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Effect of ginger (*Zingiber officinale* Roscoe) incorporated diet on growth performance of striped catfish, *Pangasianodon hypophthalmus* (Sauvage, 1878)

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Abstract
The study was aimed at determining the effects of ginger (*Zingiber officinale* Roscoe*)* as an immunostimulants on striped catfish, *Pangasianodon hypophthalmus*. Experimental diets containing ginger powder at 5, 10, 15, 20 g/kg of feed were fed to the juveniles of striped catfish and the control group was fed without incorporating ginger powder in the diet. The feeding experiment was conducted for a period of 90 days. The fishes were fed @ 5% of their body weight twice a day. Growth parameters such as weight gain, SGR, FCR and percentage survival were determined. A significant difference ($P<$ 0.05) in SGR, weight gain and FCR was observed between the treatments. Results of the study demonstrated better growth performance of striped catfish with inclusion of ginger powder at 10g/kg of feed as compared to other treatments.

Keywords: Striped catfish, ginger, growth, SGR, FCR

1. Introduction
Pangasianodon hypophthalmus is one of the popular species for cage and pond culture activities in the Asian continent for higher density rearing. Intensification of culture practices often leads to disease outbreaks and thus posing a serious threat to aquaculture industry. The use of immunostimulants in aqua-feed is considered as a modern and promising alternative to antibiotics and vaccines in intensive aquaculture. Immunostimulants have an ability to increase resistance to microbial infections and stressors like handling, transportation, grading and poor water quality in cultivated fish [1]. The effects of a number of immunostimulants such as levamisole [2], glucans [3], chitins [4], vitamin C, lactoferin [5] as well as various products derived from medicinal plants have been studied indicating their ability to preventing diseases in a variety of fish species. It is well known that these agents facilitate the function of phagocytic cells [6], increase their bactericidal activities [6] and stimulate the natural killer cells and lysozyme activity [5, 7]. These agents enhance resistance to infectious diseases by increasing the non-specific and specific defence mechanisms in fishes and shellfishes [8]. Plant derived immunostimulants have shown to be very effective alternatives to antibiotics, chemicals or synthetic compounds and vaccines. In the present study, ginger (*Zingiber officinale* Roscoe) in powdered form was incorporated in the diet of juvenile fishes of striped catfish. Ginger is considered to have broad-spectrum prophylactic and therapeutic functions [11]. It is effective for the control of a range of pathogenic bacteria [12], as a deworming substance [13], anti-inflammatory and anti-oxidative substance [14-16]. In addition, ginger is effective as an immunomodulatory agent in animals and fishes, and helps to reduce the losses caused by disease in aquaculture [17-20]. The present study was carried out to examine the effect of powdered ginger on growth performance of striped catfish, considering a scantily available literature on the fish using immunostimulants in the diets.

2. Material and Methods
2.1 Experimental Fishes
The juveniles of striped catfish with a weight range from 6.4 to 6.7 g were procured from local aquarium fish supplier. The fishes were acclimatized under laboratory conditions for a period

of seven days. During acclimatization, fish were fed with basal diet containing 32% crude protein twice a day.

2.2Preparation of the experimental diet

A total of five experimental diets with a crude protein content of 32% were formulated using locally available feed ingredients such as fish meal, soya flour, groundnut oil cake, wheat flour, rice bran, tapioca, fish oil etc. The composition of the ingredients is given in the Table 1. The above ingredients were mixed with water to make dough and cooked in pressure cooker. The cooked dough was then cooled to room temperature and after cooling, a required quantity of 5 (F1), 10 (F2), 15 (F3) and 20 (F4) g/kg ginger powder was added and mixed thoroughly. The dough was extruded through hand pelletizer having 2 mm diameter. Extruded pellets were dried in sunlight till the moisture level reduced to less than 10% and later used in the experimental trials. A control (F0) was run simultaneously without incorporating ginger.

