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Ethnomedicinal Theraupeutic Uses for Diabetes from Dharampur Area, Gujarat

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Abstract: *The survey was conducted to document the ethnomedicinal plants used for curing diabetes by the tribal of Dharampur area, Gujarat. Around 17 medicinal plants are reported during extensive field trips. This documentation record can play an important role in preserving the therapeutically uses of this areas.*

Keywords: Ethnomedicinal, Diabetes, Dharampur

I. INTRODUCTION

India is a rich heritage of medicinal plants which were native's gift to man-kind. Since the human race is started on the earth, it needs on the plants for the requirements have become essential in his life. As our country is rich in medicinal diversity of plants and ethnobotanical culturein which 400 different tribal and other ethnic groups are settled from ancient times.As the plants are safest natural resources, the traditional systems and the traditional healers plays a significant role in spreading the knowledge of medicinal and magical herbs which can treat various diseases according to tribal people of particular region.

The traditional medicinal plants have increased a demand amongst the poor people which live in isolated and intense area. As the herbal medicines are easily available and are also exploited due to deforestation as well as destruction of natural habitats for agriculture and other purposes. The spread of traditional valuable knowledge requires a proper records sot that it will be used as valid and quantified. By this aims, the present study has been carried out to highlight therapeutic values of plants used in curing diabetes from different areas of Dharampur region as it is referred to as 'Kashmir of Gujarat'.

II. METHODOLOGY

Field trips were conducted in the remote areas of Dharampur area, Gujarat. The ethnomedicinal plants were recorded from knowledgeable sources such as Vaidus, Old practitioners, Hakims, etc. The individual plant samples were collected and photographs taken by arranging regular visits of the area during the 2019-2021.Later on, these samples were identified with the help of Cooke's flora.The data regarding names of the plant parts used and their mode of preparation were also noted down. The medicinal plants were arranged in the form of: a) Botanical name, b)Family, c) Local name, d) Habit e) Parts used

III. OBSERVATION AND RESULTS

Among 17 medicinal plant species belongs to 15different families were found to be used by the inhabitant of the Dharampur area surveyed for the treatment of diabetes. Almost all the plant/ plant-extracts were found to be prepared in aqueous solution and were consumed during the early hours of the day in empty stomach. Plant parts used more frequently such as bark, leaves, tuber, fruits, seed, stem, roots etc. used for the treatment of diabetes with their Local name, botanical name and family used to cure diabetes are discussed below (Table 1).

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Table 1: Plants used to cure Diabetes

Sr. No.	Botanical name	Local Name	Family	Habit	Part used	Wild/ Cultivated
1	*Cassia fistula* L.	Garmalo	Caesalpiniaceae	Tree	Seed	Wild
2	*Catharanthus roseus* (L.) G. Don	Barmasi	Apocynaceae	Herb	Leaves	Cultivated
3	*Cocos nucifera* L	Nariel	Arecaceae	Tree	Flower	Cultivated
4	*Cyperus rotundus* L.	Chido	Cyperaceae	Herb	Leaves	Wild
5	*Ficus benghalensis* L.	Vad	Moraceae	Tree	Fruit, Bark and Root	Wild
6	*Ficus racemosa* L.	Umbaro	Moraceae	Tree	Stem bark	Wild
7	*Gmelina arborea*Roxb.	Shivan	Verbenaceae	Tree	Leaves	Wild
8	*Grewia tiliifolia* Vahl.	Gadhamni	Tiliaceae	Tree	Leaves	Wild
9	*Lagersteroemia speciosa* (L.) Pers.		Lythraceae	Tree	Leaves	Wild
10	*Mimosa pudica* L.	Lajjavanti	Mimosaceae	Herb	Root and Leaves	Wild
11	*Mirabilis jalapa* L.	Gulbas	Nyctaginaceae	Herb	Leaves	Cultivated
12	*Momordica dioica* Roxb. ex Willd.	Kantola	Cucurbitacae	Climber	Fruit	Wild
13	*Murrayakoenigi* (L.) Spreng.	Kadipatti	Rutaceae	Tree	Leaves	Cultivated
14	*Syzygiumcumini* (L.) Skeels.	Jambu	Myrtaceae	Tree	Seed	Cultivated
15	*Tamarindus indica* L.	Khati amli	Caesalpiniaceae	Tree	Seed	Wild
16	*Tridax procumbens* L.	Pardesi bhangro	Asteraceae	Herb	Leaves	Wild
17	*Ziziphus mauritiana* Lam.	Bor	Rhamnaceae	Tree	Fruit	Wild

IV. Conclusion

The current survey on ethnomedicinal knowledge of plants in Dharampur region, 17 species of medicinal plants had been identified to be used in the treatment of diabetes. The information showed that the local tribal have highly depended on medicinal plants for curing various diseases and disorders among the tribe. It is seen that the documentation plays an important role in preserving the cultural identity and explore their values of plants and its properties as it might create an awareness among the people which can lead to the welfare of further generation.

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Impact of Biofertilizers on Paddy (*Oryza sativa* L.) Cultivar Jaya

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Abstract: *In present study, impact of various biofertilizers on growth parameters (height of the plant & number of tillers) in Paddy (Oryza sativa L. cv. Jaya) was assessed. Randomized block design techniques was followed and was replicated thrice with twelve treatments such as T0: Control (without fertilizer), T1: Chemical fertilizer (19:19:19), T2: Blue Green Algae (BGA), T3: Azospirillum brasilense, T4: Bacillus megaterium, T5: Trichoderma viride, T6: Mycorrhizae, T7: Pseudomonas fluorescens, T8: BGA+Pseudomonas fluorescens,T9: BGA+Mycorrhizae, T10: Azospirillum brasilense+Bacillus megaterium and T11: Azospirillum brasilense+Bacillus megaterium+Pseudomonas fluorescens. Three splitted doses of chemical fertilizers were followed. The results show that all biofertilizers revel significant impact on height and number of tillers in Paddy, Oryza sativa (L. cv. Jaya). Also, combination of biofertilizers (T8 to T11) exhibit enhanced growth parameters than application of sole biofertilizers (T1 to T7). The results suggest that biofertilizers from microorganisms can replace chemical fertilizers to increase crop production. The study recommends that biofertilizers from microorganisms can replace chemical fertilizers to increase crop production. In principle, biofertilizers are less expensive and are more environmentally-friendly than chemical fertilizers.*

Keywords: Biofertilizers, Growth Parameters, *Oryza sativa*, Paddy, Randomized Block Design

I. INTRODUCTION

The proper feeding of the rapidly growing populations in developing countries is the most important challenge for mankind. Presently, about 800 million people in the world are suffering from chronic malnutrition due to shortage of suitable foods. In this context, improving agriculture to increase yield of crops without deteriorating the environment should be an ultimate goal. Continuous and excess use of chemical fertilizers and other agrochemicals to increase yield may lead to ground water contamination and depletion of soil nutrients, eventually resulting in reduction of crop yield (FNCA, 2006).

Agriculture plays consequential role in the growth and survival of nations; therefore, maintaining its quantity and quality is essential for feeding the population and economic exports. Over the years, agriculture has undergone various scientific innovations in order to make it more efficient (Ajmal, 2018). Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long-term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals (Mishra et al., 2013).

The excessive use of chemical fertilizers and pesticides has generated several environmental problems including the greenhouse effect, ozone layer depletion, and acidification of water. These problems can be tackled by use of biofertilizers and bio-pesticides, which are natural, beneficial, and ecologically and user-friendly. The biofertilizers provide nutrients to the plants, control soilborne diseases, and maintain soil structure. Microbial biofertilizers play a pivotal role in sustainable agriculture. (Rai, 2006).

Biofertilizers are considered as a idealistic and sustainable selected strains of beneficial soil microorganisms cultured in the laboratory and packed in a suitable carrier. They can be used either for seed treatment or soil application to increase crop productivity, stimulate plant growth, improve and restore soil fertility, reduce production costs and the

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environmental impact associated with chemical fertilization. Biofertilizers accelerate microbial processes which augment the availability of nutrients that can be easily assimilated by plants (Subhash et al., 2016).

Rice (*Oryza sativa* Linnaeus, 1753) is staple food for more than two billion people in Asia and few hundred million in Africa and Latin America (Qureshi et al., 2018). The production of rice globally exhibited a fluctuating trend in the past few years. In 2014-15, the global production of rice was 479 million tonnes (Shinde, 2017). India is world's second largest rice producer and consumer next to China. India has 43.79 million hectares (ha) total area under rice with production of 109.70 million tonnes and productivity of 2494 kg/ha. In Maharashtra state, rice is cultivated over an area about 14.66 lakh/ha with production about 34.19 lakh tonnes having productivity 1.84 tonnes/ha. Major Rice growing districts in Maharashtra are Thane, Ratnagiri, Raigad, Sindhudurg, Kolhapur and Nashik (Patil et al., 2020).

Rice contributes to the major dietary energy for body. The nutrient content of rice contains proteins (6.81 g/100 g), lipids (0.55 g/100 g), carbohydrates (81.68 g/100 g), fiber (2.8 g/100 g), energy (370 kcal) and water (10.46 g/100 g) (Rohman et al., 2014). Rice can be used as a source of staple food, starch, rice bran, rice bran oil, flaked rice, puffed rice, parched rice and rice husk. Rice is excellent source of complex carbohydrates with low fat, low salt and no cholesterol. It is also a great source of proteins, vitamins and minerals (Chaudhari et al., 2018; Pawar et al., 2021).

In light of the literature survey, it is urgent to monitor impact of biofertilizers on the growth parameters in paddy. Hence in present study, impact of various biofertilizers on Paddy (*Oryza sativa* L.) Cultivar Jaya was studied to assess grwth parameters like height of the plant and number of tillers. This study is expected to provide baseline data for the future assessment of other types of biofertilizers on *Oryza sativa* for monitoring and assessment of other parameters.

II. Materials and Methods

The present study was conducted at research farm of Rayat Shikshan Sanstha's Mahatma Phule A. S. C. College, Panvel, Dist. -Raigad (Maharashtra) (Lat 18°,59'40" E & 73° 06'50" N) during kharif season of 2014-15 and 2015-16, for two successive years on same site. Standard protocols of FNCA (2006) and Rai (2006) were followed for present investigation. The study involves 12 treatments including control and was laid in a Randomized block design in three replications with a plot size of 1 X 1 m. During rainy season, in the month of June, 21th days old seedlings were transplanted at a spacing of 15cm. Rainy season environment favours the facilitated sowing, establishment and growth of seedlings.

Seeds of Paddy (*Oryza sativa* L.) var Jaya were procured from stations such as Khar Land Research Station, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Panvel Dist. Raigad. (Maharashtra) Raigad. Biofertilizers such as *Azospirillum brasilense* (Agrosun); *Bacillus megaterium* (Biostila); *Pseudomonas fluorescens* (Remonas), *Trichoderma viride* (Bhparistricho), Blue green algae, and Mycorrhizae (Reap Mycorrhiza) were purchased from Agharkar Research Institute Gopal Ganesh Agarkar Road, Pune, Maharashtra. The chemical fertilizer (19:19:19-Paras) were collected from authorized private Agro Centre, Panvel. Following biofertilizer treatments were designed to study the response of paddy by Soil treatment method.

T0	Control	Untreated
T1	Chemical fertilizer(19:19:19)	50 kg/ha-1
T2	BGA	10Kg/h-1
T3	*Azospirillum brasilense*	2 kg/ha-1
T4	*Bacillus megaterium*	2 kg/ha-1
T5	*Trichoderma viride*	2 kg/ha-1
T6	Mycorrhiyzae	2 kg/ha-1
T7	*Pseudomonas fluorescens*	2 kg/ha-1
T8	BGA+ *Pseudomonas fluorescens*	4 kg/ha-1
T9	BGA+ Mycorrhizae	4 kg/ha-1
T10	*Azospirillum brasilense +Bacillus megaterium*	4 kg/ha-1
T11	*Azospirillum brasilense +Bacillus megaterium +Pseudomonas fluorescens*	6 kg/ha-1

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2.1 Field Experiments

1	Season	Kharif (2014-15 & 2015-16)
2	Crop	**Paddy -15***(Oryzasativa*L.)
3	Variety	Jaya
4	Plot size	1 × 1 m
5	Total number of plots	12x3=36
6	Net Experimental plot area	36 m^2
7	Crop duration	135-140
8	Date of sowing	26.06.2014-15 & 21.07.2015-16
9	Date of transplanting	16.07.2014 &12.07.2015
10	Date of harvesting	24.10.2014 &16.10.2015
11	Design	Randomized Block Design
12	Number of Treatments	12
13	Number of replications	03

2.2 Preparation of Nursery Plot

In a nearby agriculture farm, in a separate plot, the rice nursery was raised in a well tilled plot. Plot was irrigated 15 days before of sowing seeds to hasten germination of Kharif annual weeds. Plot was ploughed for soil turning and followed by cross ploughing with cultivator. The seed of Paddy (var Jaya) was treated with the fungicide Captan@ 3 g/kg seed. Treated seeds were soaked in water for 12 hrs and stored in wet gunny bags in dark for 24 hrs to hasten sprouting & sprouted seeds were sown by broadcasting. Germinated seeds were irrigated regularly to develop into seedlings of good quality.

2.3 Transplantation of Seedlings

Experimental plot was arranged in random block design with three replicates. Seedlings were uprooted from the nursery plot on the day of transplanting and twenty one days old seedlings were transplanted at 20 cm x 15 cm spacing during both the years with five seedlings per hill. Before transplantation, first dose of chemical fertilizer (NPK-19:19:19) were applied in T1 subplot as basal application. Remaining half dose of chemical fertilizer was applied in two split doses at tillering and panicle initiation stages. Recommended dose of BGA were broadcasted to standing water in T2 subplot after 5th days of seedling transplantation. The mixture of various biofertilizers as per recommended dose were incorporated in the soil at the time of seedling transplantation. Plants without treatments are considered as control (T0). Gap filling was carried out ten days after transplanting in order to ensure uniform plant population.

To study the effect of various biofertilizer treatments on the growth of Paddy, following observations were recorded on at 30^{th}, 60^{th}, 90^{th} DAT (Days after transplantation) and at harvest stage. Three hills per plot were selected randomly in the net plot and tagged for recording observations at four stages.

