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## Thyroxine Induced Changes in Collagen Characterstics in the Tissue of Bone in Common Toad

#### Gitanjali Mishra<sup>1</sup>, Sulata Kumari Sahu<sup>2</sup>, Subhasmita Pattnaik<sup>3</sup>

#### How to cite this article:

Gitanjali Mishra, Sulata Kumari Sahu, Subhasmita Pattnaik. Thyroxine Induced Changes in Collagen Characterstics in the Tissue of Bone in Common Toad. Indian J Biol. 2019;6(2):69–74.

#### Abstract

The tensile strength of bone derived from collagen fibres, extend primarily along the lines of tensile force. For normal development and function of human skeleton, thyroid hormones are vital, which evidently visible in hyperand hypothyroid conditions. Earlier studies suggest that, Thyroid effect on collagen is dose dependent, tissue specific and sometimes controversial. Hypothyroidism causes impaired bone formation and growth retardation whereas hyperthyroidism may retard collagen synthesis and decelerate the bone mass. Hydroxyproline and hydroxyllysine are essential for the collagen cross linking and strength of the bone. Hydroxyproline estimation is considered as an index of collagen metabolism. The aim of the present study is to find out the changes in collagen characteristics in bone tissue of thyroxine treated common Indian toad. As common toad (*Duttaphyrnus melanostictus*) is studied extensively to have an elementary knowledge on the anatomy of vertebrates, the above species is used as the experimental organism in the present study. The method of Neuman and Logan (1950) modified by Leach (1960) was used to find out the hydroxyproline content from which the collagen contents were found out at two different doses of thyroxine (2.0 µg/gm & 0.5 µg/gm).

Keywords: Bone; Collagen, Thyroxine, Hydroxyproline.

#### Introduction

Thyroid hormones secreted from thyroid gland are important regulators of connective tissues both in vivo and in vitro. Bone as a connective tissue is largely influenced by thyroid hormone concentration, which is evidently visible in hyperthyroidism and hypothyroidism. It is a unique tissue made up of minerals, various proteoglycans, collagens, glycoproteins, gamma-carboxyglutamic acid-containing proteins and many others. The organic matrix of bone is 90 to 95 percent collagen fibres which gives powerful tensile strength to it. In the other hand thyroid hormones have drastic effect on collagen synthesis and degradation. Any direct and indirect effect can tend to alter the structure and strength of collagen fibres are likely to have significance repercussions on the physical

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Received on 12.07.2019, Accepted on 16.08.2019

structure of organism as a whole. Hydroxyproline and hydroxyllysine are essential for the collagen cross linking and strength of the fibre. Most, if not all, of the hydroxyproline in collagen appears to be derived from proline. It has been proposed by several investigators on indirect evidence, that it is a bound form of prolinewhich is hydroxylated and incorporated into collagen (Ernest et al., 1960). Examination of hydroxyproline status can be considered as an index of collagen metabolism.

#### Aim and Objective

The present study aims to find out the changes in bone collagen characteristics in *Duttaphrynus melanostictus* through  $T_4$  administration at two different doses of 2.0 µg/gm (High dose) and 0.5 µg/gm (Low dose).

#### **Choice of Parameters**

The various biochemical parameters were found outfollowing Thyroxine ( $T_4$ ) treatment at doses of 2.0 µg/gm and 0.5 µg/gm (Low dose) in bone tissue of toad. The parameters are as follows.

- 1. Salt soluble collagen,
- 2. Acid soluble collagen,
- 3. Insoluble collagen,
- 4. Total collagen content
- 5. Salt soluble/salt insoluble collagen ratio
- 6. Acid soluble/acid insoluble collagen ratio
- 7. % of salt solubility
- 8. % of acid solubility

#### Materials and Method

Common toad (*Duttaphrynus melanostictus*) were collected from the nature of both sex types and transferred into the wire-netted wooden cage (75 × 14 × 35 cm in size) in the laboratory containing sand bed. They were maintained in laboratory condition for about 5 days. The animals were forced fed with goat liver, (composition mg/g wet weight:  $110 \pm 41$  protein,  $84 \pm 16$  lipid,  $2.3 \pm 1.1$  glycogen) and water was provided *ad libitum*.

After laboratory acclimation animals of mixed sexes were divided into two groups, i.e. control (CONT) and experimental (EXPT). Experimental groups were again divided into two groups & were treated intramuscularly with Thyroxine ( $T_4$ ) Na salts (fluka AG) of doses 2.0 µg/gm and 0.5 µg/gm body wet weight. The control animals were received an equal volume of 0.65% of NaCl solution of pH 8.3. The treatment was carried out for 7 days and on the 8<sup>th</sup> day, body weights were taken and were sacrificed in separate batches for estimation of biochemical parameters.

#### **Tissue Prosseing and Collagen Estimation**

Bone tissue was taken for extraction of different collagen fractions by using Neuman and Logan (1950) method modified by Leach (1960). To evaluate the statistical significance of the data student's *t* test was applied.

#### Results

#### Salt Solubility

The salt soluble collagen decreased significantly (p < 0.002) at T<sub>4</sub> high dose and increased insignificantly p, NS) at T<sub>4</sub> low dose as compared to control animals. Wherever, the % of salt solubility and salt soluble/ salt insoluble collagen ration increased insignificantly in T<sub>4</sub> high dose, but bothdecreased in T<sub>4</sub> low dose, as compared to control animals (Table. 1, 2 & Figs. 1,3,4).

#### Acid Solubility

There was an insignificant decrease in acid soluble collagenat  $T_4$  high dose and insignificant increase in in  $T_4$  low dose as compared to control animals. The % of acid solubility and acid soluble/insoluble

**Table 1:** Effect of thyroxine ( $T_4$ ) (2.0 µg/gm body wt.) on collagen characteristics of bone tissue in Common Indian Toad. Values for soluble, insoluble and total collagen are mg/gm tissue wet-weight (Mean ± SEM), Numbers in parentheses indicate sample size, NS, Not significant, at 0.05 confidence level.

					T4 High Dose			
	Salt soluble	Acid soluble	Insoluble	Total	% of salt solubility	% of acid solubility	Salt soluble/ Salt Insoluble	Acid soluble/ Acid insoluble
	10.83	8.48	20.03	39.35	27.75	21.87	0.387	0.445
Construct	±	±	±	±	±	±	±	±
Control	0.89	0.64	2.14	3.20	1.37	1.35	0.026	0.04
	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
р	p < 0.002	p, NS	p < 0.001	p < 0.001	<i>p</i> , NS	<i>p</i> , NS	<i>p</i> , NS	P,NS
Experimental	6.98	7.02	6.13	20.12	34.72	34.30	0.53	1.23
	±	±	±	±	±	±	±	±
	0.476	0.72	0.526	1.105	1.413	2.44	0.034	0.21
	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)

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**Table 2:** Effect of thyroxine ( $T_4$ ) (0.5 µg/gm body wt.) on collagen characteristics of bone tissue in Common Indian Toad. Values for soluble, insoluble and total collagen are mg/gm tissue wet-weight (Mean ± SEM), Numbers in parentheses indicate sample size, NS, Not significant, at 0.05 confidence level.

T4 Low Dose								
Experimental condition	Salt soluble	Acid soluble	Insoluble	Total	% of salt solubility	% of acid solubility	Salt soluble/Salt insoluble	Acid soluble/ Acid insoluble
Control	5.67	6.53	20.84	33.07	17.61	19.95	0.219	0.338
±	±	±	±	±	±	±	±	
0.60	0.809	2.233	1.94	2.52	2.32	0.039	0.057	
(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	
р	p, NS	p, NS	<i>p</i> , NS	p, NS	p, NS	<i>p</i> , NS	<i>p</i> , NS	<i>p</i> , NS
Experimental	6.445	6.94	26.05	39.43	16.51	17.73	0.198	0.27
±	±	±	±	±	±	±	±	
0.298	0.228	1.74	1.56	1.112	0.847	0.0159	0.017	
(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	

collagen ratio increased insignificantly by the administration of T4 at a dose of 2.0  $\mu$ g/gm and decrease in dose of 0.5  $\mu$ g/gm body wt. (Table. 1, 2 & Figs. 1,3,4).

#### Insoluble Collagen

The average insoluble collagen decreased significantly (p < 0.001) at T<sub>4</sub> (2.0 g/gm) and increased insignificantly (p, NS) at T<sub>4</sub> (0.5 g/gm) as compared to control animals (Table: 1, 2 & Fig: 1).

#### **Total Collagen Content**

The average total collagen from bone tissue of T4 (2.0  $\mu$ g/gm) treated animals decreased significantly (p < 0.001) and increased insignificantly (p, NS) at T4 (0.5  $\mu$ g/gm) in bone tissue of treated animals as compared to control animals statistically (Table. 1, 2 & Fig. 2 a,b).



#### Fig. 1:

Salt soluble, acid soluble, insoluble collagen fraction in bone tissue of *Duttaphrynus melanostictus* by administration of  $T_4$  (2.0 µg/gm and 0.5 µg/gm). Values are mg/gm tissue wet wt., columns represents the mean values.



#### Fig. 2a:

Fig. 2b:

Total collagen fraction in bone tissue of *Duttaphrynus melanostictus* by administration of  $T_4$  (2.0 µg/gm and 0.5 µg/gm). Values are mg/gm tissue wet wt., columns represent the mean values.

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Fig. 3: % of Salt soluble and acid soluble collagen fraction in bone tissue of *Duttaphrynus melanostictus* by administration of  $T_4$  (2.0  $\mu$ g/gm and 0.5  $\mu$ g/gm). Values are mg/gm tissue wet wt., columns represent the mean values.



**Fig. 4:** Soluble/insoluble collagen fraction in bone tissue of *Duttaphrynus melanostictus* by administration of  $T_4$  (2.0 µg/gm and 0.5 µg/gm). Values are mg/gm tissue wet wt., columns represents the mean values.

#### Discussion

Collagen is the major insoluble fibrous protein in the extracellular matrix and in connective tissue. In fact, it is the single most abundant protein in the animal kingdom. The various collagens and the structures they form all serve the same purpose, to help tissues withstand stretching. Collagens were considered as the only major resource of hydroxyproline. The colossal amount of hydroxyproline in collagen has made it a valuable measure of collagen and collagen metabolism (Srivastava, 2016).

