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Development of a nutritionally enriched fish cake from mixed fish species

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ABSTRACT

In this study, fish cake was prepared using five mixed fish species (*Pangasius pangasius, Oreochromis mossambicus, Hypophthalmichthys molitrix, Tenualosa ilisha* and *Amblypharyngodon mola)*. In addition, different ingredients were supplemented to produce nutritionally enriched fish cake. Fish cake was formulated with several compounds including mixed fish paste, wheat flour, boiled potato, jackfruit seed, raw chicken egg, fresh onion, vegetable oil, salt, chili pepper, coriander, lemon juice, monosodium glutamate and curry powder. Analysis of the proximate composition of fresh fish and prepared fish cake was carried out. The moisture, protein, fat, ash, energy, vitamin A, iron, phosphorus, calcium and magnesium were found ranged from 61.32±1.05 to 77.29±3.64%, 15.23±0.68 to 17.21±0.89%, 2.19±0.27 to 17.03±2.31%, 1.09±0.15 to 3.27±0.31%, 365.84±17.43 to 989.28±19.04 kj/100g, 8.53±1.95 to 2043.21±32.64 µg/100g, 1.42±0.06 to 5.13±0.73 mg/100g, 23.44±5.28 to 278.66±10.28 mg/100g, 5.03±1.01 to 854.42±16.36 mg/100g and 9.19±3.24 to 32.43±2.85 mg/100g respectively in those mixed fish species. The moisture, protein, fat, ash, carbohydrate, energy, vitamin A, iron, phosphorus, calcium and magnesium were found to be 44.19±1.67%, 23.08±2.18%, 17.36±0.93%, 3.14±0.56%, 11.08±2.45%, 998.94±16.31 kj/100g, 285.19±9.95 µg/100g, 7.43±1.05 mg/100g, 91.83±6.11 mg/100g, 139.51±14.49 mg/100g and 6.97±1.09 mg/100g respectively in the prepared fish cake. Based on the findings, the study suggests that the prepared fish cake was highly nutritious for human and mainly malnourished children.

Key words: Mixed fish species; supplemented ingredients; fish cake; proximate composition

1. INTRODUCTION

Fish is one of the main sources of protein. Fish production in Bangladesh is increasing day by day and supplements about 60% animal protein intake in the diet of Bangladeshi people's (DoF, 2016). People in Bangladesh are now eating 30% more fish than they did 20 years ago, but they are getting a smaller amount of important nutrients from it (Bogard et al., 2017). Indeed, Bangladesh has among the worst malnutrition rates in the world. More than one in three children with less than five years of age are stunted – an indicator of chronic malnutrition (IPHN, 2013). In this condition, we need to develop nutritionally enrich value-added products based on fish. Only one fish species cannot provide all types of nutritional components at once. However, when we use different species of fish as a single product, then all types of nutritional components get easily (Saritha and Patterson, 2014). In Bangladesh, few studies have been conducted on the development of value added fish products like fish soups, fish noodles and fish cake. Value-added seafood may be (i) minced products; (ii) breaded or coated products; and (iii) surimi products (Kamari and Shabanpour, 2013). The fish cake (also called fish cakes or fish pasta) is one of the value-added products and heavily consumed in Korea and Japan (Hwang et al., 2013). The products can be used as a rewarding diet for malnourished children. These types of products are important vehicles for providing essential nutrients (Henshaw and Agunbiade, 2004). Nutritional quality is important to obtain consumer

acceptance because the consumer should be convinced of the quality (Armand, 1995).

Nowadays, the demand for processed food, which can be easily cooked and consumed, has increased due to changes in daily life and consumer preferences (Chinedu et al., 2013). A key element in increasing fish consumption is to provide processed and fish products that preserve the high nutritional value of fish and meet customer expectations. People's eating habits are changing very rapidly of processed food in recent times (Inanli, 2011). In addition, one of the most important food processing technologies is the treatment of low-cost and available fish use as value-added fish products (Shaviklo et al., 2013).

