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Nutrient Composition of Indigenous and Exotic Fishes of Rainfed Waterlogged Paddy Fields in Lakshmipur, Bangladesh

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Abstract: Present investigation was carried to find out the nutrient composition of fishes collected from six different water logged areas locally known as *Dogi*. The common carp, *Cyprinus carpio* contained the highest moisture 83.70% and *Puntius ticto* the lowest 75.02%. The highest amount of ash (3.56%) was found in *Puntius sophore* and the lowest (0.26%) in *Cyprinus carpio*. The highest percentage of protein (19.50%) was found in *Anabus testudineus* and the lowest (15.14%) in *Heteropneustes fossilis*. The highest percentage of lipid (4.52%) was found in *Lepidocephalus guntea* and the lowest (1.40%) was found in *Pangasius pangasius*. The small indigenous fish species (SIS) contented the highest percentage of nutrient except moisture than the introduced fishes in *Dogi*. The moisture, protein and lipid were the highest in semi intensive cultured fishes than the waterlogged paddy fishes. The nutrient qualities of fishes for two culture systems (Semi-intensive and *Dogi*) were significantly varied ($P<0.05$) except ash content. In conclusion it can be stated that, *Dogi* fish culture may be used as a tool for sustainability of fish resources of an area, where natural fish can be conserved and the added culture fishes can be used for consumption as well as to support livelihood of the poor and fulfill the nutrient requirement.

Key words: Proximate Composition · Small indigenous fish species · Exotic Fishes

INTRODUCTION

Fish plays a major role in the Bangladesh diet, constituting the only animal protein source among rural poor households [1-3]. Small indigenous fish species (SIS) dominate the rural Bangladeshi diet [4,5], but the supply of freshwater fish is under great pressure and therefore an increasing share of fish available for consumption is supplied from rural carp culture of indigenous (Rui, Mrigal, Katla) and exotic carp species (silver carp, grass carp, common carp). SIS have very high content of vitamin A (2680 retinol equivalent (RE)/100g raw edible parts) commonly cultured carp species have low content (<100µg RE/100g raw edible parts) [6]. Small indigenous species (SIS) is also a rich source of dietary calcium because most of the bones are eaten [7]. At present annual fish intake by an individual is 17.52kg and the annual fish demand is 29.74 metric tons [8]. In a regional survey, the mean intake in poor rural households was 59g raw fish/personal/d over a 7 months' fish producing period [5].

The freshwater fish species of comprised of 265 species in Bangladesh, of which about 140 species are known as small indigenous fish species (SIS) [9]. In general 56-73 species mostly consumed by the poorer section were SIS. In the past SIS fishes were regarded as weed fishes and eradicated from the fish ponds by fishing or using piscicides. Only recently these small indigenous fish species have been considered as an important source of essential macro and micro nutrients [10], which can play an important role in the elimination of malnutrition in this country [11,12].

Waterlogged paddy fields are important habitat for SIS. Lakshmipur is one of the southern coastal districts of Bangladesh. This water logging has been caused by impediment to the natural drainage empolderization since

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early 60's. Traditionally in the rainy season, these waterlogged paddy fields have been utilized as a community fishery and a source of aquatic plants by poorer, landless people in the community. The fishery comprised mainly self-recruiting small indigenous species, many of them of high value. The relatively high level of fish production is attributed to the nutrient rich waterlogged area. Total number of fish species of the seasonal waterlogged area is not yet identified. However, *Anabus testudineus*, *Puntius sophore*, *Channa punctatus*, *Nandus nandus*, *Mastacembelus pancalus*, *Notopterus notopterus*, *Channa striatas*, *Mystus tengara*, *Clarias batrachus*, *Channa marulius*, *Colisa fasciatus*, *Colisa lalia*, *Heteropneustes fossilis*, *Lepidocephalus guntea*, *Pseudambassis beculis*, *Salmostoma phulo* provide the major catches from the open fresh water. These waterlogged paddy fields are different from other culture systems. Because its' habitat quality is fluctuated various fold in a day and farmers introduced some cultured fishes with indigenous fishes. Limited area, low seasonal water and high food competition among the fishes make complexity.