The thyroid hormone is seen to stimulate both the synthesis of collagen and non-collagenous proteins. Excess thyroid hormone treatment seems to have accelerated bone degradation (Taimela et al.,1994). Collagen seemed to exhibit the biphasic effect with thyroid hormone. This term refers to the fact that thyroid hormone can exhibit an optimal level and either a deficiency or excess of this level will move a given parameter in a similar direction. Thyroid hormone effect on collagen is dose dependent, tissue specific and controversial (Hell et al., 2011). Thyroxine and triiodothyronine seem to affect both collagen biosynthesis and degradation (Eugene, 1992). The changes in the collagen content in tissues reflect a cumulative effect of thyroid hormone and other connective-tissue-activating factors on collagen turnovers. The rate of collagen synthesis is decreased in hypothyroidism. In addition hypothyroidism is accompanied by decreased rate of catabolism of collagen (Guria et al., 2011). Isotopic studies have revealed that in experimental hypothyroidism the decreased excretion of hydroxyproline due to decreased rate of collagen synthesis and to decreased rates of degradation of both soluble and insoluble collagen.

In hyperthyroidism, the increased excretion of Hyp by increased rates of degradation of both soluble and insoluble collagen. Whereas the rate of collagen synthesis does not seems to be increased, but probably is decreased. Both hyperthyroidism and hypothyroidism are associated with bone degradation but in some tissues hypothyroidism increases collagen accumulation (Drobnik et al., 2009).

From the present research, it was found that salt soluble collagen decreased significantly when treated with  $T_4$  (2.0 µg/gm) and increased insignificantly at  $T_4(0.5 \ \mu g/gm)$ . Salt soluble collagen refers to newly synthesized collagen. Acetic acid extract, a form of collagen crosslinked into fibres by aldimine bond. More concentration of acid soluble collagen give an indication of presence of cross linked collagen by aldimine bond recently after synthesis and they are less stabilized. Acid soluble collagen content increased insignificantly at  $T_4$  (0.5 µg/gm). It was decreased at  $T_4$  (2.0 µg/gm). As collagen synthesis decreased at 2.0  $\mu$ g/gm of T<sub>4</sub> crosslinking formation was also halted but at  $0.5 \,\mu g/gm$  it was increasing insignificantly. The insoluble collagen are due to stabilization of the collagen fibres by inter and intramolecular bonding/crosslinking. But in the case of Insoluble collagen it show significant increase in stability at  $T_{4}$  (0.5 µg/gm) and decreased at other dose. The total collagen content reflects a balance between collagen synthesis and degradation. As per present study, total collagen content decreased significantly on administration of  $T_4$  (2.0 µg/gm) and the other dose showed insignificant output. The changes in solubility and soluble/insoluble collagen ratio are indirect indicators of alterations in the degree of cross linkages of collagen molecules (Everittet al., 1970; Walford et al., 1969: Hall, 1976; Kohn, 1978). In T4 high dose increase in salt and acid soluble collagen ratio and increased solubility in both salt and acid media signifies the prevention of cross link formation. In contrast T4 low dose enhanced the collagen synthesis simultaneously caused its degradation.

#### Conclusion

Thyroxine hormone have dynamic effect on bone collagen and is mainly dose dependent. The degree of cross-link formation in collagen affects the physiological functions of the concerned tissue (Kohn, 1978). It is also likely that factors influencing the characteristics of collagenmay affect other physiological indices as well. The salt solubility, acid solubility, salt soluble/insoluble and acid soluble/ insolubleratio of bone collagen were increased upon  $T_4$  treatment (2.0 µg/gm) but all these decreased at 0.5 µg/gm body wt. It is suggested that  $T_4$  possibly prevents cross-link formation thus retarding the aging of collagen in bone tissues at a higher dose. Conversely it enhanced the collagen synthesis and simultaneously matrix metabolism at the lower dose.

#### References

- Bassett JHD, Williams GR. Role of Thyroid Hormones in Skeletal Development and Bone Maintenance; Endocr Rev, 2016;37(2):135–87.
- Bansal M, Ramachandran GN, Ramakrishnan C. Stabilization of the collagen structure by hydroxyproine residues; Proc. Indian acad. Science, 1975;82(4):152–64.
- 3. Drobnik J, Ciosek J, Slotwinska J, et al. Experimentalhy pothyroidism Increases Content of Collagen and Glycosaminoglycans In The Heart; Journal of Physiology and Pharmacology, 2009;60(3);57–62.
- Galliford TM, Murphy E, Williams AJ, et al. Effects of thyroid status on bone metabolism: A primary role for thyroid stimulating hormone or thyroid hormone; Minerva Endocrinol, 2005;30(4):237–46.
- Gawad SSAE, Ghonaim M, Hadidy M, et al. Bone Status in Hyperthyroidism; Researcher, 2011;3(6):1–8.
- Guria S, Balmiki N, Chakrabarti S and Das M. Methimazole-induced Hypothyroidism Modulates Cytomorphology of Skin Epidermis and Collagen Synthesis In Rat; Nova Science Publishers, Inc. 2011.
- Kucharz EJ. Biosynthesis of Collagen: The Collagens: Biochemistry and Pathophysiology, 1<sup>st</sup> Edition; Springer Berlin Heidelberg, 1992;3:53–31.
- 8. Linksy, Bruce, C. Protein Synthesis in Regenerating Wound Tissue and the Effect of Thyroid Hormone. Dissertations. 1971:1147.
- Singh S, Mishra G, Dixit PK. Ascorbic acid (Vit-c) induced biochemical alternation of collagen characteristics in the heart tissue of swiss mice; International journal of current research, 2016;8(9):37575–79.
- Srivastava AK, Khare P, Nagar HK, et al. Hydroxyproline: A Potential Biochemical Marker and its Role in the Pathogenesis of Different Diseases; Current Protein and Peptide Science, 2016;17(6):596–602.
- 11. Stathatos N, Wartofsky L. Effects of thyroid

hormone on bone; Clinical Reviews in Bone and Mineral Metabolism, 2004;2(2):135–50.

12. Taimela E, Taimela S, Nikkanen V, et al. Accelerated Bone Degradation in Thyroid Carcinoma Patients during Thyroxine Treatment, Measured by Determination of the Carboxyterminal Telopeptide Region of Type I Collagen in Serum. Eur J Clin Chem Clin Biochem. 1994 Nov;32(11):827-31.

 Yamaguchi K, Yasumasu I. Effects of Thyroxine and Prolactin on Collagen Breakdown in the Thigh Bone and Tail Fin of the Rana Catesbeiana Tadpole; Development, Growth and Differentiation, 1978;20(1):61–69.

## Biomass and Biosurfactant Manufacturing of Neem Cake by Hydrocarbon Degrading Microbes

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#### How to cite this article:

Lasitha K, M Arul Sheeba Rani. Biomass and Biosurfactant Manufacturing of Neem Cake by Hydrocarbon Degrading Microbes. Indian J Biol. 2019;6(2):75–81.

#### Abstract

Naturally occurring surface active compounds drived from microorganism also called Biosurfactant. They offer several advantages over the chemical surfactants. Such as low toxicity, inherent good biodegradability and ecological acceptability. Biosurfactant which are revealed to be produced by bacteria, yeast and fungi can serve as green surfactants. The biosurfactant synthesizes by environmental isolates also has promising role in the agricultural industry. Based on the above assets, selected two oil degrading fungal species from the laboratory for the further studies. The selected microbes *Aspergillus oryzae* and *Penicillium chrysogenum* play major role in oil recovery, environmental bioremediation and pharmaceuticals owing to their unique properties such as biodegradability. The ability of oil degrading fungal species utilize neem cake to produce biomass and biosurfactant. Neem cake as it is the cheapest carbon source as compared to glucose, fructose, and other petroleum based substrate for the production of biosurfactant. The energy sources of neem cake contain different biological active compounds which undergoes by the microbial activity can provide added benefits. This will be helpful for environmental safe agricultural development. Fungal species such as *Aspergillus oryzae* and *Penicillium chrysogenum* could grow well in stone medium using water and hexane soluble fraction of neem cake in the presence of  $(NH_4)_2HPO_4$  seemed to be important for better production of biomass and biosurfactant under laboratory and neutral pH conditions. Hence, the present study aims to find out, oil degrading microbes for maximizing biosurfactant productivity using neem cake as an energy source.

Keywords: Biomass; Biosurfactant; Oil degradation; Neem press cake; Hydrocarbon-degradation.

#### Introduction

A number of microorganisms are known to synthesise surface-active agents, most of them are bacteria and yeast (Banat, 1995). But, in recent years, it has been produced by filamentous fungi as well (Castiglioni, 2009), (Velioglu and Urek 2015). Filamentous fungi are capable of degrading the whole array of hydrocarbon containing compounds (Adekunle and Oluyode, 2005); (Saratale et al., 2007; George-Okafor et al., 2009, Reuben et al., 2011) by producing capable enzymes. Hence, they are called nature's original recyclers. Furthermore fungi yield a good amount of biosurfactant when compared to bacteria. Author's Affiliation: <sup>1</sup>PhD Research Scholar, <sup>2</sup>Assistant Professor, Department of Botany, Nirmala College for Women, Coimbatore, Tamil Nadu 641018, India.

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Received on 19.08.2019, Accepted on 05.12.2019

The reason might be presence of rigid cell wall in them (Kim et al., 1999).During biological process, the microbes are utilizing natural and synthetic chemicals for their metabolism, which are less expensive and more environment friendly (Sasikumar and Papinazath, 2003). Sanyaolu et al., (2018) reported that *Aspergillus oryzae* has the ability to utilize different types of petroleum and vegetable hydrocarbon compounds.

When the microbes grown on hydrocarbon substrate as carbon source, these microorganisms synthesise a wide range of chemicals with surface activity such as glycolipid, phospholipid and others (Desai and Banat, 1997). These chemicals are apparently synthesised to emulsify the hydrocarbon substrate and facilitate its transport into the cells.

