Bangladesh J. Fish. (2019) **31**(1): 119-124

Comparative study on the quality and safety aspects of Climbing perch (*Anabas testudineus*) and Nile tilapia (*Oreochromis niloticus*) from pond and openwater of Mymensingh, Bangladesh

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Abstract. Various quality attributes of Climbing perch (*Anabas testudineus*) and Nile tilapia (*Oreochromis niloticus*) collected from pond and open water were studied. Organoleptic characteristics (SDP value), proximate composition, TVB-N, heavy metal (Cd and Cu), and bacteriological aspect of the samples were compared. The protein content of *A. testudineus* and *O. niloticus* of pond origin was 17.03% and 17.15%, whereas of open water was 16.95% and 16.24%, respectively. The lipid content of *A. testudineus* and *O. niloticus* of pond was 12.13% and 8.03 %, whereas from open water was 11.82% and 7.09%, respectively. Ash content of *A. testudineus* and *O. niloticus* from pond was 5.87 % and 4.03 % and from open water was 6.30% and 4.87%, respectively. The TVB-N content of *A. testudineus* and *O. niloticus* from pond was 2.24 mg/100g and 5.32 mg/100g but from open water were 2.63 mg/100g and 5.49 mg/100g, respectively. The bacterial load of *A. testudineus* and *O. niloticus* from pond was $2.25x10^6$ CFU/g and $1.84x10^5$ CFU/g, whereas from open water was $2.54x10^7$ CFU/g and $1.97x10^6$ CFU/g, respectively. Heavy metal concentration in *A. testudineus* and *O. niloticus* from pond was 0.39 ppm and 0.37 ppm for cadmium (Cd) and, 0.4 ppm and 0.36 ppm for Copper (Cu), respectively. On the other hand, the heavy metal concentration in *A. testudineus* and *O. niloticus* harvested from open water was 0.77 ppm and 0.96 ppm for Cd and, 0.58 ppm and 1.87 ppm for Cu, respectively. All parameters were within the acceptable limit except APC in open water fishes. Result of the present research indicated that the pond fishes were of better quality and safer than those of the open water fishes.

Keywords: Climbing perch, Nile tilapia, Proximate composition, TVB-N, APC, Heavy metal

Introduction

Fish of Bangladesh water is famous for its nutritive value, quality, freshness and delicious taste. Good quality raw fish supply is essential for domestic consumption as well as for value added product to export. So it is important to know the quality and safety aspect of fishes of Bangladesh. Climbing perch (*Anabas testudineus)* and Nile tilapia (*Oreochromis niloticus)* are very delicious fish and preferred in Bangladesh. In almost all fish markets these two species have a good market share. These two fish species have good potential for value added product development too. It is important to know the quality and safety aspect of Climbing perch and Nile tilapia of pond and open water because, both the species prefer turbid water for living, usually take nourishment from those water. Sometimes fish are caught from suspected area e.g.

near effluent discharge area or waste dump area. Moreover in pond fish farming low grade feed ingredients are used which is also a cause of reduction of quality and safety.

