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Acceptability of a food supplement from underutilized aquatic resources

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Abstract

KEY WORDS: AQUATIC RESOURCES, FOOD SUPPLEMENT, UNDER UTILIZED

The need to develop a food rich in proteins and other nutrients palatable to children is very important in respect to improve the nutritional status of the young school children. Therefore, a low cost food supplement was formulated as a soup mix using under-utilized edible aquatic resources that are rich in nutritional and therapeutic values. Karalla (Silver belly, *Leognathus splendens*) (40%), rhizomes of kohila (*Lassia spinosa*) (10%) and nelum (*Nelumbium nuciferum*) (10%), soy flour (10%), rice flour (10%) were used as major ingredients of the soup mix and it was tested for biochemical and sensory parameters. The nutritional impact of the soup mix was assessed by administering it to a group of 10-11 year old school children for a period of three months.

The results of the consumer preference test showed that the food supplement was readily acceptable as the respondents reported the highest score for taste and aroma (77.3%) followed by color (66.36%). The score for overall acceptability (78.18%) ranked the highest over other quality attributes tested. The food supplement reported a calorific value 390±26 cal/100g. The protein and fat contents were 51±1.7% and 14±1.1% respectively. Shelf life studies showed that the sensory and biochemical qualities were in satisfactory level after storage of three months in sachets. Furthermore, it was observed that this feed reduced stunting and wasting of school children by 3% and 7% respectively after 3 months of supplementation.

Introduction

The total marine fish production in Sri Lanka consists 45% of small pelagic varieties (Karunasinghe and Dayarathna, 1997). Most of the small pelagic varieties are produced as by catches and have been estimated at around 3×10^4 tons/year. Sardinella sp. dominates the small pelagic catches in all areas through out the year followed by silver bellies *(Leiognathus sp.)* (Karunasinghe and Dayarathne, 1997).

It is well known that fish is a good source of protein, rich in amino acids inclusive of lysine and methionine and highly digestible. Fish such as sardinella and silver bellies is a good source of naturally occurring micronutrients i.e. iodine, vitamins, minerals and essential fatty acids (Wickramanayaka, 1996; Edirisinghe et al., 1998).

Aquatic food plants are storehouses of nutrients, such as carbohydrates, vitamins, minerals and dietary fibers. Kohila (*Lassia spinosa)* and nelum (*Nelumbium nuciferum*) are some of the traditional, aquatic origin food plants, which have high nutritional and therapeutic values. These are commonly consumed to alleviate the condition of haemorrhoids (Jayaweera, 1981). Rhizomes and young leaves of kohila are eaten as a vegetable (Rajapaksha, 1998). These are commonly available in the local market at a reasonable price.

Among the infants, pre school children, school children, pregnant and lactating mothers improvement of the nutritional status is mandatory requirment. Out of the school children those who were around 10–11 years old and close to the growth spurts were selected for the study (pubertal growth spurt). After the puberty young girls grow rapidly and anthropometric changes (specially weight gain) can be seen within a short period of time.

There is an increasing need to develop a food which can meet the protein and other nutrients requirement of young school children. It should be highly palatable, economically feasible and socially acceptable. Under-utilized edible aquatic plants and fish varieties that are rich in nutritional and therapeutic values are available at low cost in the local market. Food supplements are formulated food mixtures means to be used in addition to the normal diet. Dry soup mixes are now an established item in the world food market: Those are low in cost and low unit volumes and need relatively short period for preparation before consumption. This factor combined with good storage life and low prices has led to a large market. Accordingly the present study was conducted to formulate a food supplement using under–utilized edible aquatic food plants as

well as fish species to produce a new low cost product for human consumption. The product was developed as soup mix. Furthermore, school children who are in 10-11 year age group were chosen to administer the food supplement for three months period to evaluate the nutritional impact of the soup mix.

Materials and Methods

Preparation of soup mix

Major ingredients of the soup mix were powdered fish (Salaya/ Karalla) (40%) Kohila (*Lassia spinosa)* [10%] and Nelum (*Nelumbium nuciferum*) (10%). Other ingredients of the food supplement were rice flour (10%), soya flour (10%), salt (9%), sugar (1.5%), powdered red onion (5.5%), pepper (1%), coriander (1%) and monosodium glutamate (MSG) (2%).

Fresh fish were purchased from Chilaw market. Dressed, cleaned fish were boiled for ten minutes and then dewatered with the help of cheesecloth. Then oven dried at 40–50^{0}C and fish grinded to fine particles.

Well-grown good quality rhizomes of Nelum and Kohila were cleaned and cut into 2-3 mm thick slices and blanched for five minutes. The slices were dried in an air blowing oven at 50^{0}C – 60^{0}C for overnight and powdered. Eight soup mixes were formulated by using different formulation steps. Comments on the early stages of the formulation of soup mix, was taken with the help of untrained tasting panel of 22 panelists and final formula is given in Table 2.