More over Factors playing important role for the production of biosurfactants, there are nature of the carbon source and the concentrations of nutrients such as nitrogen, phosphorus, magnesium, iron, and manganese, as well as the pH, temperature (Banat et al., 2010; Fontes et al., 2008; Pirôllo et al., 2006). These factors can make the production of biosurfactants more valuable than that of synthetic surfactants (Thavasi, et al., and Banat, 2007).

The end-product of Biosurfactants are structurally and functionally diverse amphiphilic, surface active compounds which lower the surface and interfacial tension between individual molecules at respective surfaces and interfaces. Hence, these are very important in the living systems to transport and exchange of the various important Materials (Lang, 2002; Banat, 1995). Biosurfactants are ecologically safe and can be applied in various industries. Although using biosurfactant are relatively high in production cost. The utilization of alternative substrate (Agro industrial waste) is the possible way to reduce the cost. The main problem related to the usage of alternative substrate is the final product depends on the composition of culture media. Hence, the present study is focused on Neem cake as it is the cheapest carbon source as compared to glucose, fructose, and other petroleum based substrate for the production of biosurfactant.





Fig. 2:

Azadirachta indica A. Juss. (Meliaceae) has been identified as one of the most suitable candidate for environmentally safe agricultural development. Neem cake is the residue obtained from neem seed (Fig. 1 & 2). It is an excellent organic fertilizer. The composition of Neem Cake after the extraction of oil varies widely depending on the raw material. It contain crude protein, carbohydrate, crude fibre, fat, ash, acid insoluble ash. The component of azadiractin in neem cake protects crops against parasite and enriches the soil (Mishra and Prasad, 1974). The neem cake is rich in most of the amino acids. It is a potential source of organic manure and contains many plant nutrients. The neem cake contains a large number of triterpenoids, more of which are being discovered. The important characteristic of the Neem cake is to reduce the alkalinity in the soil by producing organic acids when mixed with the soil. The composition of calcium and magnesium present in neem cake also aid in removing alkalinity (Gupta et al., 1993). The biological structure of neem cake undergoes a break down into simpler compounds resulting in microbial succession favouring heterotrophic nitrogen fixers. These slow and gradual changes results in the formation of nitrogen pool which is available for plant growth and development (Barbara W. Ellis and Fern Marshall Bradley, 1996). Neem cake has identified as one of the most suitable candidate for environmentally safe agricultural development. (Dhillon and Khajuria, 1996)

#### Materials and Methods

Micro organisms

- Aspergillus oryzae
- Penicillium chrysogenum

#### Materials used

Neem press cake

Nitrogen source

- Di-ammonium hydrogen orthophosphate [(NH<sub>4</sub>)<sub>2</sub>HPO<sub>4</sub>]
- Ammonium sulphate [(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>]
- Ammonium Chloride [NH<sub>4</sub>Cl]
- Potassium Nitrate [KNO<sub>3</sub>]

Medium used (Outdo et al., 1993)

- Bushnell and hash medium
- Mineral medium
- Nutrient broth medium
- Stone medium

#### Inoculum and Media

For further study, Neem press cake used as substrate. The fungal species *Aspergillus oryzae*, *Penicillium chrysogenum* were obtained from the laboratory, and the fungal species were maintained in potato dextrose agar medium. The strain was cultured in 50 ml of stone medium, 10 ml of distilled water, acetone and hexane with 5 gm of neem cake extract of the medium served as energy source.

#### **Control and Growth Conditions**

Un Inoculated medium with the carbon sources (extract of neem press cake) maintained at room temperature with neutral pH served as control. Another control was maintained with inoculated stone medium with carbon sources. The culture conditions are as follows pH4–pH9, temperature 25°C, 35°C, 40°C in BOD incubator, and 20 mg of Nitrogen sources viz.,  $(NH_4)_2HPO_4$  (di-ammonium hydrogen orthophosphate),  $(NH_4)_2SO_4$  (Ammonium sulphate),  $NH_4Cl$  (Ammonium chloride) and  $KNO_3$  (Potassium nitrate) per 50 ml of stone medium with neutral pH.

#### Biomass and Biosurfactant Production by Fungi Using Neem Cake

To 50 ml of stone medium, 10 ml of distilled water, acetone and hexane extracts of 5 gm of neem press cake powder was centrifuged and the supernant was taken in conical flask. This extract served as

carbon source. Fungal species are incubated for 7–8 days.

#### Extraction of Fungal Biomass

The mycelium was separated from the medium by filtering through pre-weighed Whatman's No. 41 filter paper. The filter paper along with mycelial mat was dried at 80°C in the hot air oven until constant weight and this weight was recorded. Difference between the weight of the filter paper bearing mycelial mat and the weight of only the filter paper represented biomass of fungal mat. Biomass was quoted in terms of mg ml<sup>-1</sup> (dry weight).

#### Isolation of Biosurfactant

After separating the Biomass, Biosurfactant in the culture filtrate was estimated according to the procedure described by Swaranjit Cameotra, (1995) and the weight was expressed as mg ml<sup>-1</sup>. The culture filtrate was centrifuged at 10,000 rpm for 30 minutes at 4°C to remove any debris. The clear supernant was then treated with 3 volumes of ice cold acetone. The precipitate is collected by centrifugation at 5,000 rpm for 30 minutes.

#### Results

## Suitable Medium for the Growth of Neem Cake Degrading Microbes using as Energy Source

In this experiment, using four different liquid medium such as Bushnell and Hass, Nutrient broth, Mineral medium and Stone medium were tested for their efficiency in supporting the growth of the neem cake degrading microbes with water, acetone, and hexane extract, under normal laboratory conditions. Two controls were maintained simultaneously to verify whether the growth of the microbes enhanced by the extract. Control I was only medium with uninoculated microbes with no energy source and Control II was medium with extract without microbial inoculants. The experimental flask contained inoculated medium with extract. Optical density of the cultures were measured at 420 nm at the end of the log phase and the results were recorded. The results suggested that stone medium is suitable for the present study.

Table 1:

Medium (O.D at	Organism	Control 1 (M + I)	Control 2 (M + E)			Control 3 (M + E + I)			
420 nm)		-	Water	Acetone	Hexane	Water	Acetone	Hexane	
Bushnall & Hass	A.O	0.13	-	-	-	0.30	0.22	0.35	
medium	P.C	0.12				0.25	0.19	0.21	
Mineral medium	A.O	0.11	-	-	-	1.0	0.47	0.85	
	P.C	0.09				0.90	0.40	0.81	

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Medium (O.D at	Organism	Control 1 (M + I)	Control 2 (M + E)			Control 3 (M + E + I)			
420 nm)			Water	Acetone	Hexane	Water	Acetone	Hexane	
Nutriant broth	A.O	0.55	-	-	-	1.4	0.56	1.3	
medium	P.C	0.40				1.3	0.85	1.2	
Stone medium	A.O	0.80	-	-	-	1.7	0.90	0.5	
	P.C	0.72				1.5	0.85	1.3	

 $(A.O \ge Aspergillus oryzae; P.C \ge Penicillium chrysogenum$ 

Biomass Production by the fungi Aspergillus oryzae and Penicillium chrysogenum using the Neem Cake

To find out whether the degrading microbes have the ability to produce biomass and biosurfactant utilizing neem cake. The fungi *Aspergillus oryzae* and *Penicillium chrysogenum* were inoculated in stone medium with extracted neem cake as an energy source. At the end of log phase the biomass was separated and culture filtrate tested for the presence of biosurfactant. Effect of various environmental parameters such as nitrogenous source, pH, temperature and nutritional conditions of the medium were also studied.

#### **Biomass Production**

Aspergillus oryzae produced significant amount of biomassinthe presence of  $(NH_4)_2HPO_4$  and  $(NH_4)_2SO_4$ . Alkaline conditions and room temperature (30°C) also favoured growth of Aspergillus oryzae. Acidic condition did not show much influence. All the other factors had no favourable effect. The result showed in Table 2. Figs. 1 & 2.

Table 2: Biomass Production

	Fresh	Weight	Dry V	Veight	
Factors	Mg/50 ml	of medium	Mg/50 ml of medium		
	Ι	II	Ι	II	
Control I	1.98	0.89	0.88	0.76	
Control II	-	-	-	-	
(NH <sub>4</sub> )HPO <sub>4</sub>	5.16	4.39	2.09	1.38	
$(NH_4)_2SO_4$	4.92	3.85	1.96	0.97	
(NH <sub>4</sub> )CL	4.11	4.11	1.76	0.82	
KNO <sub>3</sub>	2.34	2.19	1.76	0.82	
pH-4	2.02	2.89	0.78	0.63	
рН-9	3.29	3.96	1.15	1.01	
25°C	3.23	3.01	1.18	1.02	
30°C	4.96	4.26	2.23	1.08	
35°C	2.04	2.08	1.07	0.56	
40°C	1.92	1.08	0.99	0.48	

I-Aspergillus oryzae; II-Penicillium chrysogenum



Aspergillus oryzae Penicillium chrysogenum



Aspergillus oryzae Penicillium chrysogenum

Fig. 2: Biomass Production (Dry weight)

Table 3: Biosurfactant Production

The nitrogenous source  $(NH_4)_2HPO_4$  enhanced the biomass production by *Penicillium chrysogenum*.  $(NH_4)_2SO_4$  also enhanced biomass production. Other factors had influencing effect on this fungi excepting KNO<sub>3</sub> and higher temperature.

#### **Biosurfactant Production**

Both the fungi produced biosurfactant during the degradation process. But *Aspergillus oryzae* shows better production then the *Penicillium chrysogenum*. Normal laboratory temperature 30°C and the presence of nitrogenous sources excepting KNO<sub>3</sub> favoured biosurfactant production. The result showed in Table 3 & Fig. 3.