TVB-N of raw fish indicates its quality. Considerable attention has been paid to the TVB-N of raw fish and a maximum allowable limit in fish is set. This maximum allowable limit determines the acceptability and safety of raw fish (Connell *et. al.*, 1976; Ohta *et al*. 1975, Burt *et al*. 1976). TVB-N indicates bacterial spoilage as well as enzymatic degradation. The major portion of TVB-N is considered essentially to be ammonia. In well preserved fish, ammonia originates from amino acids mainly from glutamine and asparagine (Haaland and Njaa 1968). Fish caught from polluted water may contain toxic trace metals which may have been accumulated via food chain. High level of toxic metal is harmful for fish as well as for consumers. All heavy metals and elements above certain level are harmful for health. The effects of heavy metals on consumers' health are renal problem and irreversible problem in stomach. Mercury (Hg) above certain level has an additional effect on consumers' health that it damages central nervous system. Lead (Pb) above certain level has an additional effect on children that it causes retarded growth. Copper (Cu) and zinc (Zn) also cause marketing problem of fish. Polluted water also contains huge number of bacteria which usually contaminate fish. Pollution of water by waste, lagoon, and sewerage disposal usually contaminates water and finally fish. It is important to know the total bacterial count (APC) of fish as there is a maximum allowable limit of total bacterial count recommended by ICMS (1980). We have reported in our previous publication that the heavy metal concentration and total bacterial count of some fish e.g. Eurasian catfish, Bagrid catfish, Air breathing catfish, Stinging catfish of Bangladesh (Mansur *et al*. 2017, Mansur *et al*. 2018). Here in these researches we have attempted to compare the level of heavy metal, total bacterial count, quality, freshness of climbing perch and cichlid of pond and open water. Such data will be helpful for the consumers at home and abroad. It will be helpful to produce a quality product and a safe product. Such data may contribute to formulate an appropriate quality control and quality assurance programme too. The objective of the present study was to elucidate the nutritional quality and safety aspects of climbing perch and tilapia of pond and open water.

Materials and Method

***Collection, transportation, storage of fish species*:** Climbing perch (*Anabas testudineus*) and Nile tilapia (*Oreochromis niloticus*) were collected from ponds within the Bangladesh Agricultural University and open water samples were collected from K.R. Market of Bangladesh Agricultural University, Mymensingh which is reported that harvested from river adjacent to the Bangladesh Agricultural University, Mymensingh. After collection the fish samples were taken in polyethylene bags and immediately transported to the laboratory.

***Freshness* test:** Freshness test of the samples (sensory quality i.e. SDP value) was conducted by organoleptic method which was adopted from the method followed in EU and this method was proposed and described by Howgate *et al.* (1992).

Quality assessment: Quality of the samples was assessed by classical chemical test by estimating TVB-N according to AMC (1979) method. Nutritional quality was assessed by estimating proximate composition (Protein, lipid, ash and moisture percentage) of the samples

according to AOAC (1980) method. Aerobic plate count (APC) was done by consecutive decimal dilution technique (Collins and Patricia 1976).

Heavy metal analysis: Detection and quantification of heavy metal (Cadmium and Copper) was conducted by analysis of acid digested sample which was diluted and filtered through Whatman No.1 filter paper (Mansur *et al*. 2017). The colour of the solutions were measured by Atomic Absorption Spectrophotometer at a specific wave length and concentration was calculated according to the methods of Clesceri *et al*. (1989) and Eboh *et al*. (2006).

Results and Discussion

Nutritional quality: Nutritional composition of *A. testudineus* and *O. niloticus* from pond and open water shows that all nutrients were similar except lipid. Lipid content was reasonably different in pond samples (12.13%) and in open water samples (11.82%) of *A. testudineus*. In pond samples of *O. niloticus,* the lipid content was 8.03% whereas in open water samples lipid content was 7.09%.

Table I. Nutritional quality (Proximate composition) of *A. testudineus*and *O. niloticus*

Parameter	*A. testudineus*		*O. niloticus*	
	Pond (n= 5)	Open water (n= 5)	Pond (n= 5)	Open water (n= 5)
Protein	17.03±0.10	16.95±0.08	17.15±0.06	16.24±0.05
Lipid	12.13±0.08	11.82±0.02	8.03±0.06	7.09±0.05
Ash	5.87±0.06	6.30±0.05	4.03±0.10	4.87±0.10
Moisture	64.03±0.10	65.02±0.12	69.83±0.16	70.26±0.14

