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Research Article

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Heavy Metals in Farm Sediments, Feeds and Bioaccumulation of Some Selected Heavy Metals in Various Tissues of Farmed *Pangasius hypophthalmus* in Bangladesh

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Abstract

In these studies, we had determined the concentrations of heavy metals in *P. hypophthalmus* including sediment, water and Fish organs (gills, flesh, and liver) in order to evaluate the possible risk of consumption. Concentration of heavy metal was not significantly presence of water whereas heavy metal in sediment Ni: 26.31 $mgkg^{-1}$-33.03 $mgkg^{-1}$; Cu: 13.00 $mgkg^{-1}$-23.20 $mgkg^{-1}$; Cr: 7.31 $mgkg^{-1}$-15.41 $mgkg^{-1}$; Pb: 6.43 $mgkg^{-1}$-8.65 $mgkg^{-1}$; Cd: BDL (Below Detection Limits) were higher than that of fish parts (Cu-11.96, Pb-6.29, Cd-0.16 Ni-4.23, and Cr-11.03) $mgkg^{-1}$Metal concentration in fish feed followed the sequence Cr>Cu>Ni>Pb>Cd and found that both farm feeds were more or less same quality except one or two metals. The concentration of heavy metals recorded in the fish parts also indicated a certain degree of bio-accumulation. The concentration of all metals in water were below the WHO and FEPA recommended limits and suggested that the water of the farm are safe and suitable for use, but the concentration of heavy metals in gills, kidney and liver of the fish are high beyond the tolerable level, which indicated that as far as these metals are concerned, the fish is unfit for human consumption.

Keywords Heavy metals; Bioaccumulation; *Pangasius hypophthalmus*; Sediment; Bangladesh

Introduction

Bangladesh is the highly density populated country in the globe. Most of the people directly or indirectly depend on agricultural sector [1]. Among them aquaculture and fisheries sector is one of the major component of agricultural activities and plays a vital key role in economic development by ensuring food security and stimulating the growth of a number of subsidiary industries [1,2] and the national economy, contributing 3.69% to the Gross Domestic Product (GDP) of the country and 22.60% to the agricultural GDP [3]. From the Table 1 and also Figure 1 clearly shows the over the last 10 years (2004-2005 FY to 2013-2014 FY), the culture fish production was fairly steady and at an average of 5.38% per year [2]. This sector has fairly consistent growth rate within 7.32% growth in 2009 to 2010 to 4.04% growth in 2013-2014 [4]. Because our present government has set a target to become a reached middle country by 2021.As a part of the government national action planning the agricultural sector play vital role for overall gross economic development. With this aim near about 11% of the rural and urban population directly or indirectly depends on fisheries for their livelihood [2]. With the aim of this great effort Bangladesh has established a milestone in aquaculture sector development and in the year 2014, the Bangladesh was ranked 6th in the world farmed fish production [5].

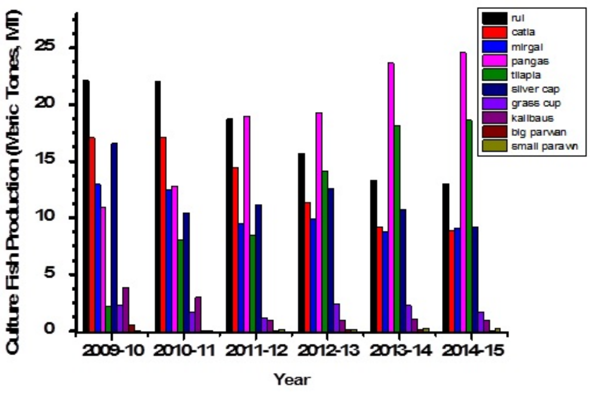

Figure 1: Most Popular Pond Fish production from 2009-2015 FY in Bangladesh.

Metals and metal oxide are highly important for metabolite activities of biological system and its used for various application like purification of waters and so on [6] In Bangladesh, out of 100% consumable animal protein about 63% of our meal comes from aquaculture sector mainly fisheries resources which are composed of freshwater native species 260, exotic fishes 12 species, freshwater prawn 24 species, marine fish species 475 and marine shrimp 36 species [7,8]. Sarker [9] reported that amongst exotic fish species Thai pangus (*Pangasius hypophthalmus*) is the best due to its friendly and easily handling culture system, favorable ambient weather condition for fish culture and extensive market demand. According to Literature Sarder et al. In Bangladesh pond culture of native pangus (*P. pangasius*) was started in 1945 at southern part mainly Khulna region. Due to the lack of specific technical knowledge and cultural management at that time it was not so popular [10].

