



## RESEARCH ARTICLE

PREPARATION OF NOVEL SEAWEED RECIPES AND STANDARDISATION FOR  
THE HUMAN CONSUMPTION

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Published Online: October 2015**Key words:**Sargassum,wightii, Ulva reticulata,  
Euchemma, seaweed and**\*Corresponding Author****S.Sumayaa****Abstract**

Edible seaweed has historically been consumed by coastal populations across the globe. In this research article we have evaluated the nutrient analysis of three seaweeds for the human consumption. From this analysis we found that of *Sargassum wightii*, *Ulva reticulata* and *Euchemma* are a good nutrient supplement, which can help in enriching the existent nutrient quality of the common recipes. So that, incorporation with the seaweed powder can be made more acceptable. Selected seaweed may be used as potential food supplements as a spice to improve the nutritive value in the diet. We have concluded from these studies, selected seaweeds namely *Euchemma*, *Sargassum wightii* and *Ulva reticulata* are safe for human consumption. From these studies we recommend the preparation of various recipes by using these seaweeds contains no toxicity.

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**INTRODUCTION**

Edible seaweed has historically been consumed by coastal populations across the globe. Seaweeds consumption appears to be growing in popularity in western cultures, due to the influx of Asian cuisine as well as health benefits associated with the consumption. Isolates of seaweed (particularly viscous polysaccharides) are used in an increasing number of food applications in order to improve product acceptability and extend shelf-life. Epidemiological evidence suggests that regular seaweeds consumption may protect against a range of diseases. The addition of seaweeds and seaweed isolates to foods has already shown potential to enhance satiety and reduce the postprandial absorption rates of glucose and lipids in acute human feeding studies, highlighting their potential use in the development of anti-obesity foods. As seaweeds and seaweed isolates have the potential to benefit both health and improve food acceptability, seaweeds and seaweed isolates offer exciting potential as ingredients in the development of new food products. Consumption of seaweeds is not so popular despite its abundance in Indian coastal areas. In India, porridge made from *Gracilaria* species and *Acanthophora* species is consumed mainly in the coastal states of Kerala and Tamil Nadu. In India people consume seaweeds indirectly in the form of phycocolloids added in chocolate, ice cream, jellies and as stabilisers in food products (Dhargalkar et al., 2005). Agar-agar, agarose and carrageenan are commercially valuable substances extracted from seaweeds. Seaweeds can help to build and sustain the broad nutritional balance of vitamins, minerals and vital nutrients on which optimum health and vitality depends. Seaweeds offer a wide range of therapeutic possibilities both internally and externally. Eating unprocessed dried seaweeds can yield many healing benefits. Many physical ailments in humans can be regularly resolved with the simple addition of seaweeds to their respective diets. Based on epidemiological and biological data, consumption of seaweeds is considered as an important factor contributing to the relatively low breast cancer rates reported in Japan. Fucans and sulfated polysaccharides extracted from brown seaweed have been shown to have inhibitory

effect on cell growth in various experimental models. These findings raise the possibility that brown seaweed like *Padina*, *Sargassum* and *Laminaria* may have clinical value in the prevention of cancer metastasis (Zakir, 2006).

Seaweeds are consumed extensively by Indonesians, Japanese and Koreans who have understood the nutritional properties. Valuable health benefits of this seaweeds are yet to be exploited by Indians. It is reported that seaweeds like *Ulva lactuca*, *Ulva reticulata*, *Enteromorpha intestinalis*, *Acanthophora spicifera*, *Gracilaria edulis*, *Padina tetrastomatica* and *Sargassum wightii* are highly concentrated in the coastal belt of Gulf of Mannar, Rameswaram to Kanniyakumari in Tamil Nadu. They are available throughout the year and can be stored for long periods in dry form. Seaweeds do not absorb toxic amounts of any element. It provides hundreds of organic compounds and is toxin free. There are extensive studies on nutritional value of fresh water algae like spirulina but seaweeds are yet to be popularized and promoted. Seaweeds are added in small amounts is power houses of nutrition.

