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Comparative study of seasonal variation in proximate composition and nutritional quality of farmed and wild Indian butter catfish (*Ompok bimaculatus)* in Tripura India

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Abstract
In the present study the biochemical compositions of farm raised pabda (FP) and wild pabda (WP) caught from Gomti River of Tripura, India was analyzed to record their proximate compositions in terms of environmental and seasonal variations. Farm raised pabda (FP) and WP with similar length and weight were collected from College of Fisheries Tripura. The different biochemical, macro and micro mineral contents were examined monthly samples from July-2012 to February-2013. The parameters were recorded namely moisture, ash and protein content. The results showed that there was no significant differences ($p>0.05$) in FP and WP, except in lipid content which was higher in FP (6.73-7.32%) than in WP (5.35-7.26%). The seasonal variation in proximate composition was recorded as there was gradually increase in the protein and lipid content from the month July to February whereas the moisture content was decreased at same time. Similarly the mineral concentration showed the higher in WP compared to FP except Iron (Fe) content. Iron content significantly higher ($p<0.05$) in FP compared to WP. Seasonal change in mineral concentration result recorded slightly decreased trends from the month July to Feb. Both habitat pabda are rich source of Calcium, magnesium, potassium, sodium, and phosphorus. The above results indicates that the pabda is good source nutrients and it could be utilized for preparation of nutrient rich value added fish product.

Keywords: Comparative study, wild, seasonal vartion, nutritional and farm raised pabda

1. Introduction
Indian butter catfish or pabda is small catfish belonging to the family Siluridae with a maximum length recorded 45 cm [3]. Pabda has shown a high demand in the market for its excellent taste and flavor, pin-boneless muscle and traditional delicacies associated with the fish. It provides superior quality protein to that of meat, milk and eggs and well balanced essential amino acid profile, necessary minerals and fatty acids [9, 5]. In addition to that fish flesh is tasty and highly digestible. Over and above it minimizes the risk of heart diseases and increases life expectancy [6]. Farmed fish is provided with nutrient rich foods in addition to natural productivity in the pond. Wild fish on the other hand has to depend totally on natural food for its sustenance. These variations have direct bearing on body composition, health status and growth of fish [6].

It is well established fact that aquaculture offers potential advantages over capture fisheries in terms of meat quality because of different aspects that are controlled in captivity including genetic selection of superior strains, the control given over diet, culture environment, harvest procedures and the timing of delivery of product to market[16]. It may be possible to modify the appearance and flavor of cultured fish relative to their wild caught counterpart in order to improve the nutritional value and consumer acceptance of the product [10]. Cultured fish tend to have a softer texture and milder less robust flavour than wild fish, which has been linked to differences in muscle structure and proximate composition [17] as well as the composition of aromatic compounds that impart particular flavours [7]. Consumer appreciation of wild fish is influenced by geographical origin and unknown environmental and dietary factors [16, 10]. Contrastingly, the wild fish is solely dependent on the natural diet with unrestricted movement and genetic mingling resulting in the formation of comparatively harder muscle texture with unparallel taste and flavor. Many studies have found that consumers prefer wild caught to farmed fish because of their superior organoleptic qualities and firmer texture e.g. studies with

Chinook and Atlantic salmon [19], channel catfish [21], and gilthead sea bream [7] have shown such consumers' preference. Therefore, the primary objectives of these studies were to identify nutritional elements of differentiation, which characterize wild and farmed pabda and to develop knowledge to the consumer about the nutritional quality of pabda.

2. Materials and methods

2.1 Sample collection

The cultured pabda were collected from the fish farm of College of Fisheries, Lembucherra, Tripura, India and wild caught fish collected from the Gomti river of Tripura were used during the study period July 2012 to February 2013. These fish had an average length 16 cm and weight about 75 g and were cultured for a period of one year. In order to match the age group, the wild pabda of similar length and weight were collected from the Gomti River of, Tripura, India.