Almost 40 years later in 1987 native P. *hypophthalmus* culture was started in closed water condition at Chandpur region at present which is the most popular fishing area in Bangladesh, but also not economic success .but the initiative did not face any notable success [9]. In 1990, The ministry of fisheries government of Republic of Bangladesh imported 100 numbers fry (0.18 g weighted) of Thai pangus (*P. hypophthalmus*) from Thailand in 1990 [9,10]. After 2000 still up to date, state of the art, Thai pangus has become one of the most popular commercial cultivable species due to its high yield within a short period of time and comparatively low production cost and highly marketable demand both rural and urban people in Bangladesh. With this fascinating farmers are highly interested in culture this fish. Farmers have been established high density and semi-intensive culture of *P. hypophthalmus* in ponds and culture rate as high as 25-30 tons/ha/year with highly protein rich diets [11]. From the Table 1 and Figure 1 clearly indicated that among the various farmed culture fish only P. hypothalamus growth rate steady and increase every year [12].

Contamination of heavy metals in the aquatic environment has attracted global attention owing to its abundance, persistence and environmental toxicity. The increasing pollution by heavy metals has a significant adverse health effects for invertebrates, fish, and humans. Farmed fishes as well as aquacultures heavily rely on formulated feed and few of the commercial feed producers failed to meet up with standards for the requirement of fish and the source of raw material for the production of the feeds tends to be contaminated with heavy metals and others [13,14]. The metal pollution of aquatic ecosystems is increasing due to the effects of urbanization and industrialization [15]. Toxic heavy metals are unrelenting environmental contaminants because they cannot be despoiled or destroyed [16] and comprise a significant portion of the problem as these metals known for their bioaccumulation and bio-magnification, which cause various health hazards to human [17]. Generally, culture fish bio-accumulate chemicals as well as heavy metals directly from polluted water by diffusion through gill and skin or they ingest with food [18]. Extensive research was going on heavy metal concentration in most popular culture fish in Bangladesh. Recently reported that heavy metals of lead, cadmium and nickel concentration in different organs of commonly consumed fishes in Bangladesh which is very important and interesting report [18]. Food and Agriculture Organization (FAO) of the United Nations state as well as The World Health Organization (WHO) monitoring eight elements investigated in fish; Copper (Cu), Zinc (Zn), Iron (Fe), Tin (Sn),Mercury (Hg), Cadmium (Cd), Lead (Pb), Arsenic (As),) is mandatory monitoring and others metals just monitory and sets a standard [19-24]. So our current study aim to evaluate the presence of heavy metals in commercial fish feeds, sediments and their accumulation in *Pangasius hypophthalmus* fish tissues aiming to evaluate the current environment status of board section in Bangladesh and metals' content in various tissues were compared against the recommended maximum permissible limit (MPL) proposed by FAO and WHO to assess the quality of fish for human consumption.

Pond aquaculture production (MT) in Bangladesh between 2010 and 2015 (FRSS, 2016) [3].

Species Name	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Rui (*Labeo rohita*)	22.13	22.02	18.71	15.7	13.34	12.96
Catla (*Catla catla*)	17.09	17.15	14.41	11.4	9.23	8.88
Mrigal (*Cirrhinus cirrhosus*)	12.99	12.45	9.46	9.86	8.76	9.12
Pangas (*Pangasius pangasius*)	10.94	12.82	18.99	19.27	23.66	24.58
Tilapia/Nilotica (*Oreochromis mossambicus/O. niloticus*)	2.16	8.1	8.43	14.09	18.12	18.64
Silver Carp (*Hypophthalmichthys molitrix*)	16.57	10.48	11.14	12.54	10.74	9.22
Grass Carp (*Ctenopharyngodon idella*)	2.35	1.72	1.19	2.41	2.24	1.69
Kalibaus (*Labeo calbasu*)	3.89	2.98	0.93	0.93	1.07	0.99
Big Prawn	0.52	0.08	0.01	0.1	0.12	0.05
Small Prawn	0	0	0.16	0.14	0.24	0.25

Table 1: Some commonly consumed Farmed Culture Fishes production in Bangladesh (Metric Tons, MT).

