

CHAPTER – V

5.0 SUMMARY AND CONCLUSION

The results of the study pertaining to “**An analytical study on the selected edible seaweeds and their efficacy test for human consumption**” are presented under the following summary:

- The general characteristics and taxonomy of the selected ten seaweeds namely *Acanthophora spicifera*, *Caulerpa racemosa*, *Caulerpa taxifolia*, *Chetomorpha linoides*, *Eucheuma*, *Gracillaria edulis*, *Hypnea valentiae*, *Padina gymnospora*, *Sargassum wightii* and *Ulva reticulata* were studied.
- The study shows that majority of the samples belonged to the green algae, chlorophyta and Rhodophyta family, soft texture and their habitat was rocks.
- The chosen seaweeds collected for the study namely *Acanthophora spicifera*, *Caulerpa racemosa*, *Caulerpa taxifolia*, *Chetomorpha linoides*, *Eucheuma*, *Gracillaria edulis*, *Hypnea valentiae*, *Padina gymnospora*, *Sargassum wightii* and *Ulva reticulata* were subjected to acute toxicity.
- The result indicates the clinical signs of toxicity on administration of single dose of seaweeds orally to animals at 2 gm /kg of body weight.

- Among the selected seaweeds *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* showed normal behavior and no clinical signs of toxicity. But other selected seaweeds had caused mild excitement in the animals at 2 gm/ dosing. Similar results were obtained till the 14th day of observation pointing out the safety of using the *Eucheuma*, *Sargassum wightii* and *Ulva reticulata*.
- Observations on clinical signs of toxicity on dosing 5 gm/kg and changes of body weight of seaweeds are studied. The result shows that, administration of seaweeds orally to animals at 5 gm/kg body weight showed that chosen edible seaweeds had caused mild to severe depression in the animals except *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* during the first two hours and though the animals exhibited a normal behavior after this period these seaweeds were not selected for further research.
- The *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* treated animals showed normal behavior from initial dosing till the final day of observation. Hence, these three seaweeds were considered safe even at higher doses of 5 gm /kg of body weight and therefore were used for further research.
- The gross pathology and mean organ weight of the rats indicates at levels of dosing 2 and 5 gm/kg body weight of seaweeds are studied. The results of the gross pathology and organ weight of animals indicates that chosen seaweeds fed rats showed gross pathological

changes and the organs showed considerable increase in their weights except *Eucheuma*, *Sargassum wightii* and *Ulva reticulata*.

- In general the selected edible seaweeds did not show any gross lesions in both the doses and the organ weights remained normal at the 14th day. From the results of the acute study, it is inferred that the three selected edible seaweeds namely *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* were safe at dosing levels 5 g/kg body weight.
- The classification of the test items are based on the Global Harmonization System (GHS) (OECD, 2001) for Lethal Dose 50 cut off limits and are grouped under Category Five. According to GHS, Category five is for chemicals which are of relatively low acute toxicity but which, under certain circumstances, may pose a hazard to vulnerable populations and Category five - Unclassified; Lethal Dose 50 > 5000 requires no label requirements and hence was applied for *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* administration and further investigation.
- From the results shows that the *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* were safe at 5gm/kg of body weight dosing and were taken for sub acute toxicity studies by feeding the animals with 5 gm/kg of body weight of seaweeds orally for a period of sixty days. The results indicates the physical changes observed in the animals

after 60 days of supplementation with the three selected edible seaweed samples between the experiment and control group of rats.

- The results of the study reveals that the animals in all the three groups showed slight increase in weight from the initial weight of 250-300g, were active, consumed food and water normally and had normal body temperature.
- From the study observed that the food consumption of all the three groups was 4-5 g/100 g body weight. Water consumption was more in the seaweeds supplemented groups (8-10 ml/100 g bodyweight) than the control group (7-9 ml/100g body weight). This may be due to the high fiber content present in the selected edible seaweeds.
- From the study observed that the fecal output increased in selected edible seaweeds fed rats which may be due to the bulk or presence of algal polysaccharides in the seaweeds. The urine pH ranged from 7.7-8.1 and *Ulva reticulata* supplemented rat had a high pH of 8.1 probably due to the alkaline nature of seaweeds which when consumed decrease the acidity of the body. Specific gravity of urine was in the range of 1.04 -1.07 for all the three groups. The respiratory rate was found to be 80-85 breaths/min in all the three groups.
- From these results the non toxicity nature of the selected edible seaweeds at the administered level of dose is indicated and hence can be considered safe for human consumption. Details of the biochemical parameters on animals supplemented with selected

edible seaweeds. The change in biochemical parameters were recorded after 60 days of supplementation of the selected s edible seaweeds.

