Quality evaluation of fish ball prepared from frozen stored striped catfish (*Pangasianodon hypophthalmus*)

M. Akter, S.N. Islami[1], M.S. Reza[2], F.H. Shikha[2] and M. Kamal[2]
Department of Fisheries Technology, SFM Fisheries College, Melandah, Jamalpur; [1]Department of Fisheries, Government of the People's Republic of Bangladesh, Dhaka, [2]Department of Fisheries Technology, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh-2202. E-mail: rezams@gmail.com / msreza@bau.edu.bd

Abstract: Fish ball is a kind of mince-based product in south Asian market. The products has been introduced in well off restaurants but not yet introduced in common consumer market in Bangladesh. The products attain a meaty texture and can conceal the fishy odor with high acceptability. This study aimed to evaluate the quality of the fish ball prepared using frozen stored striped catfish (*Pangasianodon hypophthalmus*) as raw material and other ingredients including NaCl, sugar, spices, monosodium glutamate and meshed potato. Washed and unwashed mince were used to determine the effect of frozen storage and washing on fish mince. Results indicated that frozen storage decreased the quality (texture, flavor and color) of the fish flesh affecting the quality of the final product. Washing also caused the decreases in the color and flavor of the final products.
Key words: Fish ball, *Pangasianodon hypophthalmus*, *Thai-pangus*, value-added product

Introduction

The value that is added to any product or service through a particular process that may change the nature of raw material is called value addition and the products thus produced are called value-added products. Different types of value-added products can be produced from fish such as fish fillet, fish ball, fish burger, fish finger, fish stick and other surimi-based products. Value addition and diversification will help satisfy the ever changing and diverse demands of the urban consumers. The popularity of fish product in the diet of many western nations has increased due to international recommendation to lower the total level of dietary fat. It is well known that fish flesh has some unique characteristics as having high protein content with balanced profile of amino acids, polyunsaturated and essential fatty acids with n-3 series of fatty acids and low level of harmful cholesterol and saturated fat (Edwards and Kaewpaitoon, 1981). Due to increasing awareness of the consumers on health issues, consumption of fish and fishery products are increasing day by day.

A large proportion of total landed fish remains unused due to inherent problems related to unattractive color, flavor, texture, small size, and high fat content. Recovery of flesh by mechanical deboning and development of value-added products are probably the most promising approaches. There are various possibilities for product development using mince from low-cost fishery resources. These include surimi and surimi-based products, sausages, fermented products, protein concentrates and hydrolysates, extruded products, and biotechnological possibilities. The dual advantages of this approach, namely, finding ways for better utilization of low-value fish species and providing protein-rich convenience foods, have been pointed out. However, the key to the success of this approach depends largely on the market strategies utilized (Venugopala *et al.,* 1995). For effective capacity utilization and potential production of diversified products, processing of the underutilized/low priced fish species and other prospective species into surimi-based value added products will bring immediate benefit to the existing fish processing industries of the country (Nowsad *et al*., 1994). There is much potentialities lie on tropical freshwater fish species which could successfully be used in time in surimi industry. Freshwater fish are excellent sources of high quality protein since they are well balanced in essential amino acids and highly digestible (Karmas and Lauber, 1987). The surimi making ability of many freshwater species could be upgraded by manipulating processing techniques (Onibala *et al*., 1997). Very recently, some investigations have been done on the quality of the mince of freshwater fish for the manufacture of surimi (Lin and Morrissey, 1995; Onibala *et al*., 1997). All these results explicate that much potentiality also lie on freshwater fish which could successfully be used in surimi industry.

