Journal of Agricultural Engineering and Food Technology
p-ISSN: 2350-0085; e-ISSN: 2350-0263; Volume 4, Issue 1; January-March, 2017 pp. 82-86

http://www.krishisanskriti.org/Publication.html

# Safety Aspects: An Assessment of Heavy Metals in Dried Fishes of Chalan *beel*

**F.A. Flowra[1], M.A. Bayezid[2], M. M. Alam[3], M.A. Hussain[4] and S.N. Jahan[5]**

*[1,2,3,4,5]Department of Fisheries University of Rajshahi Rajshahi-6205, Bangladesh*
*E-mail: [1]flowrabd@yahoo.com, [2]alambayezid@gmail.com, [3]mamillat@yahoo.com, [4]afzalh_ru@yahoo.com, [5]nusratru@yahoo.com*

**Abstract—***The present research was carried out from March to August 2016 with a view to assessing food safety attribute with regard to heavy metal contamination in traditionally and experimentally sun-dried freshwater fishes (Channa punctatus, Mystus vittatus, Channa striatus, Wallago attu and Puntius sp.) of Chaln beel. Heavy metal analyses revealed that in traditional and experimental dried fishes, lead (Pb) content varied from 0.6088 (Mystus vittatus) to 1.60µg/g (Puntius sp.) and 0.164 (Wallago attu) to 0.9954µg/g (Puntius sp.); Cadmium (Cd) from 0.014(Wallago attu) to 0.0198µg/g (Channa punctatus) and 0.009 (Mystus vittatus) to 0.0178µg/g (Wallago attu); Chromium (Cr) ranged from 0.63 (Wallago attu) to 1.47µg/g (Puntius sp.) and 0.44 (Wallago attu) to 1.27 µg/g (Puntius sp.); and Copper (Cu) content remained in the range of 3.03 (Channa punctatus) to 27.52 µg/g (Wallago attu) and 6.30 (Channa striatus) to 27.50µg/g (Mystus vittatus) respectively. However, all of the values were within permissible limit for human consumption.*

**Keywords***: Food Safety, Heavy Metal, Sun-dried fish and Chalan beel.*

## 1. INTRODUCTION

Food safety is a major global concern at present. Consumption of unsafe food is a serious threat to public health in Bangladesh for last couple of decades [1]. Anthropogenic activities like draining of sewerage, mining, industrial processing, use of large quantities of agrochemicals such as metal-based pesticides and fertilizers play major role in the pollution of environment and the contamination of foodstuffs by heavy metals [2, 3]. Excess amounts of heavy metals from anthropogenic sources that enter into the ecosystem may lead to geo-accumulation and bioaccumulation, which in turn pollute the environment and also affect the food chain and ultimately pose serious human health risks [4]. Heavy metals cannot be degraded; they are deposited, assimilated or incorporated in water, sediment and aquatic animals [5]. As fishes are constantly exposed to pollutants in contaminated water, they could be used as excellent biological markers of heavy metals in aquatic ecosystem [6].

High level of As, Lead (Pb), Copper (Cu), and Iron (Fe) have been found to cause rapid physiological changes in fish [7]. Cd is a known teratogen and carcinogen, probable mutagen and has been implicated as the cause of serious deleterious effect on fish. Trace metals can be accumulated by fish through both the food chain and water [8]. Pollution from any metal or element may also cause unsuspected hazards to man. The effects of the elements of most concern are cumulative poisons that cause harm to health through progressive and irreversible accumulation in the body as a result of ingestion of repeated small amounts. Mercury (Hg), Cd, Cr, Pb and Selenium (Se) are known to be potentially harmful pollutants which contaminate fish; particularly Hg has been implicated in disease to consumers caused by eating fish [9, 10].

Chalan *beel*, which contributes to substantial amount of freshwater dried fish production and located in north-west region of Bangladesh, is the largest *beel* (In rainy season: 375 square kilometers and in dry season : 52-78 square kilometers) of the country producing huge amount of freshwater fishes every year [11]. The water quality of this *beel* has been deteriorating since last few decades as during dry season, huge amount of agricultural activities like paddy and winter crops cultivation take place where enormous amount of pesticides and inorganic fertilizers are applied regardless of recommended dose. Concentration of Cd, Cu, Ag and Zn in fish liver increased in the agricultural areas in the River Basin, U.S.A. [12]. Some water bodies located in pollution prone area of Rajshahi city were likely to suffer from heavy metal contamination [13]. Many countries are now taking voluntary or mandatory action to reduce pollution of the aquatic environment with heavy metal for the food safety of aquatic food particularly fish. Considering the affect of heavy metal on fish quality and safety, the food regulatory and health authorities in some developed countries have taken serious view and adopted maximum allowable limit of harmful metals and elements. The concentration of harmful metal and element is much higher in the processed fish as moisture percentage gets reduced considerably. As a result, the concentration of pollutants in per unit weight/mass increases remarkably [14].

