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Article

Manufacture of different value added seaweed products and their acceptance to consumers

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Abstract: Naturally available seaweeds has not been utilized significantly in Bangladesh. In order to make a way for effective utilization of seaweeds, this study was focused on manufacture of different value added seaweed products and their acceptance to consumers. Four value added seaweed food products; namely, seaweed jelly, soup, ice-cream, curd; two functional food products, namely, seaweed singara, samucha/samosa, and two cosmetic products, namely, seaweed face pack, shampoo were prepared at Fish Processing Laboratory, Bangladesh Agricultural University (BAU), Mymensingh. *Hypnea* sp. seaweed powder was used in manufacture of all the products. For seaweed jelly, soup, ice-cream and curd consumer acceptance was 66.67%, 50%, 41.67% and 83.34%, respectively. For seaweed singara and samucha/samosa, 100% acceptance was found. Seaweed face pack and shampoo got 100% and 66.67% consumer's acceptance, respectively. Thus, all these products have potential to be produced commercially.

Keywords: seaweed powder; value added food products; functional food products; consumer acceptance; *Hypnea*

1. Introduction

Seaweeds are basically macroscopic marine algae of Chlorophyta, Rhodophyta, Phaeophyta and some tuft forming blue-green algae of Cyanophyta division (Round, 1970; Okazaki, 1971; Chapman, 1973; Santhanam *et al*., 1990; McHugh, 2003). Utilization of seaweed across the world is rapidly increasing for human consumption, medicine, hydrocolloid production, cosmetics, animal feed, fish feed, fertilizers and soil conditioners etc., (McHugh, 2003; Alejandro *et al*., 2005; Burg *et al*., 2012; Mesnildrey *et al*., 2012; Gade *et al*., 2013; Kılınç *et al*., 2013).

In Bangladesh, seaweeds remain available throughout the whole southern coast bordering the Bay of Bengal from Sundarbans mangrove forest to St. Martin's Island during October to April. Till now, 193 seaweed species including 19 commercially important species has been reported. As only insignificant portion of yearly available seaweed biomass is used by Mog or Rakhyine tribal community and seaweed harvesters of St. Martins' Island, seaweed has not been utilized properly in this country (Sarkar *et al*., 2016).

Recently seaweeds as human food has gained too much importance in context to food security problem, considering nutritional facts (Duarte *et al*., 2009; Majumder, 2010, Siddique *et al*., 2013). People are becoming increasingly health conscious and looking for foods with special bioactive functions (Forssell *et al*., 2006). Due to the presence of various extraordinary bioactive compounds such as fucoidans, xylans, ulvans, laminarin, phycobiliproteins, β-carotene, lutein, fucosterol, terpenoids, phlorotannins, lycopene, violaxanthin, antheraxanthin, zeaxanthin, neoxanthin etc. and high vitamins and mineral content, different kinds of functional food products can also be manufactured easily from seaweed. Those bioactive compounds are now being used in treatment of neuro-degenerative diseases (Alzeimer's and Parkinson's), gastric ulcers, diabetes, cancers,

chronic fatigue syndrome (CFS), cardio-vascular diseases, ophthalmological diseases etc. (Burtin, 2003). It has been observed in the western countries that to create an image of natural products, seaweeds are often used as ingredient on cosmetic packages, particularly in face, hand and body creams or lotions, face masks, shampoos, body gels, bath salts, and even a do-it-yourself body wrap kits. Such products have been holding consumer attention very strongly as proven that, such ingredients condition and hydrate the skin and hair while nourish, rejuvenate, detoxify, replenishes minerals and prevent aging (De Roeck Holtzhauer, 1991; McHugh, 2003).

In order to utilize unused seaweed resource properly, approach to manufacture value added seaweed foods, functional foods and cosmetic product was necessary as in context of Bangladesh, seaweed is almost unknown to mass population.