Striped catfish or sutchi catfish (*Pangasianodon hypophthalmus*, locally called *Thai-pangus*) are extensively cultured in Bangladesh. It has a great potential due to its faster growth rate. But in the peak season, the market price of these fishes often decline due to abundance of their production. So, if the farmer can used this low priced fish for the preparation of such type of products they can earn handsome money by selling the products. One of the most important minced based products is fish ball. Fish ball is a very popular and tasty food item in the fast food industry. In recent years, the preference of the consumers has significantly directed towards the fast food consumptions since there has been a rapid urbanization and an increase in working women population. With the modernization of the society, people in Bangladesh have been going out of the house more. These working people along with new generation students and young people are now more dependent on convenient foods. As a result, during the last five years, a lot of fast food shops have been opened in city, suburb and industrial areas of the country. The technology for producing fish ball is very simple and it requires less complex machinery. Commercial fish farmers can produce this product in homestead kitchen using kitchen utensils for marketing those locally. Successful manufacture and marketing of fish ball *Thai-pangus* will create a useful situation for proper utilization of the fish by removing of off-flavor and reducing high level of fat content of the fish and finally raise the price. Moreover, malnutrition is a serious problem which is caused mainly due to animal protein deficit in the diet (Nuruzzaman, 1992).

Immediately after harvesting, it is very important to preserve the fish in ice or frozen storage to maintain quality until it is used for processing. So it is essential to know the effect of storage condition and processing

technique on the quality of the products. Several studies were conducted on the production and quality stability of fishery fast food products including fish cake, fish crackers, fish ball and fish burgers produced from marine fish species (Siaw *et al*., 1985; Choi *et al*., 1988; Jensen, 1993; Lazos, 1996), but little information is available on this aspect related to tropical freshwater species. Studies were, therefore, undertaken to evaluate quality of fish ball prepared from frozen stored whole *Thai-pangus*, washed and unwashed mince.

Materials and Methods

Raw materials: Twenty (20) live *Thai-pangus* with average length of 43 cm and body weight of 1.25 kg were collected from K.R. market, Bangladesh Agricultural University (BAU), Mymensingh and transported to the Laboratory of Fisheries Technology, BAU. Fish were killed with cranial spiking and washed with tap water. Then they were placed in polythene bags and kept in ice until further use.

Storage of raw material: Fish were divided in four (4) different groups, viz. five (5) fish each for preparation of washed mince from frozen whole (WW), unwashed mince from frozen whole (UW), mince washed frozen (WM) and mince unwashed frozen (UM). First two groups of whole fish (WW, UW) were packed in polyethylene pouch and frozen stored at -20ºC. Rest of the fishes were minced by mechanical mincer and from that portion, half of the mince was washed (WM) two times with chilled water containing 0.1 % NaCl, kept in plastic box and wrapped with polyethylene pouch and frozen stored. Rest of the mince was kept as unwashed mince (UM) and frozen stored in the same way. Stored samples were used for fish ball preparation after every 10 days interval in triplicates.

Preparation of fish ball: Samples of frozen whole fish, washed and unwashed mince were taken out from the freezer and thawed at refrigerated temperature (4ºC). The thawed fishes were washed with clean water, filleted with sharp knife and skinned manually. Fillets were washed with chilled water to remove blood, visceral content etc. and mince was prepared by a mechanical mincer through a 1 mm orifice diameter so that all bones and connective tissues were removed from the muscles. All the utensils used in the experiment were cleaned with adequate washing and kept cool (5ºC). Part of unwashed mince was used as WU, and washed mince from frozen whole fish (WW) was prepared by two times washing with chilled water containing 0.1% NaCl. The mince thus obtained was ground with 2% NaCl, 2% oil, 0.6% sugar, 2% spices (onion, garlic, ginger, cumin, green chili paste and hot spices), 1% MSG (monosodium glutamate) and 25% of meshed potato for 5-7 minutes. Then the dough was shaped into 1.5 inch diameter ball, placed in a plastic box and kept at -20 ºC for 24 hours. In this way fish balls were prepared directly from frozen washed (WM) and unwashed mince (UM). After freezing, fish balls were taken out from freezer and dipped in a batter formulation with wheat flour (34%), NaCl (1%), MSG (1%), spices (1%), egg (19%). Then they were fried in dip-oil until the surface becomes golden brown color. Finally, prepared fish balls were placed on paper to allow soaking of extra oil from the surface. Scheme for the preparation of fish ball from the fish mince is presented in Fig 1.

