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Temporal changes in body composition of striped catfish (*Pangasius hypophthalmus*, Sauvage, 1878) during starvation

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Abstract
The present study was conducted to investigate the changes in body composition of Thai pangas (*Pangasius hypophthalmus*) during food deprivation at Fish Physiology and Fish Nutrition Lab of Khulna University, Khulna from 10 November to 7 December, 2007. Fish were starved for a 27 days in10 glass tanks (50cm×30cm×30 cm) at 3 individual per tank. At the initial stage (1st day) of the experiment, the water, protein, lipid and ash contents were 76.88±1.13%, 20.5±0.23%, 1.4±0.02% and 1.20±0.05%, respectively whereas at the 27th day water, protein, lipid, and ash contents were 78.35±0.42%, 19.40±0.25%, 0.80±0.02% and 1.42±0.02%, respectively. The results revealed that lipid and protein concentration of muscle was decreased with prolongation of deprivation, with a significant decline of lipid concentration recorded after 6 days of deprivation ($P \leq .05$). On the other hand, water and ash concentration was increased during deprivation without any significant variation.

Keywords: *Pangasius hypophthalmus,* starvation, body composition, temporal change.

1. Introduction
The studies on fish starvation are important in order to understand of the growth biology of fish in wild state [1]. Some of the fish species are subjected to a natural starvation period during part of the year and have developed an ability to survive without food [2]. In these species which have been studied the strategy to adapt to dietary deprivation varies considerably. Fish use energy generated from the catabolism of body reserves to maintain routine metabolism when deprived of food, either partially or completely [3, 4, 5, 6]; and the oxygen consumption rate reduced tends to conserve body energy reserves [5, 7, 8, 9]. The deprived fish lose body mass and body energy reserves with the prolongation of food deprivation [4, 10]. Some of the fish species use muscle protein as a major energy source rather than stored glycogen which is maintained by gluconeogenesis [11], but other conserve body protein at the expense of their fat and glycogen stores [12, 13]. The body composition of fish is influenced by a number of factors such as morphological, physiological and environmental and consequently there is a good indicator of condition, which is often assessed from a measure of the deviation of the mass of an individual fish species from average mass for length of population [14].
During starvation period the essential processes are maintained at the expense of accumulated energy reserve which is results in the progressive depletion of body tissue [2]. The starvation also indicated in tissue hydration [4, 15, 16]. This plays a role in the limitation of the loss or even the maintenance of wet body weight during starvation period [2]. The finding of starvation indicates the significant decrease in lipid contents of the carcass and viscera. Resulting depletion of liver lipid stores, lipid contained in perivisceral adipose tissue is utilized along with apaxial muscle glycogen. Lipid is stored in the liver, viscera, and muscles in the fish and it is broken down early in starvation, and often constitutes the main energy source for maintenance during over wintering starvation. The depletion of lipid during starvation has been demonstrated in rainbow trout [17]. The metabolic rate of fishes might be decrease during food restriction period [4] and the expenditure of energy during starvation of fish can be reduced by decreased locomotion activity [18]. The effects of food deprivation on body composition in a wide range of fish species have been studied; however the knowledge of the time sequence of changes during food deprivation is still inadequate. Striped catfish or Thai pangas (*Pangasius hypophthalmus*) is a warm-water omnivorous species, with a partial

capacity for compensatory growth. However, there is a lack of information on body composition during food deprivation. Based on the current context, the present study was undertaken to evaluate the temporal changes in body composition of Thai pangas during food deprivation.

2. Materials and Methods

2.1 Sample collection

The experiment was carried out at Fish physiology and Fish Nutrition Lab of Fisheries and Marine Resources Technology Discipline of Khulna University, Khulna from 10 November to 7 December, 2007. Thai pangas used for the experiment were collected from Khulna University Lake and were transported live in plastic drum and were maintained in glass stock tanks prior to experimentation. Fish were brought to the Laboratory and acclimatized in the experimental 10 glass tanks (50cm×30cm×30cm) at the rate of 3 fish per tank. Mean temperature of the aquaria was (25±1 °C). All other parameters of water quality like dissolved oxygen (D.O) and pH were kept constant throughout the study. In the experiment, Thai pangas (48.00±2.52 g) were deprived of food for 27 days, during which proximate composition in muscle of the fish was monitored at 3 days intervals. For measurement of body composition during food deprivation, fish were randomly sampled on days 0, 3, 6, 9, 12, 15, 18, 21, 24 and 27, respectively.

2.2 Sample Preparation

Sample was taken randomly on each experiment day for the determination of proximate composition. After collection, the sample was washed thoroughly with the fresh tap water and kept in a slanting position in a tray to remove the water. A considerable amount of sample was taken for analysis. The sample (muscle) was taken from a site near the dorsal fin. For the proximate composition, each experiment was conducted with three replications. Crude protein (Kjeldahl method), lipid concentration and water content in muscle of fish were determined according to AOAC procedures [19]. Data from the experiment were entered into software package, (MS Excel (Microsoft Corporation) and Statistical Package for Social Science, SPSS (SPSS, Chicago, IL, USA) for statistical analysis. A probability of less than 5% ($P < 0.05$) was considered as significant in all instances.

