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COMPARATIVE SHELF LIFE STUDY OF WHOLE FISH AND FILLETS OF CULTURED STRIPED CATFISH (*Pangasianodon hypophthalmus*) DURING ICE STORAGE CONDITION

Salma Noor-E-Islami[1], Md. Faisal[2*], Mousumi Akter[3], Md. Shaheed Reza[4] and Md. Kamal[4]

[1]Department of Fisheries (DoF), Government of the People's of Republic Bangladesh; [2]Department of Fishing and Post Harvest Technology, Faculty of Fisheries, Chittagong Veterinary and Animal Sciences University, Chittagong-4225; [3]Department of Fisheries Technology, Faculty of Fisheries, SFM Fisheries College, Melandah, Jamalpur-2010; [4]Department of Fisheries Technology, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

***Corresponding author:** Md. Faisal, E-mail: faisalmohammad10@gmail.com

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ABSTRACT

A comparative study on the shelf life of whole fish and fillet of cultured striped catfish (*Pangasianodon hypophthalmus*) under ice storage condition was carried out by determining organoleptic and biochemical aspects in the month of September and October. It was found that shelf life of whole fish was 21 days where as fillet had slightly lower shelf life of 18 days. Value of pH changed from 7.07 to 6.97 after 24 days for whole fish and 6.88 for fillet after 21 days at the termination of experiment, pH remained to 6.5 for fillet after 18 days of ice storage. TVB-N value increased from an initial value of 1.68 mg/100g to 28.83 mg/100g in 21 days in whole fish and finally to rejection value of 35.89 mg/100g at the end of 24 days storage period. As for fillets TVB-N value was at acceptable level of 24.79 mg/100g until 18 days of storage at same condition. Myofibriller protein solubility gradually decreased with storage period for both whole fish and fillets. The results of this study indicated that in regard to organoleptic and biochemical aspects the shelf life of *Thai-Pangas* in ice stored condition is 21 days and 18 days for the whole fish and fillets, respectively.

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INTRUDUCTION

There has been a rising demand of chilled-stored striped catfish (*Pangasianodon hypophthalmus*, locally called *Thai-Pangas*) in Bangladesh and other parts of the world over the last decade. Its consumption has grown rapidly in Russia, Spain, France and other European countries and the United States. In Europe, the presence of *Pangasianodon sp.* is overwhelming and there is practically no fish shop without *pangas* fillets. *Thai-Pangas* catfish is a low-priced fish in the common fish market. It is cultured due to its faster growth, ease of reproduction, adaptability to intensive culture, acceptability of low input sustainable feeds, resistance to impaired water quality, good taste, fewer bone content and widespread consumer acceptance (Ali et al., 2013; De Silva, 2011;).

After death *Thai-Pangas* is highly susceptible to spoilage from post-mortem autolysis and microbial growth. This accounts for use of appropriate storage method for preservation of its quality. There are several methods to preserve fresh fish; however, icing is a common method for short-term preservation. During icing or chilling storage of fish, chemical changes are known to take place. There are a number of factors that influence the quality of fish. Of which the most important one is the post-mortem changes that take place soon after death due to enzymatic action. The state of rigor in association with other biochemical changes influences the meat quality in fish and higher animals.

As such, there has been little or no study conducted in Bangladesh on the shelf life of this commercially important fish species. Although Hossain et al. (2005) studied some physiochemical changes in whole *Thai-Pangas* muscle during ice storage condition, there are no reports on different changes in its fillets under different storage conditions. This study was, therefore, carried out to investigate the shelf life of whole fish and fillets of *Thai-Pangas* by determining organoleptic and biochemical changes under ice storage condition.

MATERIALS AND METHODS

Storage condition and fish sampling

Thirty (30) live *Thai-Pangas* with average length of 43 cm and body weight of 1.25 kg were collected from 2 fish farms of Trishal and 1 fish farm of Bhaluka, Mymensingh and transported to the Laboratory of Fish Processing, Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh. Fish were killed with cranial spiking, washed with tap water, placed in plastic bags and kept in ice until subsequent experiments.