Protein content of *A. testudineus* and *O. niloticus* those caught from pond was 17.03% and 17.15%, respectively while the protein content of *A. testudineus* and *O. niloticus* those caught from open water was 16.95% and 16.24%, respectively. Lipid content of *A. testudineus* and *O. niloticus* those caught from pond was 12.13 % and 8.03%, whereas the lipid content of *A. testudineus* and *O. niloticus* from open water was 11.82% and 7.09%, respectively. The ash content of *A. testudineus* and *O. niloticus* from pond was 5.87% and 4.03%, whereas the ash content of *A. testudineus* and *O. niloticus* from open water was 6.3% and 4.87%, respectively. Moisture content of *A. testudineus* and *O. niloticus* those caught from pond was 64.03% and 69.83%, whereas the moisture content of *A. testudineus* and *O. niloticus* from open water was 65.02% and 70.26%, respectively. Love (1992) studied the moisture content of *Tilapia mossambica* from the four dams where moisture content was between 69.7% and 76.6%. Result of the present study is similar to our previous studies (Mansur 2015). Nutritional composition depends on some factors among which geographical variation, area of capture, season and feed intake are important. Nutritional quality of *A. testudineus* and *O. niloticus* of pond and open water is almost comparable with other important/commercial freshwater fish species of Bangladesh.

Freshness quality and Heavy metal content: Sensory quality i.e SDP value is higher in open water fishes than those of the pond fishes. But it remained within the acceptable limit (<5).

Open water fishes were with slightly higher value of SDP value due to certain degree of loss of sensory quality as a result of time elapsed between catch and analysis (Table II).

In almost all samples the TVB-N value was higher in open water fishes compared to pond fishes but it remained below the maximum allowable limit (MAL 30 mg/100g).TVB-N indicates quality of fish and fishery products as a result of bacterial activity and enzymatic activity. Importance is given to TVB-N of raw fish and a maximum allowable limit is set throughout the world. This maximum allowable limit determines the acceptability and safety of raw fish on the basis of freshness and quality (Connell *et al*. 1976, Burt *et al*. 1976). Fresh fish muscle contains a number of volatile compounds of which major portion of TVB-N is considered essentially to be ammonia. In well preserved fish, ammonia originates from amino acids, mainly from glutamine and asparagine (Haaland and Njaa 1988). Selection of appropriate method for the accurate determination of TVB-N is important. Many methods for determination of TVB-N have been proposed by many researchers (Ritskes 1975, Miller *et al*. 1972, Keay and Hardy 1972, Murray and Gibson 1972, Gruger 1972, Ward *et al*. 1979, Ruiter and Weseman 1976, Parris 1984, Botta *et al*. 1984). In this research, extraction with perchloric acid and steam distillation was chosen because sophisticated method was considered impractical. Moreover, steam distillation method was found most reliable and recommended by Analytical Methods Committee (AMC 1979). Result stated in Table 1 indicates that pond fishes are better in terms of TVB-N value than the river fish. In *A. testudineus* TVB-N of pond samples was 2.24 ± 0.12 mg/100g, whereas in open water samples of this species were 2.63 ± 0.06. In *O. niloticus* TVB-N value of pond samples was 5.32 ± 0.08 and in open water samples was 5.49 ± 0.11 mg/100g, i.e. the quality of pond fishes was better than the open water fishes but almost comparable between these two aquatic environments. In both cases, the TVB-N content was within the maximum allowable limit.

Table II. Quality parameters (SDP, TVB-N, APC) and Heavy metal (Cd, Cu) content of *A. testudineus* and *O. niloticus*

Parameter	*A. testudineus*		*O. niloticus*		MAL
	Pond (n = 3)	Openwater (n = 3)	Pond (n = 3)	Open water (n = 3)	
SDP	1.00	1.32	1.68	1.89	< 5
TVB-N	2.24 ± 0.12	2.63 ± 0.06	5.32 ± 0.08	5.49 ± 0.11	30 mg/100g
APC	2.25×10^6	2.54×10^7	1.84×10^5	1.97×10^6	10^6cfu/g
Cadmium	0.39	0.77	0.37	0.96	1.00 ppm
Copper	0.40	0.58	0.36	1.87	10 ppm

Table II also shows the bacterial count of the experimental fishes. APC of *A. testudineus* and *O. niloticus* of pond and open water ranges between 1.84×10^5 to 2.54×10^7cfu/g. In both species, the APC of open water samples was significantly higher than those of the pond fish samples. In almost all samples of this research the APC was above maximum allowable level as recommended by ICMS (1980). In *A. testudineus* from open water, the APC was at hazardous level. This may be due to water pollution in pond and open water from where the fishes were collected.

