, Service Learning, 21st Century Skills

INTRODUCTION

The purpose of higher education across the world has always been set as a function of time, geography, and context of development. However, "development" being a subjective agenda of the growing civilization has evolved being tuned to the political, economic, and social priorities [1]. The global race to strive for industry and market-driven economy across regions has somehow pushed the higher education institutions to be disengaged from their community. This limited experience has become the key to the perception of knowledge as the tool for the creation of wealth and self-prosperity. This behavioral deformation spreading across time and geographies has become the root of the local and global crisis. When the attention of higher education has drifted too far from its public purpose, especially about the preparation of students for productive citizenship along with livelihood, a renewed design emphasizing on the reciprocation of university-community partnership for a mutual benefit [2], can offer a true learning experience for the co-creation and co-existence in the 21st century.

The new model [3] demands the institutions to rethink their structure, pedagogy, epistemology, and integration of teaching, research, and service missions; and reward systems. Such interactions with local and broader communities

will be the key to shift from the prolonged internally focused, disci-pline-based framework of higher education to a framework directed for a stronger level of societal relevance that enhances both community and comprehensive goals of higher education [4-8].

Setting a context: Centurion University as an Incubation Ecosystem

Centurion University of Technology and Management, enacted by the State Legislature of Odisha, was set up in the Gajapati district of Odisha, which has a large tribal population (54.36%, Government of India, 2011). The University has, as part of its charter a School of Vocational Education and Training which is seeking ways to 'shape lives and empower communities, that is, seeking ways to provide alternate pathways to young people who have dropped out of formal education for various reasons, including its unaffordability. It further provides an opportunity for these young people to get back into formal education if they so desire. The learning space of the university is designed to offer a wide range of skilling opportunities through short term and long term programs that ensure good placement in the industry. The labs and action learning center established by the industry partners helps to minimize the gap between the training in campus and job role in the industry. The University has also set up several social enterprises that operate as teaching and learning laboratories for students, staff, and alumni to make the last mile connect with the local populations, be it tribal farmers, women entrepreneurs or young unemployed youth with little skills. The University also works as an incubator for staff and students to explore new ideas for enhancing production and productivity through entrepreneurship. Further, the promoters, mentors and senior management of the University have a 'grounded intelligence' and 'grounded imagination', that considers 'ground-up' learning to be the best and application of theories in the 'local', 'context-specific' manner to be the most meaningful to the community. For the proven track record in skill development and entrepreneurship, in 2019, it has been recognized as the Center of Excellence [9] for skilling ecosystem by the Ministry of Skill Development and Entrepreneurship (MSDE), Government of India.

The relationship between the University and various communities has been nurtured through identifying issues specific to the communities and respond to them. The focus of the University has been to build capacities and create competencies for survival in 21st Century. This article specifically discusses a similar pilot experiment on community action learning program (CALP) involved 220 students from the School of Vocational Education Training (SoVET) in 24 different projects across 5 states of India. Due to it's pilot nature, it can be called as CALP 1.0.

METHODOLOGY

CALP 1.0: Project Conception and Execution

The project from its designing to implementation has been through the following 5 stages.

Program Designing and Awareness

The community action learning program (Fig.1) was completely a new venture for the students of SoVET,of Centurion university. CALP acts as an opportunity for students to implement their academic learning and interpersonal skills to bring a change in their community and learn in turn.The implementation of the CAL program, idea first crop up in the mind of head of SoVET, a unit of CUTM one month before the program came in to action and all faculty meeting was arranged to discuss about this program and its implementation. In the meeting discussion was made about what is community action learning and what are the positive outcomes, if implemented as a project for the diploma students what are the changes expected from the students. Discussion was made about the regions and localities where this community action learning can be implemented and will prove to be a successful endeavour. It was finalized to carry forward this program as an initiative for a week as an experiment, to educate the students to cope with the real time problems and how to overcome the problems. The program was implemented to develop the interpersonal skills like teamwork, ownership and responsibility, improving communication skill, and many more. The same thought was shared with the students and a seminar was arranged

to create awareness among the students about community action learning program. Later the students were asked to come up with their ideas on this community action learning, with their team members and the region or locality they want to go and perform the job. The students were given the guidelines about the project implementation. According to the guideline; the students had to leave for the respective location on the second day of the program as the students need to settle in the prescribed location.

- The students need to carry forward their project for five consecutive days.
- The students have to report back on the tenth day to the university campus.
- The students have to provide the seven days activity report and presentation.

Strategy and Planning

The plan of action was designed for seven days and the students were to come up with their final individual team and discuss with the concerned faculty about the implementation of the jobs they have planned. The number of team members were discussed and finalized. With 220 students,24 teams were finalized and the students were no more treated as a student but as young team who are on their self-motivated mission to bring solution in their own community i.e.; state, city, town, village, rural locality. No restriction was imposed on the students, and they were let completely free to perform their community action learning program irrespective of their branch in their respective location.

Orientation

An orientation program was conducted for the students on day one of the project. The session was set to reduce the nervousness as the students were young enough, mostly they were in diploma after completion of their intermediate. In the orientation session was set up to build up the sense of responsibility to work with the team members , to take care of their own as well as of the team members in a new place without falling into any type of conflict otherwise they may fall in to serious problem in that particular time duration. In the session, the students were motivated to be responsible to do the job in right way and to take proper decisions to carry forward the task in a smooth way. They were advised to take all necessary assets with them which they may require in those days. In this orientation session the students were again briefed about the project they will carry forward for a week and their doubts related to the project implementation were made clear.

Implementation and monitoring

According to the discussion and planning before the project implementation, the students were informed to report every day activity to the concerned authority. This was done to track and monitor the teams whether they are performing their roles successfully or not. The team lead was instructed to give regular information to the concerned faculty about the whole day activity, starting from the day of implementation. They had to show the number of productive hours they spent in performing the community action learning in the specified location. They were even asked to take photocopy of when they were at the work and share the same to their concerned authority. The concerned authority also made video calls to the team members to find out whether everything is happening in proper order or not. This way the students were also monitored by the concerned faculty member and the community action learning program went in the right direction with the support of the faculty members who were incharge of different teams and paved the way to complete success.

Report preparation and presentation

After one week, the students returned to the campus and they had to prepare the seven days report about the job they performed in those days. The students were provided a format and accordingly they were asked to fill up the format and submit the report to the authorities about their experiment. The pupil were also asked prepare posters for the presentation purpose in the campus of the university, so that they can display the job roles they took and how beautifully they implemented it and succeeded in it. In poster they had to mention the name of their project, the

location where each team went, who were the beneficiaries and what was the learning outcome from the job role they selected. Finally, a day was selected for presentation, after the discussion all faculty members of SoVET,

CALP 1.0: Projects

This section illustrates highlights the projects. When we learn something, it becomes essential to utilize it in a productive way that can be beneficial to both the learner and later to the community. Keeping these particulars in the mind, community action learning program was brought into implementation as an experimental basis, that demonstrate its success [6][8]. The table 1 below showcase the list of project.