Organoleptic assessment

Sensory evaluation was carried out according to the guidelines described by EC freshness grade for ice stored fish (Howgate and Whittle, 1992).

Analytical methods

Measurement of muscle pH

During the determination time of rigor index 2 g of the ordinary muscle was dissected from the dorsal part of the sample and homogenized with 10 ml of distilled water in a blender. After adjusting the temperature, the electrode of the pH meter was put on the tube and the pH was measured by the pH meter (Model 250 pH/ISE).

TVB-N Value

TVB-N values were determined as described by Antonacopoulos and Vyncke (1989).

Changes in the protein solubility

Myofibrils are a part of muscle protein. Myofibrillar protein solubility indicates the denaturation rate of protein.

Preparation of myofibrils

Myofibrils were prepared from ordinary muscles immediately after excision according to Perry and Grey (1956) with slight modification. The muscle was chopped by a meat grinder and chilled minced muscle (50 g) was homogenized for 1 min in 5 volumes of 39 mM borate buffer (pH 7.1) containing 25 mM KCl and 0.1 mM DTT. The homogenate was centrifuged for 15 min at 600×g. The precipitate obtained was again homogenized and centrifuged for 15 min at 600×g. The light colored upper layer of the precipitate consisting mainly of myofibril was recovered with small volume of 39 mM borate buffer (pH 7.1) containing 0.1 M KCl and 0.1 mM DTT. The suspension was centrifuged for 15 min to remove the supernatant. Myofibrils were diluted with 4 volume volumes of 39 mM borate buffer (pH 7.1) containing 0.1 M KCl and 0.1 mM DTT and coarse materials were removed by centrifugation at 400×g. The suspension was centrifuged for 15 min at 600×g to precipitate myofibril. After the precipitate was washed three times in the same way, myofibril were suspended with desired volume of 39 mM borate buffer (pH 7.1) containing 0.1 M KCl to make a concentration of 10-15 mg/ml.

Myofibrillar protein solubility

Two ml of myofibrillar suspensions (5mg/ml) were homogenized with 2 ml of 1M KCl plus 100mM phosphate buffer (pH 7.0) using a homogenizer. The homogenate was allowed to stand at refrigerated temperature (4°C) overnight. The suspension was centrifuged for 30min at 900×g in cold condition and the supernatant was collected. Protein concentration was determined by Biuret method (Gornall et al., 1949).

Statistical analysis

Data from different biochemical measurements were subjected to t-test ($p<0.05$). Statistical software package SPSS 10.1 (SPSS Inc, Chicago, IL, USA) was used to explore the statistical significance of the results obtained.

RESULTS AND DISCUSSION

Changes in organoleptic quality under ice storage condition

The quality of fishes was graded by using the score from 1-5. The score points less than 2 were considered as excellent. The points from 2 to less than 5 were judged as good or acceptable conditions, while 5 and above considered as bad or rejected. The changes in quality of chilled fish during storage were assessed by daily organoleptic examination. Table 1 showed the changes in organoleptic qualities of whole fish and fillets of *Thai-Pangas* during ice storage in an insulated box. On the basis of the scores the fishes were found in acceptable conditions for 21 days of ice storage before becoming inedible. Hossain et al. (2005) reported that shelf life of *Thai-Pangas* muscle was 20 days under storage at insulated box in ice which is also more or less similar with the findings of present study. Reza et al. (2009) reported that the quality changes of tropical fishes in ice takes place in 4 phases corresponding to periods of 0 to 3, 4 to 6, 7 to 9 and 10 to 13 days. Similarly in the present study, it was observed that very little change occurred in whole fish and fillets during 0 to 3 days and 3 to 6 days without loss of natural flavor and odor in *Thai-Pangas*. During this period whole fish and fillets had the characteristics of excellent quality. During the periods of 6 to 9 days, 9 to 12 days and 12 to 15 days, In case of whole fish there were little deterioration apart from slight loss of natural flavor and odour, and partial loss of bloom. At this stage there was little loss of the characteristic odour and the flesh was neutral but had no off-flavour. Fillets showed the early spoilage with sour flavour during 12 to 15 days of storage whereas in case of whole fish, the early signs of spoilage was observed during 15-18 days of storage. At the beginning of this phase the flavor in whole fish and fillet was slightly sour, sickly sweet, fruity of like dried fish, which was judged as acceptable quality. The taste began to stale, as well as the appearance and texture began to show the obvious signs of spoilage for fillet under acceptable condition during the period of 15-18 days. On the other hand the taste, texture and appearance of whole fish showed the evidence of primary spoilage including the gills and the belly cavity had an unpleasant smell in the limit of acceptance during 18 to 21 days. The fillet became putrid by all of the characteristics and hence rejected during day 18 to 21 days, whereas the whole fish became rejected during 21 to 24 days for the same reason.