Heavy metal (Cd, Cu) concentration of *A. testudineus* and *O. niloticus* of pond and open water is presented in Table II. It appears that open water fishes contain more heavy metal than

the pond fish fishes. In the present research, two heavy metals namely Cd and Cu were quantified in *A. testudineus* and *O. niloticus* caught from pond and open water. In all of the samples, the heavy metal concentration was significantly higher in open water samples. But this concentration remained below the maximum allowable limit as recommended by WHO and FAO. Open water fishes contained more Cd and Cu in their muscle because the open water may be polluted by such heavy metal from various sources. Three main sources of heavy metal pollution in aquatic environment are industrial effluent discharge, waste dump, lagoon and sewerage disposal (ICMS 1980). Low grade fish feed ingredients are also a cause of heavy metal pollution in fish. Fish living in polluted water may accumulate toxic trace metals via food chain. High level of toxic metal is harmful for fish. Almost all heavy metals are harmful for human health too. Cd cause renal disease and overall risk in consumers' health if present above certain level in fish muscle. Cu cause unpleasant odour and colour in fish which create marketing problem, also cause toxicological risk and renal problem. In the present research the experimental fishes contained heavy metal concentration within the Maximum Allowable Limit. Examination of fish and fishery products for heavy metal may be necessary because sometimes fishes are caught from suspected areas as for example, from effluent discharge area, waste dump area, lagoons etc. Heavy metal in such polluted water is injurious to health.

In this study, we have attempted to create reliable data and information on quality and safety aspects of *A. testudineus* and *O. niloticus* collected from pond and open water which will be helpful for the domestic consumers as well as for foreign buyers. Such data are equally helpful to produce a quality product and a safe product. On the basis of the results of this research it may be concluded that the quality and safety aspect of *A. testudineus* and *O. niloticus* collected from pond and open water is excellent. Nutritional quality, TVB-N, SDP, Cd, Cu are in desirable level and excellent. The bacterial loads (APC) of open water samples were higher than the MAL. Pond fishes were better than those of the open water fishes.

Acknowledgement: This research study was conducted as part of MS Thesis of Mr. Showkat Akbar in the Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh.

Literature Cited

A.M.C. (Analytical Methods Committee), 1979. Recommended general methods for the examination of fish and fish products. *Analyst*, **104**: 434-450.

A.O.A.C., 1980. Official Methods of Analysis. Association of Official Analytical Chemists. (12thed.) Washington, D.C., USA.

Bhotta, J.R., J.T. Lauder and M.A. Jewer, 1984. Effect of methodology on total volatile basic nitrogen (TVB-N) determination as an index of quality of fresh Atlantic cod (*Gadus morhua*). *J. Food Sci.,* 49: 734-736.

Burt, J.R., D.M. Gibson, A.C. Jason and H.R. Sanders, 1976. Comparison of methods of freshness assessment of wet fish II. *J. Food Technol.,* **11:** 73-89.

Clesceri, L.S., A.E. Greenberg and R.R. Trussed, 1989. Standard method for the examination of water and waste water. 17th ed. American Public HealthAssociation. Washington D.C., 40-175.

Collins, C.H. and M.L. Patricia, 1976. The Gram-Negative Non-sporing Rods. In: Microbiological Methods. Fourth ed. Butterworth and Co. (Publishers) Ltd. 349-380.

Connell, J.J., P.F. Howgate, I.M. Mackie, H.R. Sanders and G.L. Smith, 1976. Comparison of methods of freshness assessment of wet fish IV. *J. Food Technol.,* **11:** 297-308.