RESULTS

Observation and Outcome

It can be observed from the above table that, this community action learning was really effective. The students were given scope to enhance their skills in different aspects not just related to what they study. It is observed that the students took this challenge as an opportunity and developed new skills like [11].

Improved Learning Engagement

The students learnt new skills through this community action learning program. The students were ready to accept project, as it was quite different and challenging from other projects usually need to work on. They showed positiveness to practice something new which they had never thought of. Through this project they learnt how to keep them self engaged and learn new things from their experience [12].

Ownership and Responsibility

This project helped the students to develop the feeling of ownership and made them a responsible individual. To take ownership and perform a task and succeed in it is an achievement in itself. This community action learning program provided the opportunity to understand the meaning of responsibility and made the students mature and take the responsibility upon their own shoulders to perform the job successfully. The observation states that the students become responsible, when they were not allowed to perform their community action learning by some local resident and by some school authorities. Instead of stepping backward, they took required measures to overcome the situation and perform their task assigned to them instead of running away from the situation. This shows the development of ownership and responsibility of the students which was lacking before the implementation of the community action learning project [13,14].

Communication and Collaboration

This community action learning program also gave a wonderful opportunity to the students to develop their communication skills. As we all know that communication is very much essential for all and if we excel this skill then we can perform any type of job role. The students in a team were having different mother tongue and it was quite difficult for them to understand other regional language of the residents of the community they visited. There were some students in the group basically belonging to other state were unable to speak or understand Oriya language and some of the students were unable to speak Hindi also were now able to communicate effectively. So, this community action learning program was a boon for those young pupils who accepted the challenge given to them through this program and succeeded in it (fig.2).

Leadership and Self-motivation

It was observed that through this program many positive aspects of the students came up, which the students were also unaware of the quality they have within themselves. When the students got involved in the project, the leadership quality which was inside them evolved and proved to be beneficial for the individual student as well as for others working together as a team. The approach to the police station by these students when they were not

allowed to perform the community action learning program highlights the development of leadership quality within the students.

Being Flexible

This community action learning program taught the students for becoming flexible and adjusts according to the situation. As different teams were formed and they had to go to the respective location even out of the city and town to the rural area, accommodation arrangements were down for them in that particular area. But it was not easy for all teams. Some of the team also had to stay in the panchayat office as no arrangement was done for the team to stay. So it will not be wrong to state that, community action learning program taught the young pupils to be more flexible and adjustable [15,16].

Unforeseen Challenges

It was not so easy for the students to visit a new place and to perform their job. Here also students faced many challenges. As the teams were formed and moved to their respective location to carry forward the community action learning program, they were opposed by the local residents the community as well as by the school authorities. The students were not allowed to perform the CAL program in those particular areas. But hats off to the students did not lose hope and accepted the challenge. They went to police station, education officer and took permission to perform this community action learning program. This was really challenging for the students as they had never faced this type of challenges before. So it can be considered as an successful act[17,18].

Collective Joy and Learning Celebration

The community action learning program challenge was not so easy for these students who are pursuing diploma after their intermediate. But yes, they overcome all the hurdles in their pathway and accomplished the target goal. It was a moment of joy and celebration for all participants for the successful endeavour. It was a moment of joy and celebration when their hardship was published in the cover story of the New Indian Express - EDEX, on 12th March 2018(fig.3) [20,21].

CONCLUSION

Education is the process which brings behavioural changes and develops interpersonal skill of a student. CALP 1.0 , as the pilot experiment, undoubtedly, has offered various positive insights to the organizers. In fact, the outcome in terms of development of interpersonal skills and realization of the holistic purpose of education has been immensely significant. It is a platform that helps the students in gaining excellent networking opportunities and also creates sense of responsibility and pride in an individual for their own self, towards family as well as for the community. The community action learning program highlights that we can broaden our skills in different disciplines and not just remains confined to a limit. This CAL program helps the students to understand their community and learn in return of involvement, at the same time encourages the young pupil to establish their own business and provide employability. As the next step, the organizers integrated CALP as a compulsory credit based project course that has later completed another year of successful execution with improved outcomes. By and large, CALP 1.0, has initiated a new culture of education at CUTM.

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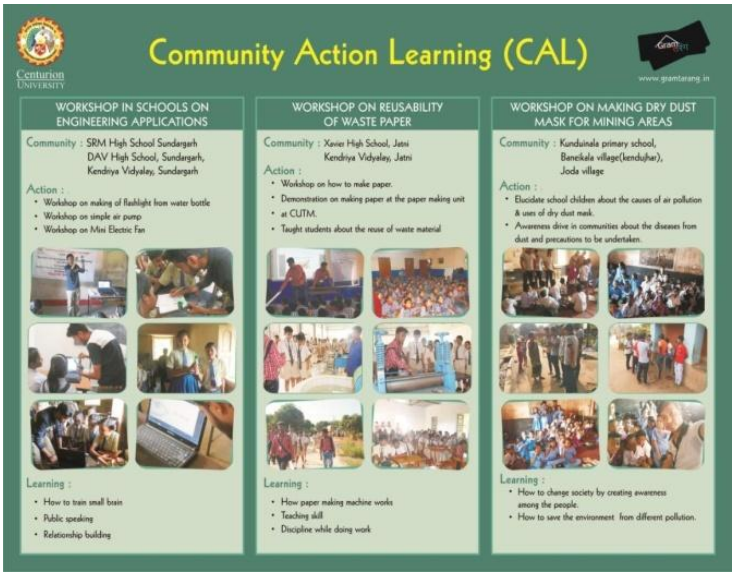

Fig.1.Sample Poster showcasing 3 CALP Projects showcased CUTM

Fig.2. Few moments of students groups during their CALP project


THE NEW INDIAN EXPRESS
MONDAY, MARCH 12, 2018
edex

ONLY ONE CAL AWAY

At Centurion University, the focus is being brought back to the communities, their problems and students are being engaged to solve them, finds *Seema Rajpal*