This study highlights the nutrient composition of *Dogi* fishes both indigenous and introduced fishes and shows a comparison between introduced fishes of *Dogi* and same fishes of semi intensive culture system.

MATERIALS AND METHODS

Study Site: The study area included two unions, Bhatra and Bholkot at Ramganj in Lakshmipur Dsitrict. There are six *Dogi* named by Amirpur, Devnagar, Dudrajpur, Miribari, Nandiara and Nolchara. From these, Miribari, Nandiara and Nolchara are situated at Bhatra union and Amirpur, Devnagar and Dudrajpur are located at Bholkot union. The geographical location of the area is in between latitude 23° 05´ and 23° 08´ 29" N and longitude 90° 54´ and 90° 58´ E (Fig. 1).

Sample Collection: Fishes were sampled during the period of June 2010 to November 2010 from various parts of these *Dogi* for nutrient analysis. At the same time eleven (11) semi-intensive cultured fishes namely *Hypopthalmichthys molitrix, Ctenopharyngodon idella,*

Fig. 1: Location of sampling sites.

Cyprinus carpio, Oreochromis mossambicus, Pangasius pangasius, Barbonemus gonionotus, Catla catla, Aristichthys nobilis, Labeo rohita, Labeo calbasu and *Cirrhinus mrigala* were collected from fish markets and different farms. The length and weight of collected fishes were closely similar with *Dogi* fishes.

Proximate Composition Analysis

Moisture (%): Moisture content was determined by oven drying method [13]. Pre weighted samples were oven dried (95-105°C) using pre weight porcelain cups. Moisture content determined as loss of weight.

Weight of the crucible = W_0 Weight of the crucible +Wet sample = W_1

$$\text{Moisture content of the sample (\%)} = \frac{\{(w1\text{-}10)-(w2-20)\}}{(w1\text{-}w0)}\times 100$$

Weight of the crucible +Dry sample = W_2

Moisture factor = (100 – moisture) / 100

Ash (%): Ash content was determined by ignition of samples in a muffle furnace at 550°C for 16 hours [13]. The percentage of ash is calculated as follows

Weight of the clean dry crucible = W_0 Weight of the clean dry crucible + dry sample = W_1, Weight of the clean dry crucible + ash = W_2

$$\text{Ash content of the fresh sample (\%)} = \left(\frac{w2-20}{w1\text{-}w0}\times 100\right)\times \text{moisture factor}$$

Crude Protein (%): Crude protein content was determined by using Kjeltec machine (Model Tecator Kjeltec System 1026 Manual, 1987). Protein conversion factor (6.25) was used in converting nitrogen to crude protein. The percentage of Nitrogen in the sample was calculated by using the following formula:

$$\%\text{ of nitrogen} = \frac{(S\text{-}B)\times A\times 14\times C\times 100}{\text{Weight of sample}\times 1000}$$

S = Titration reading for sample,
B = Titration reading for blank
A = Strength of 0.01N HCl (0.01),
C = Digest taken for distillation (dilution factor) ˜ 20
% crude protein (fresh sample) = N_2 x 6.25 x moisture factor

Crude Lipid (%): Crude lipid was determined by using the Soxhlet system (model Tecator Soxtec System HT 1043-001 Manual. 1983) for extracting lipids of samples by petroleum ether.

$$\%\text{ of fat (fresh sample)} = \left(\frac{w2-w1}{s}\times 100\right)\text{x moisture factor}$$

W_2 = Final weight of the conical flask, W_1= Initial weight of the empty conical flask S = Weight of the sample taken

RESULTS AND DISCUSSION

The nutrient values of 35 fishes collected from *Dogi* are presented in Tables (1- 7). The highest percentage of moisture was obtained by *Channa striates* (Shol), ash by *Channa punctatus* (Taki), protein and lipid by *Channa marulius* (Gajar). But *Channa striatas* (Shol) showed lowest ash and lipid content (Table 1).