Dos Santos et al., (2014) evaluated the biological activity of the dichloromethane/methanol extract (DME) from the brown seaweed *Dictyota mertensii* against *Leishmania amazonensis* and its cytotoxic potential on mammalian cells. The extract showed significant inhibitory effect on the growth of promastigote forms and low toxicity against mammalian cells. The DME was also efficient in inhibiting the infection in macrophages and significantly decreased the survival of amastigote forms within these cells. Marijana Kosanic et al., (2014) investigated the acetone extracts of macroalgae *Ulva lactuca* and *Enteromorpha intestinalis* were tested for antioxidant, antimicrobial and cytotoxic potential. Antioxidant activity was evaluated by measuring the scavenging capacity of tested samples on DPPH and superoxide anion radicals, reducing the power of samples and determination of total phenolic and flavonoid compounds in extracts. As a result of the study, *U. lactuca* extract was found to have a better free radical scavenging activity than *E. intestinalis* extract.

Recipe books promoting the use of 'sea vegetables' or 'marine vegetables' in home cooking are becoming more popular. As consumer health and nutrition become more influential in the food industry, the use of seaweed as an ingredient is on the rise and product development involving salads and wraps appears to be slowly evolving. As dried seaweed is high in dietary fibre, along with a range of other potentially bioactive components, this addition has the potential to enhance the nutritional quality of a product. Habitual consumption of seaweed may offer a nutritionally rich addition to the diet (Yang and Nam, 2010).

Research conducted in western and other Asian countries reveals that consumption of sea vegetables has prevented the onset and incidence of cardiovascular disease, obesity, cancer, osteoarthritis and diabetes mellitus. In south India the mandapam coast of Gulf of Mannar region harbours luxuriant growth of seaweed (CMCRI, 2005). Seaweeds are produced in toner, possess high nutritional value is being poorly consumed as food by the people in these areas as well as in the other part of India. Exploiting natural food resources is an easy and quick solution to prevent the rising prevalence of lifestyle and nutritional disorders. In the modern and stressful unhealthy lifestyle seaweeds are promising as natural resource in terms of availability and nutrient density. Hence keeping these facts in mind, the study was carried out with the following general objectives to:

- Incorporation of selected edible seaweeds in South Indian indigenous recipes as value addition and
- Computation of nutrients contents of standard and incorporated seaweed recipes

The seaweeds namely *Eucheuma*, *Sargassum wightii* and *Ulva reticulata* are selected for this study.

*Sargassum wightii*



*Ulva reticulata*



## *Eucheuma*



### 1. Materials and Methods

#### Incorporation of selected edible seaweeds in south Indian indigenous recipes

##### *Formulation of selected edible seaweed products*

Value added products namely pakoda and halwa were developed with the incorporation of seaweeds *Eucheuma*, *Sargassum wightii* and *Ulva reticulata*, so that they can be used to supplement humans and determine the nutrient contents in the seaweed recipes.

##### *Selected edible seaweed recipes*

Three recipes were prepared *viz*, pickle, pakoda and halwa from *Eucheuma*, *Ulva reticulata* and *Sargassum wightii* respectively and these products also prepared without seaweed powders. The selection of the product was based on the easy in preparation and packaging. Dry seaweeds powder of *Eucheuma* was prepared in 2%, 4% and 6% levels in pickle, powder of *Ulva reticulata* was prepared in 2%, 4% and 6% levels in pakoda, and *Sargassum wightii* was prepared 2%, 4% and 6% levels in halwa. All the recipes were standardized for one serving and repeated thrice to get consistent results.

Preparation of recipes is a formula specifying the quality of each ingredient required to produce a specific quantity and quality of a particular food item (Khan, 1987). A written set of description was followed for each recipe. Each ingredient was weighed using a weighing scale before and after preparation. Portion size and duration of preparation were noted in each case. All the recipes were standardized for one serving and repeated thrice to get consistent results. The recipes were then subjected to sensory evaluation to find out the overall acceptability. The sensory evaluation was done by a panel of five experts using a five point hedonic scales.

