

Nutritional Assessment of Three Commonly Consumed Bangladeshi Fish Species, *L. rohita*, *H. molitrix* and *P. hypophthalmus* from Wild and Farmed Sources

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Abstract Consumption of fish provides significant contribution to nutrition. Due to economic distress Bangladeshi people especially children are badly affected by malnutrition. In order to get rid of this devastating problem, we need to make an effective plan to combat against malnutrition. For the assessment of different nutritional parameters the selected fish species were collected from different natural and fish farming ponds. The nutrient compositions were quantified by using different well established convenient methods. Our present work showed that fishes were rich sources of various types of nutrients. From the study it was found that farmed *L.rohita* was an important source of ash and thus the source of minerals. Total protein content of this species was higher than the other selected species and it was followed by *H.molitrix* farmed species. The highest quantity of total lipid was observed in *P. hypophthalmus* species. Vitamin B content of *L. rohita* species was also higher than the other species. Therefore it could be suggested that consumption of these fish species might reduce the extent of malnutrition.

Keywords: calcium, glycogen, noneducing sugar, total protein, vitamin B-1

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1. Introduction

Fishes are considered as valuable food due to the rich sources of animal protein as well as different vitamins and minerals [1]. The nutritive values and the impacts of fish on human health have been determined from different perspectives in both developed and developing countries. Researchers and consumers are well concerned about the health benefits of poly-unsaturated fatty acids (PUFA), which play vital role in reducing blood pressure, lowering the risk of heart diseases and influencing the growth and development of infants [2,3]. The last national survey in rural Bangladesh demonstrates that the mean total protein intake was 48 g/person/d, of which 3g comes from fishes [4]. The nutritive values of fish in Bangladeshi diet should not focus on the contribution to protein as protein recommendations in the typical diet are met provided that the energy recommendations are met [5]. Human receive $24 \pm 6\%$ and $22 \pm 6\%$ calcium from small fish and milk respectively [6]. Fish oil derived from the tissues of oily fish is an important source of long-chain polyunsaturated omega-3 fatty acids, such as, eicosapentaenoic acid (EPA)

and docosahexaenoic acid (DHA) [7]. The two omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have been shown to work as antidepressants in human [8]. Thiamine plays vital role in energy production from carbohydrates, DNA and RNA synthesis and in nerve functions. The coenzyme form of Thiamine, Thiamine pyrophosphate (TPP), takes part in the conversion of pyruvate to acetyl Coenzyme A (CoA) in metabolism [9]. Riboflavin takes part in the energy production for the electron transport chain, the citric acid cycle and in fatty acids oxidation [10]. Several previous studies have demonstrated the relationship of dietary fats with cancers and fish oil is known to protect from many types of cancer such as colon, liver, breast, prostate and lung cancer [11-14]. The present study was undertaken to evaluate the nutritional status of three commonly consumed Bangladeshi fish species.

2. Materials and Methods

2.1. Sample Collection

Farmed *L. rohita*, *H. molitrix* and *P. hypophthalmus* were collected from the selected fish farming ponds and

the wild species are collected from various places of Bangladesh such as Cholon Bil (Natore) and Jomuna river (Sirajgonj ghat, Sirajgonj) in rainy season due to their availability. After collection, the samples were processed and stored in -20 °C. Only the flesh of fish was used for different experimental purposes. Sun dried samples were preferred for experiments.

2.2. Assessment of Nutritional Parameters

The nutritional parameters were determined by using different well established convenient methods. Moisture content was determined by the conventional procedure [15]. Ash content was determined by the following method of A.O.A.C [16]. The sugar content of each selected fishes were determined calorimetrically by the anthrone method [17]. Extractions of sugar from selected fishes were done by the following method as described by Loomis [18]. The quantification of reducing sugar of the fish species was done by dinitrosalicylic acid [19]. Nonreducing sugar content was determined by the following formula: Percent of sucrose or non reducing sugar = (%Total sugar -% reducing sugar) \times 0.95 [20]. The amount of total protein of each selected fishes were determined by the micro-kjeldahl method [21]. Lowry *et.al.* [22] method was used to measure water soluble protein. Lipid content of the selected fishes was determined by the method of Bligh and Dyer [23]. For the estimation of minerals, organic matter was digested by nitric acid. The released minerals were determined by atomic absorption spectrophotometer [24].