Considering these, this study was designed so to fulfill the following objectives:

a) To prepare some value added food, functional food and cosmetic products from naturally occurring seaweeds in Bangladesh.
b) To asses consumer acceptance for those products.

2. Materials and Methods

2.1. Preparation of value added seaweed products

Four value added food products, namely, seaweed jelly, soup, ice-cream, and curd; two functional food products, namely, seaweed singara, samucha/samosa, and two cosmetic products, namely, seaweed face pack, shampoo was prepared at Fish Processing Laboratory, Bangladesh Agricultural University (BAU), Mymensingh. *Hypnea* sp. Seaweed powder was used to manufacture all of those products.

2.2. Manufacture of seaweed jelly

One tea spoon seaweed powder was added to 250 ml boiling water with some table salt. After mixing well, the supernatant was collected carefully. Such 3 cup of seaweed extract was then mixed with 1 cup of sweet orange juice and some sugar. The solution was finally kept at chilled condition for 3 hours. About 300g seaweed jelly was prepared in this way.

2.3. Manufacturing seaweed soup

For hydration of dried seaweed powder, 1 tea spoon seaweed powder was soaked for 20 minutes in water at ambient temperature with some lemon juice. Then 800 ml water with some salt and vinegar was heated. Hydrated seaweed powder and hot water was mixed and seaweed extract was collected as previous. After addition of peeper and ghee to seaweed extract, heating was continued until foam aroused. Cooking pot was then taken out from stove. Two teaspoon corn flour was mixed with 1 cup of water and ½ cup of the solution was added slowly to cooking pot with gentle stirring. Again the cooking pot was heated on stove and rest of the corn flower was added with gentle stirring. Heating was continued until dense foam appeared on the liquid surface. About 1 L soup was prepared.

2.4. Seaweed ice-cream manufacturing process

With ice-cream sugar and ice-cream powder, one cup seaweed extract as processed in seaweed soup preparation was added to 0.5 liter skimmed milk and heated for 5-6 minutes, blended until foam aroused and then kept in freezer. By this way About 1 L ice-cream was prepared.

2.5. Seaweed curd manufacturing process

Half liter of whey butter milk with sugar was heated. 200ml seaweed extract with some orange pulp was added and mixed well. Then, for stabilization, the curd was kept at ambient temperature for 12hours and finally stored in refrigerator. Thus, about 0.75L curd was prepared.

2.6. Manufacturing seaweed singara and samucha/samosa

Usual manufacturing procedure of singara and samucha/samosa was followed except addition of 1 tea spoon of seaweed powder to filling.

2.7. Seaweed face pack manufacturing procedure

To prepare a onetime usable seaweed face pack, seaweed paste was made by addition of one teaspoon lukewarm water to one teaspoon dry seaweed powder. One teaspoon alovera gel and 1 teaspoon honey was added to the paste and stirred until well mixed. After addition of some water to that paste, about ½ teaspoon dried saffron crocus, sandalwood, fenugreek, linseed, stevia leaf, orange chaff, turmeric powder, rose petals, marigold petals and ginger powder was added and stirred until well mixed. At intense sunlight rather than under direct sunlight, the paste

was kept under shade for drying. One hour later when the paste became completely dried, then the cake was powdered in blender and packed in small plastic bags.

2.8. Seaweed shampoo

To the seaweed extract at first one teaspoon honey and then 1 teaspoon Sorbitan esters (surfactant) was added followed by addition of 50 g castile soap. The whole mixture was blended at high speed until the mixture become smooth and kept aside for 30 minutes so that the ingredients could infuse together. About 300 ml shampoo was prepared and packed in plastic bottles.