2.2 Analysis of Proximate Composition

The value of the proximate composition sample were determine by the standard method of [2] the sample were analyzed in triplicate.

2.3 Mineral analysis

Minerals analyses were determine by the acid insoluble ash using Atomic Absorption Spectrometer (AAS). Analysis of minerals Cu, Ca, Fe, Mg, Mn and Zn was carried out by the Atomic Absorption spectrophotometer [18] with analysist version.06, 2007, following the methods given by Parkin Elmer [18]. The analysis was done with the hollow cathode lamps (HCL) using acetylene as fuel. Na and K was determined by Flame Photometer 128 Systronics India.

Accurately 5-10 g sample was weighed in a porcelain crucible which was previously heated, cooled and weighed. The sample was dried in a hot air oven overnight at the temperature of 100 ± 5 ºC followed by drying the sample completely by heating over a burner. And then the sample was incinerated in a muffle furnace at a temperature of 550±500 ºC with adequate air supply for about 6-7h until it was completely white. The sample was taken out with the crucible and cooled in a desiccator to room temperature. The ash obtained from the sample was treated with about 25 ml HCl (1:1) in beaker with a watch glass and boiled in water bath for about ten minutes. After cooling, the boil extract was filtered through the ash less filter paper (Whatman filter paper No. 42) in a 100 ml volumetric flask which was washed several times with distilled water until the washings are free from any chlorides. Then, distilled water was added to make the volume up to the mark and mixed the solution properly. This solution was ready for the analysis of the minerals.

2.4 Statistical analysis

The results obtained were analyzed statistically by performing ANOVA and Duncun's tests where there were significant differences. All statistical analyses were performed using the Statistical Package IBM SPSS 21.0 version. Statistical significance is indicated with appropriate letters on the data tables. The results were presented as mean ± standard error (SE) and *P* value.

3. Results and Discussion

The seasonal variations in biochemical composition wild pabda and farmed pabda are prepresented in Tables 1, 2, and 3. The seasonal change in proximate compositions of wild and farmed pabda was assessed from the month of July 2012 to February 2013. The moisture content was found in the range of 74.07% to 76.48% in the wild and 74.06% to 76.26% in farmed pabda. The highest moisture content was observed during August whereas the lowest value was during February in both habitat fishes. Higher moisture content [20] also reported (80%) in fresh catfish like *Wallago attu* which belongs to the same family (Siluridae) of pabda. Maximum moisture content was found during the August, perhaps due to the spawning season of pabda during this period. In agreement to this, [14] observed the highest value of moisture in *Anabas testudinius* during May i.e. at spawning time of the fish in Bangladesh than any other time of the year. These findings are more or less similar to other related fishes [4]. From the month August to February there was a decreasing trend but in the month November and July, the moisture content was stable in the wild fish. However mean ambient temperature and humidity of different months did not show any significant effect on proximate composition of pabda during the study period. The low values of moisture during certain seasons have been observed in several other fishes by various authors and attributed to maturation of gonads [12].

The ash content was observed in the range 0.93%to1.25%in the wild pabda and 0.89% to 1.26% (Table 1) in farmed pabda. The minimum and maximum value was observed in the month July and February in wild fish, whereas in farmed fish it was found that the minimum and maximum value was in the month of November and February. Similar study also reported in *Rastrelliger kanagurta* [15].

Protein content was observed in the range of 16.13% - 17.68% with average 16.77%in the farmed pabda and 15.20% to 17.25% with the average 16.38% in wild pabda. The protein percent reached its maximum content was observed in the month of February in both fish cultured and wild fish. The protein content was stable observed during the month July and Octobers in wild pabda, whereas in the farmed pabda lowest value was observed during the month of November and July. The lowest protein content of these month in both fishes cultured and captured it may be due protein utilize for metabolic energy sources, present results are in accordance with the findings of [15] in *Rastrelliger kanagurta.*

The lipids content was found in the range 5.35% to 7.26%with the average 6.36% and 6.73% to 7.32% (Table1.) with average fat content of 7.06% in wild and culture pabda respectively, during the study period. The Lipids content gradually increased from the month July to the February. Cultured fish was found to have significantly higher lipids content than that of wild pabda, it may be due to the cultured fish fed with balanced dietary nutrients in the feed. The differences in season, depending on the availability of food at different time of the year, have a considerable effect on the tissue components particularly the fat [1]. Similar study also reported that fat content was also found increasing until December in horse mackerel and garfish, and a sudden decrease was observed in January[11].

