Seaweed extract as a natural food coloring agent in Jelly desserts on chemical, microbial and sensory quality

P.S. Jayasinghe[1*], V. Pahalawattaarachchi[2]and K.K.D. S. Ranaweera[3]

[1]*Institute of Post Harvest, National Aquatic Resource Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2] *Inland Aquatic Resources Research Division, National Aquatic Resource Research and Development Agency(NARA), Crow Island, Colombo 15, Sri Lanka*

[3]*Faculty of Food science, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

Abstract

Edible pigments can be extracted from seaweeds, which can be used as natural food coloring agent due to substitute hazards in artificial (synthetic) food coloring. Chlorophyll, carotenoid, and phycobiliproteins are major photosynthetic pigments presence in microalgae. Extraction of high quality natural food coloring and efficient impact of these coloring on chemical, microbial and sensory quality of gel dessert were evaluated. The main objectives of the present study Chlorophyll and carotenoids were extracted from *Ulva lactuca* and *Sargussum wightti* using acetone, methanol and water as solvents while and pycobiliprotein was obtained from *Gracilaria verrucosa* grinding with ice cold potassium phosphate buffer. The stability, sensory, microbial and nutritional quality was measured after application of natural colors to jell dessert. The chlorophyll, carotenoid and crude phycoerythin yielded 45 %, 31 % and 33 % respectively. These pigments have a shelf life more than six months in 5 % citric acid at ambient temperatures. The color attributes of the jelly dessert prepared using natural colors retain more than thirty days at room temperature 30 % loss whereas artificial colors were retained in similar amount.

Agar jelly prepared using natural food colors had significantly higher concentrations of calcium (120 mg/l) and Potassium (550 mg/l) when compared to jelly prepared using artificial colors. Natural food colors in jelly resulted in high Sodium content (1200 mg/l) and high magnesium content (580 mg/l) when compared to jelly prepared using artificial colors. The protein content (10.2-12 %), carbohydrate (10.8-12.3 %) and fat contents (1.16-1.9 %) in the jelly dessert prepared using natural food coloring. Natural food colors were found to be in higher rangers of nutrition indicating that these dies can be used as food supplement. Microbial and fungal counts in jelly desserts were found within the consumable levels during one month period and indicating overall acceptability and shelf life of the jelly prepared using seaweed natural pigments extract was high when compared to jelly prepared using synthetic pigments.

Keywords: pigments, natural colors, seaweeds, carotenoids, phycoerythrin

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**Corresponding author: Pradee_jaya@yahoo.com*

Introduction

Dyes and colorants from natural sources are gaining importance mainly due to health and environmental issues. Algae contain a wide range of photosynthetic pigments. These major classes of photosynthetic pigments are chlorophylls, carotenoids (carotenes and xanthophylis) and phycobilins. Phycocyanin and phycoerythrin.These pigments belong to major class of phycobilins photosynthetic pigments (Sudhakar *et al.* 2014). Seaweeds are microalgae found abundantly in coastal waters of Sri Lanka. *Ulvalactua*, *Gracilaria verrucosa* are green and red algae, which contain chlorophyll and carotenoids while *Gracilaria verrucosa* contain R-

phycocrythin and phycobliprotein. There can be exploited for pigment extraction and can be utilized as natural colorant. These are water soluble and very heat sensitive pigments which are phycocolloidalgae. These pigments have high nutritional value and are safe for usage as food colorants. The present study deals with phycoerythin, chlorophyll and carotenoid extraction from red and green algae. The studies also focus on purification, preservation and application of jelly desserts.

Materials and Methods

The *Gracilaria verricosa*, (red seaweed), *Ulva lactuca* (green seaweed) and *Sargussumwightti* were collected from northwestern and southwest coastal belt of Sri Lanka and transported to the laboratory, in insulated boxes. The seaweeds were washed several times until remove salt, sand and epiphytes. The carotenoid and chlorophyll pigments were extracted from *Ulva lactuca* and process and purified according to Muntean (2007) in 30 g of fresh biomass were destroy by organic solvents such as ethanol, methanol, acetone and water. Then the samples were stirred with magnetic stirrer for three hours. The one set of samples were sonication before taken filtrate. Phycobiliproteins was extracted from 50 g of fresh bio mass of *Gracilaria verrucosa* by grinding in a table mixer with ice cold potassium phosphate buffer (0.1M) at pH – 7.0 according to the method of Sadhakar *et al.*(2014). The phycoerythin was then separated from phycobiliprotein extract and purified in DAAE cellulose. The carotenoid, Chlorophyll and phycobiliprotein were subjected to scan in a UV - visible spectrophotometer by reading absorbance at range of 440 – 662 mn and quantified using equation of Lichtentaler and Wellburn (1985). For the estimation of phycocyanin, allophycocyanin and phycoerythin were scanned in UV-visible spectrophotometer by the absorbance range from 562-652 and quantified according to equation of Benett and Bogord (1973). Green (chlorophyll and carotenoids) and pink (phycobiliproteins) natural colors different contents (0.1,0.5 and 1.6 mg) were dissolved in 200ml the agar jelly dessert and stored in 0^0C refrigerator over one month period in order to check the stability of pigments. Shelf life of jelly dessert was determined by measuring of changes of color attributes and overall acceptability during one month period (Peryam *et al.* 1952) compared with artificial colors. The total bacterial counts (APC, SLS, 1991) and total fungal counts (AFC, SLS, 1991) were measured within weekly intervals during one month period. The nutritional composition macro, micro elements were evaluated and compared with artificial color incorporated agar dessert. The experiment results were analyzed by using statistical package SPSS 22.