2.9. Consumer's acceptance test for manufactured seaweed products

A taste panel of three heterogeneous group including the professors of the Department of Fisheries Technology, BAU as high income consumers due to their vast experience; four students and four 3rd class employee of the Faculty of Fisheries, BAU as mid and low income consumer, respectively, was set up for "Paired comparison" at Fish Processing Laboratory, BAU. Four seaweed food products, namely, seaweed soup, jelly, ice-cream, curd, and two functional food items, namely, seaweed singara and samucha were respectively presented to the panelists along with conventional soup, jelly, ice-cream, curd, singara and samucha which were collected from local market, BAU.

Natural light was used during panel testing. To avoid extraneous odour, windows and door was kept closed. For precisesensory assessmentthe door was also kept closed to eliminate any possible distraction.

To determine consumer's acceptability for seaweed cosmetic products by subjective sensory method, seaweed face pack and shampoo was given to randomly chosen three male and three female students of BAU and after 10 days their feedback was collected.

All the collected data were summarized, tabulated and analyzed by MS Excel 2013.

3. Results

3.1. Value added seaweed products

Four value added seaweed food (Figure 1), functional food (Figure 2) and 2 cosmetic products (Figure 3) were prepared in this study.

3.2. Consumer's acceptance for manufactured seaweed products

Among 12 panelists, seaweed jelly, soup, ice-cream and curd was considered as better than conventional products by8, 6, 5 and 10 panelists, respectively (Figure 4). No difference between seaweed singara, samucha/samosa and conventional singara, samucha/samosa was claimed by any panelist. So, 100% consumer acceptance was found in this case. In consumer's acceptance test for seaweed cosmetic products, seaweed face pack and shampoo was considered better than conventional products by 6 and 4 panelist, respectively (Figure 5).

Seaweed jelly

Seaweed soup

Seaweed ice-cream

Seaweed curd

Figure 1. Value added seaweed food products.

Seaweed singara

Seaweed samucha/samosa

Figure 2. Seaweed functional food products.

Seaweed face pack

Seaweed shampoo

Figure 3. Seaweed cosmetic products.

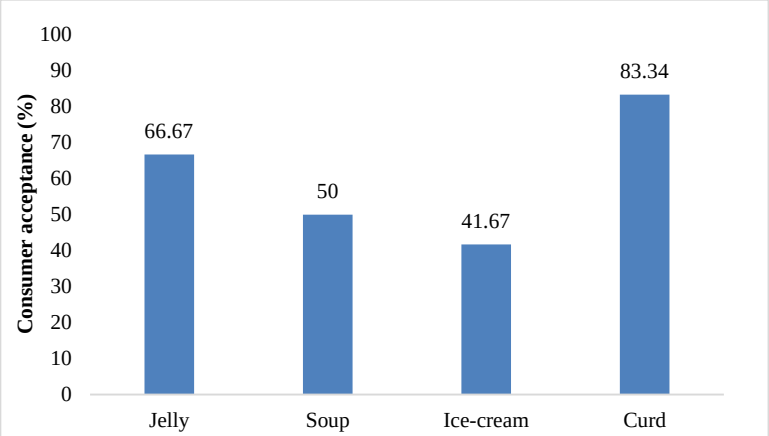

Figure 4. Consumer acceptance for value added seaweed food products.

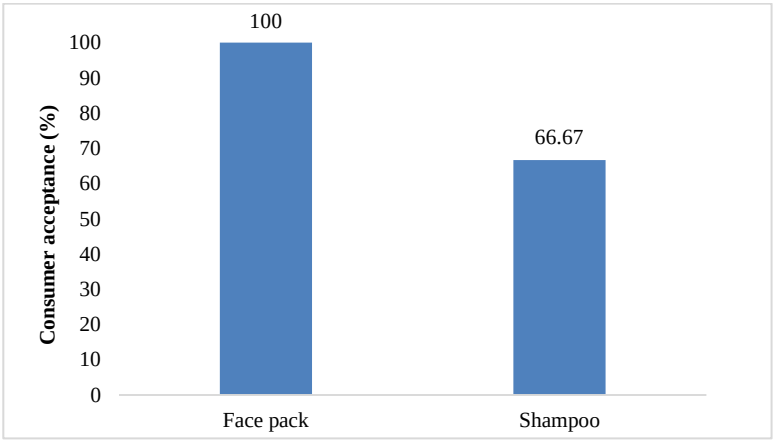

Figure 5. Consumer acceptance for seaweed cosmetics products.