3. Results and Discussion

The proximate body composition including protein, lipid, ash and moisture of Thai pangas during deprivations are shown in Table 1. The results indicated that the concentrations of lipid and protein in muscle of fish body decreased, while water and ash concentration were increased. Water content was inversely correlated to either lipid concentration ($r = -0.784$, $n= 30$, $P < 0.01$) or protein concentration ($r = -0.995$, $n = 30$, $P < 0.01$).

Table 1: Effect of starvation on proximal body composition (% wet weight) of Thai pangas

Starvation period (days)	Body composition parameter (%)			
	Protein content (mean±SD)	Lipid content (mean±SD)	Ash content (mean±SD)	Moisture content (mean±SD)
0	20.5±0.23	1.4±0.02	1.20±0.05	76.88±1.13
3	20.10±0.15	1.1±0.04	1.25±0.02	77.54±0.92
6	19.85±0.30	0.93±0.01	1.30±0.01	77.89±0.30
9	20.00±0.22	0.97±0.02	1.28±0.03	77.73±0.45
12	20.20±.0.35	0.95±0.02	1.30±0.03	77.55±0.65
15	20.00±0.31	0.93±0.01	1.32±0.02	77.73±0.14
18	19.95±0.10	0.90±0.02	1.35±0.01	77.79±0.32
21	19.75±0.26	0.87±0.01	1.35±0.02	78.00±0.26
24	19.50±0.34	0.85±0.01	1.40±0.01	78.22±0.52
27	19.40±0.25	0.80±0.02	1.42±0.02	78.35±0.42

3.1 Protein content

The protein concentration in the body of Thai pangas changed from 20.5±0.23 to 19.40±0.25 from the first date to last date of experiment (Table 1 and Fig. 1). There was no significant difference ($P \geq 0.05$) found in the changes of protein concentration. Among the experiment period drastic changes in protein content was found with 12-24 days, where it varies from 20.20±.0.35% to 19.50±0.34% afterwards it decrease gradually with the prolongation of starvation. A gradual decrease in protein content (% wet weight) which is largely due to inverse relationship of protein with water in starving fish is well documented [14]. A similar trend was observed in grass carp in which no change in protein contents (% dry weight) was found [1]. This is in confirmation with the results that the effect of food deprivation on the use of reserved protein, lipid or glycogen as a metabolic fuel seems to be species-specific [10, 13].

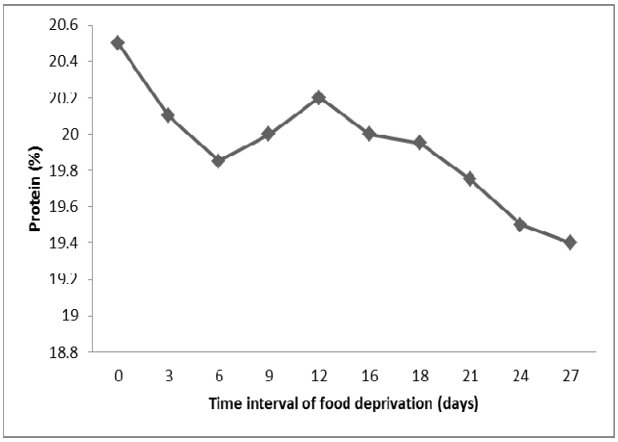

Fig 1: Protein content (% wet weight) in the muscle of Thai pangas during 27-day food deprivation.

3.2 Lipid content

Lipid content of the starved fish varies significantly during deprivation with the initial stage (P≤0.05). The Lipid content changes from 1.4±0.02% to 0.80±0.02% from the first date to last date of experiment (Table 1 and Fig. 2). Among the experiment period drastic changes in lipid content was found within 0-6 days, where it varies from 1.4±0.02% to 0.93±0.01% afterwards it decrease gradually with the prolongation of starvation. So it is clear that lipids are the most important energy provider for Thai pangas during the first week of food deprivation. Similar findings are reported by Wieser *et al*. [18] on juveniles of *Lueciscus cephalus, Chalcolburnus chalcoides mento, Scardinius erythropthalmus* and Ali *et al.* [1] for *Ctenopharyngodon idella*. Many investigators found that the first effect of starvation is the mobilization of lipids for example *Cyprinus carpio* [20], *Micropterus salmoides* [21] and *Anguilla anguilla* [3].