The highest percentage of moisture was found in *Esomus danricus* (Darkina), lipid by *Salmostoma Phulo* (Fulchela) and *Puntius sophore* (Jat Punti) contents with maximum protein and ash (Table 2).

Table 1: Nutrient quality of snakehead fishes

Snakehead Fishes					
Fish Species	Local name	Moisture %	Ash %	Protein %	Lipid %
Channa striates	Shol	82.66	0.39	15.49	1.47
Channa punctatus	Taki	81.93	1.25	15.22	1.60
Channa marulius	Gajar	81.42	0.60	16.19	1.79

Table 2: Nutrient Quality of minor carps

Minor Carps					
Fish Species	Local name	Moisture%	Ash%	Protein%	Lipid%
Puntius ticto	Tit Punti	75.02	3.34	18.08	3.56
Puntius sophore	Jat Punti	75.63	3.56	18.53	2.28
Amblypharyngodon mola	Mola	76.68	2.50	17.95	2.87
Salmostoma phulo	Fulchela	75.86	3.25	17.23	3.66
Esomus danricus	Darkina	77.20	2.54	17.12	3.13

Table 3: Nutrient quality of other indigenous fishes

Other Small Indigenous Fishes					
Fish Species	Local name	Moisture%	Ash%	Protein%	Lipid%
Pseudambassis beculis	Chanda	78.62	2.92	15.60	2.86
Chanda nama	Nama Chanda	78.03	2.15	17.77	2.05
Nandus nandus	Bheda	78.61	2.83	15.80	2.75
Colisa fasciatus	Khailsha	80.75	0.85	15.82	2.58
Colisa lalia	Boicha	77.52	2.21	16.13	4.15
Mastacembelus pancalus	Guchi Baim	76.09	1.62	18.03	4.25
Lepidocephalus guntea	Gutum	77.32	1.56	16.61	4.52
Xenentodon cancila	Kaikka	79.57	2.02	15.65	2.76
Notopterus notopterus	Foli	78.61	2.83	15.80	2.75
Anabus testudineus	Koi	76.60	1.62	19.50	2.27

Table 4: Nutrient quality of catfishes

Catfishes					
Fish Species	Local name	Moisture%	Ash%	Protein%	Lipid%
Heteropneustes fossilis	Shing	80.44	0.94	15.14	3.49
Clarias batrachus	Magur	80.74	0.95	15.22	3.08
Mystus tengara	Bajuri Tangra	77.17	1.48	17.86	3.48
Mystus cavasius	Kabasi Tangra	78.62	1.27	17.30	2.81

Table 5: Nutrient quality of introduced major carps

Introduced Major Carps					
Fish Species	Local name	Moisture%	Ash%	Protein%	Lipid%
Labeo rohita	Rui	77.91	1.43	17.49	3.16
Catla catla	Catla	79.90	1.19	16.90	2.01
Labeo gonius	Gonia	80.11	1.13	17.05	1.71
Labeo calbasu	Kalibaus	79.80	1.08	16.47	2.65
Cirrhinus mrigala	Mrigal	79.23	1.66	17.16	1.95
Labeo bata	Bata	79.48	1.36	15.42	3.73

Table 6: Nutrient Quality of introduced exotic fishes

Introduced Exotic Fishes					
Fish Species	Local name	Moisture%	Ash%	Protein%	Lipid%
Hypophthalmichthys molitrix	Silver Carp	78.70	1.05	18.12	2.13
Ctenopharyngodon idella	Grass Carp	80.60	1.00	16.06	2.33
Cyprinus carpio	Common Carp	83.70	0.26	14.60	1.44
Aristichthys nobilis	Bighead Carp	79.27	1.38	17.20	2.15
Oreochromis mossambicus	Tilapia	79.01	0.91	16.89	3.18
Barbonemus gonionotus	Thai Sarputi	79.23	1.03	15.74	3.99
Pangasius pangasius	Thai Pangus	82.76	1.12	14.71	1.40