A 6.25 g of prepared soup mix was added to the 1.5 cups of boiling water with celery and cooked it for five minutes and limejuice was added and more salt according to consumers' preference.

Evaluation of quality parameters of the soup mix:

Ranking test with five point hedonic scale was used to evaluate the sensory quality; taste, colour, aroma, and overall acceptability of the soup mix. Moisture, ash, fat and crude fiber contents of the soup mix was determined according to the standard methods (AOAC, 1978). Moisture content was determined according to Ospome and Voogt (1978). Total nitrogen, histamine contents and free fatty acids was determined according to the AOAC methods (1998). The peroxide and histamine contents of the soup mix were determined according to the standard method of peroxide determination (Lea,1952).

Administering the food supplement:

A small school at Kelaniya in Western Province was selected to administer the food supplement and children (94) from year 5 and year 6 were selected for the study. The sampling was done systematically, i.e. the first 26 children from the register in year 5 and first 21 children from the year 6 were taken as study group. The remaining 47 were taken as a control group. The children were given the food supplement in addition, their usual diet at home, thereby assured that the feeding was only supplementary and not substitute. The age weight and height of the children were taken before and after administering the food supplement. Duration of the study was three months.

Data processing:

In case of significant tests, the statistical analysis χ^2 was done by "Mini tab" statistical package.

Results and Discussion

As an island Sri Lanka is rich with aquatic resources and there is a potential to use these resources to upgrade the nutritional status of children. When selection of raw materials from aquatic resources to formulate the low cost food supplement three main characteristics were considered. Those are cost of the raw materials, availability throughout the year and continuous production. Accordingly Silverbellies and Sardinella were selected for the formulation of soup mix.

Table 1: Gross yield for the individual constituents used for soup mix:

Materials	Gross yield (%)
Fish (Karalla)	24.30 + 1.24
Kohila	14.60 + 1.32
Nelum	16.64 + 2.40
Onions	16.32 + 0.99

The gross yield of the individual constituents used for soup mix is given in Table 1. Gross yield of Karalla (24.3 %) was high when compared with the other raw materials (i.e. kohila, nelum, and onions) due to the less wastage during processing. Because concerning the nutritional value fish was taken with heads

and bones and only carcasses and peritoneum was removed as wastage. The lowest gross yield had given by the kohila (14.6%) because considerable portion of the rhizomes of kohila was removed as an inedible part, during peeling. Comparing with kohila and nelum moisture content was high in onions but the gross yield of onion was high due to less wastage.

Table 2: Ingredients (%) used for the formulation of the soup mix

Ingredients	**Percentage**
Powdered fish	
(a) Karalla	40
(b) Salaya	-
Powdered Kohila	10
Powdered Nelum	10
Rice flour	10
Soya flour	10
Powdered onion	5.5
Powdered pepper	1
Powdered coriander	1
Mono Sodium Glutamate	2
Salt	9
Sugar	1.5
Total	100
Reconstitution ratio (g/cup)	50/8
Cooking time (min.)	5

After tasting the several soup mixes it was decided not to add Sardinella sp for the final soup mix because of the high fishy flavour (Table 2). However, by adding spices i.e. pepper, coriander and onions it was able to mask the fishy flavour arised from Silverbellys. Permitted flavour enhancer Monosodium Glutamate (MSG) increased the taste of the soup mix and rice flour and soya flour has been added as a thickening agent. Considering the nutritional value of the soup mix, butter fat and skimmed milk powder were added. Dry soup mixes have very low unit volume when compared with other products. This factor combined with good storage life and low price led to a large market in the food

industry. On the other hand dry soup mixes are popular among housewives as convenience food because it requires a relatively short period of reconstitution with boiling water.

Table 3: Consumers acceptance of the developed soup mix

Consumers preference	Colour (%)	Aroma (%)	Taste (%)	Overall (%)
Like very much	04.54	18.20	27.20	13.60
Like moderately	31.80	63.60	50.00	68.20
Neither like nor dislike	54.50	04.54	13.60	13.60
Dislike moderately	09.10	13.60	04.54	04.54
Dislike very much	00.00	00.00	04.54	00.00
Total	100	100	100	100
Overall rank score	66.40	77.30	77.30	78.20

Results obtained from the ranking test carried out to determine the acceptance of developed soup mix are summarized in Table 3. Overall rank score showed highest for the taste and aroma (77.3%). The colour received lowest score in the sensory assessment (66.4%). However the overall assessment had scored the highest rank (78.2 %). According to the results obtained it is clear that the soup mix was in an acceptable range.

Nutritional quality of soup mix (moisture, ash, protein, fat, and energy) was assessed and results are shown in Table 4.