Factors	Biosurfactant Mg	/50 ml of medium
	Ι	II
Control I	0.03	0.025
Control II	-	-
$(NH_4)_2HPO_4$	0.40	0.32
$(NH_4)_2SO_4$	0.28	0.21
(NH <sub>4</sub> )CI	0.37	0.28
KNO <sub>3</sub>	0.08	0.04
pH-4	0.06	0.03
pH-9	0.13	0.11
25°C	0.16	0.10
30°C	0.8	0.4
35°C	0.5	0.35
40°C	0.4	0.09

I-Aspergillus oryzae; II-Penicillium chrysogenum



Fig. 3: Biosurfactant Production

#### Discussion

Biosurfactants are widely used in many industries such as agriculture, food production, chemistry, cosmetics and pharmaceutics. Biosurfactants increase the bioavailability of hydrocarbon resulting in enhanced growth and degradation of contaminants by hydrocarbon-degrading microbes present in polluted soil. Therefore, to meet these requirements, the present investigation focused on Biosurfactant production used by cheaper carbon source like Neem press cake. The possibility of biosurfactant production using cheaper carbon sources was already reported by Thavasi et al. (2008) in peanut cake. The efficiency of microbes is enhancing the biosurfactant production of neem cake has been tested. The experiment performed to find out the suitable medium suggested that in stone medium with water and hexane extracts of Neem cake as energy source. The oil degrading Fungi Aspergillus oryzae could produce appreciable amount of biomass and biosurfactant compare to Penicillium chrysogenum Presence of a nitrogenous source in the medium such as  $(NH_{4})_{2}HPO_{4}$  seems to play significant role under laboratory conditions and neutral pH.

#### Conculsion

As a result suggests *Aspergillus oryzae* could grow well on the medium and produces biosurfactant than *penicillium chrysogenum*, so *Aspergillus oryzae* is the best and safest oil degrading organism. Hence, Surfactants have several applications in agriculture and agrochemical industries. This studies will help in replacing the harsh chemical surfactants with green ones. Several researchers indicate that variety of environmental niches such as soil, water, and leaf surface are explored for biosurfactant producing bacteria. Plant associated microbes are known to produce biosurfactant indicating the potential role of biosurfactant in plant-microbe interaction and further application of biosurfactant in agriculture.

#### References

- 1. Adekunle AA and Oluyode TF. Biodegradation of crude petroleum and petroleum products by fungi isolated from two oil seeds (melon and soybean). J Environ Biol. 2005;26(1):37–42.
- Adrio JL and Demain AL. Fungal biotechnology. International Microbiology. 2003;6(3):191–99. View at Publisher; View at Google Scholar; View at Scopus.

- 3. Banat IM. Biosurfactants production and possible uses in microbial enhanced oil recovery and oil pollution remediation: A review. Bioresource Technology. 1995;51:1–12.
- Castiglioni GL, Bertolin TE, and Costa JA. Produção de biossurfactante por Aspergillus fumigatus utilizando resíduos agroindustriais como substrato. Química Nova. 2009;32(2)292– 95. View at Publisher; View at Google Scholar.
- Desai JD, Banat LM. Microbial production of surfactants and their commercial potential. Microbiology and Molecular Biology Reviews. 1997.pp.47–64.
- Fontes GC, Amaral PF, and Coelho MA. Produção de biossurfactante por levedura. Química Nova, 2008;31(8):2091–99. View at Publisher; View at Google Scholar.
- George-Okafor U, Tasie F and Muotoe-Okafor F. Hydrocarbon degradation potentials of indigenous fungi isolated from petroleum contaminated soils. Journal of Physical and Natural Sciences. 2009;3(1):1–6.
- 8. Gupta P, Sebastil S, Sobita SR and Mishra SM. Neem Newletter. 1993;10(1&2):37.
- 9. Haba E, Abalos A, Jauregui O, et al. Use of liquid chromatography-mass spectroscopy for studying the composition and properties of rhamnolipids produced by different strains of Pseudomonas aeruginosa. J Surfactants Deterg. 2003;6:155–61.
- Isman MB, Koul O, Luczynski A and Kaminski J. Insecticidal and antifeedant bioactivities of neem oils and their relationship to azadirachtin content. J. Argic. Food Chem. 1990;38:1406–11.
- 11. Kim HS, Yoon BD, Choung DH, et al. Characterization of a biosurfactant mannosylerythritol lipid produced from Candida sp. SY 16. Appl Microbiol Biotechnol. 1999;52:713-21.
- 12. Lang S. Biological amphiphiles (microbial biosurfactants). Curr Opin Colloid Interphase Sci. 2002;7:12–20.
- 13. Mishra SD and Prasad SK. Effect of Soil Amendments on Nematodes and Crop Yields. Indian J. Nematol. 1974;4:1-19.
- M. Pirôllo, Estudo da Produção de Biosurfactantes Utilizando Hidrocarbonetos, Universidade Estadual Paulista, Sao Paulo, Brazil, 2006.
- Reuben NO, Josiah MA, Davidson DD. and M. Allagoa. Mycoremediation of polycyclic aromatic hydrocarbons (PAH) contaminated oil-based drill-cuttings. African Journal of Biotechnology. 2011;10(26):5149–56.
- Sanyaolu AAA, Adekunle AA and AA. Osuntoki. Bioremediation Potentials of a Petroleum Hydrocarbon Polluted Soil by

Indian Journal of Biology / Volume 6 Number 2 / July - December 2019

Aspergillus oryzae (JQ675305.1) Isolated from Diseased Irvingia gabonensis Seeds. The Pacific Journal of Science and Technology. 2018;19(1):321–33.

- Saratale G, Kalme S, Bhosale S and S. Govindwar. Biodegradation of kerosene by Aspergillus ochraceus NCIM – 1146. Journal of Basic Microbiology. 2007;47:400–06.
- Sasikumar CS and Papinazath T. Environmental Management and Bioremediation of Polluted Environment. In: Burch MJ., Suresh VM. and Kumaran TV. (Eds). Proceedings of the Third International Conference on Environment and Health, Chennai-India. 2003:469.
- 19. Satpute SK, Banpurkar AG, Dhakephalkar PK, et al. Methods for investigating biosurfactants and bioemulsofers: a review. Crit Rev Biotechnol 2010;30:127-44.
- 20. Shin-foon C. The active principles and insecticidal properties of some Chinese plants, with special reference to Meliaceae. 1984:255–62.Ibid.
- Swaranjit C. Cameotra. Biosurfactant production by an oil field bacterial strain. J. Microbial. Biotech. 1995;10(1):8–16.

- 22. Thavasi R, Jayalakshmi S, Balasubramanian T, Banat IM. Biosurfactant production by Corynebacterium kutscheri from waste motor lubricant oil and peanut oil cake. Letters in Applied Microbiology, 2007;45(6):686–91. View at Publisher; View at Google Scholar; View at Scopus.
- 23. Velioglu Z and Urek RO. Biosurfactant production by Pleurotus ostreatus in submerged and solid-state fermentation systems. Turkish Journal of Biology, 2015;39(1)160-66. View at Publisher; View at Google Scholar; View at Scopus.
- 24. Vererk RHJ and DJ. Wright. Biological activity of neem seed kernel extracts and synthetic azadiractin against larva of Plutella xylostella. Pesticide sci. 1993;37:83–91.
- 25. Vipulanandham C. Pollution prevention by bioconversion of industrial waste material of biosurfactant. Geo. Environment. 2002.
- 26. Warthen JD Jr, Uebel EC, Dutky SR, et al. An adult housefly feeding deterrent from neem seeds. UD Agric. Res. Results RR-NE2. 1978.

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#### **Original** Article

## Variations in Seasonal Rainfall Under Changing Climatic Scenarios at Pantnagar Situated at Tarai Region of Uttrakhand

#### Ravi Kiran

#### How to cite this article:

Ravi Kiran. Variations in Seasonal Rainfall Under Changing Climatic Scenarios at Pantnagar Situated at Tarai Region of Uttrakhand. Indian J Biol. 2019;6(2):83–87.

#### Abstract

The present investigation was carried out on the long term rainfall data from 1981 to 2015 recorded at NEBCRC, GBPUA & T, Pantnagar, situated in Udham Singh Nagar district. The data pertaining to annual rainfall shows an increasing trend of rainfall over the period only during rainy season however the number of number of rainydays shows a declining trend for this season. During post monsoon season and summer season a decreasing trend in rainfall anomaly was found at ther rate of 0.11/year and 0.26 mm per year respectively. During all the season a decreasing trend in rainyday anomaly was found. August received average annual rainfall highest and November the minimum. Average number of rainy days found highest in July and minimum in November

Keywords: Rainfall, rainy day, anomaly, trend analysis, seasons, variability, Pantnagar, climate change.

#### Introduction

Trend analysis indicate whether the climate parameters like rainfall, temperature etc. are increasing or decreasing temporally. It is a key for predicting the rainfall and rainy days. Several studies of changing pattern of rainfall over India shows no clear trend of increase or decrease in average rainfall. (Mooley and Parthasarathy, 1984; Thapliyal and Kulshrestha, 1991; Lal, 2001; Kumar et al., 2010). Rainfall is one of the key components of all weather variables which influence the agricultural productivity. Agriculture in India is largely depends on rain as around 60% of the net sown area is rain fed (Venkateswarlu and Ramarao, 2010). Climate variability particularly the rainfall variability is the major factor for wide variation in production. In Indian conditions the southwest monsoon provides around 70% of the total rainfall. this shows considerable large inter annual variability which results into drought situations

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Received on 20.11.2019, Accepted on 20.12.2019

in the country. In India, rainfall distribution is highly erratic temporally and spatially. Rainfall is received during south-west monsoon (about 74%), north-east monsoon (about 3%), pre monsoon (about 13%) and post monsoon (about 10%) with an average annual rainfall as 119 cm over India. High coefficient of variability over any region is found to be associated with drought like situations. The past decades have shown increased extremes in rainfall over north-west India. To optimize use of available rainfall effectively, crop planning and management practices must follow the strategy based on amount and distribution of rainfall at a place.

#### Materials and Methods

The present analysis was made using the rainfall data from 1981 to 2015 recorded at NEBCRC, GBPUA & T, Pantnagar is situated in Udham Singh Nagar district (29° N Latitude 79.3 Longitude and 243.8 m MSL). This area lies in *tarai* belt located in the foothills of Himalaya with annual rainfall of about 1400 mm. the daily meteorological data was collected from the Agrometeorological Observatory situated at Normen E. Borlague Crop Research Centre at Pantnagar and verified for errors. Further the data were processed at decadal and annual

scales and various statistical analyses were made to draw any final conclusion. The magnitude of the trends of rainfall and number of number of rainydays were derived and slope of regression line using the least square method.