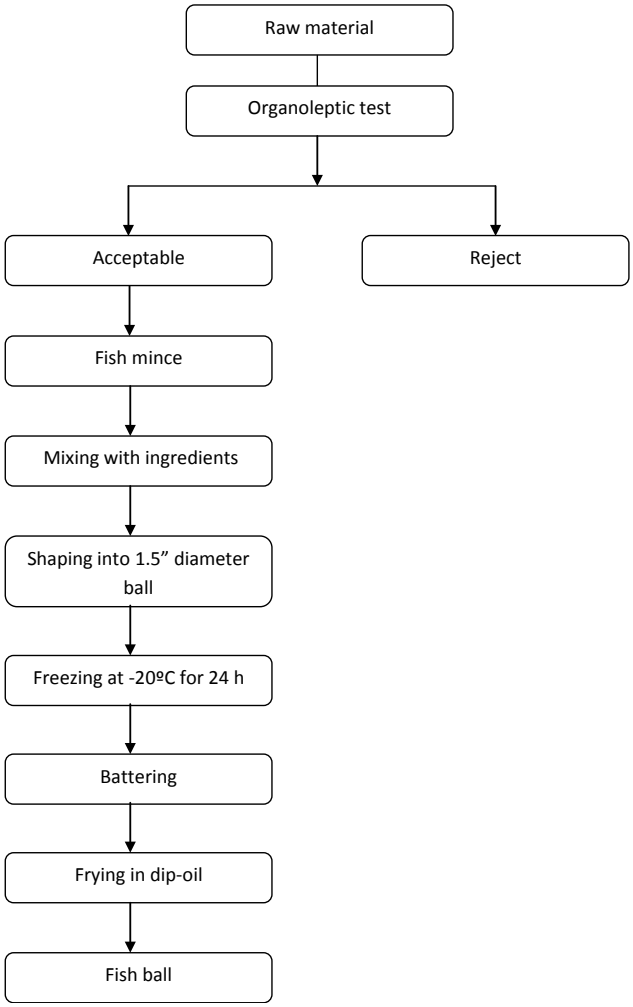

Fig.1. Flow diagram for fish ball preparation from *Thai-pangus*

Quality assessment of fish ball

Softness/firmness (S/F) and chewiness / rubberiness (C/R) tests: S/F was defined as the amount of force required to bite through the sample with incisors and C/R as the amount of effort the panelists had to exert in chewing to prepare the sample for swallowing. The quality was evaluated by the numerical scores in triplicate up to 10, where for S/F, 1=very soft; 10=extremely firm and for C/R, 1=not chewy/rubbery; 10=extremely chewy/rubbery.

Color and flavor test: Color and flavor were evaluated organoleptically. Scores used were from the range of 10 to1; where 10 = desired color and flavor; 1 = absent of color and flavor. The panel scores were recorded in the score sheet shown in Table 1 and 2.

Sensory evaluation: A nine-member panel conducted sensory assessments of the products as described by Nowsad *et al.* (2000). Prior to testing, panelists were familiarized with the properties of meat gel and the instructions relating to scoring of the samples. Three discs of gel (0.5 cm thick) were supplied to each panelist to recognize every attribute. The panel scores were recorded in the score sheet as shown in Table 1 and 2.

Statistical analysis: Data from different measurements were subjected to t-test ($p < 0.05$). The statistical analysis package SPSS 9.0 (SPSS Inc, Chicago, IL, USA) was used to explore the statistical significance of the results obtained.