By the end of the 1970s, the Bangladesh seafood processing industry had expanded rapidly. Many value-added products such as individually quick-frozen, peeled and deveined, and butterfly cut shrimp, as well as cooked products (James and Subasinge, 2003). However, Bangladesh needs to become more diversified in terms of both products and markets. So, there is a still scope to developed value added nutritious fish products for human consumption. In addition, Bangladesh is one of the countries with the highest rate of children malnutrition and up to 40% of children under the age of 5 years are suffering from chronic malnutrition and malnutrition rate of children in slums is even worse (Blössner and de Onis, 2005; World Bank, 2011; UNICEF, 2013). Therefore, it is urgent need to develop nutritionally enrich the diet to solve the problem. The objective of this study was to prepare a fish cake from mixed fish species and determine its nutritional composition.

2. MATERIALS AND METHODS

2.1 Sample collection

Fish samples were purchased from *Kawran* bazaar, Dhaka, Banglades. The sampled fish species were pangas (*Pangasius pangasius*), tilapia (*Oreochromis mossambicus*), silver carp (*Hypophthalmichthys molitrix*), mola (*Amblypharyngodon mola*) and hilsa (*Tenualosa ilisha*).

2.2 Processing of fish samples

Fish samples were washed thoroughly with potable water several times to remove dirt and debris from the surface. Scales, fins and intestines were carefully removed and washed with tap water to avoid contamination. The samples of those mixed fish species were boiled in water with spices for 30 minutes. Then fish muscle easily collected without bone. All the muscles of the fish mix with each other and converted into mixed fish paste.

2.3 Preparation of fish cake

The materials used as a percentage, fish cake prepared from mixed fish paste, wheat flour, boiled potato, jackfruit seed, raw chicken egg, vegetable oil, fresh onion, pepper, lemon juice and seasonings (Table 1). The paste of mixed fish samples and all the ingredients were grinded with the mixer blender. The mixer of all the ingredients kept in a small cake container. Then the entire container kept in the oven about 85^0C until the hard and brown fish cake was formed (Fig. 1 & 2).

Figure 1. Raw cake kept in oven

Figure 2. Final product of fish cake

Table 1. Ingredients percentage for fish cake

Ingredients	Percentage of ingredients
Mixed fish paste	78.0
Wheat flour	6.0
Boiled potato	4.0
Jackfruit seed	4.0
Raw chicken egg	2.0
Fresh onion	2.0
Vegetable oil	2.0
Salt	0.85
Chili pepper	0.56
Coriander	0.32
Lemon juice	0.14
Monosodium glutamate	0.09
Curry powder	0.04
Total	**100.00**

2.4 Proximate analysis

Proximate analysis of samples of raw fish and fish cake were analyzed, including moisture, proteins, fat, ash, carbohydrate, energy, vitamin A and minerals (iron, phosphorus, calcium and magnesium). The composition of raw fish samples and fish cake were analyzed in triplicate following the standard procedures (AOAC, 1995): moisture content by drying in an oven (PR 08, Germany) at 105^0 C for 24 h; crude protein content analysed according to the Kjeldahl method using an Auto Kjeldahl system (Kjeltec^{TM}2100, Sweden), lipid by ether extraction, ash by incineration in a muffle furnace (25186H, Germany) at 600^0 C for 6 h. The carbohydrate content was calculated based on the calculation of the difference. The preparation of samples and the determination of vitamin A from fish and fish cakes were modified by spectrophotometry of Rutkowski et al., (2006). Sample preparation for minerals (Fe, P, Ca and Mg) was performed according to a spectrophotometry (UV-1800, SHIMADZU, Japan) method described by AOAC (1990). About 5 g of sample were weighed in an acid washed crucible and dried in the oven at 105^0 C for 24 h.

2.5 Data analysis

The measured data were summarized, examined, tabulated and carefully analyzed using MS Microsoft Office Excel 2007.