Dried fish (Locally named as *Shutki*) is the most popular food items in Bangladesh and Chalan *beel* plays significant role not only in the production of freshwater dried fish but also in export earnings. The nutritive value of dried fish is already established. In Bangladesh, very little work has been accomplished to assess the content of heavy metals in freshwater fish, particularly in dried fish, despite such study may be instrumental to evaluate the prevailing status of safety and quality of fish and fisheries products for domestic consumption as well as for export. Therefore, Keeping in view of the potential contamination of fish as well as environmental pollution, it is deemed necessary to have an assessment so that food safety aspect of dried fish with respect to heavy metal contamination can be evaluated. This paper aims to presents the data on heavy metal (Pb, Cd, Cr and Cu) concentrations in some fishes of Chalan *beel*.

## 2. MATERIALS AND METHODS

### Sample collection and processing

Traditional Samples of five dried fish species (*Channa punctatus*, *Mystus vittatus*, *Channa striatus*, *Wallago attu* and *Puntius* sp.) were purchased from adjacent fish drying sites of Chalan *beel* area namely Tarash, Atrai and Vangura. In this sample *Mystus vittatu s*and *Puntius* sp. were not dressed and washed and other species such as *Channa punctatus, Channa striatus* and *Wallago attu* underwent dressing and washing in the prevailing unhygienic environment of drying yard. In case of experimental sample, raw fishwere bought from the nearby market of the water body, and all species of which were subjected to washing under tube well water and sun drying in hygienic environmentafter removal of non-edible parts like viscera, gills and scales according to common household practices. Then only edible portions including mainly muscle and some bones were chopped into small pieces and dried in an oven at 80º C until a constant weight was obtained. The dried samples were ground with a mortar and passed through a suitable mesh sieve. The fine powder was preserved in clean and dry plastic bottles in the dark until digestion.

### Digestion of samples

A known quantity of dried fish powder of each sample was weighed by an electronic balance and 5 ml of diacid mixture (5 ml conc. $HNO_3$; 3 ml 60% $HClO_4$) was added to each sample. The content was mixed for overnight. Samples were then digested initially at 80°C temperature and later at 150°C for 2 h. The completion of digestion was indicated by almost colorless appearance of the solution. The samples were separately filtered by using an ash less filter paper (Whatman No. 42). Final volume was made up to 150 ml with 0.5% $HNO_3$ [15].

### Analysis of heavy metals

Concentrations of Pb, Cr and Cd in the filtrate of digested fish samples were estimated employing furnace method and Cu in flame using an atomic absorption spectrophotometer (model: AA-6800, Shimadzu Corporation, Japan).Standard stock solutions of 1,000 ppm for all the metals were obtained from Kanto Chemical Co. Inc., Tokyo, Japan. These solutions were diluted for desired concentrations to calibrate the instrument. All samples were collected and analyzed in triplicate, and the average results were used to represent the data.The absorption wavelengths were 217.0 nm for Pb,228.8 nm for Cd, 357.87 nm for Cr and 324.75 nm forCu.The results were expressed as micrograms per gram dry weight and milligrams per litre for fish and water, respectively. Statistical analysis was performed by Microsoft Excel 2010 and SPSS 20.0 for Windows.