Table 1. Scoring table for color test using sensory method

Score	Description	Comment
1 to 3	Considerably colored (dark gray)	Poor color
4 to 7	Moderately colored (brown/light gray)	Moderately good color
8 to 10	Finely colored (bright brown)	Excellent color

Table 2. Scoring table for flavor test using sensory method

Score	Description	Comment
1 to 3	Strong abnormal odor and a markedly poor flavor	Poor flavor
4 to 7	Slightly raw or scorched odor or flavor; seasoning seems to be somewhat inadequate	Moderately Good flavor
8 to 10	Abnormal flavor and have a good characteristic fish flavor and seasoning	Excellent flavor

Results and Discussion

Softness/firmness (S/F) and chewiness / rubberiness (C/R) of fish ball quality: The changes in S/F and C/R for fish balls prepared from different types of raw materials such as frozen washed mince, frozen unwashed mince, washed mince from frozen whole fish, unwashed mince from frozen whole fish were evaluated using sensory test (Fig. 2a, b). It was observed that due to storage at -20ºC for 30 days, slight decrease in S/F and C/R occurred in all types of fish ball which is an indication of changes in texture of fish muscle during frozen storage. The results obtained from the present study are more or less in agreement with Kurokawa (1979), MacDonald *et al.* (1992) and Scott *et al.* (1988) where they reported that frozen storage reduced the gel-forming ability of muscle protein from hoki, Alaska Pollock and lizardfish. In the present study, there were no significant differences among the fish balls prepared from different types of raw materials ($p>0.05$). It was revealed that fish ball prepared from unwashed mince were more firm than fish ball made from washed mince. This may be due to the effect of washing and addition of different ingredients. Nishioka (1984) reported applying greater number of washing cycles produced mince of stronger gel-forming ability of surimi. He also showed that the relative amount of MHC increased as the washing was repeated.

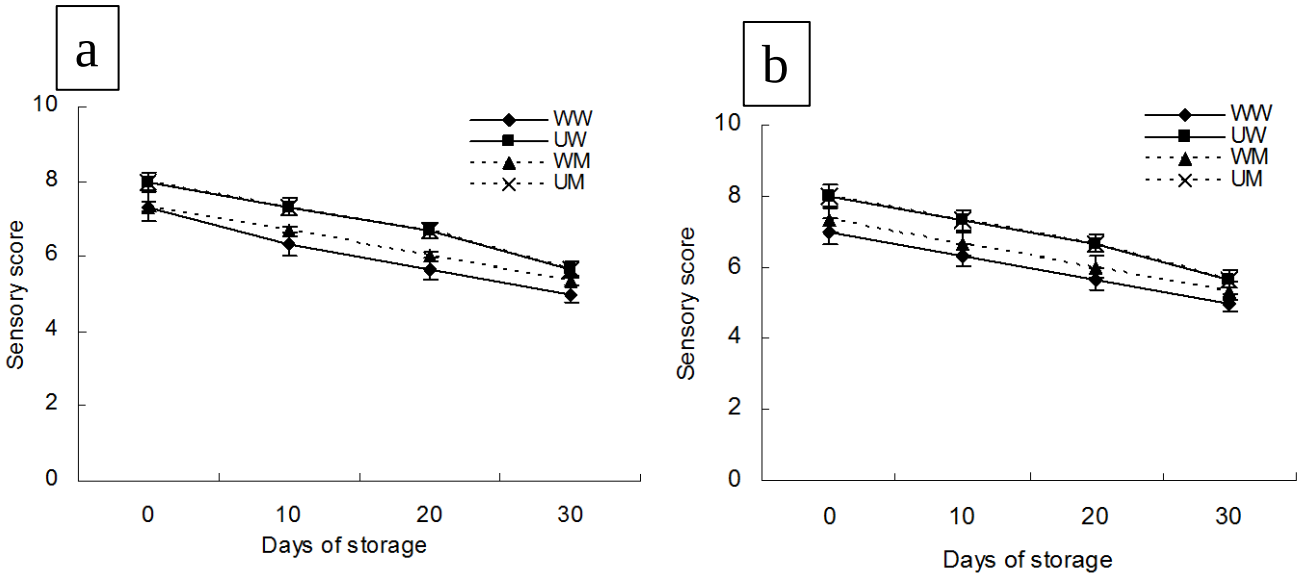

Fig. 2. Effect of frozen storage on (a) softness / firmness and (b) chewiness / rubberiness of fish ball prepared from washed mince from frozen Whole fish (WW), unwashed mince from frozen whole fish (UW), frozen washed mince (WM), frozen unwashed mince (UM). Vertical bars denote SD.