FAMOUS FIVE

Fig.3.The success story of CALP 1.0 as cover story of IE-EDEX

Table 1. Project name with location and learning outcome

Sl.No.	Project name	Student location	Beneficiary	
			Benefit to community	Benefit to the students
1	Skill work on repairing of domestic appliances	Madhusudhan Nagar, Jatni	Maintenance of domestic appliance	Building team spirit
2	Awareness drive on employability	Nearby village and college of Khurda	Motivating and mobilizing youths to pursue employment through GramTarang(A social out rich of CUTM)	Communication skills, responsibility, value of money
3	Renovating the classroom of govt. school	Dumka, Ranibahal High School	Student motivation for cleanliness ofenvironment	Developing teaching skill
4	Furniture design from waste	CUTM, Campus	Remodeling wire roller to work station	Skill development on wood engineering., and reuse of waste product
5	Orientation program for kids to attend school	Govt. School, Jatni	Kids of lower class communities	Development of critical thinking
6	Traffic safety awareness through drama /street plays	KendriyaVidyalay,Khurda Main road	Students of the school	Developed teaching skill acting
7	Anganbadi renovation in slum area	Anganbadi Kendra, BDO colony,Haribhaina square, Khurda	School children	Developed painting skill and electric wiring
8	Workshop on futuristic technology	Kusumati High School,Arugul High School,BenaPanjuri High School, Jatni	Students of the schools	Developed knowledge on futuristic technology

9	Educating the inhabitants o old age home about interne	Old age home, Jatni	Elderly persons	Value of parents
10	Workshop on Quadcopter designing	B.T.M High School,K.B.R High School, Dhanbad	Students	About Quadcopter and its technology
11	Old asset renovation	Ramchandrapur, Chintamani Nagar, Jatni	Local residents	Reshaping and remodeling old objects
12	Volunteering to the needy	Mission Ashra , Janla/AmaGhara, Patrapada, BBSR	Residents of ashram and orphanage	Understood human values,diversification in societies
13	Utility of solar cooker	Sectors in Rourkela	Local residents	Developed marketing & promoting skill
14	Sports as a tool of social change	Vinayak colony/Govt. High School, Jatni	School students	Developed communication skill to educate students through games
15	Survey on dust prone diseases & precautions	Local area in Dhanbad	School students, local people	Communication skill with different group of people
16	Improving the ecosystem of rural school	MaaSarala High School,Jagatsinghpur	School students	Communication skill, behaviouralskill,motiv ating skill
17	Awareness about career opportunities through Skill India Initiatives	Rural area, Puri	Village youth	Developed social interaction
18	Workshop on making a low cost domestic water filter	D.A.V Public School, Ranchi	School students	Learnt to make water purifier and to face challenges
19	Workshop on financial education using games	Shri D.N Kamani High School, Narbheram Hasraj School, Jamshedpur	School students	Increased confidence level & financial management
20	Activity using Mathematical formula tricks & cleanliness awareness program	Tarantua Primary School, Khurda	School students	Learnt teaching skill
21	Awareness on addiction &hygiene	SitaramSquare,Sainik School, Jatni	Local people, school students	Planning and execution with team work
22	Workshop in schools on engineering application	SRM High School, DAV High School, Kendriya Vidyalay, Sundargarh	School students	Public speaking, Relationship building
23	Workshop reusability of waste paper	Xavier High School, KendriyaVidyalay, Jatni	School students	Discipline & teaching skill
24	Workshop on making dry dust mask for mining areas	Kunduinala Primary School, Baneikalavillage, (Kendujhar) , Joda village	School students	Saving environment from pollution

Authors

Dr. Amiya Singh, brings 10 years of experience Education, Research, Development sector. He has worked in multiple development projects with internal and external stockholding/ partnerships. Grassroot innovation and Community Development have always been his passion. His efforts in the recent years have focused more on his vision to create a robust academic ecosystem integrating Skill Development, Innovation, Employability and Entrepreneurship, Wellbeing. Also, his involvement in projects related to agriculture and livelihood for rural development has been quite significant. Presently, Amiya works as the Dean (Skill Integration) at Centurion University of Technology Management, odisha. Amiya holds the 40 Under 40 Award for Education leadership by Indian Express EDEX and IVLP Fellowship (USA). He has completed his Ph.D in Wireless Communication Engineering from NIT Rourkela and acquires multiple publications to his credit.

Suchismita Nayak, come up with 11 years of experience as an educator of English language. She has the proficiency in teaching/learning new skills and adopting new pedagogy for an academic discipline in Centurion University. She possess the managerial skill and also developed a skill of composing text and highlighting research work on community action learning program and also on various social issues. At present she lecturer in Centurion University of Technology and Management (CUTM),Bhubaneswar, India.

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RESEARCH ARTICLE

Study of the Effect of Various BSE Indices on the Share Prices of Three Indian Banks Using Artificial Neural Network

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ABSTRACT

Share prices variation has a direct impact to the common man when he / she has invested for returns due to the various controlling parameters which are influencing the share price of three leading banks whether it is State Bank of India, ICICI Bank and HDFC Bank. There are reports regarding effect of different parameters on share prices however, there is no study on the impact of BSE indices on bank share prices. Thus, this study focuses on identifying 16 BSE indices on share prices of State Bank of India, ICICI Bank and HDFC Bank. The three banks showed similar trends in case of 6 BSE indices. SBI Bank and ICICI Bank showed similar trends in case of 12 BSE indices out of a total of 16 BSE indices. SBI and HDFC showed similarity in case of 9 BSE indices for the cases studied. ICICI Bank and HDFC Bank presented similar variations in share prices for 7 BSE indices. The differences and trends cited may be due to the size of the organization, product portfolio, investment pattern and reach.

Keywords: Artificial neural network; share price; BSE indices; bank; stock units.

INTRODUCTION

People invest in mutual funds with a view to gain profit and their investment is governed by change in the share prices of different institutions. These share prices of institutions depend on different parameters. The knowledge about the effect of different parameters on share prices might help people decide their investment. Qalsi et al [1]. studied the effect of various factors on the market stock price of the insurance companies in Ammal Stock Exchange. They found that the stock price was controlled by the company size, assets, types of assets, profitability, company's age and return on assets. The effect of share prices on financial institutions in the Johannesburg Stock Exchange was studied by Willows and Rockey [2] from 2015 to 2019. They observed that the share prices movements are controlled by financial statement releases. Alves et al., [3] developed a structural equation model (SEM) to identify the

controlling factors of share price and liquidity. It was reported that the ownership structure has a direct influence on the share price. Sharma [4] inquired about the empirical relationship between equity share prices and "book value per share, dividend per share, earning per share, price earnings ratio, dividend yield, dividend payout" etc., in India. Angelovska [5] examined the reasons and reaction of the market with respect to large share price movements (share price shocks). It was reported that the erratic behavior of the uninformed investors caused the share price shocks. Kaphiravan et al., [6] analyzed the effect of temperature on Bombay Stock Exchange (BSE) and National Stock Exchange (NSE) indices in India. They used statistical tools for the analysis and found that temperature controlled the volatility of the stock market in Chennai, Mumbai, Kolkata and Hyderabad but there was no effect in Delhi. Divya and Sharon [7] studied the impact of demonetization on the share prices of top ten software companies. They reported that the effect of demonetization was significant in various sectors. Singhal and Bahure [8] investigated the effect of the day of the week on Indian Stock Market and reported complex variations occurring during weekend and hence referred to it as "weekend effect". Vohra [9] reported the co-movement of BSE Sensex, BSE 100, BSE 200, BSE 500, BSE midcap and BSE small cap indices. They utilized various econometric tools such as ADF unit root, Johnson co-integration etc.