3. RESULTS AND DISCUSSION

3.1 Chemical composition of raw fishes

3.1.1 Proximate composition

The moisture, protein, fat, ash and energy content of fish species ranged from 61.32 to 77.29%, 15.23 to 17.21%, 2.19 to 17.03%, 1.09 to 3.27% and 365.84 to 989.28 kj/100g respectively (Table 2). Bogard et al. (2015) found that the moisture, protein, fat, ash and energy value were ranged of 60.2 to 85.4%, 11.9 to 20.6%, 0.3 to 18.3%, 0.7 to 5.3% and 267 to 1020 kj/100g accordingly. This finding coincided with current work. However, one thing is that only five species were analyzed in the present study, but several researchers analyzed more than five species. The variation in proximate composition depends on the season, life cycle, food habits, species, size and availability of the species at the time of sampling (Ababouch, 2005). Differences in moisture content usually inversely related to fat and energy (FAO, 1999). Some species of fish contained a high percentage of proteins that depend on diets (WHO, 2007). The fluctuation of the fat content mainly depends on the season and the dark muscle. Some species of fish stored fat in the liver, such as lean fish, but some species of fish usually contained high fat such as hilsa fish and fat used in the migration period (Nowsad et al., 2012). In the case of certain species of fish, the inclusion of bones as edible parts that lead to a higher ash content than other fish species.

3.1.2 Vitamin A

The vitamin A content of five selected fish species are shown in Table 2. The maximum amount of vitamin A was found in mola fish (2043.21 µg/100g) and lowest in tilapia (8.53 µg/100g). These findings coincided with Bogard et al. (2015), he found that in his study vitamin A was 2503 µg/100g in mola fish and 10 µg/100g in tilapia fish. Ross et al., (2002) studied that the vitamin A content of mola fish was higher than other fish species due to the eye and viscera of mola fish content extremely high level of vitamin A.

Table 2. Proximate composition of selected fish species.

Parameters	Fish Species				
	Pangas	Tilapia	Silver Carp	Hilsa	Mola
Moisture (%)	63.49±4.76	77.29±3.64	76.44±2.97	61.32±1.05	70.53±5.27
Protein (%)	16.53±1.53	17.21±0.89	16.73±1.63	15.23±0.68	16.31±2.42
Fat (%)	16.75±1.05	2.19±0.27	3.21±0.37	17.03±2.31	3.73±0.55
Ash (%)	1.33±0.09	1.53±0.24	1.09±0.15	1.18±0.22	3.27±0.31
Energy (kj/100g)	785.26±11.76	365.84±17.43	387.64±19.62	989.28±19.04	418.18±9.25
Vitamin A (µg/100g)	25.13±2.38	8.53±1.95	11.09±0.59	37.44±2.61	2043.21±32.64
Iron (mg/100g)	1.89±0.24	1.42±0.06	2.32±0.13	2.34±0.05	5.13±0.73
Phosphorus (mg/100g)	170.53±14.93	177.31±11.37	38.23±8.45	278.66±10.28	23.44±5.28
Calcium (mg/100g)	5.03±1.01	178.36±3.57	854.42±16.36	344.58±11.68	781.67±8.37
Magnesium (mg/100g)	11.29±2.37	9.19±3.24	23.61±0.58	18.11±1.24	32.43±2.85

3.1.3 Minerals

The iron (Fe), phosphorus (P), calcium (Ca) and magnesium (Mg) values are shown in Table 2. The Fe, P, Ca and Mg levels of fish species ranged from 1, 42 to 5.13 mg/100g, 23.44 to 278.66 mg/100g, 5.03 to 854.42 mg/100g and 9.19 to 32.43 mg/100g respectively. Bogard et al. (2015) found that moisture, protein, lipid, ash and energy value varied from 1.1 to 5.7 mg/100g, 0.01 to 300 mg/100g, 8.6 to 903 mg/100g and 26 to 35 mg/100 g correspondingly. This finding was consistent with the present study. The different conditions (sex, age, species, size, environment and season) could be responsible for the variation of Fe among fish species. The variation in P, Ca and Mg depends on species, size and bone in edible parts of fish species (FAO/INFOODS, 2013).