2.3 Proximate composition

The proximate composition of the feeds was analysed by following standard methods [21].

$$\text{Moisture \%} = \frac{\text{Initial weight of sample} - \text{Final weight of sample}}{\text{Initial weight of sample}} \times 100$$

$$\text{Crude Protein (\%)} = \text{Nitrogen content} \times 6.25$$

$$\text{Crude fat \%} = \frac{\text{Weight of fat}}{\text{Weight of the sample}} \times 100$$

$$\text{Crude fiber \%} = \frac{\text{Weight of crucible with sample} - \text{weight of crucible after ashing}}{\text{Sample weight}} \times 100$$

$$\text{Ash \%} = \frac{\text{Weight of ash}}{\text{Weight of the dried sample}} \times 100$$

2.4 Experimental design

The experiment was conducted for a period of 90 days in wet laboratory of the Department of Aquaculture, College of Fisheries, Ratnagiri. The setup consisted of 20 fibre glass tanks with 400 L capacity with 50 fishes in each tank. The experiment consisted of five treatments and four replicates following a completely randomized design (CRD). Aeration was provided in each experimental unit. Experimental tanks were daily cleaned by siphoning the water along with faecal matter and left over feed. Water exchange of up to 15¯20% was carried out daily. Feed was given @ 5% of body weight twice a day at 0900 and 1700 hrs. Water quality parameters were observed at periodic intervals. Samplings were done at monthly interval to assess fish growth.

2.5 Growth parameters

The growth parameters such as weight gain (%), specific growth rate (SGR) (%), feed conversion ratio (FCR) and survival rate (%) were determined according to following formulae.

$$\text{Weight gain (\%)} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100$$

$$\text{SGR \%} = \frac{\text{Log e (Final weight)} - \text{Log e (Initial weight)}}{\text{Number of days}} \times 100$$

$$\text{FCR} = \frac{\text{Total feed consumed by fish (g)}}{\text{Total weight gain by fish (g)}}$$

2.6 Statistical analysis

The values of fish weight gain in percentage were expressed as mean ± SE. Growth performance as weight gain, SGR and FCR were tested by one-way ANOVA using software program SAS 9.3.

3. Results and discussion

Results of the experiment are shown in Table 1. The fishes were grown from initial size range of 4.8 – 5.1 g to 18.43 – 22.98 g within the experimental duration of 90 days. No mortality was observed in the fishes showing 100% survival in all the treatments showing hardy nature of fishes in captive conditions. The growth trend showed an increased response up to 10 g/kg incorporated ginger diet and then it showed a declined trend. ANOVA showed a significant difference (P<0.05) between the treatments. The highest weight gain (352.20 ± 4.5) and specific growth rate (4.15 ± 0.02) were observed in the treatment F2, whereas the lowest weight gain (279.21 ± 4) and SGR (3.81 ± 0.02) were observed in the control group. The growth response shown by fish groups with dietary inclusion of ginger at 5 g, 15g and 20g/kg did not show significant difference among them. The results of this study are comparable with the findings of Nya and Austin, EI-Desouky [17, 22] who recorded higher weight gain after feeding rainbow trout and *Macrobrachium rosenbergii* respectively with ginger diet @ 10 g/kg of feed. Talpur and Ikhwanuddin [23, 24] also reported significantly higher growth rate after feeding ginger @ 10g/kg of feed to rainbow trouts. The increase in weight gain might be attributable to presence of alkaloids, flavoids, polyphenols, saponin, steroids, tannin, fibre, carbohydrates, vitamins, carotenoids and minerals in