3. Results and Discussion

Consumption of fish provides important nutrients to a large number of people worldwide and thus makes important contribution to nutrition. Fish makes a vital contribution to the survival and health of a significant portion of the world's population. Malnutrition is a great obstacle to build up a strong nation. Like others Bangladesh is one of the poorest countries in the world. Farmed fishes are provided with sufficient amount of food, so their growth rate is higher than the wild fish species. Hence the nutritional status of the farmed fishes is also different from the wild varieties [25]. The wild *L. rohita*, *H. molitrix* and *P. hypophthalmus* were found to contain 1.260%, 1.452% and 1.105% ash respectively. On the other hand the farmed fishes were found to contain 2.520%, 1.785% and 1.766% respectively. The data indicated that the ash content of farmed species were higher than wild species. Specially farmed *L.rohita* contained highest amount of ash. These values were lower than the value 4.62% of *Teramnus nlabialis* seed totally [26]. Total soluble sugar content of the selected wild and farmed fish species was presented in Table 2. It was observed that the total soluble sugar content in farmed *H. molitrix* was higher than in the wild one. But the wild *P. hypophthalmus* and *L.rohita* contained higher amount of sugar than farmed specie. Total soluble sugar presented in all these species were lower than the value of 1.9g% for brazil nut [27]. Reducing sugar is another kind of carbohydrate. The data of reducing sugar for all three fish species obtained from the experiments were cited in the Table 2. The data showed that the values of reducing sugar of fishes were

ranging from 0.028% to 0.054% for wild and 0.021% to 0.062% for farmed fishes. Reducing sugar for farmed *L. rohita*, was lower than wild species. But the farmed *H. molitrix* and *P. hypophthalmus* were found to contain higher quantity of reducing sugar than their respective wild species. The changes in reducing sugar might be due to enzymatic conversion of some non-reducing sugars to reducing sugar [28]. The moisture contents of wild and farmed selected fishes were tabulated in Table 1. It was found that the moisture contents in wild species of selected fishes varied from 74.25% to 76.53% in wild and in the farmed fish from 72.60% to 77.52%. Average moisture content in wild fishes was higher than that of the farmed ones. The study indicated that the selected fish species were good sources of moisture. These values were lower than a previous research work [29]. Glycogen is a storage carbohydrate in animal body. Glycogen serves as reserve nutrient. Glycogen content of all selected wild and farmed fish species were determined and the data were presented in Table 2. From the table it was found that the quantity of glycogen presented in wild was higher than the farmed fishes. Our present study showed that the glycogen content of the selected species was higher than a previous study [25]. The observations indicated that variations in glycogen content in test fishes were linked to their habitat and nutritive values [30]. The results in Table 3 showed that all the fish species were good sources of protein. The quantity of water soluble protein was higher in *L.rohita* and *H.molitrix* farmed species but wild *P. hypophthalmus* showed variation in this regard. The results showed that the total protein content of all of the farmed species was higher than the wild ones. The relatively high to moderate percentage crude protein may be attributed to the fact that fishes are good source of pure protein, but the differences observed in the obtained values could also be as a result of absorption capability and conversion potentials of essential nutrients from their diets or their local environment into such biochemical attributes needed by the organisms body [31,32]. The total protein content of *L.rohita* farmed species showed similarity to a previous study but the content in other species was lower [33]. It was also observed that the total lipid contents of farmed *L. rohita*, *H. molitrix*, and *P. hypophthalmus* were 32.19%, 20.89% and 14.49% higher than wild species respectively. The amount of iron, calcium, potassium, Manganese, Phosphorus, Zinc and Arsenic present in wild and farmed fishes were shown in Table 4. As shown in the Table 4, the iron content of the fish samples were ranged from 0.119mg/kg to 0.414 mg/kg in farmed and 0.117mg/kg to 0.365mg/kg in wild species. From the Table 4, the calcium content of the fish samples were ranged from 0.096 to 0.142 mg/kg in farmed and 0.093 to 0.131 mg/kg in wild species. The amount of calcium present in farmed *L. rohita*, *H. molitrix*, and *P. hypophthalmus* were increased by 8.40%, 4.12% and 3.22% respectively compared to wild species, where *L. rohita* had the highest Ca content. Potassium helps to regulate body fluids and mineral balance in and out of cells. As illustrated in Table 4, the potassium content of the fish samples were ranged from 0.043 to 0.101 mg/kg in farmed and 0.042 to 0.095 mg/kg in wild species. The amount of potassium in farmed *L. rohita*, *H. molitrix*, and *P. hypophthalmus* were increased by 6.32%, 6.52% and 2.38% respectively compared to wild species. As cited in Table 4, the amount