The analysis of various published works shows that the effect of different BSE indices on the share prices of Banks has not been studied. However, there is a need to analyze the effect of those indices on the share prices. Thus, artificial neural network has been used to analyze the effects. The present work focuses on studying the effect of specific indices on share prices of a public bank namely "State Bank of India" (SBI) and two privately operated banks "ICICI Bank" (ICICI) and "HDFC Bank" (HDFC).

METHODOLOGY

Data for analysis

In this work, published data have been obtained from the website (https://www.bseindia.com/indices/IndexArchive Data.html on 13th September 2019 at 5:15 PM IST). The historically archived different BSE indices were collected on a daily basis for the period 1st January 2015 to 12th September 2019.The closing value of the indices were used for the study. The data for holidays were not available and hence were not incorporated in the analysis. This period was chosen keeping in mind the size of the data and the same government rule since 2014.

The various indices under BSE such as Auto, Bankex, Capital goods, Carbonex, Consumer Durables, CPSE, Greenex, IPO, Metal, Oil& Gas, Power, PSU, Realty, Sensex, SMPEIPO, and Teck were downloaded from the above mentioned site. The share prices of SBI, ICICI and HDFC banks were downloaded for the same dates from investing.com website on 13 September, 2019 at 5:30 PM IST. All the BSE indices were taken as the input parameters while the share prices of the banks were taken as the output parameters for the ANN model. The data were normalized in the range of 0 to 1 and randomized to avoid the biasness of selecting data for development of the ANN model. It also enhanced the chances of having more patterns in data.

Development of Neural Network Model

Neural network works based on development of connected units or nodes similar to the neurons present in brain. Each of these nodes has the ability to transmit signal among each other. It uses processing of the brain as the basis for developing algorithms that can be used to model complex non-linear problems. Essentially, it accepts input data, analyzes it to identify patterns, manipulates them based on the errors in the predictions and finally predicts the output. In general, the model consists of an input and output layer with a varying number of hidden layers in between. There may be different connections possible in between the layers. The role of the hidden layer is to modify the data based on the functions set for each layer to facilitate pattern recognition. This process is called "training".

Initially weights (co-efficient) are assigned to the parameters. During Training, the error (computed by the difference in experimental values and predicted values) is fed back to the system according to which the weights are adjusted in a systematic fashion. This process called "learning" is repeated till the desired output is obtained. The network is developed based on trial and error. In a neural network overtraining may lead to false predictions. Thus, validation and testing data are used during the training phase. Once the model is ready a new set of data (not used during the training phase) is used to validate the model. The network topology, initialization technique, transfer function, learning rule and a training algorithm are decided based on trial and error to identify the final model. There are different tools used for modeling neural networks. In this study MATLAB R 2014a with neural network toolbox was used.

A neural network model was developed to predict the share prices of three banks as a function of different BSE indices. The objective was to compare the effect of a given index in private and public financial institutions. First, 80% of the obtained data was used for "training" of the model. The training : validation : testing during the training phase was chosen as 6 : 1 : 1.The remaining 20% of data was not used for training and used to validate the model. For all the three banks the artificial neural network structure consisted of one input layer, one output layer and two hidden layers in between. Feed forward network with back propagation algorithm was used and the number of neurons where assigned by trial and error method. Initially, the weights and biases were chosen randomly using rands function. The Leven berg-Marquardt algorithm (trainlm function in MATLAB) and gradient descent weight and bias learning function (learngd function in MATLAB) were used for training and learning, respectively. The BSE indices were given as the input to the network and passed on to the hidden layer. The first and second hidden layers were associated to sigmoidal (tansig function in MATLAB) and linear (purelin function in MATLAB) transfer functions, respectively. The prediction capability of the model was determined by comparing the predicted and experimental share values for a given set of BSE indices based on the regression coefficient. A regression coefficient greater than 90% indicated that the model was capable of predicting the trends. The predicted share values for SBI, ICICI and HDFC showed deviation within the range of ±5 (share range 151.8 to 372.4),±0.5 (share range 4.7 to 12.6), ±0.2 (share range 49.9 to 131.3), respectively. A small value of deviation indicates existence of a well-defined pattern. A high value for SBI indicates that there might be other factors that might influence its share price.

Study the effect of BSE indices on the share prices of the banks

The share price of a bank depends on all the BSE indices. Experimentally it is not possible to determine the effect of a single index on the share price as it is not possible to vary only a single parameter. A mathematical tool can help as it is possible to change a single parameter keeping other parameters constant. The effect of different BSE indices on the share prices were studied by varying a single parameter within the experimental data range keeping all other parameters constant at their average values. The predicted share prices were plotted against the parameter taken into control/considerations.

RESULTS AND DISCUSSIONS

The effect of different BSE indices on the share prices of SBI, ICICI and HDFC banks were studied.The share prices of the three banks are in INR/unit.

Effect of BSE Sensex

BSE Sensex is the benchmark index of stock exchange in India. It consists of the most actively-traded stocks and gives an insight into the progress of the economy. Factors affecting the investment and transactions in stock markets depend upon the central governing body which decides upon trade laws, domestic demand, and foreign funds. Fig.1 shows the effect of BSE Sensex (x axis) on the share prices (y axis) of SBI, ICICI and HDFC keeping all other parameters constant. Fig. 1a indicates that SBI might have been involved in large investmentsof stocks leading to a continuous rise in shares throughout the time period taken. A similar trend was marked for ICICI bank which

reports an increase in shares (Fig. 1b). However, the number of stocks is less than that of SBI. A hyperbolic curve was noted in case of HDFC bank (Fig. 1c), where it might be assumed that there had been a deviation from expenditure on shares of companies which was then marked by a rise.