3.2 Chemical composition of fish cake

3.2.1 Proximate composition

The moisture, protein, fat, ash, carbohydrate and energy value of fish cake shown in Table 3. The moisture, protein, fat, ash, carbohydrate and energy content of fish cake was found to be 44.19%, 23.08%, 17.36%, 3.14%, 11.08% and 998.94 kj/100g respectively. Oyelese et al. (2006) found that moisture; protein, lipid and ash 9.42%, 38.59%, 14.23% and 10.89% were in the tilapia fish cake. Nathaniel et al. (2013) found that moisture; proteins, lipids, ash and carbohydrate were 60.12%, 21.01%, 8.5%, 6.3% and 4.07% respectively in the spiced blended fish cake. Inanli et al. (2011) found that moisture; protein, lipids and ash were 46.59%, 5.88%, 6.66% and 1.05% accordingly in the anchovy fish cake. Basu et al. (1996) found that moisture; protein, lipids, ash and carbohydrates were 19.66%, 52.8%, 2.1%, 14.22% and 11.22%, respectively in the dried surimi based fish cake. In the present study, high level of protein, fat and low moisture content in fish cake assume that because of mixed fish species and different nutritional ingredients were used to develop the fish cake.

Table 3. Proximate composition of formulated fish cake

Parameters	Fish cake
Moisture (%)	44.19±1.67
Protein (%)	23.08±2.18
Fat (%)	17.36±0.93
Ash (%)	3.14±0.56
Carbohydrate (%)	11.08±2.45
Energy(kj)	998.94±16.31
Vitamin A (µg/100g)	285.19±9.55
Iron (mg/100g)	7.43±1.05
Phosphorus (mg/100g)	91.83±6.11
Calcium (mg/100g)	139.51±14.49
Magnesium (mg/100g)	6.97±1.09

3.2.2 Vitamin A

The value of the vitamin A of the fish cake is shown in Table 3. The value of vitamin A was found to be 285.19 µg/100g. Department of Health, (2010) found that vitamin A in marketed fish cake ranged from 0.34 to 10 µg/100g. In the present study, mixed fish

species were used to make fish cake. Among the selected fish species, mola fish contained a high level of vitamin A. For this reason, the value of vitamin A was high in the developed fish cake.

3.2.3 Minerals

The iron (Fe), phosphorus (P), calcium (Ca) and magnesium (Mg) values of the fish cake are shown in Table 3. The Fe, P, Ca and Mg contents of the fish cake were 7.43 mg/100g, 91.83 mg/100g, 139.51 mg/100g and 6.97 mg/100g respectively. Department of Health, (2010) found that Fe, P, Ca and Mg in the commercialized fish cake ranged from 0.76 to 3 mg/100g, 85 to 150 mg/100g, 42 to 233 mg/100g and 13 to 21 µg/100g respectively. In the present study, different nutritional ingredients were used to develop the fish cake. This study assume that mineral values of fish cake were higher than the other studies because of mixed fish species and other ingredients used in fish cake.

4. CONCLUSION

The formulated fish cake was rich in protein, vitamin A and minerals, and can be used as a nutritional enrichment for humans to alleviate the problem of malnutrition. However, it is necessary to explore the possibility of developing a broader range of value-added products from mixed fish species for better utilization of these nutrient resources. In addition, develop value-added products of fish cake acquire a dietary habit, who generally do not like to eat fish. While our findings are novel, further research is needed to develop fish cake by using other fish species and ingredients, and find out the consumer preference regarding of the fish cake.

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REFERENCES

Ababouch, L. 2005. Lipids. FAO Fisheries and Aquaculture Department, Rome, Italy.

AOAC, 1990. Association of Official Analytical Chemists, Washington, DC.

AOAC, 1995. Official Methods of Analysis of Analytical Chemists, 16th edition. Association of Analytical Chemists, Arlington, Virginia.

Armand, V. C. 1995. Food quality: relativity, context and consumer expectations. Food Quality Prefer. 6: 165-170.

Basu, S. 1993. Surimi based dried fish cake. J. Indian Fish. Assoc. 23: 87-90.

Blössner, M. and de Onis, M. 2005. Malnutrition: quantifying the health impact at national and local levels. Geneva, World Health Organization.

Bogard, J. R., Farook, S., Marks, G. C., Waid, J., Belton, B. and Ali, M. et al. 2017. Higher fish but lower micronutrient intakes: Temporal changes in fish consumption from capture fisheries and aquaculture in Bangladesh. PLoS ONE. 12(4): e0175098.

