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Comparative Study on Proximate Composition and Heavy Metal Concentration of *Amblypharyngodon mola* and *Channa punctatus* Collected from Pond Water and Open Water

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Abstract: Present study was conducted to evaluate proximate composition and heavy metal concentration of *Amblypharyngodon mola* and *Channa punctatus* collected from pond water and open water in Mymensingh, Bangladesh. Fresh fish were collected from nearby pond of Bangladesh Agricultural University and the Brahmaputra River during February, 2014. Moisture content of the studied fishes was most abundant composition. Protein, lipid and moisture content were higher in pond water fishes than open water fishes. Protein and ash content was higher in *C. punctatus* but lipid and moisture content was higher in *A. mola*. Level of proximate composition of *A. mola* and *C. punctatus* was as Moisture> Protein>Lipid>Ash. Arsenic (As) and Copper (Cu) concentration in *A. mola* and *C. punctatus* were within the permissible limits. Cadmium (Cd) concentration was exceeded the permissible limit in both fishes collected from pond water and open water. Arsenic concentration was not detected in *C. punctatus*. The study revealed that open water fishes accumulated more heavy metal in the muscle than pond water fishes.

Key words: Nutrient content · Heavy metal · SIS · Pond water · Open water

INTRODUCTION

Small Indigenous Species (SIS) is the main, indeed the only source of the protein and most of the fat soluble vitamins for the rural poor people [1]. *Amblypharyngodon mola*, locally known as *Mola*, is a naturally occurring auto-stocked cyprinid fish in Bangladesh. The fish is generally surface feeder and planktivorus [2]. At present, frozen block of *A. mola* is exported to Europe, USA and Middle-east from Kulierchar region of Kishoreganj district [3].

Channa punctatus, locally known as *Taki*, is well known for its taste, high nutritive value and medicinal qualities. The fish is recommended as a diet during convalescence [4]. *Taki macher bhorta* is a traditionally tasty food item especially to the rural people of Bangladesh. *C. punctatus* is carnivore in nature primarily feed on small fishes, zooplankton, rotifers, insects, crustacean larvae etc. [5].

The proximate analysis is a set of methods to get information about the nutritional value of fish. It includes major components of nutritional value of fish such as protein, lipid, moisture and ash. So, it is important to know the level of proximate composition of *A. mola* and *C. punctatus* as these are highly demanded and economically valuable fish of the country.

Heavy metals are toxic or poisonous even at low concentration [6]. The aquatic pollution caused by heavy metals is of major concern due to their persistence and accumulative nature. Amongst animals, fishes are the inhabitants that cannot escape from the detrimental influence of these pollutants [7]. Fish living in the polluted water may accumulate higher amount of toxic heavy metals through their food chain [8]. Fish reared in

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ponds and lakes with artificial feed sometimes contain heavy metal. The metal once absorbed is transported via blood to muscles, bone, liver, kidney, gills and hepatic tissues. Accumulation of metals in fish may cause structural lesions and functional disturbances [9]. Stress due to heavy metals present does create hematological disturbances, erythrocyte destruction (hemolysis) and leukocytosis in fish population, affecting the immune system and making the fish vulnerable to diseases [10]. Almost all of the heavy metal cause health hazard to the consumers. Most cause renal disease, some cause problem in stomachs, damage central nervous system, retard growth in children, cause cancer and so on.

The pollution levels in the rivers of Bangladesh from industrial effluents, urban and agricultural waste has reached alarming situation [11]. In Bangladesh the surface water qualities of the rivers are getting highly polluting gradually [12]. Considering the facts it is important to know the heavy metal concentration of fish living in open water (e.g. rivers) as well as in closed water (e.g. ponds). Therefore, the investigation was carried out to determine the proximate composition and heavy metal concentration of *A. mola* and *C. punctatus* collected from pond and open water systems.

MATERIALS AND METHODS

Study Area and Period: The present research work was undertaken in the Department of Fisheries Technology, Bangladesh Agricultural University (BAU), Mymensingh, during the month of February, 2014. Fish samples were collected at morning and immediately transported to the laboratory. The fishes were kept at ambient temperature in a tray.

Determination of Proximate Composition: Proximate composition was determined in Fish Processing Laboratory of Department of Fisheries Technology, BAU. Moisture content was determined by oven drying the muscle samples at 105°C (about 12hr) until reaching into a constant weight. Protein content was determined using the Kjeldhal method, lipid (Soxhlet acetone extractives) and ash (residual after heating at 550°C for 6hr) were determined using standard methods described by AOAC [13].