Effect of Auto

BSE Auto is a sectorial index which consists of companies classified as AUTO in the BSE 500 index which are in good terms with trading frequency and free-floating market capitalization (eg. Tata Motors, Maruti Suzuki etc.). The base value of the Index is taken as 1000 and the calculation frequency is real time.Figure 2 shows the trends in share prices (y axis) ofthe three banks being influenced by the BSE Auto index (x axis). Shares owned by SBI (Fig. 2a) and ICICI (Fig. 2b) both witnessed a decrease in share prices with the growth in automotive industries. This shows that SBI and ICICI did not contribute significantly to the automotive industries, might be in the form of investment in automobile industries or loans sanctioned to customers for buying cars. HDFC (Fig. 2c) followed an opposite tendency initially but followed the same trend as that of the other banks at higher values of BSE Auto index. This indicates that HDFC changed its pattern on investment related to the automotive industries. High value of BSE Auto index with low values of share prices indicated that these banks are not presently significantly contributing towards the growth of the automotive industries. The differences and trends between the leading banks cited may be due to the size of the organization, product portfolio, investment pattern and reach.

Effect of Bankex

BSE Bankex is an index that consists of the most liquid and large capitalized Indian banking stocks. The index has 12 stocks from the banking sector which trade on BSE. Fig. 3 shows the effect of Bankex index (x axis) on the share prices (y axis) of SBI, ICICI and HDFC. All the three banks presented an increase in their share prices with increase in Bankex index. This indicates that they are contributing to the indices as obvious from their involvement in the 12 stocks controlling Bankex. For the same change in Bankex, SBI (Fig. 3a) and HDFC (Fig. 3c) showed higher rate of increase in their share prices compared to that of ICICI (Fig. 3b).This indicates that SBI and HDFC have higher influence on Bankex compared to ICICI.

Effect of Capital Goods

Capital Goods, also known as Complex Product and Systems (CoPS), refer to durable goods that are used in production of goods and services. They play an important role in the economy by allowing businesses to provide service for consumers and also restrict inclusion of start-ups, keeping competition of the market relatively small. Fig. 4 shows the effect of BSE capital goods index (x axis) on the share prices (y axis) of the banks. Both SBI(Fig. 4a)and ICICI (Fig. 4b) marked a linear increase in investment with the rise in share prices whereas HDFC reported the opposite trend (Fig. 4c) where a fall in investment was observed. This analysis indicates that SBI and ICICI contributes significantly in production of goods and services while HDFC does not invest significantly in this sector.The differences and trends cited may be due to the organization structure, product portfolio and investment pattern.

Effect of Carbonex

The BSE Carbonex represents a carbon-based thematic index in the country, which takes a strategic view of organizational commitment to climate change mitigation. It allows investors to track the greenhouse gases emission reduction of the constituent companies among the BSE 100 companies. Fig. 5 shows the effect of BSE carbonex index (x axis) on the share prices (y axis) of the banks. Share prices of both ICICI (Fig. 5b) and HDFC banks(Fig. 5c) marked an increase with the increase in carbonex index while the share price of SBI (Fig. 5a) showed an opposite trend. The results point out towards the fact that, unlike SBI, ICICI and HDFC banks are contributing more in companies which

are trying to reduce the carbon footprint to protect the environment. The differences and trends cited may be due to the investment policy.

Effect of Consumer Durables

Consumer durables are those products that do not need to be purchased frequently because they last for an extended period of time (typically more than three years). They are also called durables or durable goods. Some major index constituents are Bajaj Electricals Ltd, Blue Star Ltd, Rajesh Export Ltd, and Symphony Ltd. Fig. 6 shows the effect of BSE consumer durables index (x axis) on the share prices (y axis) of the banks. The graph for SBI (Fig. 6a) showed a continuous increase in shares with the rise in the index value. On the other hand, ICICI reported a surge in share price only when the index had fallen (Figure 6b). A unique tendency was marked in the share prices of HDFC bank (Fig. 6c). Initially, the fall in the index value led to the growth in shares. However, above around 20000 value of the index the share prices of HDFC increased with increase in the index value. Thus, the results indicate that unlike ICICI, SBI invested in companies producing consumer durables. HDFC changed it investment pattern and presently invested in such companies. The differences and trends cited may be due to the product portfolio, investment pattern and reach.

Effect of CPSE

Central Public Sector Enterprises (CPSE) are those companies which are under the direct holding of the central government or other CPSE is 51% or more. Presently, there are around 300 CPSE's in total including 8 Maharatnas,16 Navaratnas and 74 Miniratnas. Fig. 7 shows the effect of BSE CPSE index (x axis) on the share prices (y axis) of the banks. SBI (Fig. 7a) and ICICI (Fig. 7b) showed a similar tendency of decreasing share price with increase in BSE CPSE index. On the other hand, HDFC (Fig. 7c) marked an increase in share price with increase in the index value. This clearly shows the different investment pattern for HDFC with respect to CPSEs. The differences and trends cited may be due to the policy of the organization.

Effect of Greenex

The Bombay Exchange launched the green index called greenex which is India's first carbon-efficient live index. It is the second thematic index launched by BSE. The index measures the performance of Companies in terms of carbon emissions especially targeting socially aware investors. It comprises of 20 stocks based on minimum carbon footprint, capitalization and turn over. The BSE index will assess the energy efficiency of firms based on energy and financial data. Fig. 8 shows the effect of BSE greenex index (x axis) on the share prices (y axis) of the banks. All the three banks (Fig. 7a, 7b and 7c) reported a decrease in share price with rise in the BSE greenex index. This trend is alarming in terms of the social responsibilities of the banks. This indicates that the banks do not invest significantly in those industries which are trying to reduce carbon emission in the environment.

Effect of IPO

The IPO index was used to track the current primary market conditions in the Indian capital market and measure the growth in Investor's wealth within a period of two years after the listing of a company with successful completion of Initial Public Offering. Fig. 9 shows the effect of BSE IPO index (x axis) on the share prices (y axis) of the banks. The share prices of SBI (Fig. 9a) and ICICI (Fig. 9b) decreased with increase in the IPO index value. HDFC showed the opposite trend (Fig. 9c). SBI and HDFC showed changes in their trends around some specific values of IPO index. The industries contributing to the BSE IPO are new companies. Thus, the results suggested that HDFC supported such new companies more than that by SBI and ICICI. The differences and trends cited may be due to the organization policy.