In the present study, iced stored *Thai-Pangas* was found to be acceptable up to 21 days and the fillets were acceptable up to 18 days indicating significantly lower (p<0.05) shelf life of fillets than whole fish from organoleptic point of view. While fish from the tropics had significantly higher storage life under ice compared to those from the temperate region, higher shelf life of fish fillet was obtained for *Thai-Pangas* when compared to fillet of cold water fishes (Onibi et al., 1996; Gatta et al., 2000; Pirini et al., 2000; Ruff et al., 2002). Although the present study did not consider the development of color and related color index with storage period, its use could have reduced the shelf life of *Thai-Pangas* fillets to further 1 to 2 days.

Table 1. Changes in organoleptic qualities of whole fish and fillets of *Thai-Pangas* during ice storage condition

Days of storage	Mean defect points		Grade		Overall qualities	
	Whole fish	Fillet	Whole fish	Fillet	Whole fish	Fillet
0	1.25	1.25	A	A	Excellent	Excellent
3	1.57	1.57	A	A	Excellent	Excellent
6	2.00	2.00	A	A	Excellent	Excellent
9	2.20	2.20	B	B	Acceptable	Acceptable
12	2.9	2.9	B	B	Acceptable	Acceptable
15	3.45	3.97	B	B	Acceptable	Acceptable
18	3.97	4.6	B	B	Acceptable	Acceptable
21	4.6	5.0	B	C	Acceptable	Rejected
24	5.0	-	C	-	Rejected	-

Changes in pH value

Changes in muscle pH of ice stored whole fish and fillets are shown in (Fig.1). The pH of fish muscle immediately after death was around 7.07. After 6 days of storage in ice, the pH decreased gradually to 6.11 in case of whole fish and 6.15 in case of fillets. After 9 days of ice storage pH increased gradually due to formation of basic compounds and finally reached up to 6.97 after 24 days and 6.88 after 21 days for fillets when the whole fish and fillet were organoleptically unacceptable. The correlation between pH and organoleptic scores in this study suggests that pH can be used as a reliable index of quality. Low muscle pH of the post-mortem fish muscle is associated with the quality changes in fish (Konagaya and Konagaya, 1979; Kramer and Peters, 1981; Reza et al., 2009). Muscle pH of live sardine has been reported as 7.2 (Pacheco-Aguiler et al., 2000) but following the death, muscle pH decreased to 6.8 after 2 h, 6.2 after 8 h and 5.8 after 24 h, respectively (Watabe et al., 1991). The pH values of sardine muscle stored in ice was 5.8, 6.36 and 6.57 at day 0, 9 and 18, respectively (E1 Marrakch et al., 1990).

