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QUALITY EVALUATION OF FISH SOUP POWDER SUPPLEMENTED WITH CARRAGEENAN

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Abstract: Carrageenans are widely utilized in food industry because of their physical and functional properties. In the present study, carrageenan was extracted from red seaweed and it was tested for the possibility for making healthy and nutritious fish soupfor human consumption. The spray dried carrageenan powder had a protein, ash content of 12.12%, 34.53% respectively. Fish soup powder was prepared with the addition of 5% carrageenan powder and their nutritional properties were evaluated. Fish soup powder contained corn flour was served as control. Results suggested that fish soup powder can be prepared with the supplementation of carrageenan at 5% level without affecting consistency and flavor characteristics of soup and thereby increase the nutritional value of healthy soup for human consumption.
Keywords: Carrageenan, spray drying, fish soup powder, quality.

Introduction

Seaweeds are considered healthy food owing to their richness in protein, vitamins, minerals, and bioactive compounds and at the same time having relatively lower calorie content (Lee *et al*., 2008; Gomez-Ordonez *et al*., 2010). Seaweeds are also an excellent source of bioactive compounds such as carotenoids, dietary fibre (Bhaskar & Miyashita, 2005). Seaweeds are divided into green, brown, red and blue green algae based on the type of pigments, and external and internal structures. Carrageenan is a natural polysaccharides obtained from edible red seaweeds. *Kappaphycusalvarezii* or commonly known *Euchemacottonii* is a good source of kappa-carrageenan and highly demanded for its cell wall polysaccharide (Munoz *et al*., 2004). Kappa carrageenans are widely utilized in food industry because of their physical and functional properties, such as thickening, gelling agent, stabilizer for dairy-based products; for instance, cheese, ice-creams, yogurt, butter, sausages, paste thickener and others (Bono *et al*.,2011; Arifin *et al*., 2003). When used in the food products carrageenan has the EU additive number of E407 or E407a.

In Asian countries, Japanese are the main consumers of seaweed with an average of 1.4 kg (dry weight) per capita (Burton *et al*., 2003). But in India, seaweeds are exploited mainly for

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the industrial production of phycocolloids such as agar-agar, alginate and carrageenan, not for health aspects. There is an increasing demand for ready to cook or ready serve convenience fishery products throughout the world due to its health benefits. Their beneficial effects are due to the proteins that contain all essential amino acids and are easily digestible (Elizebeth & Lund, 2013). Soup is one the value added liquid food, which is made by combining ingredients such as meat and vegetables in stock or hot water, until the flavor is extracted (Shasidhar *et al*., 2014). Soup is either prepared fresh or made from the soup powder. In the present study carrageenan was extracted from red seaweed and fish soup powder was prepared with addition of carrageenan and their quality characteristics were evaluated.

Materials and Methods

Preparation of carrrageenan

The red seaweed (*Kappaphycusalvarezii*) were collected from Chennai, Indian and cleaned with potable water and dried under shade condition. The dried red seaweed was used for the extraction of carrageenan. Clean and dried seaweed was cut in to 1-2mm size by micropulveriser (FRITSCH, Germany). Kappa carrageenan was extracted by the method followed by Winaro (1996) with slight modification. Known quantity of dried seaweed was taken and 50% water was added and mixed well. After that it was kept at overnight at room temperature. Then it was heated at 60°C and macerated to get slurry form. Then 0.2% (w/w) calcium hydroxide was added and kept at 100°C for 3hrs with occasional mixing. After extraction it was subjected to centrifugation for 2 min at 3000rpm and temperature of 40°C. Supernatant was collected and neutralized with Hydrochloric acid and then spray dried (S.M Scientech, Kolakata, India) under the following conditions; inlet temperature 160C; Out let temperature 80C, nozzle diameter 3mm, air pressure 4bar, spray flow rate 5ml/min. Crude carrageenan was obtained after spray drying.