Materials and Methods

Chemicals and reagents

All chemicals were used Analytical Grade (Merk, India). Deionised double distilled water used for throughout experimental study. EMSURE, ISO, Nitric Acid 68% (HNO_3); and EMPARTA, ACS, Perchloric acid about 70% ($HClO_4$) used during digestion procedure

Instrumentation

Atomic absorption spectrometer (AA-7000) equipped with single element hallow cathode lamp, used for the determination of metals. Esco laboratory fume hood (model: EFD-481) for digestion, hot air oven, Hanna pH meter, Do meter (Do-5509), Thermo meter for determining physicochemical parameters of water. Metals of Cd, Pb, Cr, Ni and Cu were analysed by using atomic absorption spectrophotometer (Shimadzu AA 7000, Japan) which was equipped with flame. For our experiment we choose Air acetylene flame mode condition fixed like acetylene 1.8 L/min and air 15 L/min, argon gas

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flow for inert atmosphere and the instrumental default temperature parameters were automatically fixed for each respective element analysis. For quantitative measurement of each element with its linear working range and its respective wavelength and statistical calibration graph of the correlation coefficient is listed in Table 2 and data recorded of respective elements in single measurements for its authentication which was used for standard deviation calculation.

Element	Wavelength (nm)	Lamp intensity (mA)	Slit width (nm)
Cr	357.9	7	0.2
Cu	324.8	4	0.5
Pb	217.3	10	1
Cd	228.8	4	0.5
Ni	232	4	0.2

Table 2: Operating parameter for working element.

Sample collection

Fish, soil and water samples were collected from two different Pangas fish farms (6 Pond) of Noakhali districts during August to September 2016. The collected samples were packed in plastic bags, which were kept into the icebox and primarily would be kept in a refrigerator at the laboratory on the same days, cleaned with sterile distilled water and then dissected. Fish Samples (flesh, gill and liver) were taken from fish for digestion method. The physicochemical parameters like temperature, pH, and dissolved oxygen were measured. Then the edible parts of the fish were separated and frozen at -20°C for the next analysis and dried in a hot air oven at 60°C-100°C.

Sediments of the respective culture ponds were collected and quickly air drying. After removing the moisture content, the weight was taken again and water sample preserved using HNO3 for acidification to protect further oxidation of the metals. All statistical analyses were performed using a statistical software package, SPSS 16.0 (SPSS, USA).

Feed sample was collected from the two farm namely bismillah agro fisheries and Glove fish. Bismillah used kazi feed and glove used their own produced feed. We collect nursery, grower and starter feed for analysis.

Sample preparation for determination of heavy metals

According to FAO we followed the Preparation of sub samples and analysis [25-28]. Fish samples were collected and packed in plastic bags, which are kept in a cooler box. Fishes samples were cut into small pieces using clean scissors and knife into a bowl and dried in the oven at 60°C-1000°C for 8 h and then grounded into the fine powder using a mortar. For pre-digestion 0.50g of each of the grinded fish sample was weighed into a thoroughly clean beaker. Add 10 ml HNO_3 in each beaker by using a pipette or measuring flask. Then the samples cover with a watch glass and kept overnight for pre-digestion. The digests prepared in a single with blank digestion to quantify possible contamination during sample preparation and analysis. After pre-digestion the beaker were then placed in a fume hood chamber and allowed to homogenize at first for 2 hours (heat 60°C-80°C) then remove the cover from the beaker and continue the digestion until the sample like gel type. The solution was left to cool (5 min-10 min) then add 5 ml $HClO_4$ in each sample and again place in the fume hood. After digestion, the solution was left to cool and then filtered through Whatman filter paper and the filtrate is made up to 25 mL with distilled water which was kept in the marked plastic bottle. Samples were run on Atomic Absorption Spectrophotometer. The same digestion procedure followed for sediments and feed same for heavy metal detection. The feed sample digestion procedure and metal detection were same *Pangasius Hypophthalmus.*

Calculation and data analysis

The concentration of heavy metal (mg/kg) was estimated according to the following equation:

C=(R-blank sample) ×D/W

C=concentration of metal (mg/kg).

R=reading of the digital scale of AAS.

D=Dilution of the prepared sample.

W=Weight of the sample.

The obtained results were statistically evaluated by using Microsoft excel for the standard deviation of the mean. Graphs were plotted using Microsoft Excel.