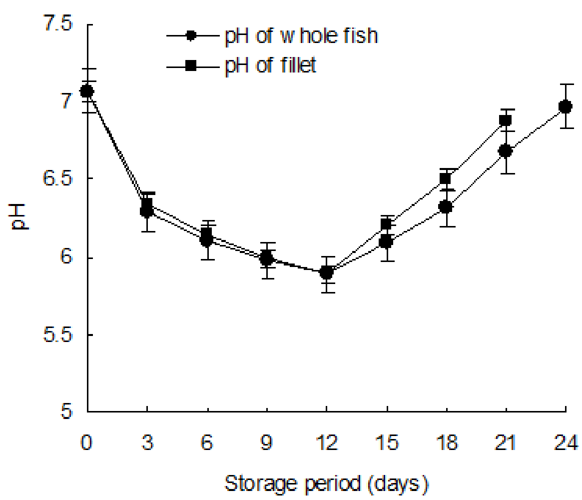

Figure 1. Changes in muscle whole fish and fillets of *Thai-Pangas* during ice storage

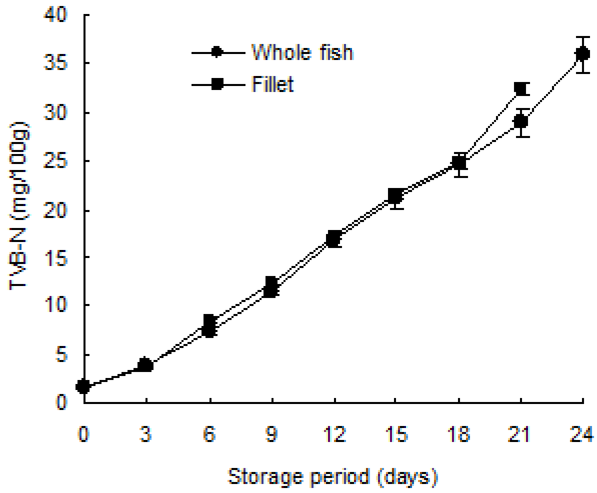

Figure 2. Comparison of changes in TVB-N of whole fish and fillets of *Thai-Pangas* during ice storage

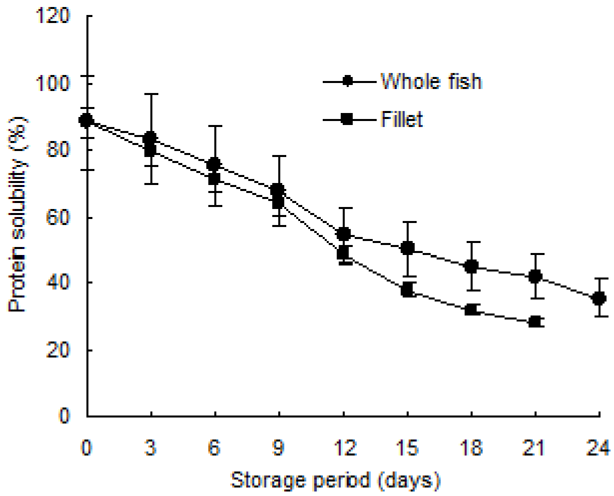

Figure 3. Comparison of changes in muscle protein solubility of whole fish and fillets of *Thai-Pangas* during ice storage

Changes in TVB-N value

The amount of TVB-N in fish increases as spoilage progresses. Increase in TVB-N with the lapse of storage may be attributed to bacterial spoilage. The results of the TVB-N (mg/100g) of experimental whole fish and fillets have been presented in Fig. 2. The initial TVB-N values were 1.68 mg/100g in *Thai-Pangas*, which gradually increased with lapse of storage period. At the end of 21 days of ice storage TVB-N value of whole fish increased to 28.83 mg/100g whereas the TVB-N value of fillets increased to 24.79 mg/100g at the end of 18 days of storage. These values are within the range of recommended values of 25 to 30 mg/100g for fresh fish (Connell, 1980). However, at the end of 24 days of ice storage the TVB-N value of whole fish was 35.89 mg/100g and at the end of 21 days of ice storage the TVB-N Value of fillet was jumped to 32.45 mg/100g due to combined action of enzymes and microbial activity and thereby exceeded the acceptable limit. It has been reported that TVB-N value mainly increased in the fish flesh during the later phase of spoilage when the bacterial population increased (Mazorra-Manzano et al., 2000). TVB-N values showed a slight increase for whole ungutted sea bass during storage, reaching a value of 26.77 mg N per 100 g muscle (day 13), whereas for fish fillet corresponding value of 26.88 mg N per 100 g muscle was recorded (day 9) (Taliadourou et al., 2003). Thus TVB-N value is low during the edible storage period and increased amount of TVB-N are found near the rejection state of fish.