Determination of Heavy Metals: The analysis was done by Atomic Absorption Spectrophotometer (HG-AAS, PG-990, PG Instrument Ltd. UK) at Agri-chemistry Laboratory, BAU, Mymensingh, followed by the method of Clesceri *et al.* [14]. The wave length of As, Cd and Cu was 193.7 nm, 217 nm and 383.7 nm, respectively. Metal concentration was calculated by the following formula:

$$\text{Heavy Metal Concentration } (\mu g/g) = \frac{\mu g/g \text{ conc. observed} \times \text{final vol. of sample in ml}}{\text{Weight of tissues taken in gm}}$$

RESULTS AND DISCUSSION

Proximate Composition: Moisture content was the most abundant composition of the studied fishes collected from pond water and open water (Table 1). *C. punctatus* contains more moisture than *A. mola*. Pond water fishes had more moisture than the fishes collected from open water. The total moisture content of *A. mola* is 77.19% [15], 76.68% [16], 75.79±0.88 [17] and 76.38% [18]. Moisture content in *A. mola* collected from pond water and open water is about similar to the above findings. The moisture content of *C. punctatus* is 81.93% [16] which is higher than the present study. Moisture content in *C. punctatus* is similar to Kamal *et al.* [19].

The small indigenous fishes occupy an important position in the popular food items of Bangladesh [20]. *A. mola* and *C. punctatus* is very common SIS of fish species and are good source of protein. In the present study pond water fishes had more protein than the fishes collected from open water (Table 1). Protein content in freshly caught *A. mola* is 17.95% [14], 15.40±0.24% [17] and 18.46% [18] which are more or less similar to the present study. Protein content (%) of *C. punctatus, C. marulius* and *C. striatus* is 15.22, 16.19 and 15.49, respectively [16]. The results showing that protein content of *Channa spp.* is more or less similar but lower than the present study. *C. punctatus* have protein content 19.13±2.40 % [19]. The variation might be due to species, habitat, season, food availability, food type etc. [21]. *C. punctatus* are carnivorous and consume animal protein whereas *A. mola* is mainly plankton feeder [5].

In the present study lipid content was higher in pond water samples. *A. mola* contains more lipid than *C. punctatus* in case of both pond and open water fishes (Table 1). The lipid content of *A. mola* is 2.87% [16] which is lower than the present study. Lipid content of *A. mola* is 5.4% [15], 5.48% [17] and 4.10% [18] which are higher than the present study. *C. punctatus* have lipid content 1.60% [14] and 4.55±1.18 % [19] which are not coincide with the present study. Variation in lipid content is mainly due to geographical location, habitat, food type, food availability, species etc. [21].

Table 1: Proximate composition of *A. mola* and *C. punctatus* (mean±SD)

	A. mola (20*)		*C. punctatus* (20*)	
Proximate composition (%)	Pond water	Open water	Pond water	Open water
Moisture content	74.40±1.51	73.03±0.82	73.44±1.87	72.73±1.65
Protein content	18.26±0.42	18.66±0.32	22.53±0.37	21.41±0.29
Lipid content	3.70±0.17	3.81±0.14	2.81±0.08	2.43±0.06
Ash content	1.23±0.11	1.19±0.12	1.41±0.05	1.27±0.09

* Number of samples given in parentheses

Table 2: Heavy metal concentration (µg/g) of *A. mola* and *C. punctatus* (mean±SD)

	A. mola (20*)		*C. punctatus* (20*)		
Heavy metal (µg/g)	Pond water	Open water	Pond water	Open water	Permissible limit (µg/g)
Arsenic (As)	0.14±0.03	0.23±0.05	ND**	ND**	0.26 [30]
Cadmium (Cd)	0.23±0.04	0.29±0.05	0.21±0.04	0.32±0.06	0.20 [30]
Copper (Cu)	2.27±0.17	2.42±0.14	2.35±0.15	2.69±0.19	10.00 [31]

* Number of samples given in parentheses

** ND = Not Detected

Present study recorded more ash content in *C. punctatus* than *A. mola*. Open water fishes are found more ash content than the fishes collected from pond water (Table 1). Ash content of *A. mola* is 2.50% [16], 1.60% [17], 1.64% [18]. Ahmed *et al.* [16] found ash content in *C. punctatus* 1.25% but Kamal *et al.* [19] estimated 6.81±0.94%. The results are not similar to the present study that might be due to geographical location, food availability, season, sex etc. [21].