Table 4 : Proximate composition and energy values of developed soup mix:

Parameter	**Value (Mean ± SD)**
Moisture	08.60 ± 0.1
Ash	20.30 ± 0.1
Protein	51.70 ± 1.7
Fat	14.00 ± 1.1
Energy	396 ± 26 Cal

Chemical analysis of the developed soup mix showed proteins 51%. This 51% mainly comes from powdered fish. It has been reported that the Protein Efficiency Ratio (PER) for fish is comparatively higher (3.55) than that for cows milk (3.09), and beef (2.3) (Shenoy et. al., 1976). Generally fish proteins are rich in essential amino acids such as lysine, which is lack in cereal base diets (Wickramanayake, 1996). Therefore this developed soup mix will be a good supplement of lysine, and methionine for diet.

The fat content of the soup mix was 14% and most of the fat comes to soup mix mainly through fish. The fish oil is a rich source of essential fatty acids, omega-3 and omega–6, which are very important for the development of brain cells of young children and for the prevention from diseases like coronary heart diseases and hypercholestoremia (Wickramanayaka, 1996). Calcium, phosphorus and iron in the soup mix should be high, since it contains 40% powdered fish (Silver bellies) with bones and heads. According to the food composition table 100 g of edible portion of silver bellies contains 715 mg of calcium, 741 mg of phosphorus and 2.2 mg iron (Perera et. al., 1989).

The quality of soup mix mainly depends upon the quality of the dehydrated fish-powder, as it was the main ingredient of the dried soup mix. Poor sanitation of raw materials of the above ingredients will effect the quality as well as storage time of the soup mix. Therefore it is important, that everything that comes in to contact with the fish should be clean. Transport the fish by mixing with crushed ice and cleaning the fish as soon as possible under the low temperature by using ice water was beneficial to minimize the spoilage of fish that used for the preparation of fish powder.

During processing, boiled fish were dewatered with the help of cheesecloth. It was a necessary step since dewatering leads to reduce the spoilage of fish and increase the storage time of the product. When fish subjected to the moderate heat treatment, the biological value of the fish proteins remain with less denaturing of the protein bonds (Wickramanayaka, 1996). Because of that dewatered fish were dried under a low temperature for long time. During preparation of dehydrated powdered kohila and nelum, rhizomes were cut into pieces of similar size. This is necessary for uniform dryness. Cut pieces of nelum and kohila were subjected to the process called blanching. This treatment was carried out to denature the enzymes, which would react and oxidize with exposure to air. Otherwise action of this enzyme would leads to chemical browning and it causes to reduce the quality of the food supplement (Samarajeewa, 1995).

Quality deterioration of the soup mix was assessed after 3 months storage period in room temperature. The results showed that the histamine, free fatty acids contents and peroxides as 6.2± 0.3mg/100g, 1.7±0.3% and 227±5.3 meq/ Kg respectively. Eventhough the levels of histamine was in a negligible range peroxide value was increased. This should be avoid by adding permited antioxidant such as ascorbic acid, in large scale production to improve the shelf life as well as keeping quality.

Cost of the raw materials to prepare the 50 g of the soup mix was Rs. 12.15. However these calculations have been made according to the retail prices prevailing in the market.

Table 5: Distribution of indicators before and after intervention

Population	Height for age (Stunting)				Weight for age (Wasting)				Weight of age (Under nutrition)			
	Before		After		Before		After		Before		After	
	No.	%	No.	%	No	%	No	%	No	%	No	%
Study group	10	21	10	21	10	21	7	14	8	17	7	14
Control group	11	23	11	23	9	19	8	17	10	21	10	21
Total	21	22	21	22	19	20	15	16	18	19	17	18

$\chi^2_{cal} = 0.0$, $\chi^2_{tab} = 3.84$ $\chi^2_{cal} = 0.119$, $\chi^2_{tab} = 3.84$ $\chi^2_{cal} = 0.039$, $\chi^2_{tab} = 3.84$

df = 1 P = 0.73

Peri adolescents school girls of a small school in Kelaniya area was selected to administer the food supplement to find out its nutritional effect. However as a small school only 94 children were in both year 5 and year 6 classes. Therefore 47 children (26 from year 5 and 21 from year 6) were taken as study group and remaining 47 as control group. The sampling was done systematically, i.e. the first 26 children from the register in year 5 and first 21 children from the year 6 were taken as study group. The remaining 47 were taken as control group. After three months of After three months of supplementation comparison was carried out to find out whether there is any significant difference in prevalence of underweight (deficit in weigh for age), stunting (deficit in weigh for height) and wasting (deficit in height for age) before and after supplementation in two groups (Table 5). The comparison was done by χ^2 test and it was shown that there is no significant difference of prevalence of under nutrition, stunting and

wasting before and after supplementation, in two groups but only reduced stunting and wasting of school children by 3% and 7% respectively.

Conclusions and Recommendation

Results revealed that the aquatic resources based food supplement was readily accepted. The great advantage of this food supplement in comparison with other available food supplement, in Sri Lanka is that this product contains more percentage of protein and minerals and cost of the packet it self is very much cheaper. This implies that the prospective potentiality of quantitative consumption is quite positive. It is recommended for trial test could be done to obtain maximum shelf life of the food supplement. To evaluate its nutritional effect also the feeding program should be continued for at least one year to get satisfactory results.

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