4. Discussion

4.1. Value added seaweed products

May be due to osmosis or other physiological functions, seaweed naturally contain significant amount of silica sand (SiO_2) within its body. Thus, seaweed powder also contains sand. In all the cases of seaweed extract preparation for different product processing, such sand was removed first by precipitation of sand with action of salt (NaCl) and lemon juice, vinegar (citric acid). It has been reported that, salt with sand form a sodium complex; $SiO\text{-}Na^+$ whereas citric acid as a monohydrate organic acid form silicon oxide-adsorbed water-acid compound and such compounds were responsible for precipitation of sand (Dove and Elston, 1992; Vorsina *et al*., 2011).

Agar, alginate and carrageenan extracted from seaweeds are extensively used as stabilizer in food processing industry (Gade *et al*., 2013; Kılınç *et al*., 2013). 40.46% agar was reported to be extracted from *Hypnea* spp (Majumder, 2010).It can be assumed that, during processing of seaweed food products when seaweed powder was boiled with hot water; agar, alginate and carrageenan was dissolved to that water and for these gel and viscosity forming agents, seaweed food products such as jelly, soup, ice-cream and curd became stabilized.

Functional food is a food given an additional function (often one related to health-promotion or disease prevention) by adding new ingredients or more of existing ingredients (Menrad, 2001; Siró *et al*., 2008). In seaweed singara and samucha/samosa; a new ingredient, seaweed powder having different bioactive compounds was added, so, such singara and samucha/samosa can be considered as functional food product although their functionality on human body have to be investigated.

The marine environment is many folds richer in its biodiversity, thereby making marine organisms and their metabolites unique (Paul C and Pohnert, 2011). Due to presence of unique compounds like phlorotannins, sulfated polysaccharides, tyrosinase inhibitors, alginic acid etc., seaweed soap, lotion, face cream, bath salt, skin moisturizer along with seaweed face pack and shampoo are produced (McHugh, 2003 ; Thomas and Kim, 2013).

4.2. Consumer's acceptance for manufactured seaweed products

Sensory judgements are sometimes influenced by external factors.The color of a product might appear different under different types of lighting (Connell, 1980).So that, it is universally recognized that environmental factors need to be controlled during sensory testing of food (Clucas and Ward, 1996).

Considering these, result of consumer's acceptance for different value added food products can be accepted. It is notable here that seaweed powder is tasteless, odorless, so, logically no difference between seaweed singara, samucha/samosa with conventional singara, samucha/samosa was found. Along with seaweed, different organic compounds having medicinal value were used in seaweed face pack, so, 100% consumer acceptance for this product may be found. On the other way, like commercial shampoo, no flavor compounds were used in seaweed shampoo. Maybe, that's why 2 of the 6 judges denied acknowledging the seaweed shampoo as better than conventional one.

5. Conclusions

Although seaweed is not familiar in Bangladesh but consumers acceptance for different value added seaweed products has showed potential for industrial production. Except *Hypnea* other seaweed species should also be

used to manufacture different products. In hotels and restaurants of Cox's Bazar and St. Martin's Island, if such products are presented with Bangladeshi trend and culture, the products may draw tourist attention. Beside, as the processing technique of these products are easy and just daily life utensils are required, so, the technology should be transferred to coastal poor fisher folk or other potential marketing places of Bangladesh through Govt. agencies, NGOs or by collaborative approaches of both. Natural seaweed stock sustainability must not be overlooked. Further research on quality aspects of these products such as proximate composition analysis and shelf life determination is required.

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Conflict of interest
None to declare.

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