Bogard, J. R., Thilsted, S. H., Marks, G. C., Wahab, M. A. and Mostafa, A. R. H. 2015. Nutrient composition of important fish species in Bangladesh and potential contribution to recommended nutrient intakes. J. Food Compos. Anal. 42: 120-133.

Department of Health, 2010. Responsibility for nutrition policy in England transferred from the Food Standards Agency to the Department of Health (DH) on 1st October, 2010.

DoF, 2016. National Fish Week 2016 Compendium (in Bengali). Department of Fisheries, Ministry of Fisheries and Animal Resources, Dhaka, Bangladesh, p. 63-66.

FAO/INFOODS, 2013. Food Composition Database for Biodiversity. Food and Agriculture Organization of the United Nations, Rome, Italy.

Henshaw, R. B. and Agunbiade, M. O. 2004. Food Oils and Fats Technology: Utilization and Nutrition. Chapman and Hall, England.

Hwang, H. J., Choi, S. and Lee, S. C. 2013. Preparation and Quality Analysis of Sodium-Reduced Fried Fish Cakes. Prev. Nutr. Food Sci. 18(3): 222-225.

Inanli, A. G., Nermin, K. and Çoban, E. Q. 2011. Sensorial, chemical and microbiological

quality of anchovy cake. Afr. J. Biotech. 10(48): 9870-9874.

IPHN, 2013. National micronutrients status survey 2011-2012. Final report. Icddr,b, UNICEF, Bangladesh. 1-140.

James, C. C. and Subasinge, S. 2003. Case study: the shrimp export industry in Bangladesh. Food safety in food security and food trade. Washington, 9-17.

Kamari, S. and Shabanpour, B. 2013. Development and Sensory Evaluation of Silver Carp (*Hypophthalmichthys molitrix*) Fish Based Snack Food. World J. Fish Mar. Sci. 5 (6): 670-673.

Nathaniel, C., Chika, I. K. and Ameachi, O. 2013. The Diet composition, sensory assessment and microbiological studies of fish cake made from shrimp bycatch. Adv. Aqu. Fish. Manag. 1(8): 76-81.

Nowsad, A. K. M. N., Mohanty, B. P., Hoq, M. E. and Thilsted, S. H. 2012. Nutritional values, consumption and utilization of Hilsa *Tenualosa ilisha* (Hamilton 1822). In: Proceedings of the Regional Workshop on Hilsa: Potential for Aquaculture, 16–17, September 2012, Dhaka, Bangladesh.

Roos, N., Leth, T., Jakobsen, J. and Thilsted, S. H. 2002. High vitamin A content in some small indigenous fish species in Bangladesh: perspectives for food-based strategies to reduce vitamin A deficiency. Inter. J. Food Sci. Nut. 53: 425–437.

Rutkowski, M., Grzegorczyk, K., Gendek, E. and Kedziora, J. 2006. Laboratory convenient modification of Bessey method for vitamin A determination in blood plasma. J. Physiol. Pharm. 57: 221.

Saritha, K. and Jamila, P. 2014. Innovative Seafood Health Mix Powder from Juveniles of *Leiognathus* sp. and Their Quality for Human Consumption. World J. Dai. Food Sci. 9 (2): 113-120.

Shaviklo, G. R., Olafsdottir, A., Sveinsodottir, K. and Thorkelsson, G. 2013. Studies on processing, consumer survey and storage stability of a ready-t-reconstitute fish cutlet mix. J. Food Sci. Tech. 50: 900-908.

UNICEF, 2013. Improving Child Nutrition, The achievable imperative for global progress, United Nations Children's Fund (UNICEF).

WHO, 2007. Protein and Amino Acid Requirements in Human Nutrition: Report of a Joint WHO/FAO/UNU Expert Consultation. WHO Technical Report Series World Health Organization, Geneva, Switzerland.

World Bank, 2011. Rice fortification: a key part of the solution to micronutrient deficiencies. The agriculture and rural development and health and nutrition and population team, World Bank.