- **Plant height** (cm): Plant height (cm) of randomly selected three hills was measured from ground level to the tip of the longest upper leaf in case of juvenile plants and for mature plants. It was measured from ground level to the tallest panicle of the hill.
- **Total number of tillers/hill:** Total numbers of tillers were counted at 30^{th}, 60^{th} and 90^{th} days after transplanting (DAT) and harvest from the randomly selected three hills and calculated their means as total number of tillers/hill.

For present investigation, data was analysed by using statistical procedures of Panse and Sukhatme (1967).

III. Results and Discussion

The results of the field experiments conducted during 2014-15 and 2015-16 on effect of bio fertilizers on growth of paddy (*Oryza sativa* L.) var. Jaya are presented with appropriate headings in (Fig. 1 & 2 & Table 1 & 2).

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3.1 Plant Height

Plant height was determined from five randomly selected plants from each treatment and control at 30, 60, 90 DAT and at harvesting. The data pertaining to plant height influenced by different bio fertilizer treatments are presented in Table 1. and Fig 1. Results show that plant height increases progressively with the growth of paddy crop and the increase being more rapid up to flowering stage (90 DAT).

Highest mean plant height of T11 (*Azospirillum brasilense+Bacillus megaterium+Pseudomonas fluorescens*) treatment was recorded was 32.29, 37.21 and 34.75 cm at 30 DAT; 63.51, 70.14 and 66.82 cm at 60 DAT; 74.58, 76.15 and 75.37 cm at 90 DAT and 75.68, 79.94 and 77.81 cm at harvest during the year 2014, 2015 and on pooled data, respectively.

The higher plant height of 31.17, 36.13 and 33.65 cm at 30 DAT; 62.60, 68.943 and 65.773 cm at 60 DAT; 73.42, 75.38 and 74.40 cm at 90 DAT and 73.97, 77.24 and 75.61 cm at harvest was recorded with T10 (*Azospirillum brasilense +Bacillus megaterium*) treatment followed by T9 (BGA+Mycorrhiyzae) and T8 BGA+ *Pseudomonas fluorescens* at harvest during the year 2014, 2015 and on pooled data, respectively.

Lowest plant height (pooled data) 27.68, 51.76, 58.1 and 59.52 at 30, 60, 90 DAT and at harvest respectively were noted during 2014 and 2015 under T0 treatment. T1 treatment also showed better value of plant height at all stages of paddy as compare to control. The mono inoculation treatment T3 have recorded the maximum plant height (Pooled data values) 31.54, 60.25, 66.68 and 68.15 at 30, 60, 90 DAT and at harvest respectively, at all the growth stages. It was on par with the treatment T2, T4, T5 and T6 while it was significantly superior over the treatments T0 (Control) at all the growth stages. Treatment T9 recorded the second highest plant height and it was followed by T6, T8 and T7.

3.2 Number of Tillers Per Hill

The average number of tiller per hill recorded at 30 DAT, 60 DAT, 90 DAT and at harvest are recorded and presented in Table 2 and Fig 3. Results shows that the number of tillers per hill increased considerably from 30 to 90 DAT and there after a gradual decline was observed from 90 to harvest stage. It is apparent from the data that different bio fertilizer treatments (alone, dual and combined form) showed significant effect on tiller production per hill at all the growth stages.

Also use of *Azospirillum brasilense+Bacillus megaterium+Pseudomonas fluorescens* (T11) significantly increased the number of tillers per hill and found superior over dual treatment (T8, T9, and T10) and alone application of BGA, *Azospirillum brasilense*, *Bacillus megaterium*, *Trichoderma viride*, Mycorrhiyzae and *Pseudomonas fluorescens* which was statistically at par with each other at all the growth stages of crop.

The highest number of tillers per hill of T11 treatment was recorded to be 8.29, 12.28 and 10.29 at 30 DAT; 12.33,16.06 and 14.20 at 60 DAT; 14.81,17.51 and 16.16 at 90 DAT and 14.16, 16.48 and 15.32 at harvest during the year 2014, 2015 and on pooled data, respectively and par with T10 and T8. Among the mono inoculation biofertilizer treatments, T7 treatment significantly recorded maximum number of tillers per hill (6.14, 10.76 and 13.44 at 30,60 and 90 DAS in both years and pooled data resp.) which was followed by T6, T2,T3, T5, and T4. The minimum number of tillers per hill were recorded in T0 treatment at 30 DAT, 60 DAT, and 90 DAT and at harvest. The treatment T1 showed significantly better results as compare to control (T0).

III. Conclusion

Treatments T8 (BGA+*Pseudomonas aeruginosa*), T9 (BGA+Mycorrhizae), T10 (*Azospirillusum brasilense+Bacillus magisterium*) and T11 (*Azospirillusum brasilense +Bacillus megaterium +Pseudomonas fluorescens*) revels more enhanced effects on height and number of tillers in paddy. Biofertilizers such as *Azospirillum brasilense, Bacillus megaterium* and *Pseudomonas fluorescens* show positive impact on growth parameters of paddy. The highest crop performance was recorded in the combined biofertilizer application. The results indicated that use of biofertilizer would be a great substitute of the inorganic fertilizers. The study recommends that biofertilizers from microorganisms can replace chemical fertilizers to increase crop production. In principle, biofertilizers are less expensive and are more environmentally-friendly than chemical fertilizers. Application of combination of biofertilizers in intensive agricultural practices may witness the great increases in crop yields and food production in developed countries.

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Figure 1: Field experiments on Paddy ((*Oryza sativa* L.) var. Jaya

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Table 1: Effect of bio fertilizers on plant height at successive growth stages of paddy (*Oryza sativa* L. cv. *jaya*) by RBD method

Treatment	30 DAT			60 DAT			90 DAT			At harvesting		
	2014	2015	PD	2014	2015	PD	2014	2015	PD	2014	2015	PD
T0-Control	25.296	30.081	27.688	47.976	55.553	51.765	57.227	58.798	58.014	59.674	59.373	59.521
T1-Chemical fertilizer	29.483	35.121	32.291	58.886	61.384	60.135	67.836	71.783	69.834	68.223	74.166	71.195
T2-BGA	27.833	34.613	31.223	58.781	60.314	59.548	64.089	67.521	65.801	66.667	67.393	67.026
T3-Azospirillum brasilense	27.941	35.146	31.543	59.952	60.563	60.256	67.916	65.453	66.685	68.093	68.227	68.156
T4-Bacillus megaterium	27.098	33.606	30.348	55.315	60.616	57.963	64.493	67.336	65.915	66.441	68.013	67.201
T5-Trichoderma viride	26.926	33.352	30.141	55.063	60.523	57.793	63.496	65.673	64.585	66.543	64.346	65.441
T6-Mycorrhiyzae	26.663	33.436	30.051	58.396	61.833	60.115	67.167	65.296	66.225	66.231	65.654	65.943
T7-Pseudomonas fluorescens	27.706	34.361	31.033	61.076	62.403	61.744	68.271	65.853	67.068	70.575	71.513	71.041
T8-T2+T7	30.081	33.582	31.832	60.804	68.146	64.475	72.485	73.376	72.928	72.631	75.956	74.296
T9-T2+T6	30.406	35.733	33.071	62.293	69.385	65.836	72.372	74.975	73.675	73.685	76.791	75.235
T10-T3+T4	31.173	36.131	33.651	62.603	68.943	65.773	73.423	75.384	74.403	73.976	77.243	75.614
T11-T3+T4+T7	32.296	37.211	34.753	63.513	70.143	66.828	74.584	76.158	75.371	75.687	79.941	77.811
SEm ±	0.319	0.847	0.583	0.667	0.795	0.734	0.965	1.539	1.252	0.558	0.484	0.521
CD at 0.05 %	0.904	2.398	1.651	1.888	2.251	2.069	2.731	4.354	3.542	1.580	1.371	1.475
C.V.%	0.161	0.356	0.258	0.164	0.181	0.172	0.205	0.324	0.263	0.116	0.099	0.108

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Table 2: Effect of different biofertilizers on number of tillers at successive growth stages of paddy (*Oryza sativa* L. cv. *jaya*) by RBD method

Number of tillers/hill												
Treatments	**30 DAT**			**60 DAT**			**90 DAT**			**At harvesting**		
	2014	**2015**	**PD**	**2014**	**2015**	**PD**	**2014**	**2015**	**PD**	**2014**	**2015**	**PD**
T0- Control	4.201	6.396	5.298	6.661	8.742	7.721	9.816	10.92	10.36	9.971	10.68	10.32
T1- Chemi. fertilizer	4.566	8.201	6.383	7.783	11.83	9.808	11.40	13.93	12.66	10.16	13.82	11.99
T2- BGA	3.736	7.871	5.803	6.572	10.01	8.291	10.66	13.40	12.03	10.02	14.06	12.04
T3- *Azospirillum*	4.023	7.226	5.625	7.764	9.583	8.671	10.52	12.01	11.26	10.37	11.49	10.93
T4- *Bacillus*	4.046	6.696	5.371	6.792	10.49	8.641	10.19	11.22	10.70	9.353	12.39	10.87
T5- *Trichoderma*	4.106	6.712	5.408	8.071	10.15	9.111	9.906	12.01	10.96	9.743	11.74	10.74
T6- *Mycorrhizae*	4.133	6.856	5.495	8.523	10.92	9.721	11.83	12.60	12.22	10.78	16.09	13.39
T7- *Pseudomonas*	4.321	7.973	6.146	10.50	11.02	10.76	12.43	14.46	13.44	11.20	15.24	13.22
T8- T2+ T7	4.503	10.54	7.521	10.82	13.90	12.36	13.72	15.87	14.79	11.12	15.59	13.35
T9- T2+ T6	4.703	8.936	6.827	11.53	12.75	12.14	13.70	17.04	15.37	12.93	17.29	15.11
T10- T3+T4	6.581	11.94	9.261	11.29	15.31	13.30	13.71	16.46	15.09	13.74	14.86	14.30
T11- T3+T4+T7	8.296	12.28	10.29	12.33	16.06	14.24	14.81	17.51	16.16	14.16	16.48	15.32
SE m ±	0.313	0.308	0.311	0.574	0.469	0.522	0.283	0.261	0.272	0.622	0.552	0.587
CD at 0.05 %	0.886	0.873	0.881	1.624	1.328	1.476	0.801	0.739	0.775	1.761	1.563	1.662
C.V.%	0.948	0.526	0.737	0.915	0.577	0.746	0.343	0.271	0.307	0.808	0.563	0.686

Morphological Characters of Fusarium oxysporum and Colletotrichum capsici Isolates and their Sensitivity using Biopesticide

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Full Length Research Article

Morphological Characters of *Fusarium oxysporum* and *Colletotrichum capsici* Isolates and their Sensitivity using Biopesticide

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A B S T R A C T

Anthracnose and wilt diseases of chilli samples were observed and collected the infected material from field and storage regions of Maharashtra. *F. oxysporum* f.sp. capsici and *C. capsica* were severe pathogens on chilli. Management of anthracnose and wilt is equally important to increase productivity of chili in Maharashtra. Recently biopesticides was the alternative of fungicide therefore, today uses bio-pesticides are eco-friendly without hazardous to crop and also soil. The management of crop diseases is much more significance applied aspects in the present investigation. Morphological characters and their sensitivity were studied. All isolates of each pathogen were tested their sensitivity against Biopesticide (*Lawsonia inermis* L). MIC values ranged between of 36.29µg/ml to 160 .07µg/ml while 19.31 µg/ml -110.12 µg/ml respectively. The isolate *Fo*-3 was sensitive (MIC-36.29 µg/ml) while *Fo*-4 was resistant (MIC -160.07 µg/ml) while *Cc*-10 was sensitive (MIC-19.31 µg/ml) and *Cc*-7 resistant (MIC- 110.12 µg/ml) *in vitro.* The highest resistance factors went up to 4.41 and 5.70 respectively.

***Key words*:** *Fusarium, Colletotrichum,* Characters, MIC, Biopesticide, Chilli

Chilli (*Capsicum annuum* L.) is an important part of vegetable belongs to family Solanaceae. It is originated in southern American tropics and is presently being cultivated throughout the world including tropical, subtropical and temperate regions [10]. Chilli is used in fresh cooked, pickled, canned in sauces and powdered for hot spices in daily kitchens. So, it is one of the most important commercial and industrial crops of India. It is grown almost all over the country. Different varieties of capsicum i.e., *C. annuum*, *C. baccatum*, *C. chinense*, *C. frutescens*, *C. pubescens* are also cultivated in different parts of the world. Chilli play is an important role in Indian food i.e., spice and condiments in all kitchen. It contains numerous biochemical compounds like steam volatile oils, fatty oils, capsaicinoids, carotenoids, vitamins, proteins, fibre and mineral elements [1]. Chilli contains pigments like capsaicin and rich source of vitamins especially vitamin C [14-15]. India is the world's largest producer, consumer and exporter country of chillie. In India chilli contributes about 36% to the total world production [13]. Nandurbar is larger producer district in Maharashtra. In India during 2019-20 Andhra Pradesh tops the list in dry chilli production of 6.66 lakh tonnes covered under 1.43 lakh ha with 4657 kg/ha productivity. According to 3rd advance estimates of the government of Andhra Pradesh, chilli production is estimated at 8.36 lakh tonnes grown under the area of 1.8 lakh ha with a productivity of 4644 kg/ha during 2020-21 [16]. The fruit of chilli is a main creature of Indian food and sustainability of chilli productions day to day threatened by various types of biotic and abiotic factors like fungi, bacteria, viruses, aphids, nematodes and temperature, light, rainfall, herbicides, pesticides which cause directly or indirectly significant yield losses in chili production all over the world. *Alternaria alternata*, *Fusarium oxysporum*, *Aspergillus niger*, *Phythium*, *Rhizoctonia*, *Penicillium expansum*, *Botrytis cinerea*, *Colletotrichum capsici*, *Rhizopus nigricans*, *R. stolonifer* and *Phytophthora cinnamon* are caused different disease to chilli [12]. Out of these *Colletotrichum capsica* (Syd.) E. J. Butler & Bisby *(Cc)* and *Fusarium oxysporum* f.sp. capsici Schlecht. Emend. Snyder & Hansen *(Fo)* caused anthracnose and wilt diseases to chilli respectively to reduce the crop productivity. Both diseases are the major economic constraints to chilli production worldwide. Total 15 isolates of *C. capsici* and *F. oxysporum* were isolated from collected rotted chilli of each pathogen and their sensitivity tested against *Lawsonia inermis* L. *Fusarium oxysporum* is a pathogenic as well as non-pathogenic fungi which caused a severe disease to plant crop and reduces the productivity of yield. The interaction of between biopesticide and

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inoculated *Fusarium* did not significantly affect the parameters of nitrogen and phosphorus content but it was significantly affected potassium content [3]. Morphological characters of *S. rolfsii* on ground nut was observed [7]. Recently farmer avoid chemical fungicides for the management of chilli diseases and alternative of fungicides use plant extract and maintained fertility of soil and reduce the chemical fertilizers as well as fungicides.