**Fig. 1: Ingredients used for preparation of seaweed Halwa with *Sargassum wightii***



1. Wheat flour 2. Sugar 3. Ghee 4. Cardamom powder 5. Warm water

**Table- 1: Ingredients used for value added seaweed Halwa and standard Method of preparation**

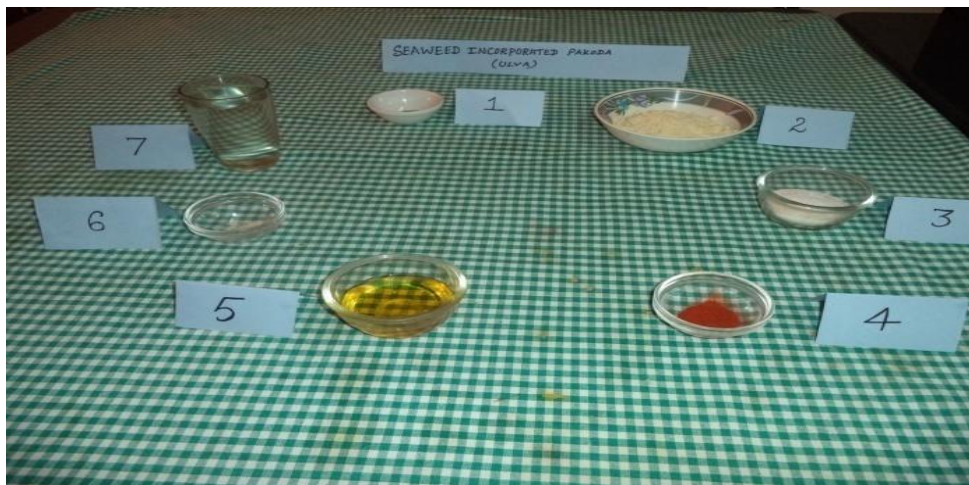
S.No	Ingredients	Standard Quantity	Level of incorporation		
			2%	4%	6%
1.	Sargassum wightii powder	-	2g	4g	6g
2.	Wheat flour	50g	50g	50g	50g
3.	Sugar	30g	30g	30g	30g
4.	Ghee	20ml	20ml	20ml	20ml
5.	Cardamom powder	2g	2g	2g	2g
6.	Warm water	200ml	200ml	200ml	200ml

**Method of preparation**

1. Take wheat flour with *Sargassum wightii* powder and add water little by little to form a stiff dough. Soak the dough in 1 cup of warm water at least for 5-7 hours.
2. Then mix the dough well with till the dough is completely dissolved without any lumps.
3. Then strain the milk using a strainer and discard the left out scum. Leave the milk to rest for 10 minutes.
4. Discard the top most clear liquid, without disturbing the settled milk
5. Fry the cashews in ghee and set aside.
6. Take a heavy bottomed pan, boil sugar with water until it reaches a single thread consistency. Then add the wheat flour milk.
7. Keep stirring until it reaches the halwa stage start adding ghee.