Results

The present study investigated the level of concentrations of Pb, Cd, Cr, Ni, and Cu accumulated in gill, flesh and liver of farm reared pangas fish along with their surrounding water, sediment and the feed which was used on the farm. The toxic concentration of Pb, Cd, Cr, Ni, and Cu of the present study might be attributed to this fact. Moreover, polluted water entering from different polluted sources may cause the higher concentration of these metals in farm reared fishes those frequently consumed by human beings.

It is reported that artificially fish feeds (supplied to the intensive and semi-intensive fish farm) are being manufactured mixing with different tannery and some industrial by products

Heavy metals in sediment

Table 3 shows the metals concentrations from pond water and sediments. The metal concentrations in sediment samples were as follow: Ni: 26.31 mg/kg-33.03 mg/kg; Cu: 13.00 $mgkg^{-1}$-23.20 mg kg^{-1}; Cr: 7.31 $mgkg^{-1}$-15.41 $mgkg^{-1}$; Pb: 6.43 $mgkg^{-1}$-8.65 $mgkg^{-1}$; Cd: 0. Metal concentrations in the pond sediments decreased in the sequence of Ni>Cu>Cr>Pb>Cd. Metal concentrations in pond water in 6 sampling sites were compared with International guidelines for heavy metals in water and sediment. It is a matter of great pleasure that the concentrations of heavy metals are not significantly presence in farmed ponds.

It was observed that in Figure 2 generally sediment recorded the highest concentration of metals amongst the three samples (fish, water and sediment). Nickel recorded its highest concentration in sediment (33.03 mg/kg) at pond 1 and had an overall mean value of 29.21 mg/kg ± 2.56. The concentration of copper is also highest (23.20 mg/kg) in the sediment at pond 1. It has an overall mean value of 17.29 ± 3.29 mg/kg. The concentration of lead was highest in sediment, 8.65 mg/kg.

Heavy metals in fish feeds

Fish culture in the present study area was completely dependent on the application of the fish feed. The result of heavy metal concentration in Fish feed of the study Farm was shown in Table 4. It was observed that the concentration of Cr was higher than the other metal. The highest concentration 301.5 mg/kg of Cr was found in case of the farm -1 grower feed (Kazi feed) which was above the maximum permissible limit. The high content of Cr in the present study area might be due to the fish feed as poultry and/tannery wastes are thought to add in fish feed where $K_2Cr_2O_7$ play a key role in cleaning.

Metal Concentration in sediments (mg/ kg)					
Sample site	Cr	Ni	Cd	Pb	Cu
Pond 1	15.41	33.03	BDL*	8.65	23.2
Pond 2	8.94	29.61	BDL*	6.43	16.45
Pond 3	8.56	26.33	BDL*	7.26	16.23
Pond 4	7.31	26.31	BDL*	6.56	13
Pond 5	7.65	29.83	BDL*	6.76	15.78
Pond 6	10.19	30.15	------	7.76	19.11
Means	9.68	29.21	-----	7.24	17.29
SD ±	2.99	2.56	BDL*	0.85	3.49
LEL(Lowest Effect Level) for sediments [29]	26	16	0.6	31	16
TEL(Threshold Effect Level) for sediments [29]	43	22.7	0.99	35.8	31.6
PEL(Probable Effect Level) for sediments [29]	111	48.6	4.9	128	149
SEL(Severe Effect Level) for sediments [29]	110	75	10	250	110
Limits WHO [30]	0.05	0.02	0.01	0.05	2
Sed=Sediment, SD=Standard Deviation, *BDL-Below detection limit, Cd=0.1 ppm					

Table 3: Heavy metal concentration in the sediment samples (mg-L).

Another source of heavy metal is the pellet feed that did not eat by fish and settled in the sediment. The decrease value of metal concentration in the fish feed followed the sequence Cr>Cu>Ni>Pb>Cd. It was found that within the two farm, farm 1 feed contains more metal than farm 2 it was clear that the feed which was used by farm 1 more contaminated and harmful for both animal and human. Farm 2 used their own produced feed, as a result, this feed was less contaminated and not harmful.