Table 1: Seasonal change in proximate composition of fresh FP and WP

Month	Moisture		Ash		Protein		Lipid		Mean Ambient Temp (°C)
	FP	WP	FP	WP	FP	WP	FP	WP	
Jul. 2012	75.13^{ab} (0.04)	76.34^{d} (0.01)	1.11^{bc} (0.15)	0.93^{a} (0.02)	15.91^{b} (0.17)	16.13^{a} (0.25)	6.73^{a} (0.19)	6.32^{ab} (0.08)	28.3
Aug.	75.26^{c} (0.02)	76.48^{d} (0.25)	1.12^{bc} (0.03)	1.02^{ab} (0.03)	16.21^{bc} (0.02)	16.26^{a} (0.15)	6.83^{ab} (0.24)	6.30^{ab} (0.04)	28.7
Sep.	75.32^{c} (0.03)	75.69^{bc} (0.24)	0.99^{ab} (0.07)	0.97^{a} (0.02)	16.26^{bc} (0.08)	16.38^{a} (0.20)	7.05^{abc} (0.10)	6.93^{b} (0.96)	28.3
Oct.	75.12^{bc} (0.42)	75.88^{cd} (0.68)	0.90^{a} (0.02)	1.06^{ab} (0.09)	16.35^{cd} (0.07)	16.13^{a} (0.15)	7.17^{bc} (0.04)	5.44^{a} (0.04)	26.7
Nov.	76.26^{c} (0.19)	76.34^{d} (0.30)	0.89^{ab} (0.03)	1.03^{ab} (0.04)	15.2^{a} (0.10)	17.08^{b} (0.14)	7.03^{abc} (0.10)	5.35^{a} (0.06)	22.3
Dec.	74.6^{ab} (0.31)	74.82^{abc} (0.26)	1.14^{c} (0.02)	0.96^{a} (0.01)	16.68^{a} (0.29)	17.19^{b} (0.07)	7.32^{bc} (0.03)	6.39^{ab} (0.02)	16.3
Jan.2013	74.17^{a} (0.01)	75.04^{ab} (0.29)	1.12^{bc} (0.04)	1.22^{bc} (0.08)	17.19^{d} (0.05)	17.33^{bc} (0.06)	7.14^{bc} (0.03)	6.89^{b} (0.02)	15.6
Feb.	74. 06^{a} (0.03)	74.07^{a} (0.03)	1.26^{d} (0.01)	1.25^{c} (0.12)	17.25^{d} (0.04)	17.68^{c} (0.08)	7.21^{bc} (0.02)	7.26^{b} (0.12)	21
Mean	74.99	75.58	1.07	1.06	16.38	16.77	7.06	6.36	23.40

Mean and temperature value of respective month is given in parentheses [values are Mean (S.E.), n=3] mean values bearing different superscripts in small letters (a, b, c etc) in the rows are significantly different (p<0.05) with respect to sampling.