Eboh, L., H.D. Mepba and M.B. Ekpo, 2006. Heavy metal contamination andprocessing effects on the composition, storage stability and fatty acid profiles of 5common commercially available fish species in Oron/Local Govt. Nog. *Food. Chem.*, **97**: 490-497.

Gruger, E.H., 1972. Chromatographic analysis of volatile amines in marine fish. *J. Agric. Food Chem.,* **20:** 781-785.

Haaland, H. and L.R. Njaa, 1988. Ammonia (NH_3) and Total Volatile Nitrogen (TVN) in preserved and unpreserved stored, whole fish. *J. Sci. Food Agric.,* **44:** 335-342.

Howgate, P.A., P. Johnson and K.J. Whittle, 1992. Multilingual Guide to EC freshness grades for fishery products. Torry Research Station, Aberdeen. Food Safety Directorate, Ministry of Agriculture, Fisheries and Food, UK. 9 p.

ICMS, 1980. International Commission for Microbiological standards. Recommended Microbiological Limits for Fish and Fish Products. (Quoted from J.J. Connell, 1980. Control of Fish Quality. Second Edition. Fishing News Books Ltd. Farnham, Surrey, England. 222 p).

Keay, J.N. and R. Hardy, 1972. The separation of aliphatic amines in dilute aqueous solution by gas chromatography and application of this technique to quantitative analysis of tri- and dimethyl amines in fish. *J. Sci. Food Agric.,* **23:** 9-19.

Love, R.M., 1992. Biochemical dynamics and the quality of fresh and frozen fish. In: Fish Processing Technology. G.M. Hall (ed.). Blackie Academic and Professional, Glassgow, UK. 1-30.

Mansur, M.A., 2015. Chemical Composition of Fish. In: Fisheries Studies. Part-III. Botomul, Dhaka. 410-448.

Mansur, M.A., M.N. Uddin, M.G.M. Jamil, M. Manik Mia and M. Karmakar, 2017. Quality and safety aspect of some traditionally processed freshwater fish and fishery products of Mymensingh district in Bangladesh. *Int. J. Curr. Res.,* **9** (11): 61867-61872.

Mansur, M.A., S.C. Chakraborty, M. Manik Mia, M. Karmakar, S. R. Kamruzzaman and S. Uga, 2018. Comparative study on nutritional composition, freshness and heavy metal concentration of three important freshwater fish (*Orechromis niloticus, Heteropneustes fossilis and Pangasius sutchi*) collected from pond and river water of Mymensingh district of Bangladesh. *Res. Soc. Diet. Habits*, **38** (3): 39-47.

Miller, A., R.A. Scanlon, J.S. Lee and L.M. Libbey, 1972. Quantitative and selective gas chromatography of dimethyl and trimethylamine in fish. *J. Agric. Food Chem.,* **20:** 709-711.

Murray, C.K. and D.M. Gibson, 1972. An investigation of the method of determining trimethylamine in fish muscle extracts by formation of the picrate salt I. *J. Food Technol.,* **7**: 35-46.

Ohta, F., H. Kikuchi and T. Ishigami, 1975. Nucleotides and volatile bases as quality indices of iced fish. *Memories Fac. Fish. Kagoshima Univ.,* **24**: 173-179.

Parris, N., 1984. An improved fluorometric method for the determination of Ammonia and Volatile Amines in meat tissue by High-performance liquid chromatography. *J. Agric. Food Chem.,* **32:** 820-831.

Ritskes, T.M., 1975. The gas chromatographic determination of trimethylamine and dimethylamine in fish, fishery products and other food stuffs. *J. Food Technol.,* **10:** 221-228.

Ruiter, A. and J.M. Weseman, 1976. The automated determination of volatile bases (trimethylamine, dimethylamine and ammonia) in fish and shrimp. *J. Food Technol.,* **11:** 59-68.

Ward, D.R, G. Finne and R. Nickelson, 1979. Use of a specific- ion electrode (ammonia) in determining the quality of shrimp. *J. Food Sci.,* **44:** 1052-1054, 1057.

(Manuscript received 24-5-2019)