Heavy Metal Concentration: Generally, accumulation depends on metal concentration, time of exposure, way of metal uptake, environmental conditions (water temperature, pH, hardness, salinity) and intrinsic factors (fish age, feeding habits) [9]. Various factors such as season, physical and chemical properties of water can play a significant role in metal accumulation in different fish tissues [22]. Moody *et al.* [23] stated that there is high accumulation of heavy metals in river fishes. Metal accumulation in fish muscle is lower than liver, kidney and gills [24, 25, 26]. In the present study, the trend of heavy metals concentration can be represented as: Cu> Cd> As in pond water and open water *A. mola* and *C. punctatus* (Table 2).

Arsenic (As) is a devastating environmental pollutant that causes severe ground water pollution in Bangladesh. Organic arsenic compounds (such as arsenobetaine) are primarily found in fish by Jarup [27]. In *A. mola*, average arsenic content was higher in open water fishes than pond water fishes but it was absent in *C. punctatus*. Hasan *et al.* [28] determined minor amount of arsenic (0.0004±0.0007 µg/g) in *C. punctatus* muscle from the river Khiru in Mymensingh. As concentrations in the present study was within the recommended limits (Table 2). As accumulation in fish muscle tissue collected from North East coast of India is 0.02-2.37 µg/g [29] which is more or less similar to the present study.

Cadmium (Cd) levels usually increase with the age of fish and the level pollution [32, 33]. Large sized fishes accumulate more Cd in muscles than small sized fish of the same species [34]. Open water *A. mola* (0.27±0.05 µg/g) and *C. punctatus* (0.28±0.06 µg/g) was found higher Cd concentration in the muscle than pond water fishes. Average Cd accumulation was higher in *C. punctatus* than *A. mola* (Table 2). *C. punctatus* muscle contains 0.0012±0.0018 µg/g Cd found by Hasan *et al.* [28]. Concentration of Cd in fish muscle tissue ranges from 0.01 to 1.10 µg/g dry weight [29] which is similar to the present study. The Cd concentration in *C. carpio* muscle is 0.02-0.13 µg/g [26]. This indicates that *C. carpio* accumulate lower Cd in the muscle than *A. mola* and *C. punctatus*. Islam *et al.* [35] showed that Cd contaminants (µg/g) in fish edible muscles varied between 0.13±0.05 – ND (not detected). Acute toxicity of Cd is related to the free ionic concentration of the metal and is variable to aquatic organisms. Cd causes abnormally low calcium levels (hypocalcaemia), by inhibiting calcium uptake from the water. Islam *et al.* [35] stated that fish can be protected from Cd uptake by increasing calcium concentration at the uptake sites. In the present study Cd concentration in *A. mola* and *C. punctatus* crossed the permissible limit (Table 2).

Copper (Cu) concentration of open water *A. mola* and *C. punctatus* was higher in the muscle than pond water fishes. Cu accumulation was also higher in *A. mola* than *C. punctatus* (Table 2). The difference is mainly due to species, sex, food and feeding habit variation. In a heavily polluted river of Bangladesh, Buriganga River, highest Cu was found in *C. punctatus* (5.27 µg/g) [36] which were higher than the present study. Cu concentration in *C. punctatus* was near the concentration (3.46±0.85 µg/g) found by Hasan *et al.* [28]. Cu contaminants in fish edible muscles varied between 3.13±2.53 and 0.63±0.06 µg/g [35] which is supported by the present study.

CONCLUSION

Most of the people do not care about the nutritional value of fishes but fish is essential food to prevent most of the life threatening diseases. In Mymensingh there are so many indigenous fishes in ponds and in the Brahmaputra River which are left for studying nutritional value. Therefore, further study has to be done for finding their nutritional value in time so that nutritionists can easily suggest the fish requirement for daily meal. It is recommended that further research should be done on the accumulation and concentration of heavy metals in fish in order to monitor and prevent them from exceeding permissible limits that make them toxic to human. Health screening should be undertaken on the inhabitants to check for symptoms of some of these heavy metals.

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