#### **Results and Discussion**

The seasonal trend of rainfall during different seasons are presented in Fig 1. winter season (Dec-Feb) shows a slight increasing trend however the 5 years moving average show a decreasing trend. For summer season there is a sharp increase in rainfall amount over the years. During post monsoon season slight decline has been observed. During winter season again a slight decline has been observed.



Fig. 1: Seasonal trend of rainfall (mm) from 1981 to 2015 at Pantnagar.



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Variations in Seasonal Rainfall Under Changing Climatic Scenarios at Pantnagar Situated at Tarai Region of Uttrakhand



Fig. 2: Seasonal trend of number of rainydays from 1981 to 2015 at Pantnagar.

The Rainfall anomaly from 1981 to 2015 is presented in Fig. 3a,b,c,d. For the years 1981–2015 an overall increasing trend of rainfall anomalies is observed. Total annual rainfall at Pantnagar also shows an increasing trend over the period 1981– 2015. Average annual rainfall is found to be highest in August and minimum in November. During post monsoon season and summer season a decreasing trend in rainfall anomaly was found at ther rate of 0.11/year and 0.26 mm per year, respectively. While during winter and sowth west monsoon. The trend was positive at the rate on 0.21 and 6.51 mm/ year respectively.

The seasonal trend of number of rainy days during different seasons is presented in Fig 2. Winter season (Dec-Feb) shows a sharp decreasing trend. Summer season shows a decreasing trend of number of rainy days. During monsoon season a slight decline in number of rainy days has been observed. During post monsoon season a decline in number of rainydays has been observed.



Rainfall Deviation (mm) (Oct-Nov)

Fig. 3a:















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The rainyday anomaly from 1981 to 2015 is presented in Fig. 4a,b,c,d,). For the years 1981-2015 a decreasing trend of number of rainydays anomalies is observed. Average number of rainydays is found to be highest in July and minimum in November. Total annual number of rainydays at Pantnagar also shows an increasing trend over the period 1981-2015 During all the season a decreasing trend in rainyday anomaly was found. While during summer season no change was found. The long term mean annual rainfall over Pantnagar is 1569.7  $\pm$  576.0 mm with coefficient of variation of 36.7%. July and August were rainiest month and November and December received the least rainfall. However the season wise rainfall distribution depicts that the 85.5% rainfall was received during monsoon followed by summer, winter and Post monsoon season respectively. Premonsoon and monsoon season rainfall has been reported to show a increasing trend while post monsoon and winter season rainfall has a decreasing trend. Ramarao et al. 2013 also have reported an increase in future rain over 173 districts of India. The total annual rainfall showed an increasing trend (Yadav, R et al., 2014). Ramarao et al. 2013 also have reported an increase in future rain over 173 districts of India.





#### Fig. 4d:

Fig. 4: Seasonal Rainy day anomaly from 1981 to 2015 at Pantnagar (a,b,c,d)

#### Conclusion

The increasing trend of rainfall in monsoon suggest an increase in future monsoon rainfall over the region. However the annual rainfall having an increasing trend with decreasing number of rainydays shows more water losses through runoff than to go to soil. Increasing trend of rainfall anomalies indicate that in future vide variations in the rainfall amount is expected. This may be due to changing climatic scenario affecting the the behavior of hydrological cycle through out the globe.

#### Acknowledgement

The author gratefully acknowledges that the data used in the study was obtained from the records of the Agromet. Observatory situated at NREBCRC at G.B. Pant University of Agriculture and Technology, Pantnagar.

#### References

- 1. Mann HB. Nonparemetric test against trend. Econometrica. 1945;13:521–28.
- Kumar V, Jain SK and Singh Y. Analysis of long-term rainfall trends in India. Hydrological Sci. J., 2010;4(55):484–96.
- 3. Mooley DA and Parthasarthy B. Fluctuations of All-India summer monsoon rainfall during 1871–1978. Climatic Change, 1984;6:287301.
- Rama Rao CA, Raju BMK, Rao AVMS, et al. Kausalya Ramachandran and Venkateswarlu
  B. Climate change projections: A Districtwise analysis for rainfed regions in India. J. Agrometeorology. 2013;15(Special Issue – I):13– 19.
- 5. Thapliyal V and Kulshreshtha SM. Climate changes and trends over India. Mausam, 1991;42:333–38.
- 6. Venkateswarlu B and Ramarao CA. Rainfed Agriculture. Challenges of Climate change. Agricultural Year book. 2010;43–45.
- Yadav R, Tripathi SK, Pranuthi G and Dubey SK. Trend analysis by Man-kendall test for precipitation and temperature for districts of Uttrakhand. J. Agrometeorology. 2014;16:164– 71.

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## A Study on Na, K ion Concentrations in few Common, Widely Sold Packaged Drinks in India

#### **Monojit Ray**

#### How to cite this article:

Monojit Ray. A Study on Na, K ion Concentrations in few Common, Widely Sold Packaged Drinks in India. Indian J Biol. 2019;6(2): 89–92.

#### Abstract

Common, available and widely sold fruit juices, milk product soft drinks differ from common carbonated soft drinks available in India, significantly with reference to sodium and potassium ions, the two important elements among the eleven bulk essential elements present in our body. For present study along with physicochemical parameters like pH, total dissolved solid (TDS), conductance etc. Sodium ion concentrations and potassium ion concentrations within some common, available and widely sold fourteen packed drinks in India are considered. These are mainly fruit drinks, energy drinks, packaged coconut water & Amul brand milk products. The variation of pH, TDS, salinity, conductance, sodium ion concentrations and potassium ion concentrations are significant among these packaged drinks.

Keywords: pH, Conductance, Salinity, TDS, Sodium, Potassium, packed drinks.

#### Introduction

Lower pH value denotes, higher the order of acidity of packed drinks. pH of human blood always remain within the range 7.15-7.45. Total Dissolved Solid (TDS) indicates the amount of dissolved substance, conductance denotes the amount of ions present and salinity value reflect the amount of salt present. [K<sup>+</sup>] / [Na<sup>+</sup>] values for carbonated soft drinks available in India are mostly less than unity. Only for RC Cola, Pepsi, Coca cola and Thums up the values are greater than unity.<sup>1</sup> All the Tropicana and Real brand packed juices contain relatively high potassium ion concentration and [K<sup>+</sup>] / [Na<sup>+</sup>] value lies between 1.07 to 48.57.2 Sodium ion regulates, blood pressure, blood volume, osmotic pressure and of pH of human blood.3 Potassium is the most important intracellular ion. The refreshing packed drinks, widely consumed specially during summer, provide sodium and potassium ions to human

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Received on 09.10.2019, Accepted on 13.11.2019

body.<sup>4-14</sup> Sodium ion concentrations and potassium ion concentrations within human body fluid and blood are almost constant. The exact concentrations of the ions are different for different type of cells. The extracellular potassium ion concentration is 0.2 g per liter (approx), at the same time, the intracellular potassium ion concentration is 6 g per liter (approx). The extracellular sodium ion concentration is 3.45 g per liter (approx), whereas, the intracellular sodium ion concentration is 0.23 g per liter (approx).<sup>3</sup> For the present study samples taken are Del Monte Pineapple juice, Del Monte Pineapple orange juice, Del Monte Mango juice, Del Monte Green apple juice, Paper Boat Coconut water, V-fresh Coconut water, Red Bull Energy Drink, Red Bull Orange Energy Drink (Limited Edition), Cavin's Rose Lassi, Amul Kool cafe cinnamon, Amul Kool cafe classic, Amul Kool elachi, Amul Lassi and Amul Masti spiced butter milk. Most of these drinks subjected for present study contain higher potassium ion concentration than sodium ion concentration. Present study reflects that coconut water is huge source of potassium ions. Amul products contain significantly higher potassium and sodium ion concentrations than other drinks.

#### Materials and Methods

Barrackpore Rastraguru Surendranath College, Barrackopre, North 24 Parganas, WB. All the packaged drinks samples used were sealed tetra pack/metal can and manufactured within last one month of study date. Sodium ion concentrations and potassium ion concentrations were measured using Systronics (India) made Flame photometer 128 µC of the Environmental Chemistry Research Laboratory, Barrackpore Rastraguru Surendranath College. Total Dissolved Solid (TDS), pH, Temperature, conductance and salinity were measured using EUTECH made Multi-parameter PCSTester 35. Redistilled and ion free water, prepared at laboratory, were used for all the analysis. All the measurements were carried out between 18°–20°C.

#### Results

Tables 1 to 3 are shown below.

The entire study was carried out at the Environmental Chemistry Research Laboratory,

Table 1: Energy value and Maker of few common, packed soft drinks in India

No.	Brand Name	Company	Energy value (Kcal/100 ml)
1	Del Monte Pineapple juice	Field Fresh Foods Privet Limited	53.0
2	Del Monte Pineapple orange juice	Field Fresh Foods Privet Limited	47.0
3	Del Monte Mango juice	Field Fresh Foods Privet Limited	62.0
4	Del Monte Green apple juice	Field Fresh Foods Privet Limited	46.0
5	Paper Boat Coconut water	Kovai Agro Foods	24.0
6	V-fresh Coconut water	Cocoas Product	20.0
7	Red Bull Energy Drink	Rauch Fruchtsafte GmbH & Co	45.0
8	Red Bull Orange Energy Drink	Rauch Fruchtsafte GmbH & Co	45.0
9	Cavin's Rose Lassi	Cavin Kare Private Limited	88.0
10	Amul Kool cafe cinnamon	Amul Fed Dairy	100.0
11	Amul Kool cafe classic	Amul Fed Dairy	100.0
12	Amul Kool elachi	Amul Fed Dairy	89.0
13	Amul Lassi	AmulFed Dairy	79.0
14	Amul Masti spiced butter milk	AmulFed Dairy	29.3

Table 2: Physico-chemical	Parameters of few common,	packed soft drinks consumed	l in India (	$(Temp = 18^{\circ} - 20^{\circ}C)$
		*		