Effect of Metal

The BSE metal index was designed to reflect the behaviour and performance of the metal sector including mining. It comprises of 15 stocks that are listed on the National Stock Exchange. The CNX metal index represents about 4.17% of the free-float market capitalization of the stocks listed on NSE and 73% of the free-float market capitalization forming the universe of metals. Fig. 10 shows the effect of BSE metal index (x axis) on the share prices (y axis) of the banks. A continuous rise in shares was observed with an increase in metal index for both SBI (Fig. 10a) and ICICI (Fig. 10b). HDFC however, showed an opposite trend (Fig. 10c). This might indicate that SBI and ICICI have invested significantly in metal production and mining sectors. The differences and trends cited may be due to the investment pattern of the organization.

Effect on Oil & Gas

The BSE oil and gas index comprises constituents of the S&P BSE 500 that are classified as members of the oil and gas sector as defined by the BSE Industry classification system. They mainly comprise of Bharat Petroleum Corporation Ltd., Castrol Industry Ltd., Gail India Ltd., Gujarat State Ltd., Hindustan Petroleum Ltd., and Indian Oil Corporation Ltd. Fig. 11 shows the effect of BSE oil and gas index (x axis) on the share prices (y axis) of the banks.SBI (Fig. 11a) and HDFC (Fig. 11c) shared a similar trend that has been displayed graphically whereas ICICI (Fig. 11b) show eda continuously decreasing trend. Initially, shares rise with the increase in index for SBI and HDFC (SBI share prices have been observed to be greater than that of HDFC) followed by the fall in prices which leads to growth in shares owned by the banks.

Effect of Power

The BSE power index comprises constituents of the S&P BSE 500 that are classified as a member of the heavy electrical equipment and electrical utilities sectors as defined by the BSE industry classification system. The major constituents are ABB India Ltd., Adani Power Ltd., Bharat Heavy Electricals, JSW Energy Ltd., NHPC Ltd., and NTPC Ltd. Fig. 12 shows the effect of BSE power index (x axis) on the share prices (y axis) of the banks. The graphical representation is analogous to oil and gas where the trends shown by SBI (Fig. 12 a) and HDFC (Fig. 12c) are similar with a downward parabolic curve. ICICI bank (Fig 12b) showed a growth in share price with increase in investment in power sector above a certain threshold. The differences and trends cited may be due to the investment pattern of the organization.

Effect of PSU

The BSE PSU (public sector unit) index ensures a reasonable history of how the central government wealth fluctuated. The base value for the index has been set at 1000 to ensure adequacy in terms of daily index movement. It tracks the performance of listed equity of PSU companies and is displayed online on the BOLT training terminals nationwide. Fig. 13 shows the effect of BSE PSU index (x axis) on the share prices (y axis) of the banks. SBI (Fig. 13a) and ICICI (Fig. 13b) reported similar trends while HDFC (Fig. 13c) bank presented the opposite trend. Unlike HDFC, both SBI and ICICI marked an increase in the share prices with increase in PSU index value. The results indicate that SBI and ICICI invest significantly in PSU. The differences and trends cited may be due to the investment pattern of the organization.

Effect on Realty

The BSE Realty index comprises constituents of the BSE 500 that are classified as members of the real estate sector as defined by the BSE classification system. The major constituents are DLF, Godrej Properties, India bulls Real Estate

Ltd., Mahindra Life space Developers, Oberoi Realty, and Phoenix Mills Ltd. Fig. 14 shows the effect of BSE realty index (x axis) on the share prices (y axis) of the banks. The share prices of SBI (Fig. 14a)and ICICI (Fig. 14b) rose with increase in the realty index. SBI graph denotes an increase in investment with a small fall in share price. The straight line observed for ICICI graph reports a linear relation between the price and growth in shares. The downward parabolic curve for HDFC (Fig. 14c) shows an increase followed by a decrease in share price. The results indicated that SBI and ICICI invested in Realty sector significantly. HDFC also invested in this sector but reduced its investment presently while the index value is high. Probably the uncertainty in the realty sector controlled the investment of HDFC.

Effect on SMEIPO

Small and Medium Enterprises (SME's) are the major contributors to Indian economy. A separate platform was opened up by the stock exchange in India to help SME's to raise funds through investors in stock market. For SME stocks to get listed and being traded on exchange, the company has to come up with an Initial Public offer (IPO) at exchange's SME platform. IPO is one of the popular ways for companies to raise funds from investors and get listed on exchange. There are several criteria that need to be fulfilled. Fig. 15 shows the effect of BSE SMEIPO index (x axis) on the share prices (y axis) of the banks. SBI reported a growth in share price with an initial rise in the index value and then a fall in share price denoted by a parabolic curve (Fig. 15a). The exponential graph for ICICI (Fig. 15b) marked an increase in shares with increase in the SMEIPO index. HDFC presented a decreasing share price with increase in the index value. The results might point out to the fact that ICICI bank supported the SME IPO sector significantly. SBI supported it to some extent. The differences and trends cited may be due to the investment policy.

Effect on Teck

The Decade of 1990 saw a huge emergence of the technology sector as a major force in Indian economy. This growth was displayed in financial markets. Viewing the trading pattern, around 19% of the turnover on the stock exchanges is taking place in the TMT sector itself. These stocks collectively account for 15% of the total market capitalization. Fig. 16 shows the effect of BSE Teck index (x axis) on the share prices (y axis) of the banks. ICICI (Fig. 16 b) and HDFC(Fig. 16c) reported a fall in share prices with the growth in the index. The parabolic curve depicted by the SBI (Fig. 16a) denoted an initial rise followed by a fall in the share prices as the index value increased. The result might indicate a lack of support for the technology sector. SBI and HDFC showed the same trend presented in case of SMEIPO index.

CONCLUSIONS

Share price variation of different organizations affect common people. Thus, it is important to understand the effect of different parameters on the share prices. However, there is no study available on the effect of different BSE indices on the share prices of different organizations. Thus, the focus of the study was to predict the effect of 16 BSE indices on the share prices of three leading banks (State Bank of India, ICICI Bank and HDFC Bank) in India using artificial neural network. The use of these mathematical tool helped to predict the effect of a single parameter keeping all others constant. It was observed that the three banks showed similar trends in case of sensex, bankex, greenex, oil and gas, realty and teck. The share prices increased with increase in sensex, bankex and realty while an increase in greenex, oil and gas and teck indicated a downward trend in share prices. SBI and ICICI showed similar trends in case of auto, capital goods, CPSE, IPO, metal and PSU, but HDFC presented an opposite trend. The share prices of SBI and ICICI decreased with increase in auto, CPSE and IPO indices while an opposite trend was observed in case of capital goods, metal and PSU indices.

