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Impact of feed starvation on Bio-indices in *Anabas testudineus* fingerling under laboratory condition

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Abstract
The present experiment was conducted to study the impact of feed starvation in bioindices of *Anabas testudineus* fingerling for a period of 15th weeks from the 4th December, 2016 to 18th March, 2017. Bioindices such as Condition factor (K), Hepatosomatic index (HSI) and Gastrosomatic index (GaSI) of fish in different treatments were recorded. The Condition factor (K) of fish in different treatments fluctuated from a minimum of1.063 (D4) to maximum of 1.33 (D2). The HSI of fish in different treatments varied from a minimum of 1.125(D4) to maximum of 1.618(control). The GaSI of fish in different treatments ranged from a minimum of 3.07 (D4) to maximum of 3.48(control) during the experimental period. There was no significant difference (P<0.05) in Condition factor of fish among the different treatments. In case of GaSI there was no significant difference (P<0.05) between the treatments and control. But in case of HSI there was significant difference (P<0.05) in D1, D3 and D4 respectively. The present study concluded that the well being status of fish was not affected.

Keywords: Feed starvation, *Anabas testudineus* fingerling, Condition factor (K), Hepatosomatic index (HSI) and Gastrosomatic index (GaSI)

Introduction
The success of commercial aquaculture depends on the availability of suitable diets that are efficiently digested and provide the required nutrients for optimum growth [1]. Knowledge on feeding rate and protein requirement is necessary to select appropriate feed quantity for a particular age group [15]. One potential way of reducing feed cost is to take advantage of the phenomenon of compensatory growth (CG). It offers the possibility of improving the growth rates of fish by a careful choice of feeding protocol in which periods of feed deprivation are followed by periods of satiation feeding [16]. If compensatory growth (CG) can completely make up for growth lost during starvation, there could be an opportunity to save on fish feed by starving the fish and making up for lost growth when feeding resumes. It is very well known fact that knowledge on fish biology Condition factor (K), Hepatosomatic index (HSI) and Gastrosomatic index (GaSI) of fish is of upmost importance in increasing the technological management [20]. The condition factor (K) provides information on the physiological state of the animals, based on the assumption that individuals of a given body length are in better condition when their mass is greater [6]. The inspection of the seasonal variation of the condition factor (k) is also being used as a complementary parameter aiming to describe natural cycles in reproduction and feeding ecology [14]. Hepatosomatic index (HSI) has been often used as indicator of energy status in relation to gonadal development and growth of fish [13]. Climbing perch Koi (*Anabas testudineus*) is one of the popular aquaculture species among small indigenous fishes. The fish is significant in term of heritage and culture of both rural and urban parts of the most part of the India. *Anabas testudineus* fetches a high market price and is a highly preferred fish in international and domestic market due to its high nutrition, good taste and flavor, good growth and its ability to withstand unfavorable environmental condition in its habitat both natural water and culture ponds (3). Knowledge on these indices patterns provides an important baseline to understand the base of species biology and their dietary needs. Earlier studies [2, 11, 17] on this species mainly focused on normal feeding habits but details study on starvation condition is rare. In this context, the present study was conducted to observe the bio-indices of climbing perch under starvation condition.

2. Materials and Methods

2.1 Preparation of experimental aquaria

The experiment was carried out in 15 glass aquaria (60 x 30 x 30 cm3) and each aquarium on an average twelve number of fingerlings was kept. The aquaria were cleaned thoroughly using scrub and then dried for a week. They were filled with good quality tap water up to a depth of 20 cm.

2.2 Proximate Composition of formulated diet

Proximate composition such as moisture, crude protein, crude fat and total ash of formulated diet were analyzed immediately after preparation. The proportion of different ingredients used for preparation of formulated diet is presented in Table 1.

Table 1: Proportion of ingredients used in formulated diet

Ingredients	Formulated diet (gm)
Fish meal	400
Ground nut oil cake	400
Wheat flour	20
Rice polish	150
Vitamin-mineral mixture	10
Soya bean oil	20ml

2.3 Feeding protocol

Fishes of four treatments (Starvation) were feed under deprivation protocol and were designed as D1, D2 and D3 and D4 respectively. Here fishes were starved for one day, two days and three days and four days respectively in each week towards end and then fed at the rate of 5 percent body weight for rest of days of the week. Thus the corresponding feeding cycles were (One day starvation + 6 days feeding), (2 days starvation + 5 days feeding) and (3 days starvation + 4 days feeding) and (4 days starvation + 3 days feeding) for treatments D1, D2 and D3 and D4 respectively. This experiment continued for the period of 105 days and terminated on 106th day. Water quality parameters such as temperature pH, alkalinity, hardness and dissolved oxygen contents of such aquarium were monitored at weekly intervals following standard methods [7].

2.4 Biological indices

Condition factor (K): Total fish weight (g)/Length3 (cm) X100 [8].

2.4.1 Gastrosomatic index (GSI): Weight of the gut and its content (g)/Total fish weight (g) X100 [10].

2.4.2 Hepatosomatic index (HSI): Weight of the liver (g)/Total fish weight (g) X 100 [21].

2.5 Statistical analysis: Mean values of bioindices were tested for significance using t-test.

3. Results and Discussions

Bioindices or organic indices such as Condition factor (K), Hepatosomatic index (HSI) and Gastrosomatic index (GaSI) of fish in different traetments were recorded during termination of the experiment. Such values were presented in Table. 2 as well as in Fig: 1, Fig: 2 and Fig: 3 respectively.