MATERIALS AND METHODS

Collection and isolation of pathogen

Chilli (*Capsicum annuum* L) is an important spices and condiments crop India. Survey was made in field and storage condition of infected chilli frequently. Observing symptoms of anthracnose and wilt of chilli were collected in polythene bags and brought at laboratory. Same infected chillies were kept for 24 hrs. in laboratory at room temperature. Rotted chillies were cut into small pieces 3-4 mm sterilized with 1% $HgCl_2$ and washed 3-4 times with D/W. Three treated small pieces of each disease symptoms were kept on PDA in each petri dish and incubate for two days at room temperature. The hyphal tips of pathogen were emanating from the tissue of infected chilli parts and transferred to new PDA petri plates for purification and further growth of pathogen. Fungal growth was observed and isolated it using single spore isolation technique.

Cultural and morphological characters

Same pathogens were inoculated on sterilized PDA in 90mm petri plates and incubated at 28±2°C at room temperature. Parameters of each isolate like colony, size, pigmentation, conidia and formation pattern was recorded after the incubation of 7-8 days. The mycelial growth rate was observed after every 24-hour interval till the last petri plate was completely colonized. The *F. oxysporum* and *C. capsica* were identified using literature and conidia with mycelium on the basis of their morphological character. *Fusarium* was showed white cottony growth, mycelium septate, circular, micro and macro conidia with 3-4 septa while *Colletotrichum capsici* showed white fluffy, cottony, white, irregular colony, hyaline spore [11].

Sensitivity of F. oxysporum and Colletotrichum capsici

Fifteen isolates of each pathogen were isolated from rotted chillies. Sensitivity tested against *Lawsonia inermis* L. aqueous extract taking the same isolates at different concentration (10-100%). Fresh culture of each pathogen was used for the same and transferred aseptically on *Lawsonia inermis* L. aqueous extract containing PDA petri plates at different concentration. The plates were kept at incubation for further growth. The growth of the pathogens was observed after every 24 hours till control petri plate was not completely colonized. After that the sensitivity result were recorded. Similarly, Sensitivity of all isolates was tested against *Lawsonia inermis* by food poisoning method [8].

RESULTS AND DISCUSSION

Morphological characters of F. oxysporum f. sp. capsici Schlecht. emend. snyder & Hansen and C. capsica (Syd.) E. J. Butler & Bisby

Morphological characters of *Fusarium oxysporum* Link produced red pigments, colourless sporulation and scattered cottony mycelium growth, large quantity of microconidia, one celled, comma shaped, hyaline and macroconidia,3-4 septate, half-moon shaped, pointed ends and resting chlamydospores (Plate 1) and *Colletotrichum capsici* Corda is produced regular margin with cottony fluffy mycelium with small conidia with or without setae (Plate 2). This result is correlate with cultural and morphological characterization of *Colletotrichum capsici* produces colony colour white to grey, yellow pigmentation, with fluffy mycelium [5].

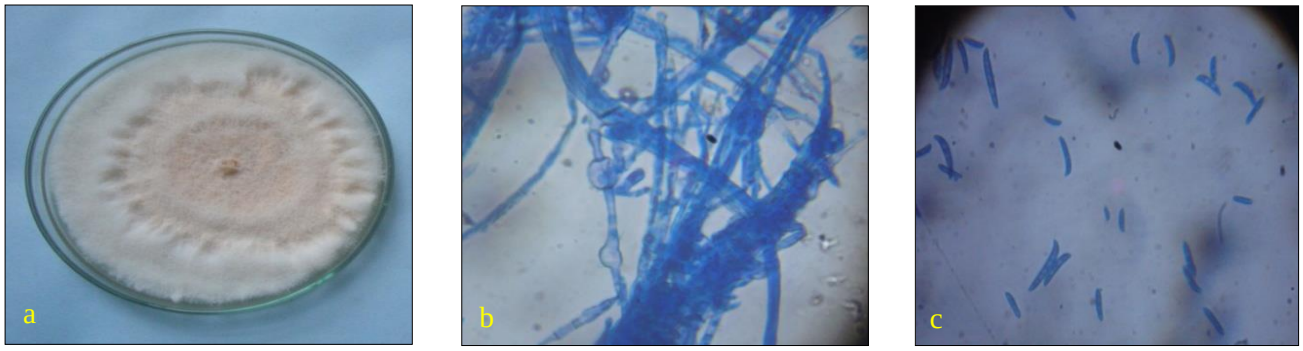

Plate 1 a) Pure culture of *F. oxysporum* L., b) Mycelium with microconidia and c) macroconidia

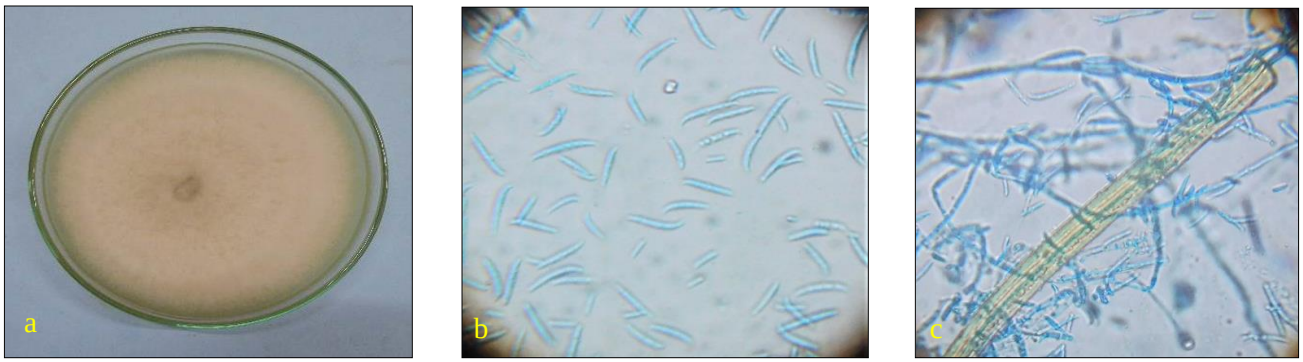

Plate 2 a) Pure culture of *Colletotrichum capsici* Corda, b) Conidia and c) Mycelium with conidia

Sensitivity tested against Lawsonia inermis L. aqueous extract

All these isolates were tested their sensitivity against *Lawsonia inermis* L. Results are depicted in (Table 1-2). The sensitivity of *Fusarium oxysporum* and *Colletotrichum capsica* were tested using *Lawsonia inermis* L. aqueous extract. MIC values were in ranged of 36.29µg/ml to 160 .07µg/ml while 19.31µg/ml -110.12µg/ml respectively. The isolate *Fo*-3 was sensitive MIC-36.29 µg/ml while *Fo*-4 was resistant MIC -160.07 µg/ml while *Cc*-10 was sensitive (19.31 µg/ml) and *Cc*-7 resistant (MIC- 110.12 µg/ml) *in vitro* (Plate 3-4). The highest resistance factors went upto 4.41 and 5.70 respectively. Also, the results of the present study are similar to in vitro evaluation of bio-control agents, biopesticide and botanicals against *Colletotrichum truncatum* causing anthracnose of horse gram [9]. Similar results correlated with the antifungal activity in aqueous extracts, ethyl acetate and ethanol extract at 1mg/100µl of flowers and leaves against some selected phytopathogenic fungi are suitable sources for further screening of bio-pesticides [4]. Fungicide resistance in fungal pathogens of various crops and its integrated management was illustrated [17]. Similar results correlated with the management approach towards disease of anthracnose caused by *Colletotrichum spp.* to chilli [6]. Results of present study is correlated with using plant extract for inhibitory growth of *C. capsici* under in vitro observed highest radial growth (57.78%) in *Polyalthia* methanol and highest inhibition of biomass production was observed in ginger chloroform (32.78%) [2]. Statistical analysis of (Table 1-2) indicated that standard error, critical difference was hypothetically significance.

Table 1 Sensitivity of *Fusarium oxysporum* f. sp. capsici against *Lawsonia inermis* L. using agar medium

Isolate No.	Location	Data characteristic to dose response curve (*In-vitro*)					
		Regression constant	Regression coefficient	Correlation coefficient	ED50 (µg/ml)	MIC (µg/ml)	R/F
Fo - 1	Akole	87.12111	-0.88613	-0.98771	65.92	133.25	3.67
Fo - 2	Alephata	76.68583	-0.94558	-0.96053	28.56	85.33	2.35
Fo - 3	Bhandardara	50.52778	-0.70833	-0.86377	21.71	36.29	1.00
Fo - 4	Ghoti	93.80556	-0.585	-0.98041	37.26	160.07	4.41
Fo - 5	Kalyan	44.41667	-0.253	-0.99306	52.36	106.46	2.93
Fo - 6	Karjat	86.91667	-0.29833	-0.98358	56.47	105.70	2.91
Fo - 7	Kolhapur	84.63389	-0.86383	-0.9254	40.17	84.19	2.31
Fo - 8	Malegaon	42.74056	-0.4089	-0.92952	38.03	80.05	2.20
Fo - 9	Nashik	81.77778	-0.645	-0.99798	51.67	108.37	2.98
Fo - 10	Osmnabad	65.37111	-0.7378	-0.93875	46.73	94.38	2.60
Fo - 11	Pune	80.86111	-0.66167	-0.99872	39.16	104.06	2.86
Fo - 12	Satara	88.09333	-0.8678	-0.98874	50.03	110.81	3.05
Fo - 13	Shahapur	81.37111	-0.87113	-0.9949	25.76	95.13	2.62
Fo - 14	Sinner	74.12083	-0.85502	-0.97054	33.28	98.99	2.72
Fo - 15	Yavatmal	89.47222	-0.57167	-0.98944	22.36	94.64	2.60
			SE	: 3.38			
			SE	: 6.90			
			CD at 0.05	: 2.624			
			0.01	: 1.761			

*Values of three replicate

Whereas *Fo* – *Fusarium oxysporum*, ED_{50} - Ethal Dose, MIC –Minimum Inhibition, Concentration, R-Resistant, F-factor, SE – Standard Error, CD –Critical Difference

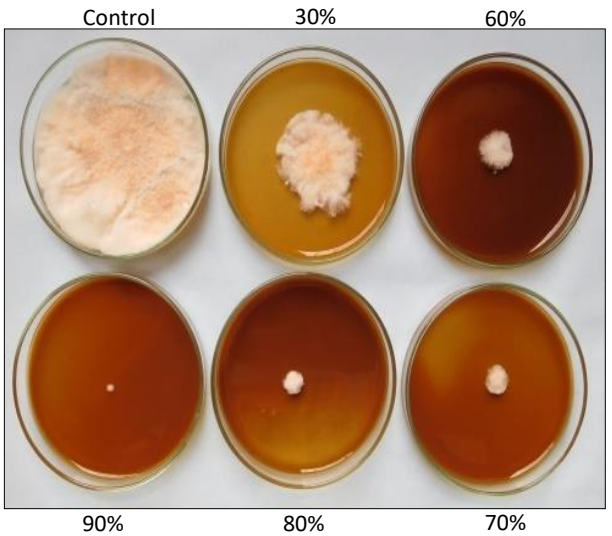

Plate 3 Sensitivity of *F. Oxysporum* Link against *Lawsonia inermis* L. using PDA

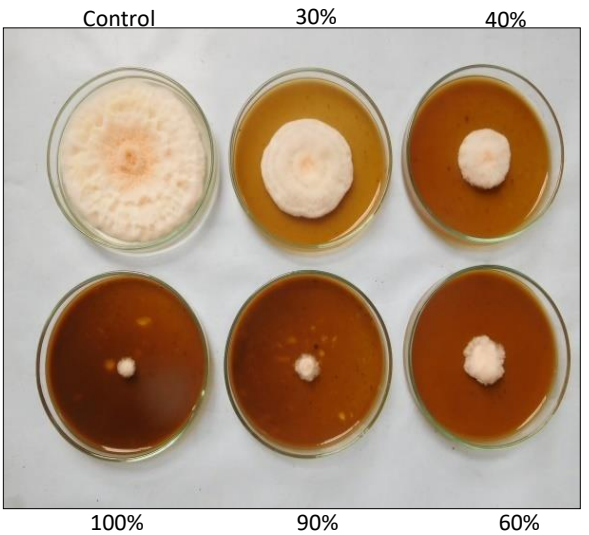

Plate 4 Sensitivity of *Colletotrichum capsici* Corda against *Lawsonia inermis* L. using PDA

Table 2 Sensitivity of *Colletotrichum capsici* against *Lawsonia inermis* L. using agar medium

Isolate No.	Location	Data characteristic to dose response curve (*In-vitro*)					
		Regression Constant	Regression Coefficient	Correlation Coefficient	ED50 (µg/ml)	MIC (µg/ml)	RF
Cc - 1	Akole	75.08333	-0.88833	-0.9822	42.02	90.06	4.66
Cc - 2	Alephata	64.38889	-0.59667	-0.99028	52.69	67.38	3.48
Cc - 3	Bhandardara	67.55556	-0.87333	-0.96691	25.78	52.27	2.70
Cc- 4	Ghoti	26.95333	-0.365	-0.92264	27.23	57.02	2.95
Cc- 5	Kalyan	57.65833	-0.69837	-0.90583	47.00	95.34	4.93
Cc- 6	Karjat	77.45444	-0.8128	-0.98866	51.67	108.29	5.60
Cc- 7	Kolhapur	56.91667	-0.53833	-0.89889	51.32	110.12	5.70
Cc- 8	Malegaon	37.72222	-0.29667	-0.84311	41.46	87.52	4.53
Cc- 9	Nashik	90.69444	-0.805	-0.99565	50.89	108.37	5.61
Cc- 10	Osmnabad	55.38889	-0.79667	-0.78006	09.45	19.31	1.00
Cc- 11	Pune	53.09306	-0.59668	-0.99625	42.36	90.26	4.67
Cc- 12	Satara	73.17639	-0.91168	-0.93745	49.98	102.42	5.30
Cc- 13	Shahapur	67.02778	-0.75167	-0.9985	45.90	95.03	4.92
Cc- 14	Sinner	68.13889	-0.89833	-0.93661	35.48	77.47	4.01
Cc- 15	Yavatmal	57.04667	-0.7128	-0.95678	40.46	83.46	4.32
			SE :	3.12			
			SE :	6.46			
			CD at 0.05 :	2.624			
			0.01 :	1.761			

*Values of three replicate

Whereas, *Cc-Colletotrichum capsici*, ED_{50}-Ethal Dose, MIC –Minimum Inhibition, Concentration, R-Resistant, F-factor, SE – Standard Error, CD –Critical Difference

CONCLUSION

The present paper investigation that altogether 15 isolates of *F. oxysporum* and *Colletotrichum capsci* was isolated from anthracnose and wilt of chilli was studied. For their 15 isolates sensitivity was tested against biopesticides. There was quite large variation in MIC of biopesticide. Fo-3 isolate was sensitive while Fo-4 was resistant where as in case of *Colletotrichum*, Cc-10 isolate was sensitive while Cc-7 was resistant.