ginger according to Otunola *et al.* [25] and Shirin and Prakash [26]. The herbal diets are reported to improve animal performance by stimulating secretion of the digestive enzyme that could result in improvements in digestibility, stimulating the appetite and increasing food consumption according to Elabd *et al.* [27]. Feed conversion ratio (FCR) was ranged between 1.82±0.02 to 1.88±0.01:1. The treatment F2 showed significantly better response ($P<0.05$) than F0. No significant difference was noticed between F2 and remaining treatments. Ranges of water quality parameters viz. temperature, pH, dissolved oxygen and total alkalinity were 21−23 ^{0}C, 7.0 −7.5, 4.8 −6.0 mg/L and 75 −88 mg/L, respectively. The observed water parameters are within in range for favourable growth performances of documented by Boyd [28]. Thus, it can be concluded a ginger incorporated diet with 10g/kg of feed evinced better weight gain, specific growth rate in striped catfish juveniles. The study can be useful for formulating striped catfish diet in commercial grow-out operations to enhance the growth rates in the fishes.

Table 1: Proportion of the ingredients and proximate composition of test diets

Ingredients composition (g/kg)	**F0**	**F1**	**F2**	**F3**	**F4**
Soyaflour	350.00	350.00	350.00	350.00	350.00
Fish meal	280.00	280.00	280.00	280.00	280.00
Wheat flour	80.00	80.00	80.00	80.00	80.00
Maize flour	70.00	70.00	70.00	70.00	70.00
Tapioca	70.00	70.00	70.00	70.00	70.00
Groundnut oil cake	80.00	80.00	80.00	80.00	80.00
Rice flour	50.00	50.00	50.00	50.00	50.00
Fish oil	20.00	20.00	20.00	20.00	20.00
Ginger	0	5	10	15	20
Proximate composition (%)					
	F0	F1	F2	F3	F4
Protein	32.01	32.35	32.45	32.31	32.26
Fat	5.73	5.89	5.67	5.71	5.58
Fiber	14.86	14.91	14.83	14.87	14.67
Ash	6.63	6.59	6.71	6.78	6.69
Moisture	10.10	10.33	10.21	10.26	9.85
Growth parameters					
Weight gain (%)	279.71^{a}	320.20^{b}	352.20^{c}	317.18^{b}	311.00^{b}
Specific growth rate (%)	3.81^{a}±0.02	4.01^{b}±0.02	4.15^{c}±0.02	3.98^{b}±0.02	3.96^{b}±0.03
Feed conversion ratio	1.88^{a}±0.01	1.86^{ab}±0.01	1.82^{b}±0.02	1.87^{ab}±0.01	1.83^{ab}±0.01