No.	Brand Name	pН	TDS mg/lit	Salinity mg/lit	Conductance µS/cm
1	Del Monte Pineapple juice	3.00	595	412	839
2	Del Monte Pineapple orange juice	3.45	1230	878	1732
3	Del Monte Mango juice	3.15	628	436	880
4	Del Monte Green apple juice	2.93	978	690	1378
5	Paper Boat Coconut water	4.25	7970	6390	11220
6	V-fresh Coconut water	4.42	8750	7110	12330
7	Red Bull Energy Drink	3.34	1360	974	1917
8	Red Bull Orange Energy Drink	3.05	1010	709	1430
9	Cavin's Rose Lassi	4.61	3030	2270	4290
10	Amul Kool cafe cinnamon	6.23	2740	2030	3930
11	Amul Kool cafe classic	6.03	2620	1950	3720
12	Amul Kool elachi	6.38	2210	2960	4190
13	Amul Lassi	3.75	2290	1680	3270
14	Amul Masti spiced butter milk	3.90	8870	7120	12500

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No.	Product Name	Brand	Batch Number	Na⁺mg/lit	K⁺ mg/lit
1	Pineapple juice	Del Monte	HC20E9	20.7	495.1
2	Pineapple orange juice	Del Monte	HC27B9	288	8125
3	Mango juice	Del Monte	HC02G9	37.7	576.3
4	Green apple juice	Del Monte	HC24G9	77.5	98.4
5	Coconut water	Paper Boat	UP13F19A1	223	5794
6	Coconut water	V Fresh	B230519A01	189	7168
7	Energy Drink	Red Bull	1720292	16.2	3.0
8	Orange Energy Drink	Red Bull	1734915	610.5	6.4
9	Rose Lassi	Cavin's	BC58 "L3"	2342	2591
10	Kool cafe cinnamon	Amul	KEW1431	2564	5280
11	Kool cafe classic	Amul	KEW1661	782	1994
12	Kool elachi	Amul	GAW1661	1754	3501
13	Lassi	Amul	GAW1849	1144	2210
14	Masti spiced butter milk	Amul	GAW1926	21862	8014

Table 3: Na, K ion concentrations of few common, packed soft drinks consumed in India (Temp = 18°-20°C)

#### Discussion

The energy value / 100 ml packed drinks subjected under present study are listed in Table 1. Amul Kool café classic, Amul Kool cafe cinnamon, Amul Kool Elachi and Amul Lassi provide maximum energy while, packed coconut water and Amul Masti spiced butter milk provide minimum energy to human body. Among these drinks only Red Bull energy drink contain caffeine, the stimulating agent used for refreshing body and mind. Del monte products contain original fruit parts. Paper boat and V fresh Coconut water packs contains original coconut water. Amul products are derived from milk products. pH, Conductance, salinity and TDS data are listed in table 2. Sodium ion and potassium ion concentration data are represented in Table 3. Healthy 19 to 50 years old adult should consume 1.5 g sodium ion and 2.3 g potassium ion per day. Any human body having 70 kg weight, contain 15 liters extracellular fluid, which contain approximately 50 g sodium ion, and this is the 90% of the total body sodium ion.<sup>3-7,9-14</sup> Amul products and Cavin's rose lassi contain relatively very high sodium ion concentration. It should be noted that Amul brand Masti spiced butter milk contain 21862 mg/liter sodium ion concentration which is extraordinarily higher than other soft drinks, fruit juice and carbonated soft drinks available in market. It is significant that, non-fruit soft drinks which are common and available in India contain potassium ion concentration between 0-80 mg/liter.<sup>1</sup> Appy brand apple drinks contain around 107-114 mg/ liter potassium ion, Maza and Frooti contain 154-155 mg/liter potassium ion,<sup>1</sup> Tropicana brand fruit drinks contain always above 238 mg/liter potassium ion, Real brand fruit drinks contain above 130 mg/

liter potassium ion,<sup>2</sup> whereas Del Monte brand fruit drinks contain 98.4 to 8125 mg/liter potassium ion concentration. Packed coconut water contains very high potassium ion concentration, i.e. above 5700 mg/liter. Amul products also contain high potassium ion concentrations and potassium ion prevent stroke, osteoporosis, kidney stone and hypertension.

#### Conclusion

All the drinks are acidic (pH < 7) and most of them have high TDS and conductance values. Del monte green apple juice is most acidic (pH = 2.3) and Amul Kool elachi is least acidic (pH = 6.38). The energy value/100 ml packed drinks ranges between 20-100 Kcal. According to energy value the drinks can be broadly arranged as: Amul Kool products/Lassi > fruit juices > coconut water. Except Del Monte pineapple juice all the other drinks have TDS value above 600 mg/lit. According to World Health Organization (WHO) drinks having TDS value less than 300 mg/lit are "Excellent" and that having between 300 mg/lit to 600 mg/lit are "Good".1 Amul Masti spiced butter milk and coconut waters shows high conductance values. High conductance value indicates the presence of larger amount of dissolved salts. This is also evident from sodium ion and potassium ion concentration data (Table 3). The products subjected for present study can be arranged in terms of sodium ion content as follows: Amul Masti spiced butter milk > Amul Kool cafe cinnamon > Cavin's Rose lassi > Amul Kool elachi > Amul lassi > Amul Kool cafe classic > Red Bull Orange Energy Drink > Del Monte pineapple orange juice > Paper boat coconut water > V fresh

& pure coconut water > Red Bull energy drink > Del Monte green apple juice > Del Monte mango juice > Del Monte pineapple juice.

The above mentioned drinks can be arranged in terms of potassium ion content as follows: Del Monte pineapple orange juice > Amul Masti spiced butter milk > V fresh & pure coconut water> Paper boat coconut water> Amul Kool cafe cinnamon> Amul Kool elachi > Cavin's Rose lassi > Amul lassi > Amul Kool cafe classic > Del Monte mango juice > Del Monte pineapple juice > Del Monte green apple juice > Red Bull Orange Energy Drink > Red Bull energy drink.

In all the drinks subjected for study [K<sup>+</sup>] / [Na<sup>+</sup>] is greater than unity except both the Red bull energy drinks, which also contain added vitamins. All the Amul products and coconut water have very high potassium ion content. Patients suffering from kidney diseases or problem should not consume drinks containing high potassium concentration, hence, they should avoid coconut water, Del Monte pineapple orange juice and Amul product drinks. During summer, sweating release significant amount of sodium ions from the body fluid. Amul products and Cavin's rose lassi can provide large amount of sodium ions.

#### Acknowledgement

The author is extremely grateful to Governing Body and Research monitoring committee of Barrackpore Rastraguru Surendranath College for financial assistance & funding a research project.

#### References

 Ray M and Nag C. Some Important Physicochemical Parameters and Sodium, Potassium ion concentrations in common, available and widely consumed Soft drinks in India. Indian journal of experimental biology 2015;5(12):51-54

- Ray M and Chatterjee O. Comparison of physico-chemical parameters, sodium and potassium ion concentrations: A study on packed fruit juices in India, Conscientia. 2015.
- 3. AK Das. Bioinorganic Chemistry. Books and Allied (P) Ltd.; 2008.
- 4. O Aurelia, O Cristian. Testing of the hygenic quality of the carbonated soft drinks, Analele Universitatii din Oradea, Fascicula Protectia Mediului. 2011.
- 5. Carbonated drinks: Good hosts to bad health, 2011, Consumer voice.
- 6. Ashurst P. Soft drink and fruit juice problems solved. Woodhead Publishing Limited. 2009.
- 7. Gibson, Sigrid. Sugar-sweetened soft drinks and obesity: a systematic review of the evidence from observational studies and interventions». Nutrition Research Reviews. 2008.
- 8. Louis J.C., 1980, The Cola Wars. Everest House.
- 9. Martin Hickman Caution. Some soft drinks may seriously harm your health, The Independent on Sunday. 2007.
- 10. Michael F Jacobson PhD. Liquid Candy: How Soft Drinks are Harming Americans' Health, Washington DC. 2005.
- 11. Oliver, Thomas, 1986, The Real Coke. Random House.
- 12. Tordoff MG, Alleva AM. Effect of drinking soda sweetened with aspartame or high-fructose corn syrup on food intake and body weight, American Journal of Clinical Nutrition. 1990.
- 13. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: a systematic review and metaanalysis, American Journal of Public Health, 2007.
- Wolff E, Dangsinger ML. Soft drinks and weight gain: How strong is the link?, Medscape Journal of Medicine. 2008.

## Algal Biodiversity Along Southern Coasts of India: A Review

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How to cite this article:

K Athulya, T Anitha. Algal Biodiversity Along Southern Coasts of India: A Review. Indian J Biol. 2019;6(2):93-101.

#### Abstract

Recent studies of phycological researches have shown that marine algae should be given with the equal consideration like any other groups of plant kingdom, primarily because these groups of plants also play or can also play a great role in human life when used in a sustainable manner. Thereby, finding of algal resources has evolved to be a chief necessity for phycological research. Along with the biodiversity assessment, comparing those survey works that has already undertaken can provide more information regarding with the establishment of new species, vanishing off of existed species, migration or invasion of species etc. Current paper reviews marine algal wealth along southern coasts of India and the comparative analysis of distribution, occurrence and richness of species along the different coastal areas of the southern coast.

Keywords: Phycological; Marine alga; Invasion.

#### Introduction

India has a coastline of about 7500 km including those of islands of Andaman & Nicobar and Lakshadweep. It harbors unique marine habitats which display a wide variety of marine biological diversity. The variety of coastal ecosystems along the Indian coastline includes estuaries, lagoons, mangroves, backwaters, salt marshes, rocky coasts, sandy stretches and coral

reefs. These marine habitats play very significant role in ecological and economical stability of the country. It has an Exclusive Economic Zone (EEZ) of around 2.5 million sq km and accounts for about 8% of the global biodiversity (Oza, 2005).

Among the various marine organisms, seaweed plays ecologically and economically important role as they exhibit various properties which make them suitable to be used in many economic purposes like

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Received on 25.10.2019, Accepted on 20.12.2019

medicine, food, industry etc. Thereby Phycology or study of algae has become an interested field in botanical researches. It is important to primarily assess the biodiversity and richness of these groups as a preliminary step of phycological researches. Current paper reviews the algal survey works undertaken by various authors along the southern coasts of India, i.e. along the selected coastal areas of Kerala, Tamil Nadu, and Karnataka (Fig. 1).



Fig. 1: India map showing southern coasts.