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Correlative an Accounts of Oil, Emulsifier and Agrochemical Pollution in Industrial Area of Kalyan and Dombivli

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Abstract: *Discharge of polluted water contains various toxic metals released by oil and emulsifier as well as agrochemical industries in Dombivli. A correlative account of heavy metals were studied and observed toxic metals like Cu, Ni, Cr, Pb, Fe and Zn. Oils and emulsifier and agrochemical. Oils and emulfifier were studied in details in season wise i.e. Rainy, winter and summer. In all seasonFe toxic metal was higher as compared to other metals in the influent and effluent. In winter season Fe influent was recoded more as compare to effluent while in summer season also increased Fe toxic metal andCu mg/L in Industry S3. Heavy metals were reported in all season like rainy, winter and summer. In rainy season influent and effluent were observed and found Fe and Cu more while in effluent Pb was higher and winter season Fe and Cu also higher amount were recorded effluent was reported in Pb mg/l while in summer six metal were also studied. Fe and Cu were much higher than that of rainy and winter influent and effluent.In presently investigated that the comparative studies of Oils and Surfactants (S3) and Agrochemical (S4) industries in Dombivli manufacturing industries were reported toxic metals viz. Cu, Ni, Cr, Pb, Fe and Zn more or less quantizes were observed Rainy S3 and S4 influent Fe (3.31 and 1.50) and effluent (Fe.25 and Pb in S4. Winter season influent Fe was higher in both Industries but 51.0 Fe was reported highest pollution as compared to effluent of both industries Fe Zn Cr and Cu less amount while in Summer season Fe (15.47 and Cu 12.58) in S3 and Fe(42.67) Cu (29.86)influent more concentrated then other between them and effluent S3(Fe and Zn more while in case of S4 Fe toxic metal was very high conc.*

Keywords: Influent, Effluent, Toxic Metals, waste water, Industrial Belt and Kalyan and Dombivli

I. INTRODUCTION

Maharashtra is the most developed industrial area situated in MIDC Kalyan and Dombivli. Oil and emulsifier and agrochemical manufacturing industries release different wastes like solid and liquid. Oil and surfactants and agrochemical industries release huge toxic heavy metals Like Cu,Ni, Cr, Pb, Fe, and Zn. These heavy metals are harmful to aquatic flora and fauna. Before releasing heavy metals toxic pollutant release from industries was required treatment to reduce water pollution. Presently two industrial comparative accounts were studies and reported toxic metals viz. Cu, Ni, Cr, Pb, Fe and Zn. Toxic heavy metals were released more or less concentration observed in rainy season oils and surfactants (S3) and agrochemicals (S4) in influent Few as 3.31mg/Land 1.50 mg/L) and effluent 0.25mg/LFe and Pb in S3and S4. Winter season influent Fe was higher in both Industries but 51.0mg/LFe was reported highest pollution as compared to effluent of both industries Fe Zn Cr and Cu less amount while in Summer season Fe (15.47 mg/Land Cu 12.58mg/L) in S3 and Fe (42.67mg/L) Cu (29.86mg/L) influent more concentrated in S4. Effluent in industries S3(Fe and Zn more while in case of S4 Fe toxic metal was very high conc. Therefore, heavy metals were studied and rapid effects on growth of population and expansion of various developmental activities have both greatly aggravated resource depletion and degradation of the environment in India. Malthusian formulated before the agricultural revolution, presumes that the productivity of environmental resources such as land is fixed. Malthus did not

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foresee the important technological advances that have accompanied modernization. Writing after the agricultural and industrial revolutions,

II. MATERIALS AND METHODS

Kalyan and Dombivli industrial area was established by Maharashtra Industrial Development Corporation in around 1964. The industrial belt occupies an area of about 347.88 hectares, is located in Dombivli and Ulhasnagar River and about45.00 km from Mumbai international airport. There are about 30 highly polluting small to large scale chemical industries located in this industrial belt. Quantity of industrial influent and effluent generated in the industrial area is about 15 million liters per day, which is finally discharged into the Kalyan Dombivli and Thane creek through open drainages which was passing through residential area. Tropical climate Dombivli is suitable for enjoying with mean annual temperature of 27.3ºCto 35.9ºC and hottest in April-May temperature rises to 38.0ºC. The humidity is usually in the range about 84 -90 Percent. The average rainfall is in the range of 1850 mm to 2000 mm and average annual rainfall in the region is the range from 1286 to 1233 mm Action, 2010. Heavy metals like Cu, Ni, Cr, Pb, Fe and Zn of industries Oils and surfactant (S3) and agrochemical industry (S4) were analysis. The glassware's used in the analysis were washed with distilled deionized water; the pipettes and burette were rinsed with the experimental solution before final use.

The industrial waste water influent and effluent samples were collected randomly from Dombivli and Kalyan 3 times in a month in morning, afternoon and evening session from S3 and S4 industries like oil and surfactant and agrochemical fine chemical industries of Dombivali. The samples were collected every month from three seaseon like Rainy, winter and summers of conjugative two year i.e.2017 and 2018. Polyethylene bottles of 2.5 L were used to collect the toxic water samples. The bottles were thoroughly cleaned with hydrochloric acid, washed with tape water to render free of acid, washed with distilled water twice, again rinsed with the water sample to be collected and then filled up the bottle with the sample leaving only a small air gap at the top. The sample bottles were finally sealed with paraffin wax. Water samples (500 mL) were filtered using Whatman No. 41 filter paper for estimation of heavy metal content. Filtrate (500 mL) was preserved with 2mL Nitric acid to prevent the precipitation of metals. The samples were concentrated on a water bath depending on the suspected level of the metals (Chen and Ma, 2001). The analysis of the potentially toxic metals like Cu, Ni, Cr, Pb, Fe and Zn was done by Perkin Elmer ASS-280 Flame Atomic Absorption Spectrophotometer. A reagent blank sample was run throughout the method, and the blank readings were subtracted from the samples to correct for reagent impurities and other sources of errors from the environment. Average values of three replicates were calculated for each determination.

III. RESULTS AND DISCUSSION

Heavy metals of the Influent and effluent for S3 and S4 industries were given in **Table 1 and 2.** Heavy metals were studied and observed toxic metals like Cu, Ni, Cr, Pb, Fe and Zn. Oils and surfactants and agrochemical. Oils and Surfactants were studied in details in season wise i.e. Rainy, winter and summer. In all season Fe toxic metal was higher as compared to other metals in the influent and effluent. In winter season Fe influent was recoded more as compare to effluent while in summer season also increased Fe toxic metal and Cu mg/L in Industry S3. In rainy season influent and effluent were observed and found Fe and Cu more while in effluent Pb was higher and winter season Fe and Cu also higher amount were recorded effluent was reported in Pb mg/l while in summer six metal were also studied. Fe and Cu were much higher than that of rainy and winter influent and effluent. In presently investigated that the comparative studies of oils and emulsifier (S3) and agrochemical (S4) industries in Dombivli manufacturing industries were reported toxic metals viz. Cu, Ni, Cr, Pb, Fe and Zn more or less quantizes were observed Rainy S3 and S4 influent Fe (3.31 and 1.50 mg/L) and effluent Fe 0..25 S3and Pb in S4. Winter season influent Fe was higher in both Industries but 51.0 Fe was reported highest in S4. Influents of Fe (15.47), Zn(6.15), Cr(1.15) and Cu (29.86) in S4 industries were less amount while in Summer season Fe (15.47 and Cu 12.58) in S3 and Fe(42.67) Cu (29.86) influent more concentrated then other between them and effluent S3(Fe and Zn more while in case of S4 Fe toxic metal was very high conc. Heavy metals viz, copper, nickel and chromium was observed to be less than 1.0 mg/L at effluents for S3 and S4 industries for seasons. Lead, iron and zinc were found to be less. Effluents for S3 industries for conjugative

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two years it is concluded that the effluent treatment plants (ETPs) is working properly for S3 and S4 industries.Results were also correlated with other researcher the toxic metal content in the industrial waste water effluent samples oil & surfactants and agrochemical industries of Dombivli. Trace elements are those elements which are present in relatively low concentration of less than few mg L^{-1}. Among the special group of trace elements are the potentially toxic metals like Cr, Ni, Zn, Cu, Pb and Fe which are having the potential to create health hazards among humans, plants and other aquatic life. The Cucontent was found to be minimum of 0.41mg/l in the effluents S3 and S4. Results of present investigations were compared with previous finders and correlated with Moore and Ramamoorthy (1984) observed that the toxic metals in natural waters and applied monitoring and impact assessment. Chakravarty et.al. (1959) stated that a quantitative study of the plankton and the physico chemical conditions of the River Jumna at Allahabad. Khurshid et.al (1998) noted that the effect of waste disposal on water quality in parts of Cochin. Zingde and Govindan (2001) observed that the health status of coastal waters of Mumbai and regions around. Pachpande and Ingle (2004) illustrated that the recovery of the chromium by chemical precipitation from tannery effluent. Young(2005) stated that toxicity profiles toxicity summary for cadmium, risk assessment information system. Tiwana et.al (2005) observed that the on the impact of *Ni* on human health due to short-term exposure , however it may results in loss of body weight, damage to heart and liver as well may results in skin irritation on long time exposure. Aghor (2007) illustrated that the chemicals make Thane creek the worst polluted water body. Gbaruko et.al.(2008)recorded that the ecotoxicology of arsenic in the hydrosphere: implications for public health. Rajaram and Das (2008) recorded that the water pollution by industrial effluents in India: discharge scenarios and case for participatory ecosystem specific local regulation. Kazi et. al (2009) noticed that the correlation of arsenic levels in drinking water with the biological samples of skin disorders. Ana et.al 2009) stated that remediation of heavy metals contaminated soil, phytoremediation as potentially promising cleanup technology correlate with present investigation and found similar results. Cai et.al (2009) obsreved that the genes involved in arsenic transformation resistance associated with different levels of arsenic contaminated soils. Saidi(2010) experimental studies on effect on heavy metals presence in industrial waste water on biological treatment. Lokhande et.al (2011) recorded that the toxicity study of toxic metals pollutants in waste water effluent samples collected from Taloja Industrial Estate of Mumbai, India.Ogyoyi et.al (2011) determination of heavy metals contents in water, sediment and microalgae from Lake Victoria east Africa. Singare et.al (2011) noticed that the water pollution by discharge effluents from Gove Industrial Area of Maharashtra, India: Dispersion of Toxic metals and their Toxic effects. Abdullhai (2013) recorded that toxic effect of lead in human and overview. Ognerobor et.al (2014) observed that the heavy metal pollutants in waste water effluents: Sources, effects and remediation.

Akpor (2014) studied heavy metals pollutants in wastewater effluent as sources effect and remediation and found similar results. Gunatilake (2015) suggested that the methods of removing heavy metals from Industrial waste water . Journal of multidiscilinary engineering science studies. Narendra et. al. (2016) suggested that the study of Toxicity of Heavy Metal Pollutants in Waste water Effluent samples International Journal of latest Trends in engineering and Technology. In plants, excess of Cumay cause root da- mage, the growth of roots get inhibited, development of number of short, brownish coloured secondary roots and also results in destroying the normal cell membrane structure. Since Cuis readily accumulated in organisms, its toxicity arises when the absorption rate is more than the excretion rate. Hence it is very important to keep check on the concentration levels of Cuin waste water. The Ni content reported in the present investigation was found to vary between 0.34 mg L^{-1} in the effluents released from pharmaceutical industries, to 1.10 mg L^{-1} in the effluents released from textile industries. Rohitsharma (2020),Analysis of Water Pollution Using Different Physicochemical Parameters: A Study of Yamuna River. Frontiers in environmental science :bdullahi,M.S. (2013).Toxic effect of lead on human: an overview. Global Advanced Journal of Environmental science and Toxicology. 2(6): 157-162.

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Table 1: Estimation of toxic heavy metals from waste water samples of oils and emulsifier (S3) industry in Kalyan Dombivli.

Heavy Metals	Raney season		Winter season		Summer season	
	Influent	Effluent	Influent	Effluent	Influent	Effluent*
Cu(mg/L)	1.14	0.09	5.90	0.21	12.58	0.41
Ni(mg/L)	0.48	0.10	0.67	0.10	1.56	0.10
Cr(mg/L)	0.80	0.10`	1.82	0.10	9.34	0.15
Pb(mg/L)	1.46	0.10	1.00	0.11	1.10	0.11
Fe(mg/L)	3.31	0.25	8.54	0.45	15.47	0.53
Zn(mg/L)	0.89	0.22	1.75	0.35	2.73	0.50

Fig. indicate triplicate means

Table 2: Estimation of toxic heavy metals from waste water samples of agrochemicals (S4) industry in Kalyan and Dombivli.

Heavy metals	Raney season		Winter season		Summer season	
	Influent	effluent	Influent	Effluent	Influent	Effluent *
Cu(mg/L)	1.10	0.05	12.0	0.13	29.86	0.25
Ni(mg/L)	0.47	0.10	0.72	0.10	0.90	0.10
Cr(mg/L)	0.48	0.10	0.84	0.10	1.15	0.10
Pb(mg/L)	0.60	0.25	0.90	0.20	1.20	0.10
Fe(mg/L)	1.50	0.05	51.0	3.18	42.67	2.40
Zn(mg/L)	0.86	0.14	4.0	0.53	6.15	0.57

Fig. indicate three replication of mean.