SBI and HDFC showed similar trends in case of consumer durables, power and SMEIPO. In these cases, ICICI showed a reverse trend. The share prices of SBI and HDFC decreased with increase in power and SMEIPO while they increased with a rise in consumer durables. Unlike SBI, ICICI and HDFC presented an increase with increase in carbonex value. The results show that SBI and ICICI follow similar business strategies in terms of most of the indices (12 out of 16). SBI and HDFC showed similar trends in case of 9 indices out of 16. ICICI and HDFC presented similar trends in 7cases.

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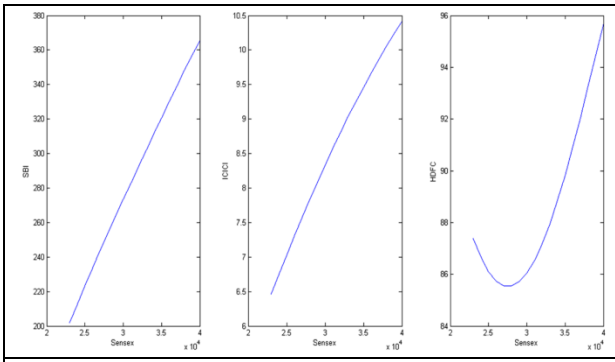

Figure 1. Effect of BSE Sensex on share prices of SBI, ICICI and HDFC banks.

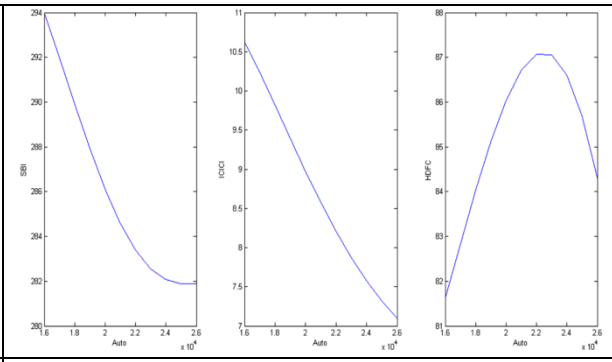

Figure 2. Effect of BSE Auto on share prices of SBI, ICICI and HDFC banks

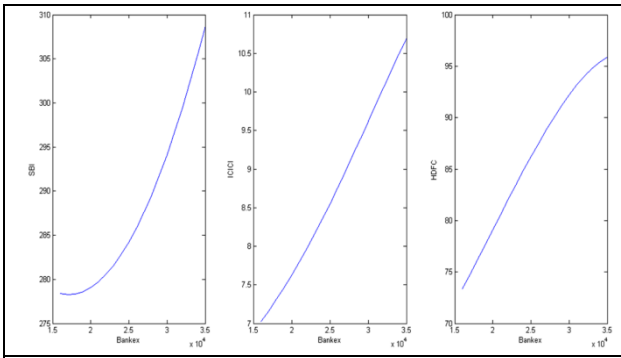

Figure 3. Effect of BSE Bankex on share prices of SBI,ICICI and HDFC banks.

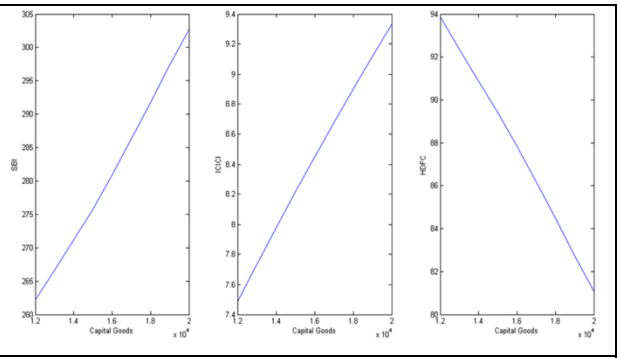

Figure 4. Effect of BSE capital goods on share prices of SBI,ICICI and HDFC banks.

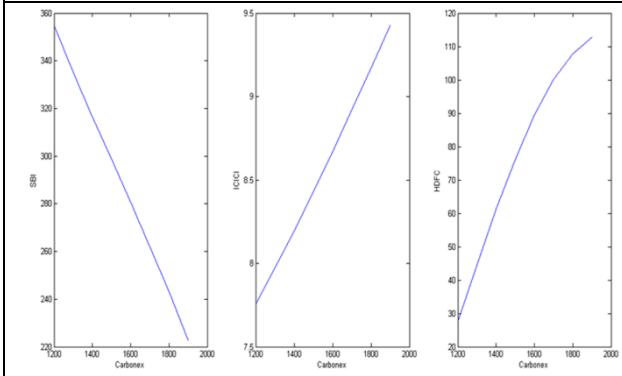

Figure 5. Effect of BSE carbonex on share prices of SBI, ICICI and HDFC banks.

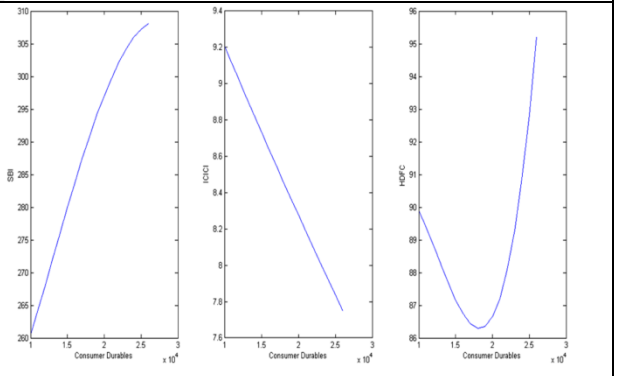

Figure 6. Effect of BSE consumer durables on share prices of SBI, ICICI and HDFC banks.

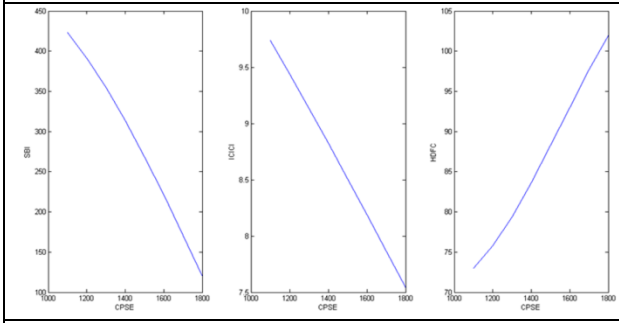

Figure 7. Effect of BSE CPSE on share prices of SBI, ICICI and HDFC banks.