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## Economically Important Seaweeds of Kerala coast, India: A Review

SK Yadav and Mookkan Palanisamy, 2015 have conducted extensive field surveys along Kerala coast During September 2011 to March 2013 to study the algal wealth of Kerala. Kerala has a coastline of about 580 km, which is extended in 9 districts of the state from Poovar, Thiruvananthapuram district in south to Thalapady, Kasaragod district in north. It is the third largest coast of India after Gujarat with 1600 km (Jha et al., 2009) and Maharashtra with 720 km (Sakhalkar & Mishra, 2014). The coast of Kerala supports a large number of marine flora and fauna, owing to its variety of habitats such as beaches, back waters, estuaries, cliffs, lagoons, mangroves and coral reefs. Thus it forms an integral part of the marine biodiversity of India.

During the current study entire coast of Kerala was studied. A total of seven field tours were conducted to collect seaweeds in various seasons during the low tides as per Meteorological data. More than 1200 field numbers of seaweeds were collected from a total of 125 localities in Kerala coast. The seaweed samples were collected randomly from the intertidal regions. Collected samples were thoroughly washed in sea water and subsequently in fresh water without damaging the specimens. A set of herbarium specimens were prepared for each field number and the live samples were preserved in 4% formalin. All the collected specimens are deposited at Botanical Survey of India, Madras Herbarium (MH), Coimbatore. The results of present study reveal that a total of 42 economically important seaweeds species found in Kerala coast (Table 1 and Fig. 2). Among these, 29 species are edible for humans, 24 species are suitable for industries to extract the phycocolloides (agar-agar, agaroids, algin, carageenans etc.), 14 species as fodder for domestic animals, 11 species for the production of manures and 7 species are medicinal. The number of species cited above for each usage explicitly indicates that many of them have multipurpose significance. Total of 14 species are used as both food and fodder while 3 species of green seaweeds such as Enteromorpha compressa, Ulva fasciata and U. quilonensis are used as food, fodder and medicine. The class wise representation of enumerated seaweed species indicates the dominance of red algae (Rhodophyceae) with 19 species (45%), followed by green algae (Chlorophyceae) with 14 species (33%) and brown algae (Phaeophyceae) with 9 species (22%).

Name of the taxa S1. No. Uses 1. Class: Chlorophyceae, Family: Ulvaceae Edible, Fodder, Medicinal Enteromorpha compressa (L.) Nees 2. Ulva fasciata Delile Edible, Fodder, Medicinal 3. Ulva lactuca L. Edible, Fodder, Medicinal, Manure Edible Ulva reticulata Forssk. 4 5. Ulva rigida C. Agardh Edible

Table 1: List of the economically important seaweeds of Kerala coast, India

Ulva quilonensis Sindhu & Panikkar

Acrosiphonia orientalis (J. Agardh) P.C. Silva

Family: Acrosiphoniaceae

Family: Cladophoraceae

Cladophora prolifera (Roth) Kutz.

Medicinal

Edible, Fodder

Edible, Fodder, Medicinal

Sl. No.	Name of the taxa	Uses
9.	Cladophora fascicularis (G. Mertens ex C. Agardh) Kutz.	Edible, Fodder
10.	Family: Bryopsidaceae	Edible, Fodder, Manure
	Bryopsis plumosa (Huds.) C. Agardh	
11.	Family: Caulerpaceae	Edible, Fodder, Manure
	Caulerpa peltata J.V. Lamour.	
12.	Caulerpa racemosa (Forssk.) J. Agardh	Edible
13.	Caulerpa sertularioides (S.G. Gmel.) M. Howe	Edible, Fodder, Manure
14.	Caulerpa taxifolia (Vahl) C. Agardh	Edible, Fodder, Manure
15.	Class: Phaeophyceae	Edible, Fodder, Medicinal, Manure
	Family: Dictyotaceae	
	Dictyopteris bartayresiana J.V. Lamour.	
16.	Lobophora variegate (J.V. Lamour.) Womersley ex E.C. Oliveira	Industrial
17.	Padina gymnospora (Kutz.) Sond.	Edible, Fodder, Industrial, Manure
18.	Padina tetrastromatica Hauck	Edible, Fodder, Industrial, Manure
19.	Family: Sargassaceae	Edible, Manure, Industrial (Algin)
• •	Sargassum myriocystum J. Agardh	
20.	Sargassum tenerrimum J. Agardh	Edible, Manure, Industrial
21	Saraassum znightij Grozz	(Agaiola) Edible Eodder Industrial (Algin)
21.	Jurgussum wignin Grev. Turbinaria convides (I. Agardh) Kutz	Industrial (Algin)
22.	Turbinaria ornate (Turper) I. A gardh	Edible Industrial (Agaroid)
23.	Class: Rhodonhycoao	Eurole, industrial (Agarold)
24.	Family: Bangiaceae	Edible
	Porphyra indica V. Krishnam. & Baluswami	
25.	Porphyra kanyakumariensis V. Krishnam. &	Edible
	Baluswami	
26.	Gelidiaceae	Edible, Industrial (Agar)
	Gelidium micropterum Kutz.	
27.	Gelidium pusillum (Stackhouse) Le Jolis	Industrial (Agar)
28.	Gelidiella acerosa (Forssk.) J. Feldmann& G. Hamel	Industrial (Agar)
29.	Family: Gracilariaceae	Industrial (Agar)
	Gracilaria corticata (J. Agardh) J. Agardh	
30.	Gracilaria corticata (J. Agardh) J. Agardh var.	Industrial (Agar)
31.	Gracilaria edulis (S.G.Gmel.) P.C. Silva	Edible, Industrial (Agar)
32.	Gracilaria foliifera (Forssk.) Borgesen	Industrial
33.	Gracilaria verrucosa (Hudson) Papenf.	Manure, Industrial (Agar)
34.	Family: Bonnemaisoniaceae	Edible, Industrial (Antifouling
	Asparagopsis taxiformis (Delile) Trevis.	agent)
35.	Family: Halymeniaceae	Edible, Industrial (Carageenan)
	Grateloupia filicina (J.V. Lamour.) C. Agardh	
36.	Family: Corallinaceae	Medicinal
27	Corallina elongate J. Ellis & Sol.	<b>T 1</b> . • 1
37.	Jania adherens J.V. Lamour.	
38.	Family: Hypneaceae	Edible, Medicinal, Industrial
20	Humag valuatige (Turner) Mont	(Catageenan) Edible Medicinel Industrial
39.	rigpheu outentitue (Turner) Mont.	(Carageenan)
40.	Family: Lomantariaceae	Industrial
	Gelidiopsis intricata (C. Agardh) Vickers	
41.	Family: Ceramiaceae	Industrial (Agaroid)
	Spyridia hypnoides (Bory) Papenf.	,
42.	Family: Rhodomelaceae	Edible, Industrial (Agaroid)
	Acanthophora spicifera (Vahl) Borgesen	



Ulva fasciata

Acrosiphonia orientalis



Caulerpa peltata



Lobophora variegate





Dictyopteris bartayresiana



Gelidium pusillum



Turbinaria conoides



Gracilaria edulis

Acanthophora spicifera Fig. 2: Various algae reported from Kerala coast.

#### **Distribution and Diversity Assessment of Marine** Macroalgae at Four Southern Districts of Tamil Nadu, India

K Sahayaraj et al., have examined occurrence and seasonal distribution of marine macroalgae from four southern districts (Kanyakumari, Tirunelveli,

Tuticorin and Ramanathapuram) of Tamil Nadu. A total of 19 coastal areas have been selected further from these districts for the current study. For each of the specimen collected, different biological indices like Specific species score of localities (SSpL), Specific score of a locality (SSL), Berger-Parker index, Shannon index etc. were



Graph 1: Total number of algal taxa of different classes at various districts.

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calculated. Their examination results into a record of species, which belonedg to 56 taxa of algae among which 24 species were of Rhodophyceae, 18 were of Chlorophyceae and 14 species belong to the class Ochrophyceae (Phaeophyceae) (Fig. 3 and Table 2). On analyzing the data district wise (Graph 1), it was observed that Tirunelveli district harbored a maximum of 48 taxa (SSpL=84%) with a highest Berger-Parker index value of 0.615. Tirunelveli was followed by Tuticorin (SSpL=47%) and Ramanathapuram (SSpL=26%).

In all the four selected districts red algae were dominated over green and brown algae. For instance the red algae *Gracilaria corticata* (Fig. 3) was recorded in all the four districts dominating all other species followed by the green algae *Caulerpa scalpelliformis*, which was recorded during all four seasons. All other species were specifically present at certain seasons only. Intense seasonal variations of macroalgae populations were observed among the four sampling periods. During the study period, 57, 21 and 7 species were recorded from Bay of Bengal, Indian Ocean and Arabian Sea respectively. Higher Shannon index, Simpson index and Evenness index were recorded for Tuticorin district, whereas Berger-Parker index was in favor of Ramanathapuram.



Fig. 3: Dominant Species of Tamil nadu coast-gracilaria corticata.

Table 2: List of algae collected from Tamil Nadu coasts

Chlorophyceae	Phaeophyceae	Rhodophyceae
Bryopsis plumose	Chnoospora fastigiata	Acanthophora spicifera
Caulerpa cupressoides	Hormophysa triqutra	Amphiroa anceps
Caulerpa racemosa	Lobophora variegate	Amphiroa fragilissima
Caulerpa scalpelliformis	Padina gymnospora	Ceramium trunkatum
Caulerpa veravalensis	Padina pavonica	Ceramium sp.
Chaetomorpha antennina	Padina tetrastromatica	Chondrococcus hornemanni
Chaetomorpha crassa	Sargassum wightii	Galaxaura marginata
Cladophora fascicularis	Sargassum sp.1	Geledium pusillum
Enteromorpha compressa	Sargassum sp.2	Gracilaria corticata
Enteromorpha intestinalis	Sargassum sp.3	Gracilaria edulis
Enteromorpha prolifera	Sargassum sp.4	Gracilaria fergusonii
Halimeda macroloba	Spathoglossum asperum	Gracilaria foliifera
Halimeda tuna	Stoechospermum marginatum	Gracilaria verucosa
Udotea flabellum	Turbinaria ornata	Grateloupia sp.
Ulva fasciata		Hypnea musciformis
Ulva lactuca		Hypnea sp.
Ulva reticularis		Hypnea valentiae
Valoniopsis pachynema		Jania adhaerenes
		Laurencia ceylanica
		Liagora ceranoides
		Polysiphonia sp.
		Sarconema filiforme
		Sarconema sp.
		Spyridia sp.