RESEARCH ARTICLE

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Traditional Ethnomedicinal Plants used for Skin Diseases by Dharampur Taluka of Gujarat State, India

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ABSTRACT

The present study deals with ethnomedicinal uses of plants with respect to skin diseases, utilized by tribal inhabitants of Dharampur taluka of Gujarat state, India, which is one of the tribal area. The local people depends on the plant species for curing various diseases by taking the help of medicine healers. The paper discuss about overall 42 plant species which has used in protecting and enhancing the beauty of the skin. Among which Leguminosae (05) family is found to be dominant among the rest of the family followed by Asteraceae, Solanaceae, Asclepiadaceae, Acanthaceae, Moraceae and Euphorbiaceae (02) with Sapindaceae, Puniaceae, Apocynaceae, Araceae, Papaveraceae, Bombaceae , Cruciferae, Anacardiaceae, Cariaceae, Amaranthaceae, Apiaceae, Verbenaceae, Cuscutaceae, Liliaceae, Balsaminaceae, Oleaceae, Boraginaceae, Rhamnaceae, Burseraceae, Combretaceae, Meliaceae, Nyctaginaceae, Rubiaceae and Nymphaceae.

Key Words: Ethnomedicinal, Dharampur, Gujarat, Leguminosae.

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INTRODUCTION

Since time immemorial medicinal plants have been used as source medicines in virtually all cultures. From the ancient time an immense range of medicinal plants plays an important role in human life as our country is rich in vegetation. In India, 2500 medicinal plants and their products are used in curing, treating various ailments have been documented.

The traditional drug adapted from plants or animals were used by local peoples in many areas of India in their region. But the herbal plants were used to cure various diseases from the past. Due to the expanding awareness, among the rural as well as urban people of India has developed an increasing appeal for traditional medicines like Ayurvedic, Homeopathic, Unani& Siddha.

The relationship of past and present between plants and the traditional system can provide an information regarding the ethnobotanical knowledge. The existence of local knowledge enable to investigate about traditional use and management of local flora but also its phonological and ecological features in case of indigenous species. The ethnobotany contributes as natural medicines to the society along with beneficial things such as food, fodder, shelter, fibre, dyes, etc.

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Dharampur is a taluka located in Valsad district of Gujarat. Many plant species found in this region are abundance in the Ethnobotanical heritage. So, the study area is selected for the research work. It acts as an important source of ethnobotanical knowledge as this traditional knowledge system is fast eroding from the people. That's the reason it needs to investigate and record all ethnobotanical information among the ethnic communities before the traditional cultures are completely vanished. In view of the above reference the ultimate aim is to collect the ethnobotanical knowledge from the tribal in the form of survey.

MATERIALS AND METHODS

The present study was conducted in Dharampur area during 2019-2020.The data collection was done by personal interviews and observations among local people, traditional healers or medicine men. The information regarding the species have been documented in the form of photographs were further confirmed using demonstration of photographs from standard published books or web-site.

RESULTS & OBSERVATIONS

The present study reveals 42 plant species of plants which were found to be abundantly used by the tribals of Dharampur area. Among which Leguminosae (05) family is mostly utilized in compared to the total recorded plant species followed by Asteraceae, Solanaceae, Acanthaceae, Euphorbiacea, Moraceae(02) with Sapindaceae, Puniaceae, Apocynaceae, Araceae, Papaveraceae, Bombaceae, Cruciferae, Anacardiaceae, Cariaceae, Amaranthaceae, Apiaceae, Verbenaceae, Cuscutaceae, Liliaceae, Balsaminaceae, Oleaceae, Boraginaceae, Rhamnaceae, Burseraceae, Combretaceae, Meliaceae, Nyctaginaceae, Rubiaceae and Nymphaceae has been used as medicine in curing skin diseases. The plant species used by the tribals are mentioned in (Table .1) with their botanical & local names, family and plant parts used in various hair disorder.

Table -1: Plants used for Skin disorders

Sr.No.	Botanical Name	Family	Local Name	Uses
1.	*Acorcuscalamus* Linn.	Araceae	Ghoda punch	The root paste is used as therapyfor skin disorders.
2.	*ArgemonemexicanaL.*	Papaveraceae	Darudi	The root decoction is apply in curing skin diseases.
3.	*Artocarpusheterophyllu* sLamk.	Moraceae	Phanas	The leaves paste are used in treating skin diseases
4.	*Bombaxceiba L.*	Bombaceae	Simalo	The bark spines powdered mixed with milk and apply to remove black spots on the skin.
5.	Brassica juncea(L.) Czem.	Cruciferae	Rai	The seed oil is used as a remedy in skin eruptions
6.	*Buchanialanzan*Spreng	Anacardiaceae	Charoli	The leaves pulp is applied in curing skin diseases.
7.	*Calotropisgigantean* (L.) R.Br.	Asclepiadaceae	Sakedakdo	Root bark is used to cure skin diseases
8.	*Carica papaya*Linn.	Cariaceae	Papaiya	The pulp apply externally on face, it improves the beauty of the skin.
9.	*Cassia fistula L.*	Caesalpiniaceae	Garmalo	The seed paste is used in curing skin disorders.
10.	*Celosia argentea*Linn.	Amaranthaceae	Lepadi	The leaves extract is remedy in skin eruptions.
11.	*Centellaasiatica*(L.) Urb.	Apiaceae	Brahmi	The leaves extract is used to cure skin diseases such as leprosy.

Sr.No.	Botanical Name	Family	Local Name	Uses
12.	*Clerodendroninermis*(L.) Gareth	Verbenaceae	Mahendi	The leaves & rootextract are used in skin diseases.
13.	*Crossandrainfundibuliformis*(L.) Nees.	Acanthaceae	Aboli	Bark and turmeric paste is mixed and apply to skin disease of children.
14.	*Crotalaria spectabilis*Roth.	Papilionaceae	Rattlepod	The plant extract is used as a therapy in skin diseases..
15.	*Cuscutachinensis*Lam.	Cuscutaceae	Naniamarvel	The whole plant boiled in water and this water is used to cure skin infections.
16.	*Daturametel*Linn.	Solanaceae	Dhanturo	Leaves are crushed along with sugar and apply on infected part.
17.	*Desmodiumtriflorum*(L.) DC.	Fabaceae	Jinopandariyo	Root extract is used externally in skin diseases.
18.	*Dyschoristedalzellii* (T. Anders. ex Bedd.)	Acanthaceae	_____	The leaves mixture is used to cure skin diseases
19.	*Eupatorium odoratum*L. forma squarrosumKoster	Asteraceae	_____	Leaf pulp is used as a remedy in skin diseases.
20.	*Euphorbia antiquorum*L.	Euphorbiaceae	Tidhari	The stem pulp is used to cure skin diseases such as sores and scabies
21.	*Ficusreligiosa*Linn.	Moraceae	Piplo	Bark is crushed with water and apply on boils and pimples.
22.	*Garugapinnata*Roxb.	Burseraceae	Kakad	Fruit pulp is apply on skin eruptions.
23.	*Gloriosasuperba*	Liliaceae	Kankasani	Corn juice is used to cure skin diseases such as leprosy.
24.	*Hemidesmusindicus*(Linn.) R.Br.	Asclepiadaceae	Dudhvel	Root juice is preferable in skin infections.
25.	*Impatiens balsamina*L. var.rosea(Lindl.)Hook.f.	Balsaminaceae	_____	Leaf juice is taken in skin diseases.
26.	*Jasminumsambac*(Linn.) Ait	Oleaceae	_____	Leaves paste is applied in skin diseases.
27.	*Jatropacurcas*L.	Euphorbiaceae	Ratanjyot	Latex from young shoot is applied on skin diseases.
28.	*Meliaazedarach*L.	Meliaceae	Limbdo	The seeds oil is used externally on skin infections.
29.	*Mirabilis jalapa*Linn.	Nyctaginaceae	Gulbas	The root paste is smeared in scabies and skin disorders
30.	*Morindatomentosa*Heyne ex. Roth	Rubiaceae	Alande	Leaves are crushed and apply a paste of it on skin diseases.
31.	*Nelumbonucifera*Gaertn.	Nymphaceae	Kamal	The flower paste is apply on face to increase the beauty of the skin
32.	*Parkiabiglandulosa*Wight&Arn.	Mimosaceae	Chanduphal	The root decoction is used to cure different skin infections
33.	*Phyllanthusamarus*Schum&Thonn.	Euphorbiaceae	Bhonyaamli	The leaf paste with turmeric is taken internally in skin problems.
34.	*Plumeirarubra*Linn.	Apocynaceae	Champo	Bark paste is apply to cure scabies and other skin disorders
35.	*Pongamiapinnata*(Linn.) Pierre	Fabaceae		The leaf oil is used as a remedy in skin diseases.

Sr.No.	Botanical Name	Family	Local Name	Uses
36.	*Punicagranatum*L.	Punicaceae	Dadam	The fresh fruit juice is taken to retain skin health.
37.	*Schleicheraoleosa*(Lour.) Oken	Sapindaceae	Kusum	The oil is used externally in skin disorders.
38.	*Solanumtorvum*Sw.	Solanaceae	_____	The fresh fruit acts as booster the skin health.
39.	*Spharanthusindicus*Linn .	Asteraceae	Gorakh	The leaves powder is used to treat in skin diseases.
40.	*Terminaliacatappa*L.	Combretaceae	Deshibadam	The young leaf paste is applied to cure theskin diseases such as scabies.
41.	*Trichodesmaindicum*(L.) Lehm.	Boraginaceae	Undha -Phuli	The root paste is used to treat skin infection.
42.	*Ziziphusrugosa*Lam.	Rhamnaceae	Toran	Leaf paste is used to treat externally on skin diseases.

CONCLUSION

The present paper revealed the utilization of local plants and their widespread as well as meticulous uses by the tribal people of Dharampur area. According to the medicine men or healers says that the combination of plants parts gives more effective result rather than individual plant part .As the local tribals have a constant relationship with the surrounding areas, they have collected virtuous information regarding the utility of plants by their trial and error method. The generation to generation this knowledge is well preserved and kept as a secret of healing powers for curing various diseases.

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ASSESSMENT OF ULHAS RIVER WATER TO CHECK ITS QUALITY AND EFFECT ON ENVIRONMENT

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Abstract: **The present study evaluates the quality of water of the *Ulhas* River in Maharashtra, India on a monthly basis for a period of 3 years. The site of study experiences daily influx of industrial & household sewage discharge while clay & POP idol immersions and *nirmalaya* disposal during *Ganesh* festival. The presence of landfill adds to the overall deterioration of the river water. The study aims to document the quality of the river water over the duration of study and state the possible reasons for the results obtained. Physico-chemical parameters like pH, temperature, EC, TSS, TDS, DO, BOD, COD, acidity, alkalinity and total hardness of the river water were analyzed and the results obtained were compared with the standard values provided by BIS and EPA. Only pH was found to be in acceptable range, BOD is slightly higher whereas COD, TDS, Alkalinity and Total Hardness values very high than acceptable values. This comparison indicated the grave state of the river and the need to take care of it. To understand the effect of one parameter on another, Karl Pearson's coefficient of correlation was studied statistically.**

Index Terms - Ulhas River, Durgadi Fort, COD, BOD, TDS, TSS.

I. INTRODUCTION

Water is elixir of life and needs to be sustained for future generations. It is a well-known fact that water bodies are deteriorating day by day. UNESCO's report highlights how India is staring at seeping water crisis with few steps being taken to ameliorate this bleak situation. According to UNESCO, India will suffer from an intensified water crisis by 2050 (M. Vyawhare 2018). According to CPCB, 49 rivers of Maharashtra are polluted including Ulhas River (B. Chatterjee 2017). The Ulhas River receives effluent wastewater from industries that eventually enters into the sea causing water pollution. This puts aquatic life under the risk of causing irreversible changes in them. Water pollution also promotes water-borne diseases. Therefore, monitoring the pollution levels of water bodies for a prolonged period of time is necessary Water analysis measures the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. Water analysis includes determination of chemical (Chemical Oxygen Demand, Acidity, Alkalinity, Total Hardness), physical (Temperature, pH, Conductance, Total Dissolved Solids, Total Suspended Solids, Biological Oxygen Demand) and radiological characteristics of water. The most common standards used to assess water quality related to the health of ecosystems, safety of human contact, and potable water. Sewage disposal into the Ulhas River near the Durgadi Fort, Kalyan area has led to elevated levels of pollution of the river. Disposal of floral offerings, immersion of idols made of clay and POP, recreational activities like boating that acts as a tourist attraction for people are among some of the common practices that are detrimental to the marine biome. The food stalls installed at the site of sample collection, discards the organic waste into the river, adding to pollution. The acres land of Adharwadi dumping ground that handles about 700 metric tonnes of solid waste a day is situated next to the river bank. This dumping ground has been used since 1984 by Kalyan Dombivli Municipal Corporation to dispose the waste prior to application of any scientific procedure to prevent its consequences like environmental pollution and health hazards. Only 10% of the 216 million liters a day (MLD) sewage generated daily by the Kalyan-Dombivli Municipal Corporation (KDMC) is treated before it is released into the river (https://numerical.co.in/numerons/collection/59b41b66250a41f81b6ef477%20(accessed%20Apr.%2016,%202020)). In 2016,

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Bimetal decorated carbon nano material synthesized from waste cotton (plant based precursor) for enhanced hydrogen uptake capacity

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Abstract: Carbon nanomaterials (CNMs) known for large surface area, unique physical and mechanical properties are studied for their hydrogen adsorption capacity. For enhancing hydrogen uptake capacity, CNMs prepared from waste cotton are decorated with metal nano particles like Ni and Cu separately and in combination. Hydrogen adsorption capacity was measured by static volumetric technique using Seivert's apparatus at ambient temperature. Metal decoration on CNMs enhances capacity is observed before but this comparative study shows promising results for further exploration with increasing the hydrogen uptake capacity for bimetal decorated CNMs.