of manganese present in farmed *L. rohita*, *H. molitrix*, and *P. hypophthalmus* were found 1.96%, 3.03%, and 2.17% higher than their corresponding wild species. Phosphorus is essential for acid base regulation, bone and teeth formation. The amount of phosphorus presented in experimental fishes was showed in Table 4. The phosphorus content in farmed *L. rohita*, were found to be increased by 3.54%, where farmed *H. molitrix* were decreased by 1.89%. No changes of phosphorus content were found in *P. hypophthalmus*. The amounts of zinc in experimental fishes were presented in Table 4. The zinc contents were found to be ranged from 0.031 to 0.049 mg/kg in farmed and 0.032 to 0.047 mg/kg in wild species. The result showed that the zinc contents in farmed *L. rohita* was found to be higher but *H. molitrix* wild species showed exception. No change was observed in both *P. hypophthalmus* species. Fatty fish and fish products are quite good sources of calcium, especially when eaten with the bones intact like sardines which contain 420 mg/100 g [34,35]. The skeletal effects of calcium are well known but calcium may also protect against cardiovascular diseases by lowering blood pressure [35,36]. Specifically, potassium has been noted to reduce both systolic and diastolic blood pressure in people with normal and high blood pressure [37,38]. Calcium, Potassium, Manganese, Phosphorus, Zinc and Arsenic were measured in the selected fish species and these values were lower than a previous study but the Iron content was higher and the quantity of arsenic was consonant to the same study [39]. Arsenic has been reported to be associated with multi-site cancers, cardiovascular diseases, diabetes mellitus, dermatitis, immunotoxicity, lymphoproliferative disorders, peripheral neuropathy and many other complications [40,41,42]. The B₁ contents were ranged from 0.235 ± 0.040 to 0.372 ±

0.031 mg% in farmed and 0.243 ± 0.063 to 0.317 ± 0.047mg% in wild species having the highest content in *L. rohita* and lowest in *P. hypophthalmus*. As shown in the table, vitamin B₁ contents were higher in farmed *L. rohita* and *H. molitrix* respectively compared to their corresponding wild species. No significant changes of vitamin B₁ content was higher in farmed *L. rohita* and *H. molitrix* respectively compared to their corresponding wild species. Vitamin B₂, a crystalline pigment, is the principal growth-promoting factor of the vitamin B complex. The B₂ contents were found to be ranged from 1.075 to 2.657 mg% in farmed and 0.969 to 2.403 mg% in wild species. From the table, vitamin B₂ content was increased by 10.57%, 5.8% and 7.64% in farmed *L. rohita*, *H. molitrix* and *P. hypophthalmus* respectively as compared to their corresponding wild species. Riboflavin (vitamin B₂) deficiency results in the condition of hypo- or ariboflavinosis, with sore throat; hyperaemia; oedema of the pharyngeal and oral mucous membranes; cheilosis; angular stomatitis; glossitis; seborrheic dermatitis; and normochromic, normocytic anaemia associated with pure red cell cytoplasia of the bone marrow [43,44].

Table 1. Moisture and Ash contents of selected fishes (gm %)

Name of fish Specie	Moisture	Ash
L. rohita (Wild)	76.53 ± 0.086	1.260 ± 0.105
L. rohita (Farmed)	72.60 ± 0.075	2.520 ± 0.633
H. molitrix (Wild)	74.25 ± 0.007	1.452 ± 0.087
H. molitrix (Farmed)	73.36 ± 0.002	1.785 ± 0.129
P. hypophthalmus (wild)	76.48 ± 0.002	1.105 ± 0.075
P. hypophthalmus (Farmed)	77.52 ± 0.074	1.766 ± 0.456

Notes: Values are means ± standard deviation.