## 3. RESULTS AND DISCUSSION

The content of heavy metals obtained from different traditional and experimental dried fish samples are listed in Table. Concentration (dry weight basis) of lead was observed from 0.6088 (*Mystus vittatus*) to1.60µg/g (*Puntius sp.*) and from 0.164 (*Wallago attu*) to 0.9954 µg/g (*Puntius sp.*) in traditional and experimental sample respectively (Fig. 1). This finding was considerably lower than the results (1.44 mg/kg in Mozambique tilapiaand 23.993 mg/kg in *Catla*) of a study [16] and which also remained within the prescribed limit where the maximum permitted concentration of Pb for fish proposed by the Australian National Health and Medical Research Council (ANHMRC) is 9.6 mg/kg dry weight [17, 18].This may be attributed to the complete dressing of sample which excluded gill, viscera, kidney and scales except edible portion or muscle because gills and liver is the major sites for accumulation of Pb and kidney is for Cr [19]. The observed value were fairly comparable with the mean Pb concentration (2.08 µg/g) recorded in the muscle tissues of the three species of fish from the freshwater Dhanmondi Lake, Bangladesh [20] and also with the Pb concentration (0.393 µg/g in muscles of *L. rohita*) observed in a study [19]. However, Pb content of the present study remained within recommended limit (4 µg/g dry weight) of FAO [21].

**Table** Concentration of heavy metals in traditional and experimental samples of dried fish of Chalan *beel* (µg/g, dry weight)

| Heavy Metal | Fish Species | Traditional sample | Experimental sample |
|---|---|---|---|
| Lead (Pb) | *Channa punctatus* | 1.2883 | 0.1939 |
| | *Mystus vittatus* | 0.6088 | 0.2399 |
| | *Channa striatus* | 0.9968 | 0.2421 |
| | *Wallago attu* | 0.6172 | 0.164 |
| | *Puntius sp.* | 1.60 | 0.9954 |
| Cadmium (Cd) | *Channa punctatus* | 0.0198 | 0.0146 |
| | *Mystus vittatus* | 0.0163 | 0.009 |
| | *Channa striatus* | 0.0179 | 0.0116 |
| | *Wallago attu* | 0.014 | 0.0178 |
| | *Puntius sp.* | 0.0149 | 0.0117 |

| | | | |
|---|---|---|---|
| Chromium(Cr) | *Channa punctatus* | 0.91 | 1.02 |
| | *Mystus vittatus* | 0.72 | 0.65 |
| | *Channa striatus* | 0.99 | 1.08 |
| | *Wallago attu* | 0.63 | 0.44 |
| | *Puntius sp.* | 1.47 | 1.27 |
| Copper (Cu) | *Channa punctatus* | 3.03 | 6.44 |
| | *Mystus vittatus* | 23.6 | 27.50 |
| | *Channa striatus* | 6.60 | 6.30 |
| | *Wallago attu* | 27.52 | 23.68 |
| | *Puntius sp.* | 6.12 | 6.51 |

Present study observed Cd contents from 0.009 (*Mystus vittatus* of experimental sample) to 0.0198µg/g (*Channa punctatus* of traditional sample) (Fig. 2). This findings were supported by a study [16] which revealed that Cadmium concentration was from 0.0223mg/kg in *Catla* to 2.11 mg/kg in *Wallago* (dry weight basis) while This observation was also comparable with another study [12] which observed Cd content as 0.053 µg/g in *L. rohita* and 0.097 µg/g in *W. attu*. Cadmium was listed as endocrine-disturbing substance and may lead to the development of prostate cancer and breast cancer [22]. According to the ANHMRC [17] and Western Australian Food and Drug Regulation [18], maximum limit of cadmium in fish is 2.0 and 5.5 mg/kg F.W., respectively. The average concentration of Cd in dried fish sample of this study was considerably lower than the prescribed limits.