Color and flavor of fish ball quality: Fig 3a showed no significant changes in color of fish ball prepared from different types of raw materials ($p>0.05$), although slight differences in color between the fish ball prepared from washed and unwashed mince was observed. This might be due to effect of washing of fish mince with 0.1% NaCl solution. Hossain *et al.*, (2004) suggested a use of 0.1% NaCl washing solution to obtain good quality surimi from *Thai-pangus* fish mince. Washing is necessary to remove water-soluble substances, mainly sarcoplasmic protein and other undesirable materials like pigments (Hall and Ahmad, 1997).

Fig 3b showed the changes in flavor of fish ball prepared from different types of raw materials during frozen storage at -20ºC for 30 days. There was a significant change in flavor of fish ball occurred during frozen storage (during 0 and 20 days storage, $p<0.05$; during 10 and 30 days storage, $p<0.01$). A significant difference in flavor of fish ball was observed between the fish ball prepared from washed and unwashed mince. This may be due to the washing of fish mince. Washing of fish mince reduced the

flavoring agent of fish mince and removes the residual sarcoplasmic proteins rendering gel of greater quality.

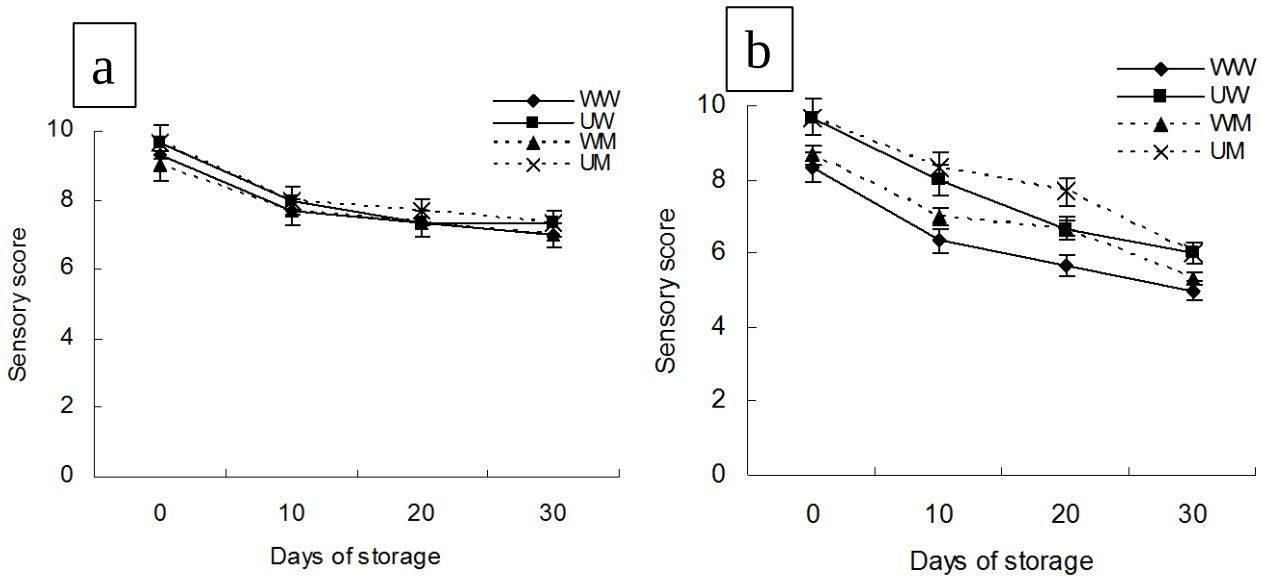

Fig 3. Effect of frozen storage on (a) color and (b) flavor of fish ball prepared from Washed mince from frozen whole fish (WW), unwashed mince from frozen whole fish (UW), frozen washed mince (WM), frozen unwashed mince (UM). Vertical bars denote SD.