Bryopsis plumose



Sargassum wightii



Caulerpa racemosa



Lobophora variegate





Enteromorpha compressa



Padina pavonica



Acanthophora spicifera Amphiroa anceps Fig. 4: Some of the marine algae collected from Tamil Nadu coasts

## Coastal and marine floral biodiversity along the Karnataka coast

P.Kaladharan, P.U.Zachariaand K. Vijayakumaran, 2016, Assessment of floral biodiversity along the Karnataka coast carried out by P. Kaladharan, P. U. Zacharia and K. Vijayakumaran during 2005– 2006. Karnataka has a coastline of about 300 km starting from Talapadi in the south to Karwar in the north. Distribution of marine algae in the littoral zone of the entire Karnataka coast was first studied in detail by Agadi (1985) and is found to be of 43 species. For sample collection, the Karnataka coastline is divided into nine sampling grids. Seaweeds were collected from 48 intertidal as well as estuarine stations and 12 stations from the island ecosystems along the Karnataka coast during low tide period. From the island ecosystems, seaweeds from the reef slope and subsurface were collected.

Gracilaria edulis

A total of 78 species (Table 4) of seaweeds were observed along the Karnataka coast belonging to 52 genera and 28 families. Generally, seaweed vegetation was found sparsely populated along the coast. Intertidal rocks in the Islands registered fairly good flora of brown seaweeds dominated by *Sargassum ilicifolium*, having economic importance in extracting alginate. Table 3 represents the classwise distribution of collected marine algae.

Table 3: Distribution of green, brown, red and blue green algae along the Karnataka coast

	Chlorophyceae	Phaeophyceae	Rhodophyceae	Cyanophyceae	Total
Order	3	7	7	1	18
Family	9	6	12	1	28
Genus	14	14	22	2	52
Species	26	21	29	2	78

98

Chlorophyceae	Phaeophyceae	Rhodophyceae	Cyanophyceae
Enteromorpha intestinalis	Giffordia mitchellae	Porphyra vietnamensis	Lyngbya majuscule
Enteromorpha clathrata	Ectocarpus sp.	Grateloupia filicina	Schizothrix sp.
Enteromorpha flexuosa	Sphacelaria frucigera	Grateloupia lithophila	
Ulva reticulate	Sargassum ilicifolium	Cheliosporum spectabile	
Ulva fasciata	Sargassum tenerrimum	Gelidium pusillum	
Ulva lactuca	Sargassum myriocystem	Gelidiella acerosa	
Ulva rigida	Sargassum wightii	Gracilaria corticata	
Monostroma sp.	Sargassum cinereum	Gracilaria foliifera	
Chaetomorpha antennina	Turbinaria ornate	Gracilaria edulis	
Chaetomorpha linum	Stoechospermum marginatum	Gracilariopsis lemaneiformis	
Chaetomorpha media	Spathoglossum asperum	Gelidiopsis variabilis	
Cladophora fascicularis	Dictyota bartayresiana	Rhodymenia australis	
Spongomorpha sp.	Dictyota dichotoma	Champia parvula	
Codium decarticatum	Dictyota dumosa	Amphiroa fragilissima	
Microdictyon sp.	Padina gymnospora	Amphiroa sp.	
Ernodesmis verticillata	Padina tetrastromatica	Jania adherence	
Caulerpa peltata	Dictyopteris australis	Melobasia sp.	
Caulerpa racemosa	Dilophus fasciola	Hypnea musciformis	
Caulerpa sertularioides	Lobophora variegata	Hypnea pannosa	
Caulerpa scalpelliformis	Ralfsia sp.	Hypnea cervicomis	
Caulerpa prolifera	Colpomenia sinuosa	Centroceros clavulatum	
Caulerpa taxifolia,		Ceramium fastigatum	
Bryopsis plumose		Antithamnion sp.	
Struvea sp.		Chondria armata	
Chlorodesmis hildebrandtii		Caloglossa leprieuri	
Avrainvillea amadelpha		Acanthophora spicifera	
		Laurencia papillosa	
		Polysiphonia sp.	

Table 4: List of species collected from Karnataka coast



Cladophora fascicularis



Ulva fasciata



Polysiphonia macrocarpa

Turbinaria ornate



99



Sargassum ilicifolium



Gracilaria foliifera



Schizothrix sp. Fig. 5: Some of the marine algae collected from Karnataka coast.

#### **Comparative Analysis of Algal Distribution along** the Selected Coasts

Current study has reviewed algal diversity of three coasts of southern India along Kerala, Tamil Nadu and Karnataka. When comparing floristic wealth of three coasts, Karnataka coast showed many number of species. A total of 78 species were recorded from Karnataka coast while, 56 and 42 species records were obtained from Tamil Nadu and Kerala respectively. From all three plots selected, algae from classes, Chlorophyceae, Rhodophyceae and Phaeophyceae were observed, but from Karnataka coast in addition to these three common algal classes, 2 Cyanophycean algae were also recorded, indicating certain variations or adaptive ecological features of this coast may be made the establishment of these new groups possible. In all the selected



Lyngbya majuscule

coasts Rhodophyceae was the dominating group.

species-wise cross checking of algal А composition in the coasts suggested that the commonness of species occurrence is very much appreciable along all the three coasts selected. A total of 14 species were common in all the three western coasts selected, and they are Acanthophora spicifera, Amphiroa fragilissima, Bryopsis plumose, Caulerpa racemosa, Cladophora fascicularis, Gracilaria corticata, Gracilaria edulis, Gracilaria foliifera, Hypnea musciformis, Padina tetrastromatica, Sargassum wightii, Ulva fasciata, Ulva lactuca, Ulva reticulate. Neither the variations in climatic changes nor any other environmental factors may play a significant role in these areas. As expected, western marine coasts of India exhibit many common genera as well as species.

No	Species	Karnataka	Tamil Nadu	Kerala
1	Acanthophora spicifera	+	+	+
2	Amphiroa fragilissima	+	+	+
3	Bryopsis plumose	+	+	+
4	Caulerpa peltata	+	-	+
5	Caulerpa racemosa	+	+	+
6	Caulerpa scalpelliformis	+	+	-
7	Caulerpa sertularioides	+	-	+
8	Caulerpa taxifolia	+	-	+
9	Chaetomorpha antennina	+	+	-
10	Cladophora fascicularis	+	+	+
11	Dictyota bartayresiana	-	+	+
12	Enteromorpha intestinalis	+	+	-
13	Gelidiella acerosa	+	-	+
14	Gelidium pusillum	+	-	+
15	Gracilaria corticata	+	+	+
16	Gracilaria edulis	+	+	+
17	Gracilaria foliifera	+	+	+
18	Grateloupia filicina	+	-	+
19	Hypnea musciformis	+	+	+
20	Hypnea valentiae	-	+	+
21	Padina tetrastromatica	+	+	+

Table 5: Some common species along western state coasts of India

No	Species	Karnataka	Tamil Nadu	Kerala
22	Sargassum tenerrimum	+	-	+
23	Sargassum wightii	+	+	+
24	Spathoglossum asperum	+	+	-
25	Stoechospermum marginatum	+	+	-
26	Turbinaria ornate	+	-	+
27	Ulva fasciata	+	+	+
28	Ulva lactuca	+	+	+
29	Ulva reticulate	+	+	+
30	Ulva rigida	+	-	+

#### Conclusion

The scope of algal research has recently reached a crucial point that these natural resources have to be conserved as they act as a reservoir of various medicinal as well as nutritional Phytochemicals. The objective of current study was to highlight India as a rich country for the inhabitance of its coastal areas with a rich occurrence of marine algae. Current paper reviewed various algal diversity assays along the southern coasts of India conducted by different investigators. Apart from the independent algal diversity assessment of each coast, a comparative analysis between these selected coasts has also undertaken (Table 5). It has been found that all the three southern coasts of India along Kerala, Tamil Nadu, and Karnataka harbor a rich vegetation of marine algae along their marine coast with a promising diversity, distribution and abundance of algal species. Comparative Analysis on species commonness have shown to be negligible variations in environmental as well as climatic factors may only taken place in these areas and hence many species were identified as common along all the three coasts studied.

#### References

- 1. Agadi VV. Distribution of marine algae in the littoral zone of Karnataka coast, In: V. Krishanmurthy and A. G. Untawale (Eds.) Marine Plants. SRUA, 1985.pp.35-42.
- 2. Jha B, Reddy CRK, Thakur MK et al. Seaweeds of India: The diversity and distribution of Seaweeds in Gujarat Coast. CSMCRI, Bhavnagar. 2009.p.215.
- K Sahayaraj et al. Distribution and Diversity Assessment of Marine Macroalgae at Four Southern Districts of Tamil Nadu, India, Indian Jour. Geo-Marines Sciences. 2014;43(4):607–17.
- Oza, Rohit M. Biodiversity of Benthic Marine Algae along the Indian Coast. In: Handbook of Biotechnology: 2005.p.48.
- Kaladharan P, Zacharia PU and Vijayakumaran K. Coastal and marine floral biodiversity along the Karnataka coast, Jour. Marine Biol. Ass. India, 2016;53(1):121–29.
- 6. Yadav SK and Palanisam M. Kerala coast, India; A Review. Elixir Biosciences 2015;82:32147-53.
- Sakhalkar SS and Mishra RL. Biodiversity of Marine Benthic Algae from Intertidal Zone of Konkan Coast (Maharashtra). 2014;4(2):1–3.

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[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540–7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347–55.

#### Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone-iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3–9.

#### Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792–801.

#### **Unpublished article**

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

#### Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

#### Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. pp 7–27.

#### No author given

[8] World Health Organization. Oral health surveys - basic methods, 4<sup>th</sup> edn. Geneva: World Health Organization; 1997.

#### Reference from electronic media

[9] National Statistics Online – Trends in suicide by method in England and Wales, 1979–2001. www. statistics.gov.uk/downloads/theme\_health/HSQ 20.pdf (accessed Jan 24, 2005): 7–18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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