Table 2: Bioindices of fish in different treatments

Treatments	CF (K)	HSI	GaSI
C	1.23±0.12	1.618±0.14	3.48±0.23
D1	1.27±0.10	1.464±0.12	3.44±0.25
D2	1.33±0.14	1.477±0.11	3.36±0.29
D3	1.067±0.16	1.266±0.13	3.11±0.33
D4	1.063±0.18	1.125±0.14	3.07±0.33

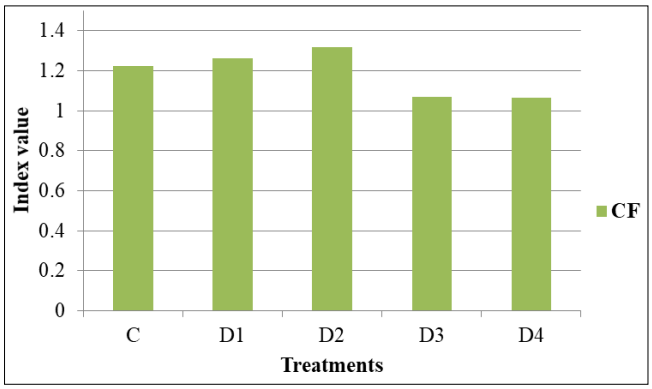

Fig 1: Condition factor in feed deprivation protocol

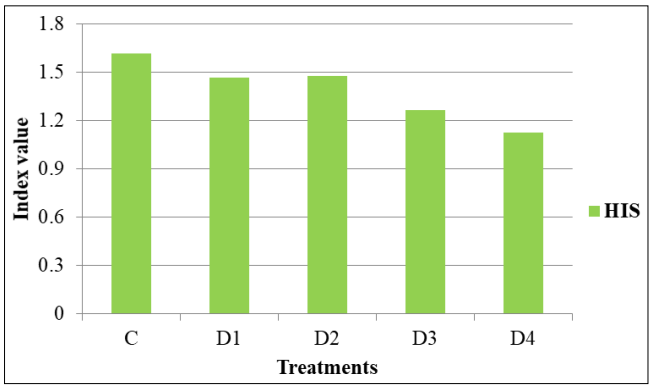

Fig 2: Hepatosomatic index in feed deprivation protocol

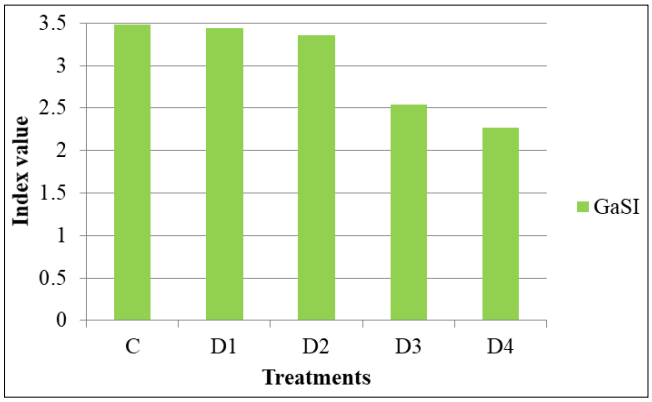

Fig 3: Gastrosomatic index in feed deprivation protocol

The Condition factor K of fish in different treatments fluctuated from a minimum of 1.063 (D4) to maximum of 1.33 (D2) during the period of investigation. Intermediate value of 1.067, 1.23, and 1.27 were recorded in the treatment D3, control, and D1. There was no significant difference in condition factor of fish among the different treatments during the experiment. The HSI of fish in different treatments varied

from a minimum of 1.125(D4) to maximum of 1.618(control) during the period of observation. Intermediate value of 1.266, 1.464 and 1.477 were found in the treatment of D3, D1 and D2 There was significant difference ($P< 0.05$) between in HSI of fish between control and D3 as well as D4. The GaSI of fish in different treatments ranged from a minimum of 3.07 (D4) to maximum of 3.48(control) during the experimental period. The intermediate value of 3.11, 3.36 and 3.44 were observed in the treatment D3, D2, D1. There was no significant difference in GaSI of fish among different treatments. There was no significant difference in CF of fish among the different treatments. It indicate that the well being status of fish was not affected. In case of HSI there was significant difference in D1 ($P<0.05$), D3, ($P<0.05$) and D4 ($P<0.05$) It might be due to starvation which induced reduction in organo somatic indices including HIS due to the mobilization of deposited fat as an energy source and adaptation to low metabolic rate [5, 9, 18]. In case of GaSI there was no significant difference between the treatments and control. Mobilization of body tissues has been observed under conditions of nutrient restrictions.

The pattern of tissue mobilization and recovery after resumption of feeding differs between species [19]. Reported a complete catch up occurred in body mass and structure. There was also replenishment in distorted organ indices and body compositions, except protein which was still less in RP15 (15% dietary protein) C45 (45 % dietary protein) in rainbow trout, *Oncorhynchus mykiss* [22]. Found that the body indices like Condition factor, HIS and GaSI were not afftected by periodic starvation (one day, two days and three days in a week). It was suggested that the protection of body condition had a higher priority than the protection of growth rates as food availability declined [4].

4. Conclusion

Bio indices in these two treatments D1 and D2 exhibited similarity with the control. However there was significant difference bio indices in the fish of treatment D3 and D4 compared to control in treatments indicating lack of full compensation in growth. It indicated that feed restriction of treatment D1 and D2 can compensate the growth and thus reduce the feed consumption considerably. Such cost effective feed strategy can be tested in field condition for profitable aqua farming.

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