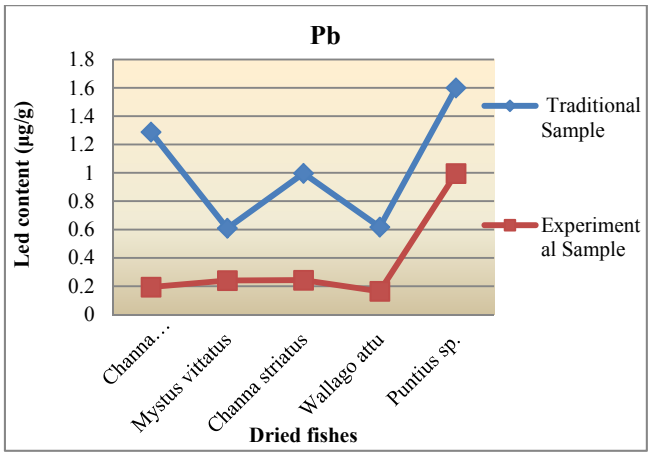


**Fig. 1: Lead content in different fishes**

Chromium concentrations ware recorded from 0.44 (*Wallago attu* of experimental sample) to 1.47µg/g (*Puntius sp.* of traditional sample) (Fig. 3) which conformed to the results (0.422 mg/kg in *L. rohita* 1.225 mg/kg in *Catla*)) found in a study [16]. Chromium concentration in the muscles of different fresh frozen fish of Korea was recorded between 0.10 and 1.03 mg/kg and in canned fish between 0.09 and 1.32 mg/kg [23], which agree well with the present result. Recorded Cr concentration values of the study were in agreement with the observations of (0.218 µg/g in muscle of *L. rohita*) another study [19] and were also below the threshold values(2 µg/g dry weight) set in FAO standard [21].

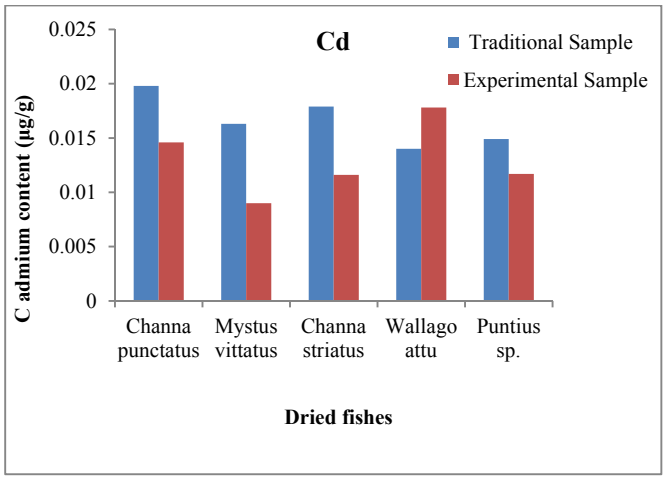


**Fig. 2: Cadmium content in different fishes**

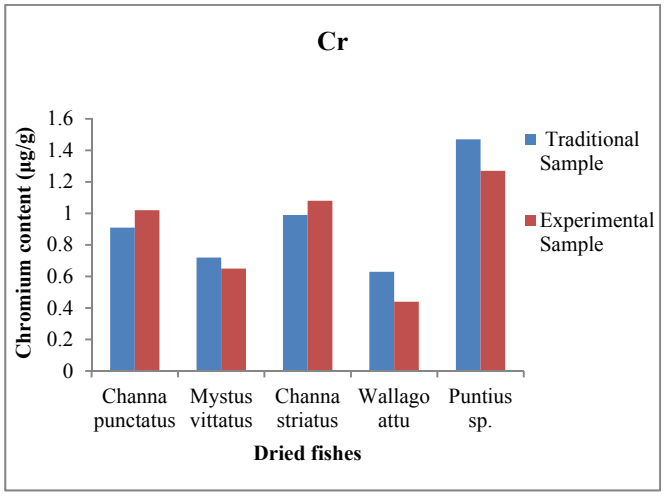


**Fig. 3: Chromium content in different fishes**

Copper concentrations ware recorded from 3.03(*Channa punctatus* of traditional sample) to 27.52µg/g (*Wallago attu* of traditional sample) (Fig. 4) which are comparable with the values (3.36 - 6.34mg/kg) found in a study [24]. Another study [25] reported that the Cu concentration ranged between 2.80 and 12.40 ppm in different fish species and other study [26] observed that Cu varied between 0.65 and 58.1 mg/kg on a (dry weight basis) for five different species of fish in the Bay of Bengal region of Bangladesh coast, in addition, results of one research [27] reveals that Cu content remained from 1.48 to 21.30 µg/g, all of which agree well with the present results.