**Fig. 2: Halwa standard and incorporated with *Sargassum wightii* seaweed powder**



**Fig. 3: Ingredients used for preparation of seaweed pakoda with *Ulva reticulata***

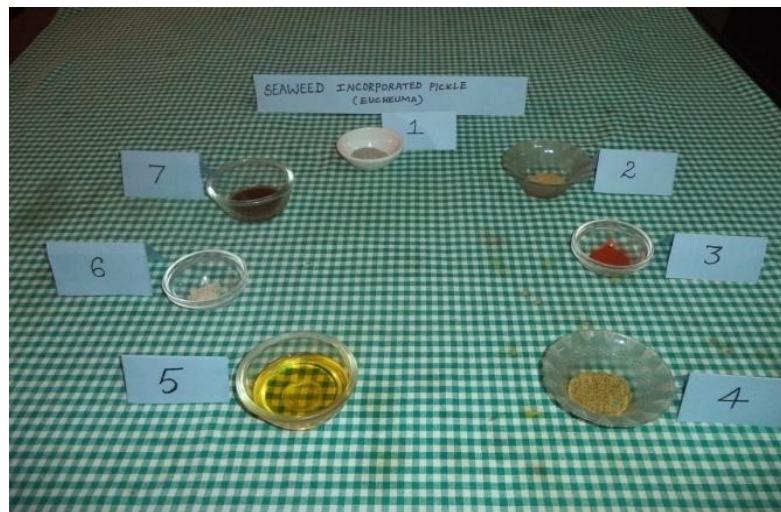
1. Seaweed powder 2. Gram flour 3. Rice flour 4. Chilli powder 5. Oil 6. Hing 7. Water

**Table – 2: Ingredients used for preparation of edible seaweed pakoda with *Ulva reticulata* seaweed powder**

S.No	Ingredients	Standard Quantity	Level of incorporation		
			2%	4%	6%
1.	Ulva seaweed powder	–	2g	4g	6g
2.	Gram flour	50g	50g	50g	50g
3.	Rice flour	20g	20g	20g	20g
4.	Chilli powder	10g	10g	10g	10g
5.	Oil	25ml	25ml	25ml	25ml
6.	Hing	1g	1g	1g	1g
7.	Water	100ml	100ml	100ml	100ml

**Method of preparation:**

1. Cut onion thinly lengthwise and keep it aside.
2. In a bowl, mix together onion, gram flour, rice flour, seaweed powder, chilli powder, 1 tsp hot oil and hing. Add water and mix well.
3. Heat oil and add prepared pakoda batter and drop it into the oil.
4. Fry until golden brown, stirring in between. Remove it from the oil and drain excess oil on a colander or paper towel.

**Fig. 4: Pakoda standard and incorporated with *Ulva reticulata* seaweed powder****Fig. 5: Ingredients used for preparation of edible seaweed pickle with *Eucheuma* seaweed powder**

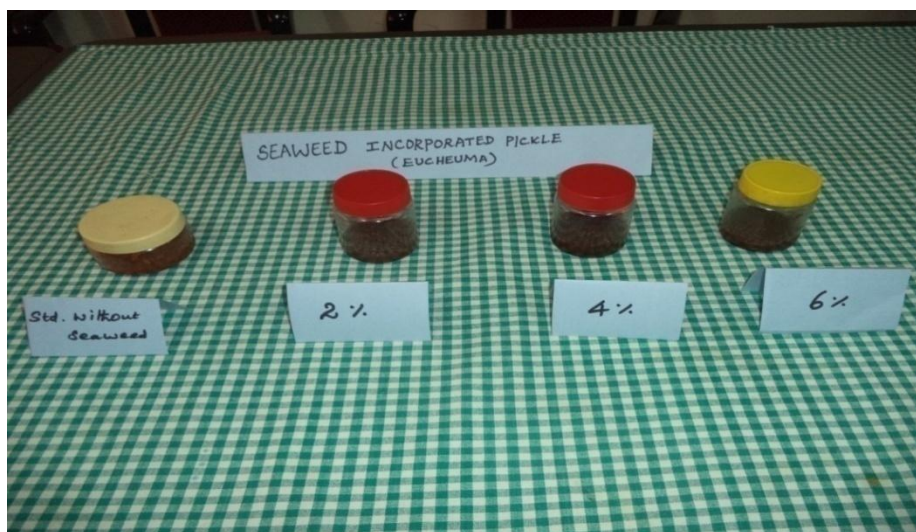
1. Seaweed powder
2. Fenugreek powder
3. Chilli powder
4. Mustard powder
5. Gingelly oil
6. Asafodita
7. Tamarind extract