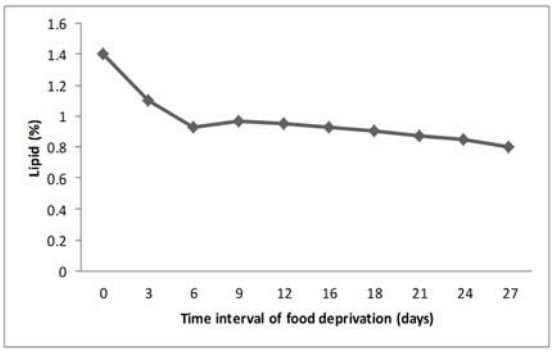

Fig 2: Lipid content (% wet weight) in the muscle of Thai pangas during 27-day food deprivation

3.3 Water content

Water content of the starved fish during the experimental period were increased gradually but not differ significantly (P≥0.05).The water content were changed from 76.88±1.13% to 78.35±0.42% from the first date to last date of experiment (Table 1 and Fig.3). The results indicated a trend of increase in water contents with increase in number of days of starvation. Among the experiments period main changes in water content was found with 12-27 days, where it was varied from 77.55±0.65% to 78.35±0.42%. An inverse relationship between body lipid and water content occurs due to the replacement of catabolized lipid by an equal volume of water. A similar trend reported by Denton and Yousef [22]; Love [2] and they mentioned that body weight is maintained by water uptake to compensate for organic matter losses during starvation. Numerous studies have been demonstrated a rise in water content in several fish species during starvation [3, 4, 15] and similar trends were found in the present study. The amount of water is inversely related with the quantity of lipid in the muscle of fish body and it was found that maximum quantity of water was present in starved fish. A similar trend was documented for *Esox lucius* (*L*.), *Cirrhinus mrigala* and *Ctenopharyngodon idella* [1, 14].

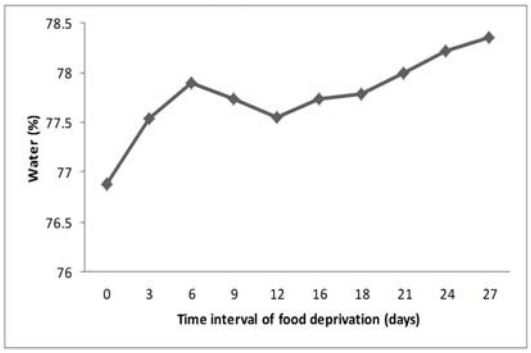

Fig 3: Water content (% wet weight) in the muscle of Thai pangas during 27-day food deprivation

3.4 Ash Content

A gradual increase in ash content was observed till 27 days of starvation, it was changed from 1.20±0.05% to 1.42±0.02% during the experimental period (Table 1 and Fig.4). Ash content remained constant 18-21 days. A well-marked increase was observed between 0-6 and 21-27 days of starvation which was 1.20±0.05% to 1.30±0.01% and 1.35±0.02% to 1.42±0.02% gradually. A gradual increase in ash contents was observed during starvation in the present study which was similar for grass carp [1]. There was no significant change in ash contents was found in the present study which was also similar to the response of other species [1]. Herrera and Munoz [23] and Phillips and Livingstone [24] reported that total ash content increased during starvation period for *Sardina pilchardus and Salvelinus fontinalis*, respectively which was conformity of the present study results. Although fatty and non-fatty fish have different distribution of reserve lipid, both respond to starvation in a similar way in that much of the lipid, whether in liver or muscle drawn upon before the protein is utilized, any reserve of carbohydrate are used first of all [2]. So it is concluded that, Thai pangas utilize lipids as a major energy source during the first week of deprivation and it is further concluded that fish body tried its best through physiological and biological means to buffer the effect of starvation on its body composition. This biochemical strategy to maintain body composition during periods of starvation may be an adaptation to seasonal periods of fasting that many fish experience as part of their natural life cycle [15].

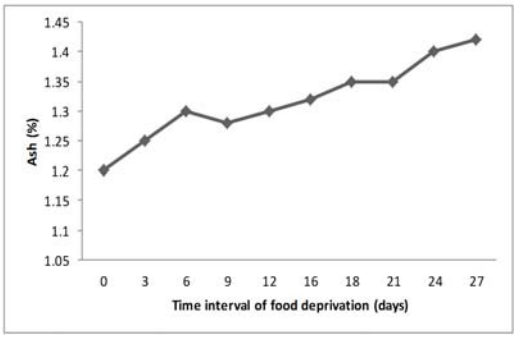

Fig 4: Ash content (% wet weight) in the muscle of Thai pangas during 27-day food deprivation

4. Conclusion

The study assessed the body composition response with relation to stress induced by different food deprivation regimes. The present study results revealed that water and ash concentration was increased while lipid and protein concentration was decreased with the prolongation of starvation. The results also indicated that Thai pangas utilize body lipid as a major energy source during the first week of food deprivation, and turn to utilize body proteins as an alternative energy source when maximum body lipids are exhausted. However, possible attempt has been made to throw some light on the study of this species. Finally it can be concluded that the findings of the present study could be helpful to create greater interest among the fisheries scientist of the country for intensive research on culture and proper management of Thai pangas.

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