Results and Discussion

The results observed from the analysis revealed that jelly incorporated with artificial colors have best acceptable colour even after four weeks with the mean value 7 while natural pigment samples had in the mean value range 6-6.2. However, the results revealed that there was no significance difference between mean values of both type of pigments. The results of sensory evaluation of colour attributes shows that jelly in corporate artificial colors scored bright

colours than naturally extracted colors from seaweeds during the storage. This may be due to natural pigments are poor in stability than artificial pigments.

As comparable to the artificial colours the retaing period of natural colours were around 30 days in refrigerator without preservatives. The sugar, citric acid and sodium benzoate are accepted as preservative for phycobiliprotein chlorophyll and carotenoid could retain the colour for longer period. However Sudhakar e*t.al.* (2014) reported that shelf life of phycobiliprotein in water and soda without preservatives could not retain the colour even for shorter period of three days.

Yield of natural pigments: The results revealed that the yield of R-phycoerythrin obtain was 0.067 mg/g in crude extract. In fresh sample of *Gracilaria verrucosa* reported higher amount of (phycoerythrin) Pe-0.067mg/g and (phycocyanin) Pc - 0.38 mg/g in Fresh Weights. The Chlorophyll a extracted using 90% ethanol ranged from 6.3mg/g to 24.5mg/g with minimum in red seaweed and maximum in *Ulva lactuca*. The carotenoids extracted from 80% acetone ranged from 8.3mg/g (*Ulva lactuca*) to 32mg/g (*S. wightti*).

The artificial food color incorporated jelly had the lowest Na content1200 mg/kg when compared to jelly dessert in natural colorant. The natural colors incorporated agar jelly has highest Magnesium (Mg) content than the artificial color products were in the 580± mg/l. The level of Magnesium (Mg) content in natural colored jelly and artificial colored jelly were not significantly difference ($p < 0.05$). In comparison to the natural colored jelly, artificial colored jelly exhibited lower potassium (K) content. This may be due to agar and *Gracilaria verrucosa* were abundant with potassium (K) and available considerable amount of K in jellies. All the jelly product have detected very low manganese (Mn). The differences in the manganese (Mn) content of seaweed based jelly may be traced to the possible differences in the raw material used.

For the protein content in Agar jelly were found red color incorporated jelly have the highest level. Natural green color incorporated jelly recorded second highest protein value 4.42±0.25%. Artificial color green reported significantly lowest ($p>0.05$) content of protein 3.09 ± 0.78 %. The brown natural color jelly has highest (3.67 ± 1.2%) fat content while the artificial color incorporated red have lower fat contents (1.16 ± 0.23%). Natural brown colored jelly records the high ash content indicating their high mineral content. All the natural colored jelly types have carbohydrate content range from 10.8 - 12.3%.

Shelf life studies of jelly: The seaweed based jellysample exhibited highest shelf life during the one month period. The overall acceptability was gradually decreased in all the samples with storage period. The decrease in acceptability started after three weeks. Statistical analysis revealed that treatments and storage effect on all the samples weren't significant. For the commercial jelly labeling that it is expired after two weeks.

Conclusion

The present study revealed that water and ethanol extracted pigment from *Gracilaria verrucosa*, *Ulva lactuca* and *Sargussum wightti* can be used as an alternative source for natural food colorant for jelly. R-phycoerthrin chlorophyll & carotenoids stability on jelly showed favorable outcome from this study. These pigments have nutritious and bioactive compounds than artificial pigments would affected on other nutritional benefits. Even though low stability of these major natural colorant they could be maintain more than three months without discoloration using in citric acid 5%.

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