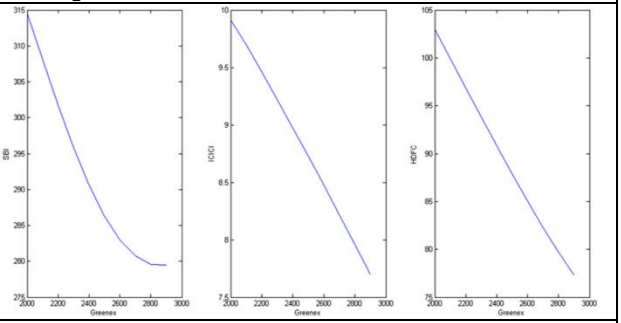

Figure 8. Effect of BSE greenex on share prices of SBI, ICICI and HDFC banks.

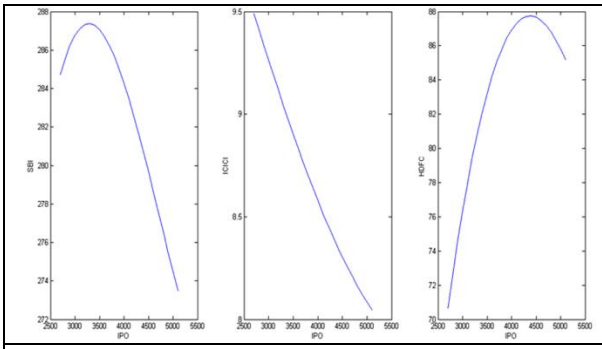

Figure 9. Effect of BSE IPO on share prices of SBI,ICICI and HDFC banks.

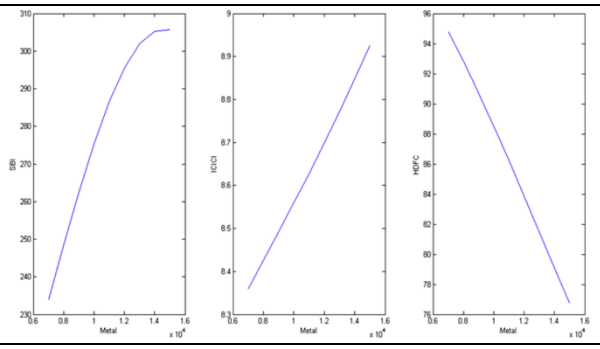

Figure 10. Effect of BSE metal on share prices of SBI,ICICI and HDFC banks

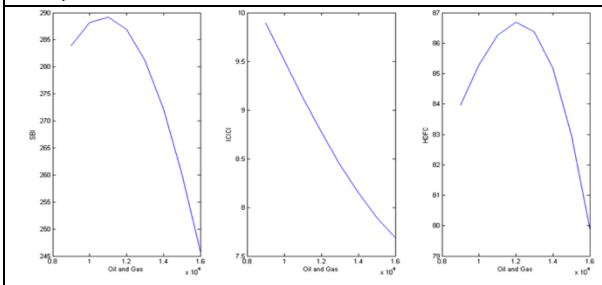

Figure 11. Effect of BSE oil and gas on share prices of SBI, ICICI and HDFC banks.

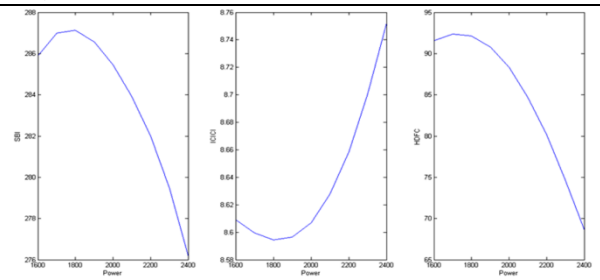

Figure 12. Effect of BSE power on share prices of SBI, ICICI and HDFC banks.

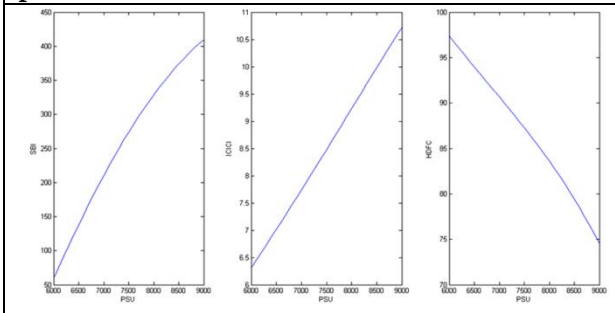

Figure 13. Effect of BSE PSU on share prices of SBI, ICICI and HDFC banks.

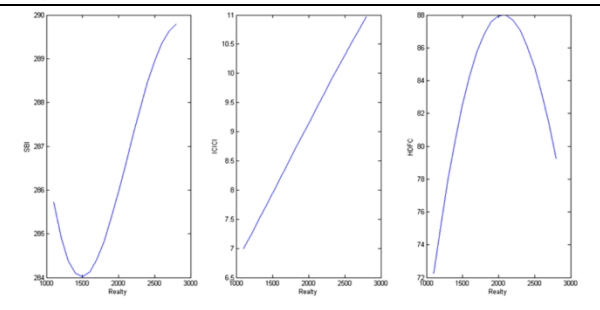

Figure 14. Effect of BSE realty on share prices of SBI, ICICI and HDFC banks.

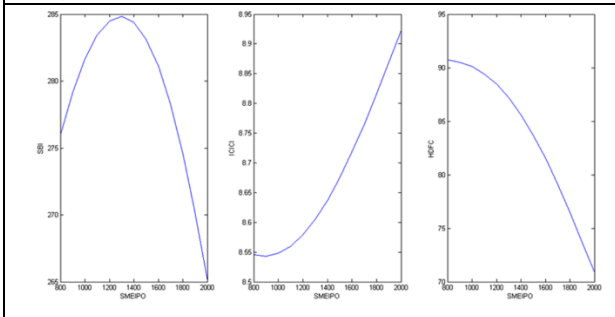

Figure 15. Effect of BSE SMEIPO on share prices of SBI, ICICI and HDFC banks.

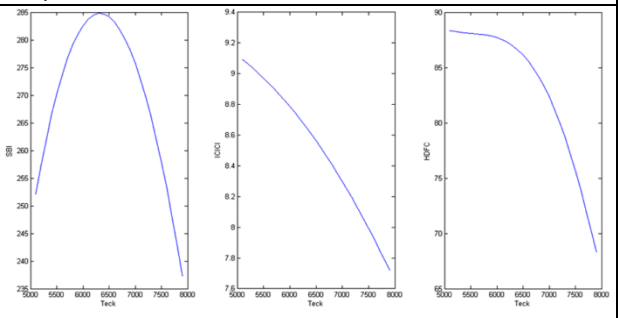

Figure 16. Effect of BSE SMEIPO on share prices of SBI, ICICI and HDFC banks.