Keywords **- Waste Cotton, CNMs, Bimetal, Thermal rapid evaporation, Hydrogen adsorption.**

I. INTRODUCTION

The efficient storage of energy as well as the effective capture and conversion of unwanted greenhouse emissions are considered the major challenges towards a progressive, sustainable and environmental friendly society on a global scale (Ren et. al., 2017). Hydrogen is highly advantageous over fossil fuels. It is lightest fuel, richest in energy per unit mass (Jain, 2009). The combustion of hydrogen provides thermal energy, which can be used as eco-friendly fuel and it is emerging as the important material in various fields of Applied Science (Schlapbach et. al., 2001; Liu, 1999; Rosi, 2003; Xia et. al., 2014). Automobile industry is one of those, in this sector the 500 km driving range requires 5-10 kg of usable hydrogen depending upon the size of the vehicle. Therefore, a lot of research is invested in finding a compact, safe, reliable and inexpensive and energy efficient method of hydrogen storage (Durbin et al., 2013). For past few years, a number of different hydrogen storage technologies have been proposed viz. liquefied hydrogen, compressed hydrogen, metal hydrides and hydrogen physisorption on different substrates, including carbon nanomaterials (CNMs). Metal hydride alloys are capable of storing hydrogen but its heaviness and intrinsically low thermal conductivity makes system uneconomical. The storage for liquid hydrogen is costly and has a risk of explosion at ambient temperature. To overcome these issues hydrogen storage method using porous carbon materials has been proposed (Fukuzumi and Suenobu, 2013; Brooks et. al., 2014; Silambarasan et. al., 2013; Jung et. al., 2009; Mukherjee et. al., 2013). Currently, activated carbons are available in other physical forms such as bars, pellets, cloths or felts in order to satisfy advancing industrial technological needs, recent developments in activation procedures and/or precursors allow a better control over the pore size distribution (Sevilla and Mokaya, 2014). Our work includes synthesis of such CNMs extracted from waste cotton, its activation and study of effect of metal decoration on capacity of hydrogen adsorption. Attachment or decoration of metal nano particles on CNMs enhances hydrogen storage capacity due to hydrogen spill-over effect (Zhou et. al., 2014; Orimo et. al., 2007; Yaghi et. al., 2003).

II. EXPERIMENTAL

2.1 Synthesis of Carbon nanomaterials (CNMs)

Waste cotton was used for synthesis of CNMs. AR grade chemicals were used for process so further purification of chemicals was not done. Pyrolysis method was used to synthesize CNMs. Properly cleaned waste cotton was pyrolyzed in Lyndberg's horizontal furnace at 750°C for 3 hours with inert atmosphere created by Argon. Obtained CNMs were treated with 1N NaOH. Treated CNMS was then decorated with Nickel by using Nickel nitrate solution prepared with distilled water (DW) with thermal rapid evaporation and then annealed at 700°C in CO_2 atmosphere for 2 hours, named as (Ni-CNM) Similarly CNM was decorated with Copper (Copper nitrate solution prepared with DW) and then annealed with temperature 700°C in CO_2 atmosphere for 2 hours named as (Cu-CNM). Process is repeated for bimetal decoration on CNMs by using mixture of Copper nitrate and Nickel nitrate solutions with thermal rapid evaporation named as (Cu+Ni-CNM) for comparative study of hydrogen adsorption.

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Synthesis of carbon nano beads from 2-propanol by spray pyrolysis and its use in microwave absorption

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Abstract: Present work is an attempt to synthesize metal (Ni and Ni-Al alloy) nano catalyst by Solvo-thermolytic process and use for synthesizing carbon nano materials by spray pyrolysis. The precursor used was 2-propanol. The optimal temperature was found to be 900ºC for pyrolysis in presence of Ni-Al alloy. The carbon nano material thus synthesized was confirmed to be multi walled hollow carbon nano bead by TEM and SEM. Moreover, its graphitic nature was confirmed by XRD. Further characterization by Raman spectra showed both G & D bands. The carbon synthesized using Ni-Al catalyst was found to be a good candidate for microwave absorption. Microwave absorption capacity was studied in the frequency range of 12- 18 GHz.

Key words: **Carbon nano beads, solvo-thermolytic process, spray pyrolysis, microwave absorption.**

I. INTRODUCTION

Carbon nanomaterials (CNM) like carbon nanotubes (CNT), carbon nano beads (CNB), carbon nanofibers (CNF), etc. are of great importance due to their various inherent properties like mechanical, electrical, thermal, optical, micro-wave absorption, drug delivery properties among many other [Sharon and Sharon 2006, Sharon *et.al*. 2005, Deanne *et.al.* 2008]. Alcohols are excellent precursors for both single-wall and multi-wall CNTs formation [Maruyama *et.al.*, 2002; Li *et.al*., 2004; Zheng *et.al*., 2004, Igarashi *et.al*., 2004, Miyauchi *et.al*. 2004, Nasibulin *et.al.*, 2006]. Alcohol molecules decomposes to produce OH radicals which further take part in the etching reactions resulting in the purification of CNTs formed [Maruyama *et.al.*, 2002; Murakami *et.al*., 2003]. Alcohols viz. ethanol, octanol [Nasibulin *et.al.*, 2006] have been used alone or in presence of promoters like thiophene to produce CNTs. CNBs have been prepared from different sources but not using alcohols. In this article the effort to successfully synthesize CNB from 2-propanol and study its use in microwave absorption using Vector Network Analyzer (VNA) apparatus in 12-18 GHz frequency ranges is presented.

II. EXPERIMENTAL

Preparation of Nano Catalyst **–** The catalyst required in these experiments was produced by modified Solvo-Thermolytic method [Pramanik 1996, Ko and Hwang 2003, Kundu *et.al.*, 2003]. Two types of catalysts were prepared (i) Ni and (ii) Ni-Al alloy. Nickel catalyst was prepared from Nickel nitrate while Ni-Al alloy was prepared from a mixture of nickel nitrate and 10% aluminum chloride. The nano size Ni-Al catalyst was confirmed by SEM (Fig. 1).

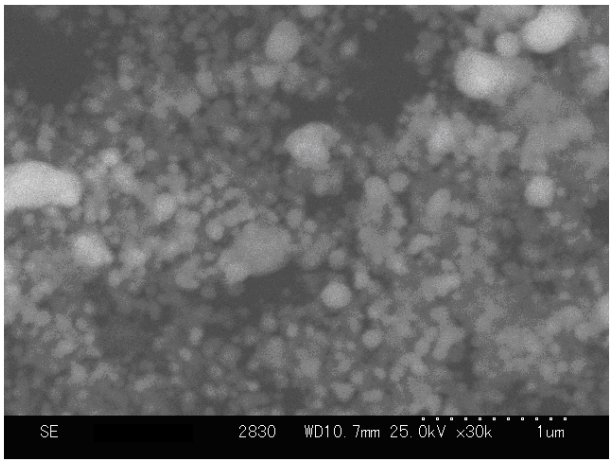

Fig. 1 -SEM of Ni-Al nanoparticles

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Synthesis of Carbon Nanobeads from Plant base Precursor for Electrode Material of Supercapacitor

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Abstract: Supercapacitors are an important energy storage devices due to their capability of higher energy density and higher power density. Carbon materials such as graphene, carbon nanotubes, active carbon and graphite with high surface area have been widely investigated as electrode materials in electrical double layer capacitors. In present work the activated carbon nanobeads have been synthesized by chemical vapor deposition technique using cold pressed Safflower seed oil (Kardai oil) and Fe nanoparticles as catalyst. TEM analysis shows the size of carbon nanobeads are around 82 nm. XRD study shows the graphitic crystalline nature of carbon nanobeads. The surface area of carbon nanobeads by BET measurement is 879 m^2/g. Specific capacitance measured by cyclic voltammetry, shows maximum value 425 F/g at scan rate 5mV/s in 6M KOH electrolyte solution.

Keywords- *carbon nanobeads; specific capacitance, pyrolysis, chemical vapor deposition, Fe nanoparticles, safflower seed oil*

I. INTRODUCTION

Supercapacitors are used as energy storage devices because of their capability of higher energy density and higher power density. Supercapacitor can offer many desirable properties compared to conventional batteries such as super long cycle life, short charging time and high power density [1-7, 30]. The properties of the electrode materials and the electrode/electrolyte interface affect directly the performance of supercapacitors [8-10, 30]. Carbon is the most naturally occurring abundant material exhibiting a variety of molecular and structural forms such as graphite, diamond, nanotubes, nanobeads, graphene, fullerene, nanodiamonds, amorphous carbon, porous carbon, etc. with various applications [11-17, 30]. Carbon-based electrodes for supercapacitor applications have been widely investigated because of its chemical and thermal stability and excellent electrical properties [18-22, 30]. Also carbon-based materials shows high power and cycling performances and they are of interest because of their properties like high specific surface area [18-20, 30]. Currently, carbon materials, such as graphene, carbon nanotubes, activated carbon, porous carbon, have been successfully applied in energy storage area by taking advantage of their structural and functional diversity. Among these graphene or carbon nanotube, as a promising and rising star in carbon materials, exhibits specific structure and exceptional physicochemical properties [23–26], nevertheless, their preparation process is usually complicated [27, 28]. The high quality graphene is commonly prepared through chemical vapor deposition using fossil fuel-based molecules as precursors (such as methane, acetylene, ethylene), which suffers from high cost and very low yield [26, 27, 29]. Plant based-derived carbon, as a type of electrode materials, has attracted much attention because of its structural diversities, adjustable physical/chemical properties, environmental friendliness and considerable economic value. Sharon M. research group have been able to synthesize various types of Carbon Nano Materials from different plant based precursors [30].

In this work, Carbon nanobeads are synthesised by optimizing the temperature by chemical vapor deposition. The plant based precursor-Safflower oil obtained from seeds is used. The obtained carbon nanobeads are activated chemically and its viability as electrode material for supercapacitor is investigated.

II. MATERIAL AND METHODS

Materials:

Safflower oil: The Safflower plant (Carthamus tinctorius) has yellow and orange flowers. The cold pressed safflower oil (Kardai oil) obtained from seeds of this plant.

Metal catalyst: Fe nanomaterial,

Chemicals: KOH, $ZnCl_2$, HCl, HNO_3

Synthesis of Carbon nanobeads from Safflower oil

Pyrolysis unit in the form of Chemical Vapor Deposition (CVD) furnace is used in the synthesis of carbon nanobeads from Safflower oil.

The CVD furnace has two heating zones; (i) Oil vaporizing zone and (ii) Pyrolyzing zone of furnace for carbonization. In oil vaporizing zone a quartz boat containing 50 ml safflower oil was and placed at the centre of heating zone. In pyrolyzing zone, an

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Evaluation of water quality of *Ulhas* River to unravel the causes.

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Abstract: The present work evaluates the quality of water of the *Ulhas* River for a period of three years, on a monthly basis and make a genuine attempt to unravel the various possibilities for the present state of pollution level in the river water. The natural water bodies are treasures to be preserved for future generations. Regular and prolong monitoring of various parameters of water bodies should be carried out by independent bodies. *Ulhas* River, in the western part of Maharashtra State, India, provides potable water to the extent of 60% to the population along its path. Unfortunately, industrialization with utter disregard for the environment, in addition to lopsided population growth has vitiated the pristine nature of the river. These factors necessitated the monitoring of the water quality of the river. The Physico-chemical properties of the river water monitored were viz. pH, temperature, conductance, TSS, TDS, DO, BOD, COD, acidity, alkalinity, total hardness of water and studying the statistical correlation within these parameters by applying Karl Pearson's Coefficient of Correlation. The drastic variations observed in the levels of the selected parameters, in comparison to the accepted levels raise severe questions on the awareness level among the population in general. The high levels of COD, BOD, DO are indicators of the grave state of the river. The concept of '*the polluter pays*' needs to be implemented in its 'letter and spirit', in addition to massive awareness among the masses to restore some of the lost glory of the river.

Index Terms **- *Ulhas* River, *Karl Pearson's Coefficient of Correlation*, COD, BOD, TDS, TSS, the polluter pays**

I. INTRODUCTION

Water is said to be the universal solvent. The water bodies form an important part of ecosystem (Ripl *et. al.* 2003), thus needs to be conserved and well maintained (Wanjui, 2013). The effluent from different industries is disposed-off in the rivers, to creeks which is eventually discharged into the sea. When untreated effluent is discharged into water bodies pollution of water occurs, harming marine life and severely altering bio-geo-chemical systems. This phenomenon was exemplified in the book titled 'Silent Spring' by Rachel Carson way back in 1950s (Rachel, 1962). Hence, it is necessary to study pollution level in water bodies and the bio-geo-chemical pathways. Considering the importance of quality check of the river water, such a study was undertaken spanning for 3 years. The river water quality was checked at three different sites – the origin, the mid-course and the mouth to study the effect of anthropogenic activities on the pollution level in the course of river. This paper discusses about the quality of water at the mouth of the river.

Water analysis refers to the study of the various characteristics of water viz. physical, chemical, biological and radiological features. The measure of water quality is relative to the requirements of biotic species, human needs, and purposes (Midhun et al. 2016). The results of such analysis are compared with standard values to relate to the health of the ecosystem and the potability of water. The selection of tests varies with the intended use or discharge location.

Temperature affects the chemical and biological characteristics of surface water (Deshmukh, 2013). Thermal pollution lowers Dissolved Oxygen (DO) and increases Biochemical Oxygen Demand (BOD) of hydrophytes (Kale, 2016). Its repercussions are observed in the photosynthesis of hydrophytes, metabolic rates of aquatic beings and their sensitivity to pollution, parasites, and diseases (Bhateria and Jain, 2016).

Changes in pH of the aquatic ecosystem affects its living beings (Maoxiao *et. al.* 2018). pH below optimal level makes fish susceptible to fungal infections and disturbs their reproduction (Przeslawski *et. al.* 2008). Lower pH enhances solubility of heavy metals like Al, Pb, Cu and Cd, which is fatal for marine lives. While pH above optimal levels damages gills and skin of aquatic animals causing an irreversible damage (Zhang *et. al.* 2018).

The Chemical Oxygen demand (COD) of a water sample is normally in the range of 1.3 to 1.5 times the BOD. If COD is more than twice the BOD, it indicates a significant portion of organic matter in the sample is not biodegradable by ordinary organisms (Woodard, 2001). As per 'The Environment Protection Rules, 29 of 1986' (of India) (Singare and Dhabarde, 2017) and BIS, for Inland surface waters, the maximum limit for COD is 250 mg/L. The BOD indicates the presence of putrescible organic pollutants in water. Higher BOD levels cause rapid depletion of DO, leading to less availability of oxygen for the propagation of marine life (Kozisek, 2005). Natural water sources have dissolved minerals and gases, some of which are undesirable for domestic and industrial use (Jaishankar *et. al.* 2014). Most of the common ions which interfere with different processes are Ca^{+2}, Mg^{+2}, Fe^{+3}, Cr^{+3}, As^{+3} and

GETTING TO THE ROOT: THE USE OF ETYMOLOGY IN THE TEACHING OF LIFE SCIENCES

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Abstract:

The teaching of etymology and morphology is generally confined to an English language classroom. Taking note of the fact, the present research article sets out to show how knowledge of etymology is essential to comprehend abstruse scientific jargon. The chief objective of the article is to exhibit how etymology can be used effectively in the teaching of biological sciences by a resourceful teacher so that the process of learning becomes meaningful and interesting rather than drab, dreary and dull.