Table 2. Sugar content of selected fishes (gm %)

Name of fish Specie	Total soluble sugar	Reducing sugar	Glycogen
L. rohita (Wild)	0.377 ± 0.167	0.028 ± 0.023	0.996 ± 0.036
L. rohita (Farmed)	0.237 ± 0.159	0.021 ± 0.037	0.849 ± 0.098
H. molitrix (Wild)	0.321 ± 0.053	0.054 ± 0.124	0.543 ± 0.034
H. molitrix (Farmed)	0.342 ± 0.067	0.062 ± 0.143	0.328 ± 0.064
P. hypophthalmus (wild)	0.456 ± 0.085	0.032 ± 0.171	0.886 ± 0.076
P. hypophthalmus (Farmed)	0.426 ± 0.140	0.045 ± 0.043	0.801 ± 0.046

Notes: Values are means ± standard deviation

Table 3. Protein and lipid contents of selected fishes (gm %)

Name of fish Specie	Water soluble protein	Total protein	Total lipid
L. rohita (Wild)	0.786 ± 0.328	17.027 ± 0.258	2.159 ± 0.083
L. rohita (Farmed)	0.971 ± 0.007	19.359 ± 0.057	2.854 ± 0.064
H. molitrix (Wild)	0.324 ± 0.076	16.321 ± 0.054	2.015 ± 0.075
H. molitrix (Farmed)	0.447 ± 0.064	17.785 ± 0.075	2.439 ± 0.043
P. hypophthalmus (wild)	0.551 ± 0.036	15.223 ± 0.035	3.628 ± 0.038
P. hypophthalmus (Farmed)	0.432 ± 0.087	17.709 ± 0.034	4.157 ± 0.054

Notes: Values are means ± standard deviation.

Table 4. Amount of mineral content in selected fishes (mg/Kg)

Name of fish Species	Iron (Fe)	Calcium (Ca)	Potassium (K)	Manganese (Mn)	Phosphorus (P)	Zinc (Zn)	Arsenic (As)
L. rohita (Wild)	0.365	0.131	0.095	0.051	0.113	0.047	0.016
L. rohita (Farmed)	0.414	0.142	0.101	0.052	0.117	0.049	0.015
H. molitrix (Wild)	0.242	0.097	0.046	0.033	0.053	0.032	0.023
H. molitrix (Farmed)	0.246	0.101	0.049	0.034	0.052	0.031	0.023
P. hypophthalmus (wild)	0.117	0.093	0.042	0.046	0.035	0.034	0.025
P. hypophthalmus (Farmed)	0.119	0.096	0.043	0.047	0.035	0.035	0.024

Values were measured as mg/kg body weight.

Table 5. Vitamin B₁ and B₂ contents of selected fishes (mg %)

Name of fish Species	Vitamin B ₁	Vitamin B ₂
L. rohita (Wild)	0.317 ± 0.047	2.403 ± 0.028
L. rohita (Farmed)	0.372 ± 0.031	2.657 ± 0.037
H. molitrix (Wild)	0.263 ± 0.039	1.931 ± 0.049
H. molitrix (Farmed)	0.294 ± 0.064	2.043 ± 0.018
P. hypophthalmus (wild)	0.243 ± 0.063	0.969 ± 0.024
P. hypophthalmus (Farmed)	0.235 ± 0.040	1.075 ± 0.034

Notes: Values are means ± standard deviation.

4. Conclusion

Our experiment showed that the selected fish species were good sources of moisture and other nutrients. Highest quantity of total lipid was found in farmed *P. hypophthalmus* species. Vitamin B₁ content was highest in *H. molitrix* farmed species but highest amount of vitamin B₂ was present in *L. rohita* farmed species. The quantity of total protein was also highest in *L. rohita* farmed species. Estimated mineral content was also highest in this species.

Competing Interests

The authors declare that there is no conflict of interests regarding the publication of this article.

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