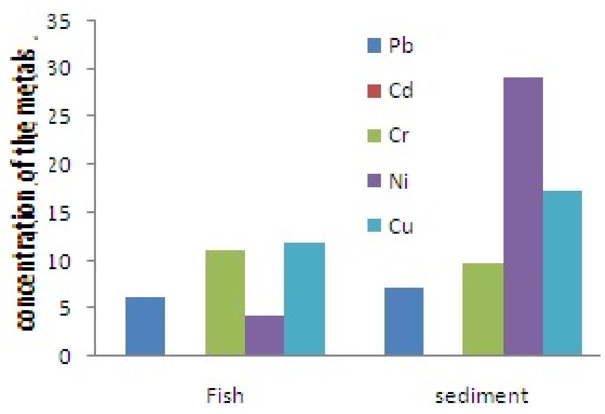

Figure 2: Comparison of heavy metals of culture fish and sediments.

Heavy metals in various tissues of *P. hypophthalmus*

The result of heavy metals in the fish sample was presented in Tables 5 and 6. The mean concentrations of heavy metals Pb, Cd, Cr Ni and Cu in *P. hypophthalmus* fish were shown in Table 6. The average concentration of Cd, Cr, Ni, Cu and Pb in *P. hypophthalmus* was found as Cu>Cr>Pb>Ni>Cd. The highest value of Cu in studied fish might be due to using of anti-fouling paints a potential source of Cu in farmed fish. There have been some efforts to use copper to reduce the abundance of algae that cause off-flavor in catfish. Copper also had its highest value (28.55 mg/kg) in fish liver and its least (3.39 mg/kg) in muscle with an overall mean value of 11.96 mg/kg. The highest value of Cu was found in case of pond 2 and 5 lowest values in case of pond 4. As the present investigation explored the abnormal accumulation of selected heavy metals (Cr, Ni, Cu and Pb,) in studied species of fishes so, there is a high health risk to consumers of the fishes in the area for heavy metal toxicity. Concentrations of metals were found to be generally lower in fish muscles than in the gills and liver. Sequence of metals concentrations in various tissues of fishes are liver>gill>muscle. Levels of Cd and Ni in the muscle of fish were generally low whereas Pb, Cr and Cu was highest in gill and liver. From Table 6 clearly shows that the maximum levels of Cd and Pb in muscle are significantly lower than the permissible tolerable limit [27] and do not constitute any threat to fish consumers. This is of great importance because muscles contribute the greatest mass of the flesh being consumed as food for man and other animals. Max level of Pb (12.25 mgkg^{-1}) was found in fish liver and means level was in fish muscle (1.67 mgkg^{-1}). Cadmium (Cd) like any other substance could be absorbed via the gills and has been known to cause damage to fish gills. Cd poisoning could lead to anemia, renal damage, bone disorder and cancer of the lungs, highest level of Cd was 0.24 mgkg^{-1} in fish liver and the lowest level in fish gill 0.11 mg kg-1 in this present study. Cd profiles recorded in this study were lower than the permissible limits. Thus consumption of fish from this farm could not pose any Cd-induced health hazard. Ni and Cr were above the maximum permissible limit set by WHO/FAO which was shown in Figure 3, highest level of Ni and Cr was 9.29 mg/kg in fish liver and 25.40 mg/kg also in the fish liver. Figure 3 clearly shows the comparison of metal concentration in a different part of fish with WHO/FAO recommended value [27].

Sampling site		Farm-1(Kazi feed, pond 1-3)			Farm-2 (Glove feed pond, 4-6)				
Feed item	Nursery	Grower	Starter	Nursery	Grower	Starter	Mean	SD	
	Pb	0.94	BDL	BDL	BDL	BDL	BDL	0.166	0.38
	Cd	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.01
	Cr	20.25	301.5	211.06	BDL	16.27	BDL	91.51	131.06
	Ni	2.66	0.4	1.2	BDL	1.4	2.53	1.49	1.11
	Cu	6.3	4.18	4.66	0.162	5.51	13.36	5.69	4.32
*BDL=Below Detection Limits, Cr, Ni, Cd, Pb and Cu=0.1 ppm, concentration in ppm									

Table 4: Heavy metal concentration in the sediment samples (mg-L).