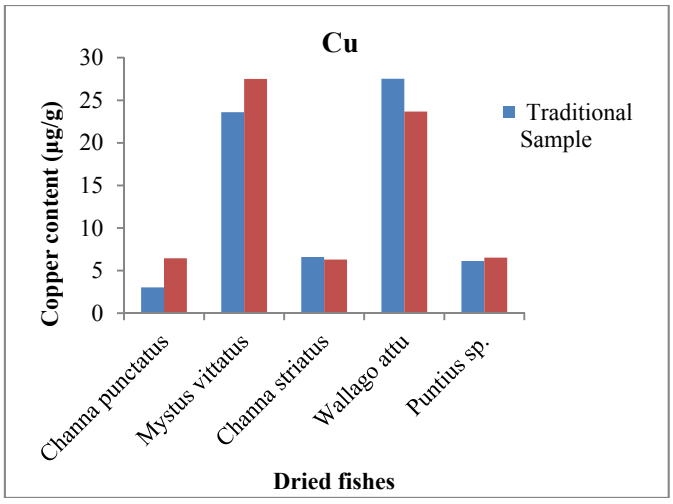


**Fig. 4: Copper content in different fishes**

This finding was also comparable with another research conducted in urban pond of Rajshahi [28]. Cu is an essential part of several enzymes and is necessary for the synthesis of haemoglobin [29], but very high intake of Cu is likely to cause adverse impact to health. However, present results of Cu concentration were higher than the threshold values (10 µg/g dry weight) set by FAO [23].

## 4. CONCLUSION

In the present study, the sequence of heavy metals accumulation in dried fish muscle is Cu >Pb> Cr > Cd. From food safety point of view, Pb, Cd, and Cr contents remain below the respective recommended limit while Cu is slightly higher than the prescribed limit of FAO, which might be attributed to the excessive use of pesticides and inorganic fertilizers in agricultural activities within *beel* area. However, prevailing condition is likely toget aggravated if rampant use of inorganic fertilizer and harmful pesticides is not curbed. Therefore**,** it issuggested that regular monitoring and further research is imperative in this regard in order to maintain healthy ecosystem as well as ensure food safety, and to protect consumer's health from potential risks of heavy metal contamination.

## 5. ACKNOWLEDGEMENTS

The authors express cordial thanks to the concerned authority of Central Science Laboratory of University of Rajshahi and Higher Education and Quality Enhancement Project (HEQEP), Window-2, Round 3 for providing necessary supports.

## REFERENCES

[1]Ali, A. N. M. A. Food safety and public health issues in Bangladesh: a regulatory, *European Food and Feed Law Review* 2013, 8(1):31-40.

[2] Loutfy, N., Mentler, A., Shoeab, M., Ahmed, M. T. & Fuerhacker, M. Analysis and exposure assessment of some heavy metals in foodstuffs from Ismailia City, Egypt. *Toxicological and Environmental Chemistry*, 2012, 94: 78–90.

[3] Pourang, N. & Noori, A. S. Assessment of metals infourteenspecies of vegetables and crops cultivated in asuburban area using multivariate analysis. *Toxicologicaland Environmental Chemistry*, 2012, 94: 694–712.

[4] Weldegebriel, Y., Chandravanshi, B. S. and Wondimu, T. Concentration levels of metals in vegetables grown in soils irrigated with river water in Addis Abada, Ethiopia. *Eco-toxicology and Environmental Safety*, 2012,77: 57–63.

[5] Linnik, P. M. & Zubenko, I. B. Role of bottom sediments in the secondary pollution of aquatic environments by heavy-metal compounds. *Lakes and Reservoirs: Research and Management,* 2000, 5: 11–21.

[6] Nsikak, U. B., Joseph, P. E., Akan, B. W. and David, E. B. Mercury accumulation in fishes from tropical aquatic ecosystems in the Niger Delta, Nigeria. *Current Science,* 2007, 92(6): 781–785.

[7] Tarrio, J., Jafor M. and Ashra, M. Levels of selected heavy metals in commercial fish from freshwater Lake of Pakistan. *Toxicol. Environ. Chem*., 1991, 33:133-140.

[8] Hadson, P. V. The effect of metabolism on uptake, disposition and toxicity in fish .*Aquatic Toxicology*, 1988, 11: 3–18.

[9] Connell, J. J. Intrinsic Quality In: "Control of Fish Quality". Fishing News Books Ltd. Farnham, Surrey, England, 1975, pp. 4-30.

[10] Connell, J. J. Intrinsic Quality. In: "Control of Fish Quality". (Second Edition) Fishing News Books Ltd. Farnham, Surrey, England, 1980, pp. 4-30.

[11] Hossain M. A. R., Nahiduzzaman M., Sayeed M. A. The Chalan Beel in Bangladesh: Habitat and biodiversity degradation, and implications for future management. *Lakes & Reservoirs: Research and Management*, 2009, 14: 3-19.