Table 7: ANOVA for showing the variation of moisture, ash, protein and lipid in two systems

Nutrient	Source of Variation	SS	df	MS	F	Sig.
Moisture %	Between systems	20.977	1	20.977	9.524	0.006*
	Within systems	44.053	20	2.203		
	Total	65.030	21			
Ash %	Between systems	0.082	1	0.082	0.605	0.446
	Within systems	2.706	20	0.135		NS
	Total	2.788	21			
Protein %	Between systems	6.324	1	6.324	5.527	0.029*
	Within systems	22.882	20	1.144		
	Total	29.205	21			
Lipid %	Between systems	3.166	1	3.166	5.809	0.026*
	Within systems	10.902	20	0.545		
	Total	14.068	21			

(*) Significant at 0.05 levels NS, Not significantly different

The highest percentage of moisture was found in *Colisa fasciatus* (Khailsha), ash in *Pseudambassis beculis* (Chanda), protein in *Anabus testudineus* (Koi) and lipid in *Lepidocephalus guntea* (Gutum) (Table 3).

The highest percentage of moisture was found in *Clarias batrachus* (Magur) and lipid by *Heteropneustes fossilis* (Shing) but *Mystus tengara* (Bajuri Tangra) showed maximum ash and protein content. Ash content was lowest in *Heteropneustes fossilis* (Shing) and *Clarias batrachus* (Magur) (Table 4).

The highest percentage of moisture was obtained from *Labeo gonius* (Gonia), ash by *Cirrhinus mrigala* (Mrigal), protein by *Labeo rohita* (Rui) and lipid by *Labeo bata* (Bata) (Table 5).

The highest percentage of moisture was found in *Cyprinus carpio* (Common Carp), ash in *Aristichthys nobilis* (Bighead Carp), protein in *Hypophthalmichthys molitrix* (Silver Carp) and lipid in *Barbonemus gonionotus* (Thai Sarputi) (Table 6).

Cyprinus carpio (Common Carp) contented highest moisture and *Puntius ticto* (Tit Punti) lowest. The highest amount of ash was found in *Puntius sophore* (Jat Punti) and minimum by *Cyprinus carpio*. Protein was higher in *Anabus testudineus* (Koi) and lower in *Heteropneustes fossilis* (Shing). Lipid was higher in *Lepidocephalus guntea* (Gutum) and lower in *Pangasius pangasius* (Thi Pangus) (Tables 1-6).

The nutrient qualities of fishes for two culture systems (Semi-intensive and *Dogi*) were significantly varied ($P<0.05$) from each other except ash content. Percentage of moisture, protein and lipid were higher in semi intensive cultured fishes than the waterlogged paddy fishes (Table 7).

The highest level of protein, ash and lipid were found in small indigenous fishes sampled form the waterlogged paddy lands. The highest level of ash (3.56%) was found in *Puntius sophore* (Jat Punti), protein (19.50%) in *Anabus testudinus* (Koi) and in *Lepidocephalus guntea* (Gutum) (3.49%). While the highest amount of moisture content (83.70%) was found in *Cyprinus carpio* which was in *Dogi* system to increase production. Percentage of ash for both systems was got similar values. The reasons of the low nutrient value of introduced fishes of *Dogi* were relatively high food competition due to reason of higher stocking density, low water depth and relatively unmanaged and instable habitat quality.

In conclusion it can be stated that, fishes of *Dogi* contain high amount of nutrient elements. So, Dogi fish culture may be used as a tool for sustainability of fish resources of an area, where natural fish can be conserved and the added culture fishes can be used for consumption as well as to support livelihood of the poor and fulfill the nutrient requirement. Importantly, poor people can benefit by two ways first one easily available of animal protein source of food and another these available fish food substitute over vegetable food sources which are unavailable during post-monsoon because of submergence of cropping areas.

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