Sampling site	Pb			Cd			Cr			Ni			Cu		
	M	G	L	M	G	L	M	G	L	M	G	L	M	G	L
Pond 1	BDL	4.36 ± 0.43	2.69 ± 0.9	0.26 ± 0.37	BDL	BDL	BDL	BDL	5.14 ± 10.65	0.4 ± 1.91	0.35 ± 1.06	BDL	5.88 ± 1.23	8.38 ± 0.66	13.61 ± 23.93
Pond 2	1.98 ± 0.95	7.01 ± 0.31	5.08 ± 5.3	0.34 ± 0.48	0.53 ± 0.04	0.49 ± 0.03	BDL	BDL	BDL	0.74 ± 1.04	1.09 ± 2.78	7.88 ± 6.95	4.14 ± 1.26	7.37 ± 0.14	70.40 ± 21.59
Pond 3	1.48 ± 0.45	2.50 ± 2.65	BDL	0.21 ± 0.29	0.11 ± 0.16	0.22 ± 0.31	3.51 ± 10.58	2.98 ± 12.49	14.02 ± 23.59	BDL	7.48 ± 11.65	BDL	4.23 ± 0.79	4.56 ± 0.72	4.74 ± 18.03
Pond 4	BDL	8.16 ± 7.18	34.8 ± 7.54	0.01 ± 0.02	BDL	BDL	5.28 ± 3.48	10.82 ± 1.02	84.84 ± 18.27	4.59 ± 2.78	0.88 ± 3.86	BDL	3.44 ± 2.27	1.51 ± 3.67	BDL
Pond 5	3.55 ± 0.05	4.28 ± 2.64	6.61 ± 7.379	BDL	BDL	0.08 ± 0.02	6.89 ± 1.08	5.68 ± 2.74	15.14 ± 14.84	BDL	1.21 ± 4.69	BDL	1.08 ± 0.24	1.78 ± 0.38	68.59 ± 37.54
Pond 6	2.98 ± 08	3.41 ± 09	24.3 ± 7.82	BDL	BDL	0.65 ± 1.18	3.57 ± 0.12	7.45 ± 1.44	33.27 ± 44.49	3.62 ± 4.73	BDL	47.89 ± 39.78	1.57 ± 0.59	BDL	13.97 ± 21.08
Note: M=Muscle, G=Gill, L=Liver. Mean of two parallel determinations ± standard deviation of measurements.															

*BDL=Below Detection Limits, Cr, Ni, Cd, Pb and Cu=0.1 ppm, concentration in ppm

Table 5: Presence of heavy metals concentration in various tissues of *P. hypophthalmus* (mg/kg).

Fish part	Pb	Cd	Cr	Ni	Cu	Mean
Gill	4.95	0.11	4.49	1.84	3.93	3.064
Muscle	1.67	0.14	3.21	1.56	3.39	1.994
Liver	12.25	0.24	25.4	9.29	28.55	15.146
Mean	6.29	0.16	11.03	4.23	11.96	-
Maximum limit WHO/FAO (mg/kg)	2	0.5	0.05	0.1	3	-

Table 6: Comparisons with standard references of means total concentration of heavy metals in various tissues of *P. hypophthalmus* (mg/kg).

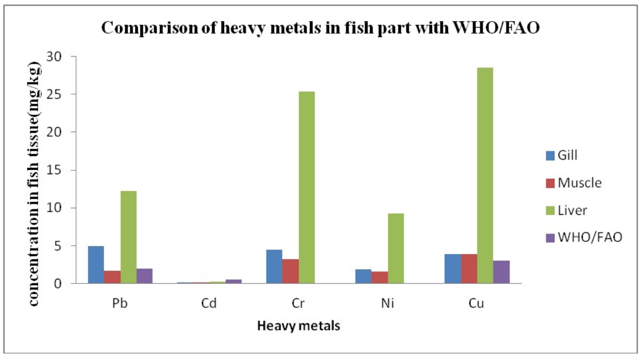

Figure 3: Comparison of heavy metals in *P. hypophthalmus* with WHO/FAO [27-28].

Discussions

Results of the study have been discussed and compared with the finding of other studies in the relevant field. This study was undertaken to investigate heavy metal concentrations in edible parts of commercially important fish *P. hypophthalmus* species in Noakhali because the concentration of Heavy metal in commercial fish available in this region was rarely investigated.

The average metal concentrations from the present study were found to be respectively for Cd, Pb, Cr, Ni and Cu as follows: 0.16, 6.29, 11.03, and 4.23 and 11.96 ppm in the fish parts which was shown in the Table 6. The maximum levels of Cd and Pb in the muscle at this study are significantly lower than the permissible tolerable limit for these elements (Table 6) [29] and do not constitute any threat to fish consumers but Ni and Cr were above the maximum permissible limit set by WHO/FAO. According to Kamal et al. [30,31] heavy metal concentrations found in the muscles varied from Cu: 0.251-0.907, Zn: 3.705-20.535, Mn: 0.376-0.834, Ni: 0.453-0.978 and Pb: Nd-0.552l g/g on wet basis. The estimated levels of all metals in the present study were lower than the limits permitted by Food and Agriculture Organization of the United Nations/World Health Organization (FAO/WHO), European Community Regulation (EU), the United Kingdom Minis-try of Agriculture, Fisheries and Food (MAFF), Turkish and Saudi guidelines[27,29,32].