Thai-pangus is a suitable species for producing value-added surimi-based products. However, prolonged frozen storage of fish fillets or mince decreases the texture, flavor and color of the fish flesh slowly which have effect on the quality of the final product.

References

Choi, S. I., Han, B. H., Krin, J. C., Bae T. J. and Cho, D. H. 1988. Prediction of thermal diffusivities of fish meat paste products. Bull. Korean Fish. Soc., 21: 288-291.

Edwards and Kaewpaitoon, 1981. *Fish Farming with Livestock Manure*. Paper presented at a seminar on Maximum Livestock Production from Minimum Land, jointly organized by the Department of Animal Science, BAU, NYRDP-DANIDA, Bangladesh Agricultural University, Mymensingh, 2-5 February, 1981.

Hall, G.M. and Ahmad, N.H. 1997. Surimi and fish mince products. In: Hall, G.M. (Ed.), Fish Processing Technology, pp. 74-91. Blackie Academic and Professional, London.

Hossain, M.I., Kamal, M.M., Shikha, F.H. and Hoque, M.S. 2004. Effect of washing and salt concentration on the gel forming ability of two tropical fish species. Int. J. Agri. Biol., 6: 762–766.

Jensen, J. 1993. Fancy fish products. Food Marketing and Technology, August.

Karmas, E. and E. Lauber 1987. Novel products from underutilized fish using combined processing technology. *J. Food Sci.*, 52: 7–9.

Kurokawa, T. 1979. Kamaboko-forming ability of frozen and ice stored lizard fish. Bull. Japan. Soc. Sci. Fish., 45: 1551–1555.

Lazos, S. E. 1996. Utilization of freshwater bream for canned fish ball manufacture. J. Aqua. Food Products Technol., 5: 47-64.

Lin, D. and Morrissey, M.T. 1995. Northern squawfish (Ptychocheilus oregonensis) for surimi production. J. Food Sci., 60: 1245-1247.

MacDonald, G. A.,. Lelievre, J and Wilson, N. D. C. 1992. Effect of frozen storage on the gel-forming properties of hoki (Macruronus novaezelandiae). J. Food Sci., 57: 69–73.

Nishioka, F. 1984. Leaching treatment. In: Shimizu, H. (Ed.), Science and Technology of Fish Paste Products, pp. 62-73. Koseisha-Koseikaku Publishing Co., Tokyo.

Nowsad, A. A., Kamal, M. and Hossain, M. I. 1994. Seafood Resource Availability, Utilization and Research in Bangladesh. Proceeding of The international Seafood Research Meeting of the Mie University. Mie Academic Press. 109-126.

Nowsad, A. A., Kanoh, S., Chanda, S. C. and Niwa, E. 2000. Gel forming ability and other properties of eleven underutilized tropical marine fish species. J. Aquatic Food Product Technol., 9: 71-75.

Nuruzzaman, A. K. M. 1992. Aquaculture: towards solving malnutrition. The Bangladesh Observer, October 17, 1992, Dhaka, Bangladesh.

Onibala, H., Takayama, T., Shindo, J., Hayashi, S. and Miki, H. 1997. Influence of freshness on occurrence of setting and disintegration in heat-induced gels from tilapia. Fish. Sci., 63: 276-280.

Scott, D. N. 1988. Effect of freezing and frozen storage of Alaska Pollock on the chemical and gel-forming properties of surimi, *J. Food Sci.* 53: 353-358.

Siaw, C. L., Idrus, A. Z. and Yu, Y. 1985. Intermediate technology for fish craker (Keropok) production. J. Food Tech., 20: 17-21.

Venugopala, V., Shahidia, F. and Tung-Ching Leeb 1995. Value-added products from underutilized fish species. J. Cri. Rev. Food Sci. Nutri., 35: 431 – 453.