[12] Heing, J. S. and Tate, C. M. "Concentration, distribution and compassion of selected trace elements in bed sediment and fish tissue in the south platue River Basin", U.S.A., 1992–1995, *Arch. Environ. Contam. Toxicol.,* 199, 32:246–259.

[13] Flowra, F. A., Ghosh, J. K., Jewel, M. A. S., Tumpa, A. S. and Hussain, M. A. Analysis of Heavy Metal Components in Some Urban Ponds in Rajshahi, Bangladesh. *J. Life Earth Sci*., 2012, 7: 115-117.

[14] Mansur, M.A., Rahman, S., Khan, M.N.A., Reza, M.S., Kamrunnahar and Uga, S.Study on the quality and safety aspect of three sun-dried fish .*African Journal of Agricultural Research*, 2013, 8(4): 5149-5155.

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

[16] Saha, N. and Zaman, M.R. Evaluation of possible health risks of heavy metals by consumption of foodstuffs available in the central market of Rajshahi City, Bangladesh. *Environ. Monit. and Assess*., 2013, 185: 3867–3878.

[17] Bebbington, G. N., Mackay, N. J., Chvojka, R., Williams, R. J., Dunn, A. andAuty, E. H. Heavy metals, selenium and arsenic in nine species of Australian commercial fish. *Australian Journal of Marine & Freshwater Research*, 1977, 28: 277–286.

[18] Plaskett, D. and Potter, I. C. Heavy metal concentrations in the muscle tissue of 12 species of teleost from Cockburn Sound, Western Australia. *Australian Journal of Marine & Freshwater Research*, 1979, 30: 607–616.

[19] Malik, N., Biswas, A. K., Qureshi, T. A., Borana, K. and Virha, R. Bioaccumulation of heavy metals in fish tissues of a freshwater lake of Bhopal. *Environ Monit Assess*, 2010, 160:267–276.

[20] Begum, A., Amin, M. N., Kaneco, S. and Ohta, K. Selected elemental composition of the muscle tissue of three species of fish, *Tilapia nilotica, Cirrhina mrigala* and *Clarius batrachus*, from the fresh water Dhanmondi Lake in Bangladesh. *Food Chemistry*, 2005, 93: 439–443.

[21] FAO., Compilation of legal limits for hazardous substance in fish and fishery products (Food and Agricultural Organization). *FAO fishery circular*, no. 464, 1983, pp. 5–100.

[22] Pan, J., Plant, J. A., Voulvoulis, N., Otates, C. J. and Ihlenfeld, C. Cadmium levels in Europe: Implications for human health. *Environmental Geochemistry and Health*, 2010, 32: 1–12.

[23] Islam, M. M., Bang, S., Ahmed, M. K., Kim, K. W. and Jannat, M. Heavy metals in frozen and canned marine fish of Korea. *Journal of Scientific Research*, 2010, 2: 549–557.

[24] Ahmad, M. K., Islam, S., Rahman, M. S., Haque, M. R. and Islam, M. M.Heavy Metals in Water, Sediment and Some Fishes of Buriganga River, Bangladesh. *Int. J. Environ. Res.,* 2010,4(2):321-332.

[25] Zingde, M. D., Singbal, S. Y. S., Moraes, C. F. and Reddy, C. V. G. Some observations on pollutants of Velsao Bay (Goa). *Mahasagar Bull*. *Nat. Inst. Ocean*., 1979,12 (2): 69-74.

[26] Khan, A. H., Ali, M., Biswas, S. K. and Hadi, D. A.Trace elements in marine fish from the Bay ofBengal. *Sci. Total Environ*., 1987,61: 121-130.

[27] Amin M.N., Begum, A. and Mondal, M.G.K. Trace Element Concentrations Present in Five Species of Freshwater Fish of Bangladesh. *Bangladesh J. Sci. Ind. Res*., 2011,46(1): 27-32.

[28] Ahmed, S. Effects of Pollution on Growth performance and Fish Quality in Different Pond of urban area, Rajshahi. Department of Fisheries, University of Rajshahi, *M.S. Thesis*, 2014, pp. 83-84.

[29] Sivaperumal, P., Sankar, T. V. and Nair Viswanathan, P. G. Heavy metals concentrations in fish, shellfish and fish products from internal markets of India vis-àvis international standards. *Food Chemistry,* 2007, 102: 612– 620.