Preparation of fish soup powder

Croaker fish (*Johniusdussumieri*) was purchased from local fish market. Ingredients for soup powder preparation is given in Table 1. Cleaned and steam cooked fish meat was taken and known quantity of water was added and it was made in to paste by blender. Beside, onion was fried in vegetable fat and powdered coriander and pepper was added. Then it was added to the ground fish paste along with other ingredients except milk powder. Then the whole mass was poured in thin layer in aluminium traysand driedin vacuum dryer at about 60^0C. Then the dried mass was powdered and skimmed milk powder was added and mixed well to

get a homogeneous product. Fish soup powder was packed in aluminum foil bags for the further analysis.

Table 1: Ingredients used for preparation of soup powder

Ingredients	**Quantity (g)**
Cooked fish	75
Onion	75
Coriander powder	1.2
Pepper powder	1.5
Butter	15
Corn flour/ Carrageenan	25 / 5
Milk powder	10
Sugar	3
Ascorbic acid	0.15
Caboxy methyl cellulose	0.3
Salt	17
Water	Required

Quality analysis of carrageenan and fish soup powder

Proximate composition was estimated according to the method of AOAC (2005). Fatty acid composition of raw seaweed, carrageenan and fish soup powder was performed using Gas Chromatography (Varian, CP-3800). The total lipid was extracted by the method of Folch *et al*. (1957). Then the lipids were converted to fatty acid methyl esters (FAME) using the BF_3-methanol. Aminoacid composition of carrageenan and fish soup powder was determined using high performance liquid chromatography (HPLC) as per the procedure of Ishada *et al.* (1981). The colour profile of was measured using Hunter Colour Lab (Mini XE, Portable type, USA) having setting of cool white light (D65) was used to measure the Hunter *L** (Brightness = 100/lightness = 0), *a** (+redness/ greenness), *b** (+yellowness/ blueness) values. Viscosity of carrageenan powder and fish soup supplemented with carrageenan was determined using Brookfield digital viscometer (Brook field Engineering Laboratory Inc., Stoughton, MA). Viscosity was expressed as centipoises (cP). Sensory evaluation of fish soup was done by ten member panel based on characters such as appearance, colour, odour, flavor and consistency according to the method described by Meilgaard *et al*. (1999).

Result and Discussion

Proximate composition of raw seaweed,carrageenan powder, fish soup powder

Proximate composition in the food components includes five main categories: moisture, protein, ash, fat and carbohydrate. For carrageenan, the moisture and ash contents are the most vital components in determining the quality of the product. Moisture plays a crucial role in food products especially dry powdered products. According to the Food Chemicals Codex (FCC) (1981), the maximum moisture content allowed in carrageenan is 12%. Carrageenan tends to absorb moisture over time due to its hygroscopic properties. In the present study, the moisture content of the carrageenan samples follower prescribed limit (5.35 %). The crude protein content of raw seaweed and carrageenan was 10.12%, 12.75% respectively. Ash is the most abundant component in carrageenan. Ash content reflects the extent of mineral content in the seaweed (Romenda *et al*., 2013). The international standard of ash levels in carrageenan is at least 15%, but not more than 40% (JECFA, 2006). In the present study ash content of raw seaweed and carrageenan powder was in the range of 34.53- 39.49 %. This result was in accordance with Basmal *et al*. (2009) who reported that ash content of k-carrageenan ranged from 18.5 to 36.4% and varied with processing techniques and sanitation levels. Amimi*et al*. (2007) stated that the levels of minerals (ash content) in the thallus of seaweed were greatly affected by seasonal variations. Further both sample had low level of fat content (0.02-0.04%). Phosphorous content varied from 0.71- 1.08 %