In the present study the average concentration of Cd, Cr, Ni, Cu and Pb in *P. hypophthalmus* were found as Cu>Cr>Pb>Ni>Cd; whereas Tiimub et al. [33] found concentrations of heavy metals in the fish samples in descending order of Fe>Mn>Cd were detected, but, the rest of metals (Pb, Hg and As) were not detected. The highest concentration of cadmium (0.808 mg/kg) was detected in the muscles of catfish while the lowest value (0.129 mg/kg) in Tilapia.

According to Demirezen et al. [34] it is well known that, copper, manganese, nickel and zinc are essential elements, required by a wide variety of enzymes and other cell components and having vital functions in all living organisms, but very high intakes can cause adverse health problems. On the other hand, Cd and Pb, have no biological role and hence they are harmful to living organisms even at considerably low concentrations. The overall average concentrations of metals were found to accumulate in the order of Zn>Ni>Cu>Mn>Pb>Cd, with concentrations of essential elements were higher than non-essential elements. These results may confirm the essential role of the former metals to fish species.

Copper (Cu) is one of the metals which are essential to human health. Its presence in the aquatic environment may be due to the accumulation of domestic and agricultural wastes. Copper combines with certain proteins to produce enzymes that act as a catalyst to help in the body functions and it's also necessary for the synthesis of hemoglobin [15]. The profile of Cu in this study was liver>gill>Muscle. The Cu recorded greater than 3.00 mg/kg that is, the WHO permissible limit, the fish got from this farm is not safe. Edward et al. [35] found the profile of Cu at the sequence of muscles<liver<kidney<gills. However, very high intake of Cu can cause adverse health effects for most living organisms [15].

Edward et al. [35] found Lead (Pb) level was due to its relatively toxicity which can be probably due to contamination of the river by the activities of car wash operators and automobiles repair workshop located in the area also found the Pb profile in the fish's organ was muscles<kidney<gills<liver. In the present study, lead levels were above the recommended limits of 2.0 mg/kg for fish food. Pb profile in the fish's organ for this study were muscles<gills<livers [35].

It is also worth to mention that, the contribution of fish consumption to heavy metal exposure in while a large number of literature is available on heavy metal concentrations in fish, the majority of them were concerned either in different fish species collected from the same water body or in the same fish species collected from different localities. Therefore, comparing our results with other studies is difficult and should be taken in precaution. However, there was some limitation in our study because we have not yet conducted systematic studies to estimate the impact of the phenomenon; detailed surveys on accumulation of these pollutants in aquatic ecosystems and evaluations of the impact of heavy metals on the environment and public health is also lacking.

Health-risk assessment for fish consumption

We know that muscles are not an active site for metal biotransformation and accumulation but in polluted aquatic habitats the concentration of metals in fish muscles

may exceed the permissible limits for human consumption and imply severe health threats like lung cancer, anaemia, nausea, vomiting, kidney malfunctions and cardiovascular diseases as well as mental disorder. From the Tables 5 and 6 to assess the public health risk of the farmed culture fishes consumption, we compared metal levels in muscles of the current study with the maximum permissible limits for human consumption (MPL) established by WHO and FAO and others international organization and comparing metal concentrations in muscles recently reported in similar fish species [18] .

Conclusions

This presence study determined the health hazardous heavy metals concentrations in the edible part of various tissues of *Pangasius hypophthalmas* as well as sediment, water and feed sample of aquaculture farm. In the heavy metal analysis cadmium, lead, Chromium, Nickel and Copper were studied. The highest concentration of heavy metals accumulate in (28.55 mg/kg) in fish liver and its least consumed (3.39 mg/kg) in muscle with an overall mean value of 11.96 mg/kg). Concentration of Cu was higher than all the international standards and other two metals Pb and Cr were slightly higher than standard set parameters and the overall conclusions is that continuously eating this fishes are not suitable for human health and it may cause carcinogenic diseases like including lung cancer, anaemia, nausea, vomiting, kidney malfunctions and cardiovascular diseases as well as mental disorder in the long run [36].

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