Changes in protein solubility

Changes in protein solubility of whole fish and fillets of *Thai-Pangas* during ice storage have been presented in Fig. 3. Solubility of myofibrillar protein immediately after death was 88.21%, which decreased gradually to 35.27% in case of whole fish at the end of 24 days of storage whereas at the end of 21 days of storage the solubility of myofibrillar proteins from fillet was 28.12%. The solubility of carp myofibrils decreased from 95% to 20% during ice storage within 2-3 weeks (Seki et al. 1979). Similar findings were also reported for for mrigal (*Cirrhina mrigala*) (Hossain, 1995) and ruhu (*Labeo rohita)* (Faruk, 1995). According to Seki et al. (1980) the fall in solubility during ice storage was due to lowering of pH. The loss in myofibril solubility of milkfish during storage was due to aggregate formation by disulfide, hydrogen and hydrophobic bonds (Jiang et al., 1988). The solubility in muscle protein of croaker, lizardfish, threadfin bream and big-eye snapper decreased continuously during prolonged storage. The results obtained from the present study indicated that the decrease in solubility of pangas muscle might be due to aggregation as well as denaturation of muscle protein during ice storage.

CONCLUSION

Cultured *Thai-Pangas* fillet samples showed a significantly shorter shelf life (18 days) compared to its counterpart whole fish (21 days) samples in ice storage condition. Fillets were found to be more prone to oxidation than the counterpart whole fish species, because of a greater expouser of the fish muscle in fillets to oxygen. If longer shelf-life times are commercially required for fillets, protective treatments such as vacuum packaging, modified atmosphere packaging and natural antioxidant application are recommended. Improvements in the shelf life of a product can have important economic impact by reducing losses attributed to spoilage and by allowing the products to reach distant new markets and in this fashion very helpful to prepare value added products.

REFERENCES

1. Ali H, MM Haque and B Belton, 2013. Striped catfish (*Pangasianodon hypophthalmus*, Sauvage, 1878) aquaculture in Bangladesh: an overview. Aquaculture Research, 44: 950–965.
2. Antonacopoulos N and W Vyncke, 1989. Determination of volatile basic nitrogen in fish: a third collaborative study by the West European Fish Technologists' Association (WEFTA). Zeitschrift Fur Lebensmittel-Untersuchung Und-Forschung, 189: 309-316.
3. Connell JJ, 1980. Quality deterioration and extrinsic quality defects in raw material. In: control of fish quality, 2nd, ed. Fishing News Books Ltd. Surrey, England. pp. 31-35.
4. De Silva SS and NT Phuong, 2011. Striped catfish farming in the Mekong Delta, Vietnam: a tumultuous path to a global success. Reviews in Aquaculture, 3: 45–73.
5. El Marrakch A, M Bennour, N Bouchriti, A Hamama and H Tagafatit, 1990. Sensory, chemical and microbiological assessments of Moroccan sardine (*Sardina pillchardus*) stored in ice. Journal of Food Protect, 53: 600-605.
6. Faruk MAR, 1995. Studies on the post-mortem changes in rohu fish (*Labeo rohita*). M. Sc. Thesis, Department of Fisheries Technology. Bangladesh Agricultural University, Mymensingh.
7. Gatta PP, Pirini M, Testi S, Vignola G and Monetti PG, 2000. The influence of different levels of dietary vitamin E on sea bass *Dicentrarchus labrax* flesh quality. Aquaculture Nutrition 6: 47–52.
8. Gornall AG, CJ Bardawill and MM David, 1949. Denaturation of serum proteins by means of the biuret reaction. Journal of Biological Chemistry, 751-766.
9. Hossain MI, 1995. Studies on the post-mortem changes in mrigal (*Cirrhina mrigala*). M.Sc. Thesis. Department of Fisheries Technology. Bangladesh Agricultural University, Mymensingh.