Functional properties of raw seaweed powder and carrageenan powder

The water-holding capacity is a critical property of proteins in viscous foods, e.g. soups, dough, custards and baked products. It measures the capability of the gel to retain the water when subjected to external forces (Ganesan *et al*., 2012). In the present study, water holding capacity of raw seaweed powder, carrageenan showed 2.29, 3.56 g water/g of powder respectively. In food systems, good interactions of water and oil with proteins are imperative as this would indirectly affect the flavour and texture of foods. The fat absorption capacity is a critical determinant of flavour retention. In the present study, fat absorption capacity of carrageenan powder was higher (4.69 g oil /g of powder) than the raw seaweed powder (2.25g oil /g of powder). Fleury *et al*. (1991) reported that fat absorption capacity of seaweed are also related to the particle size, overall charge density and hydrophilic nature of the individual particles.

Sensory analysis

Fish soup was prepared with incorporation of carrageenan at different concentration (1%, 3%, 5%, and 7%). It was found that fish soup powder contained 5% carrageenan powder had almost similar viscosity and taste of control (contained corn flour). Control had a viscosity of 17.80 cP whereas the 5% carrageenan added sample had a viscosity of 18.70cP. Further, Sensory analysis showed higher score (8.5) for over all acceptability of the fish soup powder contained 5% carrageenan powder and hence, it was selected for the further analysis.

Proximate composition, Fatty acid and Amino acid profile of fish soup powder

In food systems, proximate analysis allows the quantitative analysis of the different macronutrients that are found in a food product. In the present study, fish soup powder prepared with 5% carrageenan had a moisture content of 2.98%, protein – 21.11%, fat – 13.15%, and 22.53% ash content. The storage quality of powdered foods will be affected if the moisture content exceeds 14% because mould growth, insect infestation, and clumping will start to occur (Aziah *et al*., 2009). In the present study, carrageenan had lower moisture content. It may be due to carrageenan prepared under spray drying process. Physico-chemical properties of fish soup powder are given in Table 2.

Table 2: Physico-Chemical Properties of Fish soup powder

Parameters	**Fish soup powder with corn flour (25%)**	**Fish soup powder with Carrageenan (5%)**
Moisture (%)	4.74 ± 0.25	2.97 ±0.05
Protein (%)	22.15 ±0.15	21.11 ±0.30
Fat (%)	13.92 ±0.20	13.15 ±0.15
Ash (%)	16.55 ±1.5	22.53 ±0.85
Carbohydrate (%) by difference	27.79 ±0.65	40.24 ±0.55
Phosphorus (%)	0.72 ±0.04	0.84 ±0.02
Water activity (aw)	0.326 ±0.02	0.266 ±0.03
*L**	66.85 ±0.85	68.35 ±0.75
*a**	2.29 ±0.05	2.53 ±0.06
*b**	16.31±0.25	15.29 ±0.20

Fatty acid profile of Carrageenan and fish soup powder revealed that both carrageenan and soup powder had highest saturated fatty acids (45.54 - 48.85%). Mono unsaturated fatty acid was found to 37.52 – 42.01%. Polyunsaturated fatty acid (PUFA) was found between 12.35 -

13.17%. Most abundant amino acids present in the fish soup powder are Threonine, Glutamic acid, proline, Alanine, Isoleucine, phenylalanine, tyrosine, histidine, lysine,arginine. Among the aminoacids, proline(35.99%), Isoleucine (28.95%), lysine (6.45%), threonine (2.97%), arginine (2.55%), tyrosine (2.5%) were found higher in the fish soup powder contained cornflour/ carrageenan. There is no significant ($p > 0.05$) difference in amino acid composition of fish soup contained corn flour or carrageenan.

Conclusion

Carrageenans have been widely used by food industry for improving functional properties of foods. Results from the study indicated that carrageenan is rich in mineral content. It suggested that Carrageenan can be used for fortifying fish soup to enrich the nutritional status, especially in terms of mineral content. However, further investigations are required to determine bioavailabity of carrageenan and its degradation metabolism in the gastrointestinal tract.

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