- The results of the study revealed that all the parameters namely serum ferritin, serum iron, red blood cells, white blood cells and haemoglobin increased considerably in experimental group treated with selected edible seaweeds than the control group.
- From the study shows that the total ferritin levels were comparatively high in selected edible seaweeds administered animals with 125.35 ± 1.59 to 180.0 ± 2.26 . The serum iron increased in *Sargassum wightii* supplemented animals (121.67 ± 2.08) than control. This increase may be attributed to the iron content present in the seaweeds. Though there is an increase in the iron content the values are well within the normal range of 60-170mcg/dl of blood.
- The study indicates that the glucose content of experimental animals a significant variation when compared against the control. The analysis of the data infers that majority of the parameters namely cholesterol, protein and albumin increased by 1-2 per cent in the seaweed samples supplemented rats against the control group.
- The study reveals that the minerals like sodium, phosphorus, calcium and magnesium was high for the experimental group than the control group. The increase in mineral content in *Sargassum wightii* and

Eucheuma supplemented animals may be attributed to the high mineral content naturally present in the seaweeds.

- The study indicates that the increase in the blood parameters were well within the normal range. Urea nitrogen, globulin and chloride decreased in *Eucheuma* treated rats and increased in *Sargassum wightii* treated rats.
- The study shows that the serum marker enzymes such as Serum Glutamate Oxaloacetate Transaminase (SGOT), Serum Glutamate Pyruvate Transaminase (SGPT) and Alkaline Phosphatase (ALP) were found to be within normal limits in both the seaweeds supplemented groups. This result indicates that the selected three edible seaweeds were safe for human consumption and do not indicate hepatotoxicity and liver damage.
- Among the chosen seaweeds *Chetomorpha linoids* had a high amount of carbohydrate of 24.2 gm and *Sargassum wightii* had the lowest of 2.5 gm.
- From this study found that the protein content of the chosen edible seaweeds ranged from 6.2 to 32.4 gm/100gm. *Ulva reticulata*, green algae had the highest amount of protein (32.4 gm) among the selected edible seaweeds. The fiber content was high in *Eucheuma* with 42gm and *Sargassum wightii* with 39gm. Edible seaweeds have high fibre content, making up to 32 to 50 per cent of dry matter.

- The study shows that the lipid content of the seaweeds were found to be in the range of 0.4 to 4.2 gm with the least amount in *Hypnia valentia* and the highest amount in *Gracillaria edulis*.
- Among the selected seaweed samples micronutrients like iron (50.5 mg), calcium (80 mg) phosphorous (18 mg), sodium (36 mg) and selenium (1.2 gm) are high in *Eucheuma*.
- The result shows that the selected edible seaweeds have heavy metals at a very low concentration, which is below detectable level (BDL).
- The moisture and microbial content of the selected edible seaweeds powders were studied. From the study indicates that the total moisture content was found to be high in *Hypnea velentia* (18.6 %), followed by *Padina gymnospora* (12.5%).
- The study represents that the total bacterial count of the selected edible seaweeds were low in *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* with 18 cfu/100gm and the highest colony count among the selected seaweeds was observed in *Hypnea velintia* with 65 cfu/100gm.
- The qualitative analysis of the selected edible seaweeds revealed that the absence of *Escherichia coli*, *Salmonella*, *Bacillus* and *Pseudomonas*. On storage the bacterial count decreased in all the seaweeds and it was totally absent in *Eucheuma*, *Sargassum wightii* and *Ulva reticulata*.

- The three selected edible seaweeds namely *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* were used for the preparation of following food recipes such as pickle, halwa and Pakoda respectively.
- The study represents that the organoleptic characteristics point out that *Sargassum wightii* is bitter to taste and has a fishy odour, but when added in small amounts in dishes it was acceptable. *Ulva reticulata* also had a bitter taste and fishy odour but the odour was comparatively less than that of *Eucheuma* and *Sargassum wightii*. Since the three seaweeds samples had the above said qualities they were dried, powdered and incorporated into selected recipes.
- The three selected edible seaweeds were incorporated in different traditional recipes at different levels of incorporation ranging from 2, 4 and 6 per cent. The recipes were evaluated for acceptability by five hedonic rating scales. The different recipes prepared were Halwa, Pakoda and pickle incorporated with selected edible seaweeds means acceptability scores were observed.
- The mean acceptability scores of seaweed incorporated recipes shows that *Ulva reticulata* incorporated pakoda recipe to be more acceptable than other two seaweed recipes namely *Eucheuma* incorporated pickle and *Sargassum wightii* incorporated Halwa.

- The standard and incorporated selected edible seaweeds recipes were subjected to nutrient computation using Nutritive value of Indian Foods, ICMR, NIN. The result shows that, the nutrient content of Carbohydrate, Protein, Fat, Energy, Fiber, Calcium, Iron and β -carotene were present high amount in the chosen edible seaweeds incorporated recipes when compared with non incorporated edible seaweed recipes.

CONCLUSION

Edible seaweeds is a food stuff that has been historically consumed around the globe but is only consumed in appreciable amounts in certain areas of the world today. Edible seaweeds from the Mandapam coast were analysed for nutrients and ash content. The nutrient analysis is found to be higher in all levels of incorporation thus *Sargassum wightii*, *Ulva lactuca* and *Eucheuma* are a good nutrient supplement, which can help in enriching the existent nutrient quality of the common recipes. So that, incorporation with the edible seaweed powders can be made more acceptable. Selected edible seaweeds may be used as potential food supplements to improve the nutritive value of the diet. To conclude from these studies, selected edible seaweeds namely *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* are safe for human consumption. From these studies we recommended to prepare various recipes by using these seaweeds contain no toxicity for human consumption.