10. Hossain MI, MS Islam, FH Shikha, M Kamal and MN Islam, 2005. Physicochemical Changes in Thai Pangas (*Pangasius sutchi*) muscle during ice-storage in an insulated box. Pakistan Journal of Biological Sciences, 8: 798-804.
11. Howgate PAJ and. KJ Whittle, 1992. Multilingual Guide to EC Freshness Grades for Fishery Products. Torry Research Station, Food safety Directorate, Ministry of Agriculture, Fisheries and Food, Aberdeen, Scotland.
12. Jiang ST, DC Hwang and CS Chen, 1988. Effect of storage temperature on the formation of disulfide and denaturation of milkfish actomyosin (*Chanos chanos*). Journal of Food Science, 53: 1333-1335.
13. Konagaya S and T Konagaya, 1979. Acid denaturation of myofibrillar protein as the main cause of formation of Yake-Niku, a spontaneously done meat, in red meat fish. Nippon Suisan Gakkaishi, 45: 145.
14. Kramer DE and MD Peters, 1981. Effect of pH and refreezing treatment on the texture of yellowtail rockfish (*Sebastes flavidus*) as measured by Ottawa texture measuring system. Journal of Food Technology, 16: 493-504.
15. Mazorra-Manzano MA, R Pacgeco-Aguilear, EI Diaz-Rojas and ME Lugo-Sanchez, 2000. Postmortem changes in black skipjack muscle during storage in ice. Journal of Food Science, 65: 774-779.
16. Onibi GE, Scaife JR, Fletcher TC and Houlihan DF, 1996. Influence of α-tocopherol acetate in high lipid diets on quality of refrigerated Atlantic salmon (*Salmo salar*) fillets. In: Proceedings of the Conference of IIR Commission C2, Refrigeration and Aquaculture, 20–22 March. International Institute of Refrigeration, Paris, France. pp. 145–152.
17. Pacheco-Aguilar R, ME Lugo-Sanchez and MR Robles-Burgueno, 2000. Postmortem, biochemical and functional characteristics of Monterey sardine muscle at 0° C. Journal of Food Science, 65: 2586-2590.
18. Perry SV and TC Grey, 1956. A study of the effects of substrate concentration and certain relaxing factors on the magnesium activated myofibrillar adenosinetriphosphatase. Journal of Biochemical, 64: 184-192.
19. Pirini M, PP Gatta, S Testi, G Trigari and PG Monetti, 2000. Effects of refrigerated storage on muscle lipid quality of sea bass (*Dicentrarchus labrax*) fed on diets containing different levels of vitamin E. Journal of Food Chemistry, 68: 289–293.
20. Reza MS, MAJ Bapary, CT Ahasan, MN Islam and M Kamal, 2009. Shelf life of several marine fish species of Bangladesh during ice storage. International Journal of Food Science and Technology, 44: 1485–1494.
21. Ruff N, RD Fitzgerald, TF Cross and JP Kerry, 2002. Comparative composition and shelf-life of fillets of wild and cultured turbot (*Scophthalmus maximus*) and Atlantic halibut (*Hippoglossus hippoglossus*). Aquaculture International, 10: 241–256.
22. Seki N, M Ikeda and N Narita, 1979. Changes in ATPase activities of carp myofibrillar proteins during ice storage. Nippon Suisan Gakkaishi, 45: 791-798.
23. Seki N, Y Oogane and T Watanabe, 1980. Changes in ATPase activity and other properties of sardine myofibrillar proteins during ice storage. Nippon Suisan Gakkaishi, 46: 607–615.
24. Taliadourous D, V Papadopoulos, E Domvridou, IN Sawaidis and NG Kontominas, 2003. Microbiological, chemical and sensory changes of whole and filleted Mediterranean aquacultured sea bass (*Dicentrachus labrax*) stored in ice. Journal of the Science of Food and Agriculture, 83: 1373-1379.
25. Watabe S, M Kamal and K Hashimoto, 1991. Post mortem changes in ATP, creatine phosphate and lactate in sardine muscle. Journal of Food Science, 56: 151154.