**Table – 3: Ingredients used for value added edible seaweed powder (*Eucheuma*) pickle and standard**

S.No	Ingredients	Standard Quantity	Level of incorporation		
			2%	4%	6%
1.	<i>Eucheuma</i> seaweed powder	–	2gm	4gm	6gm
2.	Fenugreek powder	2gm	2gm	2gm	2gm
3.	Chilli powder	10gm	10gm	10gm	10gm
4.	Mustard powder	1gm	1gm	1gm	1gm
5.	Gingelly oil	15ml	15ml	15ml	15ml
6.	Asafoetida	1gm	1gm	1gm	1gm
7.	Tamarind extract	5ml	5ml	5ml	5ml

**Method of preparation**

1. Heat gingelly oil and add mustard seeds, fenugreek powder, chilli powder, asafoetida, seaweed powder and tamarind extract.
2. Mix well and keep covered for a day.
3. Next day cover the bowl with a muslin cloth and keep in sunlight for few hours for a day.
4. Add the gingelly oil in the jar, the oil will be at least 1 inch above the pickle level.
5. Cover the jar with the lid and let it mature for a week before start using.

**Fig.6: Pickle standard and incorporated with *Eucheuma* seaweeds powder**

## 2. Computation of nutrients contents of standard and incorporated seaweed recipes

The standard and incorporated seaweed recipes were subjected to nutrient computation using Nutritive value of Indian Foods, ICMR, NIN (Gopalan, 2002). The results of nutrient content of the value added three recipes are presented in Table 18 & 19. In addition that, estimation of nutrient content of recipes prepared without seaweed also mentioned. The energy value was computed. The nutrients namely Carbohydrate, Protein, Fat, Energy, Fiber, Calcium, Iron and Carotene were computed.

**Table 4: Computed nutrients contents of the standard and incorporated *Sargassum wightii* halwa recipe**

Name of the Nutrients	Standard	2%	4%	6%
Carbohydrate (g)	67.61	67.66	67.71	67.76
Protein (g)	5.73	6.29	6.86	7.42
Fat (g)	20.49	20.51	20.52	20.54
Energy (Kcal)	477.9	480.34	482.7	485.06
Fiber(g)	0.55	1.33	2.11	2.89
Calcium(mg)	17.7	18.67	19.65	20.63
Iron (mg)	1.48	2.26	3.036	3.81
Carotene (µg)	12.5	12.6	12.79	12.94

**Table -5: Computed nutrients contents of the standard and incorporated *Ulva reticulata* pakoda recipe**

Name of the Nutrients	Standard	2%	4%	6%
Carbohydrate (g)	51.87	52.27	52.67	53.07
Protein (g)	13.39	14.03	14.68	15.33
Fat (g)	29.15	29.25	29.35	29.45
Energy (Kcal)	532.17	534.85	537.53	540.21
Fiber(g)	6.72	7.48	8.24	9.00
Calcium(mg)	68.9	69.51	70.12	70.73
Iron (mg)	3.64	4.58	5.51	6.454
Carotene (µg)	133.54	133.66	133.79	133.92

**Table - 6: Computed nutrients contents of the standard and incorporated *Eucheuma* pickle recipe**

Name of the Nutrients	Standard	2%	4%	6%
Carbohydrate (g)	6.40	6.81	7.23	7.64
Protein (g)	2.50	2.95	3.41	3.86
Fat (g)	21.84	21.92	22	22.08
Energy (Kcal)	213.19	218.95	224.71	230.47
Fiber(g)	6.52	7.38	8.2	9.04
Calcium(mg)	55.5	57.2	58.7	60.3
Iron (mg)	1.91	2.92	3.93	4.94
Carotene (µg)	75.58	75.66	75.74	75.82

From the above tables shows that, the nutrient content of Carbohydrate, Protein, Fat, Energy, Fiber, Calcium, Iron and Carotene were present high amount in the chosen seaweed incorporated recipes when compared with non incorporated seaweed recipes.



### 3. Conclusions

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. 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 seaweeds powder can be made more acceptable. Selected seaweeds may be used as potential food supplements to improve the nutritive value of the diet. To conclude from these studies, selected 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.

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