Table 2: Seasonal change in macro elements concentration in fresh FP and WP (mg/100g)

Month	Sodium (Na)		Magnesium (Mg)		Calcium (Ca)		Phosphorus (P)		Potassium (K)	
	FP	WP	FP	WP	FP	WP	FP	WP	FP	WP
Jul	107.43^{c} (0.23)	110.60^{e} (0.40)	107.01^{c} (0.70)	110.88^{e} (1.76)	24.84^{c} (0.69)	26.00c (0.22)	480.89^{a} (0.67)	490.65^{c} (0.14)	120.40^{b} (1.20)	124.89^{c} (0.33)
Aug	107.8^{c} (0.4)	109.80^{c} (0.26)	108.80^{d} (0.35)	109.17^{ab} (0.03)	23.81^{bc} (0.32)	25.50^{c} (0.67)	482.26^{a} (1.53)	489.60^{c} (0.31)	120.44^{b} (0.34)	121.49^{b} (0.92)
Sep	105.46^{b} (0.31)	109.33^{ab} (0.34)	107.43^{cd} (0.33)	108.10^{c} (0.58)	23.13^{abcd} (1.00)	24.38^{b} (0.23)	478.94^{a} (0.35	485.28^{b} (0.04)	119.55^{ab} (0.27)	119.60^{ab} (0.24)
Oct	104.76^{b} (0.34)	108.83^{c} (0.06)	107.56^{cd} (0.30	107.56^{cd} 0.30	22.12^{ab} (0.00)	24.13^{ab} (0.01)	479.42^{a} (0.06)	483.36^{ab} (2.00)	117.78^{a} (0.39	120.92^{b} (0.74)
Nov	100.13^{a} (0.03)	105.10^{a} (0.30)	104.74^{b} (0.69)	105.48^{b} (0.69)	23.44^{b} (0.33)	23.44^{ab} (0.33)	462.03^{a} (0.33)	484.32^{b} (0.98)	117.88^{a} (0.73)	118.53^{a} (0.69)
Dec	99.96^{a} (0.43)	100.67^{a} (0.27)	105.24^{b} (0.08)	105.24^{b} (0.08)	23.10^{abcd} (0.00)	23.15^{a} (0.00)	460.28^{a} (0.55)	481.27^{a} 0.61)	118.2^{a} (0.57)	119.32^{ab} (1.03)
Jan	98.90^{a} (0.75)	100.51^{a} (0.18)	100.59^{a} (0.33)	100.21^{a} (0.09)	21.44^{a} (0.67)	23.11^{a} (0.01)	471.91^{a} (1.72)	485.57^{b} (0.39)	118.87^{ab} (0.33)	119.87^{ab} (0.42)
Feb	99.53^{a} (0.66)	100.27^{a} (0.07)	100.61^{a} (0.33)	100.86^{a} (0.37)	22.77^{ab} (0.32)	23.44^{ab} (0.34)	475.22^{a} (0.10)	485.30^{b} (0.05)	119.39^{ab} (0.22)	119.57^{ab} (0.39)
Average	103.00	105.64	105.24	105.94	23.08	24.13	473.87	485.67	119.06	120.52
Std. Dev.	3.63	4.37	3.07	3.78	1.25	1.14	12.45	3.19	1.32	2.12

Mean value of respective month is given in parentheses [values are Mean (S.E.), n=3] mean values bearing different superscripts in small letters (a, b, c etc) in the rows are significantly different (p<0.05) with respect to sampling.