There is no gainsaying that the knowledge of etymology is indispensable to comprehend jargon employed across all subjects and disciplines; nonetheless the present article restricts itself only to life sciences and cites examples particularly from zoology.

Index Terms: Etymology, Root, Prefix, Suffix, Lingua franca, Binomial Nomenclature.

I. INTRODUCTION:

The present research article is an inter-disciplinary endeavour and attempts to exemplify how etymology can be used effectively in a life science classroom so that learning becomes an interesting process rather than drudgery. In fact, the knowledge of Greek and Latin roots, prefixes and suffixes is beneficial in understanding jargon used in all subjects and disciplines. However, the present article is limited only to life sciences.

II. WHAT IS ETYMOLOGY?

The term etymology is derived from the Greek word '*etymologia'* which means "analysis of a word to find its true origin,"[1] Thus, etymology is the discipline that studies the roots of words.

The root can be defined as the central and most significant part of a word; it is the part of the word that is loaded with most of the meaning. Roots can stand independently on their own and have meaning embedded in them. For instance the Greek root " therm' (heat) occurs in many words like: Thermometer ,Exothermic, Endothermic, Thermal, Geothermal, Thermoregulation etc.

Since, ancient Germanic languages evolved into English, some English word-roots come from these languages. As about thousand years ago, England was conquered by the Norman French, some of the roots come from ancient French too. It is a misconception that English is descended from Latin. However, the fact remains that most of the words were borrowed from Latin, apart from Greek and Norman French, as these were high status languages.

III. WHY STUDY ETYMOLOGY?

The study of etymology is primarily significant as it makes one a better wordsmith. It enables one to use a right word at the right place. It also helps one to guess the meaning of a word that one has never previously encountered. If one is familiar with the root of a particular word, one is able to infer the meanings of other similar sounding words too.

IV. WHY USE ETYMOLOGY IN LIFE SCIENCES CLASSROOM?

As Neil Postman[2] rightly puts it in his book, *Teaching as a Conserving Activity*, Biology is not merely about plants and animals. Rather, it is specialized language employed to talk about plants and animals. History is not just pertaining to events; it is specialized language describing and interpreting events. This statement by Neil Postman aptly highlights the significance of language and terminology that a teacher or textbook employs. The book 'Word Power Made Easy' by Norman Lewis[3] is one such book that aims at building vocabulary through etymology and by categorizing words with common roots.

The use of etymology is beneficial and useful in the teaching of all subjects and disciplines as it expands the vocabulary of a student and makes his passive vocabulary active[4]. However, the present paper is limited to the use of vocabulary in the teaching of life sciences and Zoology in particular.

English is the *lingua franca*[5] that is used in almost all scientific books and journals. Various technical terms derived from Greek, Latin, French etc. are used in scientific texts. This technical jargon can pose a difficulty to a student in comprehension. Memorizing or cramming a scientific term without comprehending it, is only a short term solution. Rote learning an abstruse and apparently obscure scientific term makes studies formidable and burdensome. However, on the contrary, if one understands the meaning and etymology of a scientific term, learning becomes an enjoyable process.

V. HOW TO USE ETYMOLOGY IN LIFE SCIENCES CLASSROOM?

Most of the biological terminology stems from Latin and Greek roots. A scientific term can be well understood only after knowing the meaning of these Greek and Latin root words. A majority of the scientific and biological (in the context of this paper) terms are compound words with at least two units viz. roots, prefixes and suffixes[6]. For instance, the word ' Biology' is a combination of two Greek roots ' bios'(life) and 'logos' (study/knowledge of/discourse). Many similar sounding words that end with '-logy' can be understood as ' the study of' if one knows that this word ending unit '- logy' is derived from the Greek root 'logos' (study of) as mentioned above. Some such words that end with the word-unit 'logy' are: Microbiology ('micros' small) Zoology ('zoon' animal), Embryology (' embryon' unborn), Paleontology ('palaeos' old) Entomology (' entomon' insect), Ornithology ('ornis' bird), Herpetology (' herpeton' reptile), Parasitology('parasitos' person who eats at the table of another), Ichthyology (' ikhthus' fish) Histology ('histos' tissue),Cytology ('cyton' cell), Osteology ('osteon' bone), Mycology ('mukes' fungus), Dendrology ('dendron' tree) etc.

Similarly, if a student is aware of the fact that the root ' bios' means 'life', he can easily understand other terms like biochemistry, biotechnology, biophysics, biodegradable, bioluminescence, biosphere, bioenergetics, biometrics, biostatistics, bionomics etc.

It is noteworthy that, there are quite a few examples in which a unit of a technical word functions sometimes as a prefix and in certain cases as a suffix. For instance, the unit ' zoon' (animal) is prefixed in the word ' Zoology'. Whereas, in the word protozoa ['protos' (first); 'zoon' (animal) i.e. the animal which evolved first] it is a suffix. Thus, the root can occur word-initially, word-medially or word-finally. For instance, the root 'bio (life)' occurs in different places in various scientific terms like biogas, symbiosis, abiotic, antibiotic, geobios, limnobios etc. Whether a unit is used as a suffix or a prefix, its meaning does not alter.

In life sciences certain suffixes are used quite often and if a student knows their meaning, he is able to comprehend the meaning of other similar sounding words. For instance, the suffix ' –ata' means 'a group'. It is used in many terms like: Acoelomata, Hemichordata, Stomata, Coelenterata, Vertebrta,Chordata etc. Likewise, the suffix '-sis' is used in terms referring to many diseases such as Entamoebiasis, Wuchereriasis, Dracunculiasis, Taenisis, Giardiasis which are caused by parasites like *Entamoeba*, *Wuchereria*, *Dracunculus*, *Taenia*, *Giardia* etc. that dwell in human body.

Similarly, there are more than two thousand enzymes-biocatalysts discovered so far. But, one can easily make out that a scientific term refers to an enzyme as it ends with the suffix '-ase'. Thus, there are six major classes of enzymes viz. Oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases and Ligases which all end with the suffix '-ase'

Sometimes, one comes across such terms which originate from a single Greek or Latin root. For instance, the name of the micro-organism '*Amoeba proteus*' is derived from the Greek word 'amoibe' and modern Latin 'Amoeba' which means ' alteration or change'. The term ' proteus' comes from Greek mythology. Proteus was a God who could alter his shape at will. Thus, Amoeba Proteus is an organism that 'can change its shape at will'. Similarly, the organism Hydra, which is a member of Phylum Coelenterata and which has regenerative ability, takes its name from a serpentine demon 'Lernaean Hydra' from Greek mythology. Lernaean Hydra had many heads and if one of them was cut off, two would appear in its place.

In the Binomial Nomenclature[7] also the language used is Latin. Binomial Nomenclature is a two-term naming system composed of two units in which the first unit specifies the genus of the animal/plant while the second unit identifies the species. For example, the binomial name for human beings is ' *Homo sapiens* '. The Latin word ' homo' refers to ' man/ human' while the term 'sapiens' means 'wise.' Thus, knowing the Latin root is necessary to comprehend the Bionomial terms.

It is worth-noting that certain Greek/Latin roots have two meanings. The Greek root '-ura' or '-uros' is a case in point. The root '-ura'/ '-uros'is used to refer to 'urine' as well as 'tail'. Thus, the word ' Urology' means ' study of urine'. While, ' Urochordata' is a subphylum of Chordates and is constituted of three Greek units ' 'uros' (tail), 'chord'(rod) and 'ata'(a group). Thus the term ' Urochordata' refers to a 'group of organism that have a rod/ notochord in the tail'. Similarly, the term ' *Uromastyx*' is derived from two roots namely, ' uros' (tail)and 'mastix' (whip) and is used to refer to a spiny-tailed lizard which has a whip-like tail.[8]

Thus, comprehension of scientific jargon becomes easy if the student is aware of the Greek and Latin roots. While talking about different types of cells, a biology teacher can refer to their etymology. For example:

1. Archaeocytes : [Latin 'archae (ancient/first/ primitive)' and 'cyton' (cell,empty vessel, box)] referring to 'undifferentiated first cells'.
2. Thesocytes**:** [Greek 'thesos / thesis' (deposit) and 'cyton' (cell,empty vessel, box)] thus meaning , 'the cells with deposits of reserved food'.
3. Porocytes: [Latin 'porus' (pore) and 'cyton' (cell,empty vessel, box)] i.e. large tubular porous cells, aligned with the body wall of sponges like Leucosolenia.
4. Myocytes:[Greek 'mys' (muscle) and 'cyton' (cell,empty vessel, box)] i.e. the cells with muscles-like property of contraction and relaxation, present around ostia/ oscula to regulate the diameter of the opening.
5. Collencytes: [Greek 'koll' (glue) and 'cyton' (cell,empty vessel, box)] i.e. the cells which are glued together owing to pseudopodia branching to form syncytial network.
6. Trophocytes: [Greek' trophos' (nutrition) and 'cyton' (cell,empty vessel, box)] i.e. the cells that provide nutrition to the animal.[9]

Similarly, while dealing with the unit ' Protozoa' the teacher can use etymology, which will aid in comprehension and make learning interesting . For example:

1. Pseudopodia: [Greek 'pseudo'(false) and 'podium' (foot)] used as locomotory organ by Amoeba.
2. *Plasmodium* :[Latin 'plasma' (mould formation) and Greek 'odium' (like)] i.e., an organism like a stage of slime mould.
3. Sporozoa: [Greek 'sporos'(spore) and 'zoon' (animal) i.e. Protozoans that are spore like or their life cycle involves sporogony (spore formation).
4. Ciliophora: [Latin 'cilium' (eyelash) and ' pherein / ferre'(to bear)] i.e. Protozoans that bare eyelash-like locomotary organs e.g. *Paramecium* .
5. *Paramecium* : [Greek' paramekes' (oval or oblong) or 'para' (on one side, against or beside) and 'mekos'(length)] i.e . oval or oblong organism.
6. Acellular : [Latin 'a' (without) and old French 'celle'/Latin 'cella'(chamber/storeroom)]
7. Unicellular: Latin 'uni'(one) and old French 'celle'/ Latin 'cella'(chamber/storeroom)
8. Heterotrophic: Greek 'heteros' (other/ different/ various) and ' trophe' (nutrition) i.e. Those organisms that cannot produce their own food but take nutrition from other sources/ animals / plants.
9. Holophytic: Greek 'holos' (whole / complete) and 'phyton' (plant) i.e. completely plant-like nutrition.
10. Holozoic: Greek 'holos' (whole/ complete) and 'zoikos'(of animals) i.e. completely animal-like nutrition.
11. Saprozoic: Greek 'sapros' (rotten) and 'zoikos' (of animals) i.e. feeding on dead or decaying animal matter.
12. Saprophytic: Greek' sapros' (rotten) and 'phyton' (plant) i.e. feeding on dead or decaying plant matter.
13. Chloroplast: Greek ' chloros' (pale green) and 'plastos' (moulded) i.e. cellular organelles containing pale green pigment for Photosynthesis.
14. Foraminifera: Latin 'forminifer/foramen' (holes)and '–fer/ferre'(to bear) i.e. marine Protozoans with uni- or multi-chambered calcareous shell with one or more openings through which pseudopodia /reticulopodia emerge out e.g., *Elphidium*.

15. Eukaryota :Greek. 'eu'(true, well) and ' karyon'(nut, kernel , nucleus) i.e. those cells that contain a well-defined nucleus enveloped by nuclear membrane.
16. *Entamoeba* :Greek. 'entos' (within/internal) and 'amoeba' (alteration/ change)thus referring to a vertebrate parasite of digestive tract causing amoebic dysentery specially by the species *Entamoeba histolytica* [Greek ' histos' (tissue) and ' lysis' (to dissolve)][10].

The above-mentioned examples are by no means exhaustive and indicate how etymology can be used in a life sciences classroom.

Sometimes, the knowledge of elementary Greek/ Latin grammar is also essential to comprehend certain terms. For instance, a student needs to be aware of the fact that the plural forms of words like alga, vertebra, larva, bacterium, mycelium, bacillus, fungus, nucleus, nucleolus are algae, vertebrae, larvae, bacteria, mycelia, bacilli, fungi, nuclei and nucleoli respectively.

Thus, if a teacher takes some efforts to introduce students to such basic nitty-gritty of Greek and Latin, it will promote learning and will enrich the overall classroom ambience.

VI. WHICH STRATEGIES TO EMPLOY TO TEACH UNFAMILIAR SCIENTIFIC TERMINOLOGY IN A CLASSROOM?[11]

While introducing a new scientific term to the students the teacher should:

1. Read aloud the word to students using its correct pronunciation.
2. Write the word on the board and break the word down into its parts (root, suffix, prefix) – These components of a word can be highlighted using different coloured chalk sticks.
3. Repeat the word again and again, duly emphasising the different parts of the word and its meaning.
4. Discuss the etymology of the word and link the word with other words in everyday parlance that the students are familiar with. For instance, while introducing terms like non-chordata, non-photosynthetic one can ask students other words used in day- to-day life that begin with the prefix 'non-' such as 'noncooperation' 'nonsense' etc.
5. Use the newly-taught word in a sentence and ask students to write their own sentences using the new word they have learnt.
6. Regularly reinforce the new vocabulary by revisiting it. Various word games and spelling tests can be used for this purpose.

VII. CONCLUSION :

All the foregoing discussion makes it amply clear that etymology can be used effectively in a life sciences classroom by a resourceful teacher to introduce abstruse scientific terms to the students. Thereby, a teacher can banish monotony from the classroom and make learning a meaningful and enjoyable process.

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4. Passive vocabulary comprises the words that one understands when one hears and/or reads them without actually using them in one's speech and writing. On the contrary, active vocabulary consists of the repertoire of words that one uses in one's speech or writing
5. Lingua franca is an Italian phrase that means,' common language used by speakers whose native languages are different'
6. Prefix is an affix attached at the beginning of a word; whereas, a suffix is an affix attached at the end of the word.
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ULTRASTRUCTURE OF UTERUS OF THE ALBINO RAT FOLLOWING THE TREATMENT OF AN ANTI-CANCER DRUG MELPHALAN.

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Abstract: Melphalan is an anticancer drug. It is extensively used in the treatment of multiple myeloma, ovarian cancer, breast cancer and neuroblastoma. It is an alkylating agent of the bischloroethylamine type that shows a cytotoxic effect. Uterus helps to develop the foetuses. In the present study, microscopic observation had been done by treating the anti- cancer drug melphalan to female albino rat and observed its effects on these rats. Some noticeable changes were observed in the uterine epithelial cells of these rats. This study is significant contribution in understanding the side effects of anti-cancer drug Melphalan on female reproductive system specifically uterus.

Index terms: Melphalan, alkylating agent, uterus.

INTRODUCTION: Reproductive system consists of ovaries, uterus, cervix vagina. Uterus play very important role in reproduction During ovulation, oviducts attached to the ovaries receive the mature eggs. Sperms fertilizes the egg in the upper third of the oviduct. This is followed by implantation in one of the uterine horns.

Various anticancer drugs are used in cancer therapy. A class of chemotherapy drugs called ' Alkylating agents' is especially toxic to reproductive cells. (Chapman and Sutcliffere 1986 ; Rauschecker et al.1991) Melphalan is an alkylating agent of the bischloroethylamine type that exerts a cytotoxic effect through the formation of interstrand or intrastrand DNA cross links or DNA protein cross links via its two chloroethyl groups (Samuels and Bitran,1995). It is one of the most accepted therapy because of its ease of administration, minimal toxicity and reliable activity. Chemotherapy, especially combination therapy can damage or destroy the cells in testes and ovaries from which sperms and eggs evolve. Radiation causes similar problems, and can damage the uterine lining or fallopian tubes (Schuez et al ;1979 ; Kreuser and Hetzel 1990 ; Rauschecker et al.1991 ; Meirow and Nugent 2001). 73% of older women who received a cumulative dose of 340 mg/m^2 developed ovarian failure, whereas a higher cumulative dose of 510mg/m^2 led too ovarian failure in only 22% of women less than 39 year of age (Fischer et al. 1977). Present study describes the toxicity of melphalan on uterine tissue.

MATERIALS: Sexually matured healthy 20 albino virgin female rats of 180 ± 05 of body weight were procured from Raj- biotech laboratory, Pune for experiment. Food made available by the Lipton India Ltd. and water was *ad libitum* provided. All animals were acclimatized in the lab for ten days prior to the experiment. Animal maintenance and experimental procedure was strictly followed by "Principles of lab animals care (NIH) and also by local "Ethical regulations". Melphalan of 100%purity was marketed by wellcome pharmaceuticals from Glaxo group.

METHOD: Animals were divided into two groups control and treated. Experimental animals were orally fed with 0.25mg/animal/day for four and eight weeks of melphalan to treated groups. The control group of animals was also fed orally the same volume of vehicle (DW). At the end of the treatment the animals were weighed. Animals were sacrificed in Co_2 chamber as per the guidelines strictly followed by ethical regulations. For ultrastructural studies the required tissues were immediately excised and fixed in 3% gluteraldhyde and processed.

For Electron microscopic examinations uterine tissue was sliced into 1mm Pieces and fixed in one drop of 3% gluteraldehyde buffer and then immersed in fresh ice cold fixative for two hours and then for four hours in 0.1 M cacodylate buffer and then post fixed in 2% osmium tetraoxide for 1-2 hrs. Tissue were dehydrated in ascending series of alcohol followed by propylene oxide and embeded in resin, which was polymerised at 60° C. Blocks were prepared in araldite and then cut with glass knife at 1µm thickness on ultra microtome mounted on glass slides, stained with buffer toluidene section were observed and photographed on Jeol-1010 electron microscope.

OBSERVATION: In Control rat ultra-structural studies of the uterine epithelium showed lumen with luminal epithelium. It shows secretion in the lumen with sterocilia. Numerous prominent irregular expansions of intercellular spaces were seen with cell processes. In some cell cytoplasm with scanty rough endoplasmic reticulum, abundant ribosome and pleomorphic mitochondria. But in some cells elongated nucleus with indented chromatin were noted. Narrow and regular uterine gland mainly situated in the lateral side. Some cells were without lumen, dense stroma with connective tissue. Overall, it represents normal structure (Fig. 1 and 2). Rat fed with melphalan for eight weeks showed the changes in uterine epithelium with shrinkage in uterine structure. When studied at ultrastructural level, overall shrinkage in epithelium was noted. Lumen showed reduced secretion, loss of stereocilia, reduction in microvilli and atrophy in the epithelial cell and nucleus. In some cells dark nucleolus also seen. Cytoplasm showed appearance of prominent vacuoles (Fig. 3 and 4). Treatment of melphalan to the rat for eight weeks showed its effect on the uterine epithelium and gland.

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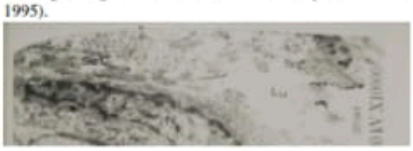
DISCUSSION AND CONCLUSION: Oral administration of Melphalan for eight weeks with noticeable changes in uterus with appearance of viscous peritoneum. Ultrastructural study revealed cyclical changes in the endometrium. uterine abnormalities are implicated in infertility, abnormal vascular pattern are also associated with Myomas. Uterine scaring may produce infertility. Chronic endometriosis and degenerative changes in the uterine wall with prominent changes in endometrium, which affected superficial layer of epithelial cells as atrophied. The stromal layer also showed changes in both epithelial cells and columnar secretory cells with reduction or atrophy in the cell, shrinkage in nuclear size with formation of nuclear debris in epithelial cells. Fertility assessment showed considerable damage to ovarian reserve in all participants after high dose melphalan.

Present results indicate abnormalities in the uterine epithelium with shrinkage in epithelium and secretory cells. [illegible] are in good agreement with the earlier study carried out on abnormalities of uterus. (Ross, 1995; Brown et [illegible] 1995).



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ANTIMICROBIAL ACTIVITY OF *GARCINIA INDICA* AGAINST FOOD SPOILING BACTERIA

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ABSTRACT

The emergence and spread of antibiotic resistance, as well as the evolution of new strains of disease causing agents, are of great concern to the global health community. Effective treatment of a disease entails the development of new pharmaceuticals or some potential source of novel drugs. Commonly used medicinal plants of our community could be an excellent source of drugs to fight off this problem. *Garcinia indica* (Kokam) native to India is one of such plants which has shown many therapeutic uses. The present study shows the antimicrobial activity of fruit extracts of *G.indica* against *Staphylococcus aureus* (gram positive bacteria) and *Escherichia coli* (gram negative bacteria). Out of three screened fractions (Chloroform, ethyl acetate and water fraction), ethyl acetate fraction was found to be more effective against *S.aureus* and *E.coli* as compared to other fractions.

KEYWORDS: Food spoilage, Antibacterial activity Natural preservatives, Fruit extracts, *Garcinia indica.*

INTRODUCTION

Food spoilage is a metabolic process that causes foods to be undesirable or unacceptable for human consumption. Food borne sickness is any illness resulting from the consumption of contaminated food, pathogenic bacteria, viruses, or parasites that infect food & we consume that spoiled food consciously or unconsciously.[1] Food borne illness usually arises from improper handling, preparation, or food storage where hygienic approach is not followed. There is potential for a wide range of food products to become contaminated with microorganisms. Most of the reported outbreaks have been associated with bacterial

contamination, particularly members of the Enterobacteriaceae. Of these, *Salmonella* and *Escherichia coli* are of particular concern.[2] Other bacteria commonly responsible for food spoilage are *Bacillus cereus, Staphylococcus aureus,* etc. Thus, considering all the above facts it is important to explore remedy to illness caused by food spoilage. It is also important because we are daily exposed to such infections in our lives. We consume such food that might be unhygienic or casually prepared. Ultimately we compromise with our health. Remedy to all such disorders is not far away. As soon as we realize that nature has entitled us with solution to all of our problems. There has been a constant increase in the search of alternative and efficient compounds for food preservation aimed at a partial or total replacement of antimicrobial chemical additives.

India is rich in biodiversity and has a wide spectrum of habitats from tropical rainforests to alpine vegetation and from temperate forests to coastal wetlands. About one third of the country's recorded flora is endemic and is concentrated mainly in the North-East, Western Ghats, and North-West Himalaya. Western Ghats of India are known for their valuable biodiversity and has been considered as one amongst the top most important eight hotspots in the world. This hotspot of biodiversity is a treasure house of genetic resources of many plant species. *Garcinia indica* (family- Clusiaceae) is one such tree species endemic to tropical rain forests of Western Ghats of India and is included under the list of endangered species of medicinal plant of Southern India.[3] Its fruits are a rich source of Hydroxycitric Acid (HCA), an important biologically active plant metabolite used as anti-obesity and anti-cholesterol drug. The fruits are also used to prepare a pleasant attractive beverage which has bilious action. The fat extracted from the seeds is used in cosmetics as emollient. A lot of work has been carried out on various aspects of extracts separated from fruit rinds of *G.indica*. Fruit rind extracts have shown good anti hyaluronidase and anti elastase properties.[4] Garcinol and Hydroxycitric Acid (HCA) present in *G.indica* have showed significant anti oxidant and anti hyperlipidemic activity**.** Fruit rinds of *G. indica* contain anthocyanins like cyanidin-3-glucoside and cyanidin-3-sambuboside.[5] Along with this, garcinol the yellow colored pigment and cambogiol present in the fruit rinds showed good antioxidant activity due to presence of phenolic group.[6] Fruit extract of *G.indica* showed antidandruff activity against *M. furfur*.[7] But there are very few reports on anti microbial activity of fractions separated from fruit rinds of *G.indica.* Taking this into consideration it was decided to screen various fractions of fruit rinds of *G.indica* for their antimicrobial activity against *E.coli and S.aureus.*.

MATERIALS AND METHODS

1. Plant Source

The ripe fruits of *G.indica* were collected from Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra.

2. Microorganism used

The organisms used in this study were *E.coli* (ATCC 11775) & *S.aureus* (ATCC 35552) were procured from MTCC, Chandigarh, India.

3. Reagents and chemicals

This work was carried out in Research Laboratory of Department of Botany, K.V. Pendharkar College, Dombivli. The ripe fruits of *G.indica* were collected from Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra.

4. Preparation of fruit extracts

Preparation of Methanolic Extract: The methanolic extract (ME) was prepared by immersing (20 gms) of dried fruit rinds of *G.indica* in 200 ml of acidified methanol (2% Concentrated HCl). The extract was poured in the evaporating dish and allowed to dry at room temperature to obtain 6 gm solid (ME).

Separation of fractions: One gram of ME was dissolved in 50 ml of D/W. To this 50 ml of ethyl acetate and 50 ml of chloroform was added and three fractions were allowed to separate in a separating funnel for at least one hour. Ethyl acetate fraction (EAF), chloroform (CF) and water fraction (WF) were separated. All the fractions were air dried to obtain 0.2 gm EAF, 0.3 gm CF and 0.5gm WF. These fractions were used to study antimicrobial activity.

Antimicrobial test assay

Antimicrobial susceptibility test was carried out by the disc diffusion method. The petridish containing nutrient agar was plated with 0.1 ml culture of both bacterial strains (*E. coli*, and *S. aureus*). The plates inoculated with bacteria, were made in triplicate. The discs containing the fractions (10mg/ml and 25mg/ml) separated from fruit rinds were placed on the agar using sterile forceps. Gentamycin (30 mcg) was used as positive control. The plates were incubated at 37°C for about 24 to 48 hours. The diameter of resultant zone of inhibition was measured in millimeters.

RESULTS AND DISCUSSION

Numerous studies have documented the antimicrobial potency of the crude extracts from genus *Garcinia* as well as that of some of their antimicrobial components.[8], [9] Although the *Garcinia* species are gaining much attention worldwide due to their potential bioactivities, the *Garcinia* species in the Western Ghats are least investigated for their bioactivities. *Garcinia indica* commonly known as Kokam plant has already gained a lot of attention due to its various anti inflammatory, anti oxidant, free radical scavenging as well as antidandruff activities. (-) Hydroxycitric acid from leaves and fruit rind is antiobesity and anti cholesterol drug. Fruits are rich source of Hydroxycitric Acid (HCA), an important biologically active plant metabolite used as anti-obesity and anti-cholesterol drug. The fruits are also used to prepare a pleasant attractive beverage which has bilious action. The fat extracted from the seeds is used as cosmetics as emollient.

Our studies showed that parent methanolic extract was not that effective against both the bacteria. Very less inhibition was observed. As compared to this, ethyl acetate fraction at 10mg/ml showed significant inhibition (17.34 ± 0.37 for *E.coli* & 18.33 ± 0.50 for *S.aureus*) respectively and for 25mg/ml results were comparable with Gentamycin **(Table No. 1).** On the other hand water and chloroform fraction were not that effective against both the microorganisms.

Table No. 1: Antimicrobial activity of various fractions of fruit rinds of *G. indica* against *E.coli and S.aureus.*

Sr. No.	Drug used	Concentration	Diameter of zone of inhibition (mm)	
			E. coli	***S. aureus***
1	Methanolic Extract	10 mg/ ml	7.00 ± 0.57	9.00 ± 0.57
		25 mg/ ml	12.33 ± 0.37	14.22 ± 0.22
2	Ethyl Acetate Fraction	10 mg/ ml	17.34 ± 0.37	18.33 ± 0.47
		25mg/ ml	22.45 ± 0.37	27.33 ± 1.22
3	Water Fraction	10 mg/ ml	8.33 ± 0.37	10.22 ± 0.50
		25mg/ ml	10.2 ± 0.37	11.22 ± 2.12
4	Chloroform Fraction	10 mg/ ml	9.22 ± 0.37	9.45 ± 0.44
		25mg/ ml	12.33 ± 0.37	14.22 ± 0.58
5	Gentamycin	30mcg	23.00 ± 1.155	25.11 ± 1.15

CONCLUSION

Food spoilage is often caused by the growth of many pathogenic bacterial strains. Prevention of food spoilage in food industry and food stuff is mainly based on the application of

chemical preservatives. The adverse effects of these chemical preservatives on human health increase the demand to search for potentially effective, healthy safer and natural food preservative. In this preliminary studies, ethyl acetate fraction of fruit extract of *G.indica* which proved to be potentially effective as (*E.coli and S.aureus*) can be used as natural alternative preventives to control food poisoning diseases. Synergistic effect of this fraction with other plant extracts could be further exploited.

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