Table 3: Seasonal change in macro elements concentration fresh FP and WP

Month	Iron (Fe)		Cupper (Cu)		Manganese (Mn)		Zinc (Zn)	
	FP	WP	FP	WP	FP	WP	FP	WP
Jul	1.62^{c} (0.04)	0.83^{bc} (0.04)	0.81^{b} (0.10)	0.54^{aa} (0.02)	0.12^{a} (0.00)	0.17^{a} (0.01)	0.87^{bc} (0.04)	0.78^{c} (0.04)
Aug	1.49^{b} (0.02)	0.96^{d} (0.00)	0.62^{a} (0.01)	0.59^{d} (0.00)	0.13^{a} (0.00)	0.14^{a} (0.00)	0.96^{d} (0.00)	0.74^{bc} (0.01)
Sep	1.48^{b} (0.00)	0.96^{d} (0.00)	0.63^{a} (0.00)	0.57^{cd} (0.00)	0.13^{a} (0.00)	0.16a (0.00)	0.96^{d} (0.00)	0.73^{bc} (0.01)
Oct	1.49^{b} (0.00)	0.93^{d} (0.02)	0.53^{a} (0.01)	0.54^{abc} (0.01)	0.12^{a} (0.01)	0.16^{a} (0.01)	0.93^{d} (0.02)	0.77^{bc} (0.00)
Nov	1.41^{ab} (0.02)	0.87^{c} (0.01)	0.52^{a} (0.00)	0.53^{bc} (0.00)	0.13^{a} (0.00)	0.15^{a} (0.00)	0.87^{c} (0.00)	0.62^{abc} (0.00)
Dec	1.42^{ab} (0.00)	0.82^{b} (0.00)	0.53^{a} (0.00)	0.55^{bc} (0.02)	0.12^{a} (0.00)	0.15^{a} (0.01)	0.82^{b} (0.00)	0.68^{abc} (0.07)
Jan	1.39^{a} (0.02)	0.72^{a} (0.00)	0.53^{a} (0.01)	0.51^{a} (0.01)	0.12^{a} (0.01)	0.18^{a} (0.01)	0.72^{a} (0.00)	0.59^{ab} (0.03)
Feb	1.46^{ab} (0.02)	0.71a (0.01)	0.52^{a} (0.01)	0.53^{ab} (0.01)	0.12^{a} (0.00)	0.17^{a} (0.00)	0.71^{a} (0.00)	0.51^{a} (0.11)
Average	1.74	0.85	0.54	0.54	0.16	0.16	0.67	0.67
Std. Dev.	0.10	0.10	0.02	0.02	0.01	0..01	0.11	.11

Mean value of respective month is given in parentheses [values are Mean (S.E.), n=3] mean values bearing different superscripts in small letters (a, b, c etc) in the rows are significantly different (p<0.05) with respect to sampling.

The seasonal changes in Macro minerals concentration (Na, Mg, Ca, P, and K) the range was observed Na 98.90-107.80, Mg 100.27-110.60, Ca 22.12-24.84, P 460.28-482.26 and K117.78-120.40 respectively(Table,2). Whereas in case of wild it was observed Na 100.27-110.60, Mg 100.21-110.88,Ca 26.00-23.11,P485.30 490.65and K118.53-124.89, during the study periods. The range of Macro minerals was higher in wild fish in compared to cultured fish. The results of micro minerals concentration showed. The Micro minerals concentration was observed in the range Fe 1.36-1.71 Cu 0.5-0.92, Mn 0.11-0.14 and Zn, 0.70-0.97 in case of farmed pabda where as in case of wild pabda it was observed Fe 0.70-0.72, Cu 0.51-0.54, Mn 0.17-.18 and Zn 0.38-0.87. All the microminrals concentration was higher in case wild pabda except Iron (Fe) content iron content was higher in wild in compared to farm pabda.

Similar study reported the values of major elements of Indian fishes remains in the order of in the decreasing order of P> K>Na>Mg>Ca in most fishes [6]. Present study also supports this order of abundance in pabda. Their abundant presence may be due to the facts that the body needs these macro elements in more amounts than the micro elements in the structure and function of the body [8]. In fish, calcium and phosphorus together accounts for 60-70% of the minerals in the skeleton. Apart from being a constituent of the skeleton, phosphorous has many roles in fish. It is present inadosine polyphosphates; the key substances for energy release and also in phospholipids [13]. Calcium, magnesium, potassium, sodium, and phosphorus are abundant in pabda which shows this fish is good source of mineral elements.

4. Conclusions

The results suggest that the proximate composition of fish species varies during different season. This might be due to physiological reasons and changes in environmental conditions such as spawning, migration, and starvation or heavy feeding. However, both habitat fish samples can be considered as good sources of micro and macro minerals contents. Therefore, it is recommended to consume Indian butter cat regularly as it could provide most of minerals and essential fatty acid needed by human body. This study showed information on variations in proximate composition of fish species studied in order to develop the product using the pabda as raw material.

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