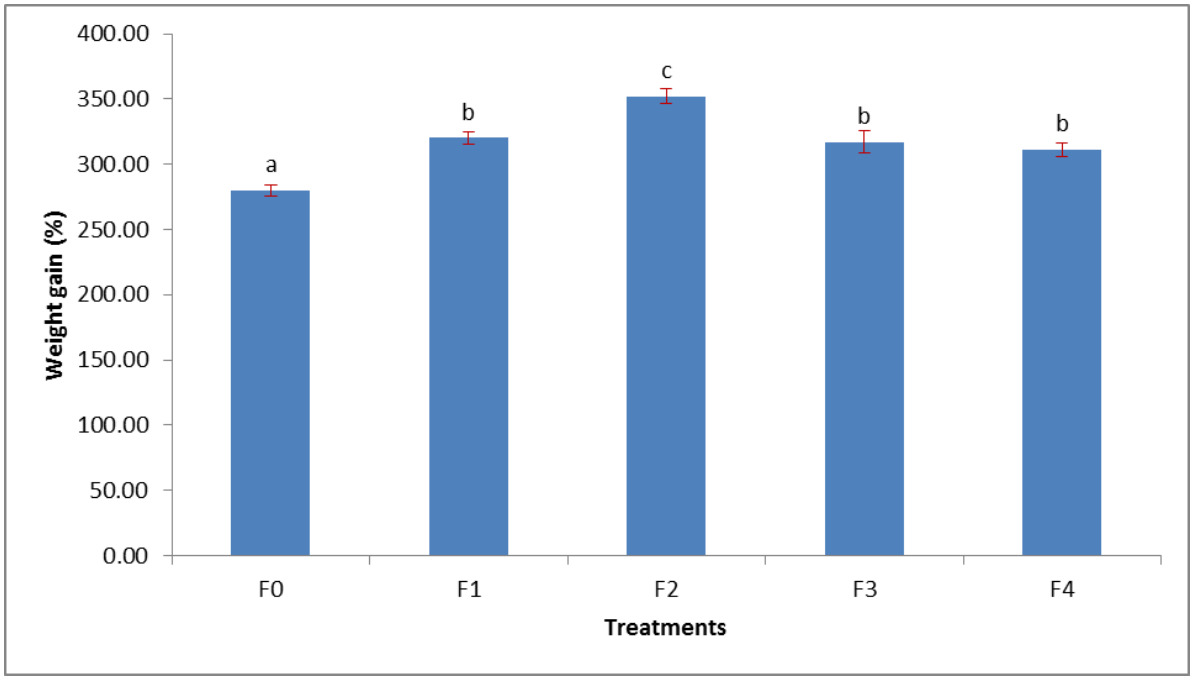

Fig 1: Weight gain (%) observed in the experiment

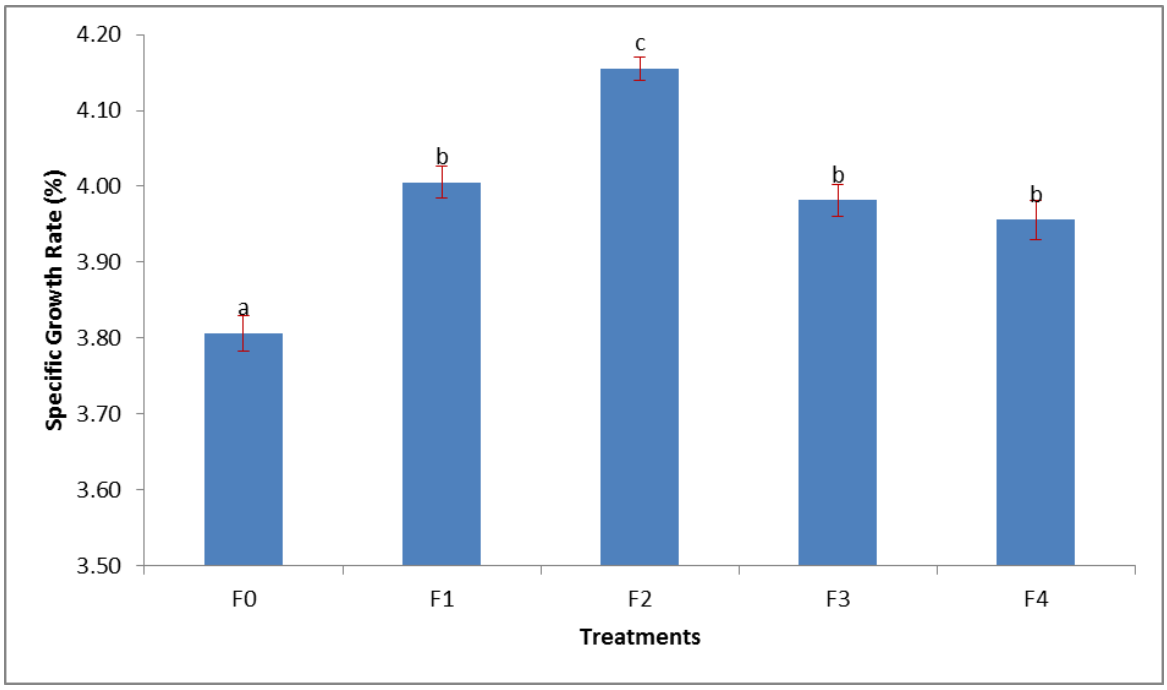

Fig 2: Specific growth rate (%) observed in the experiment

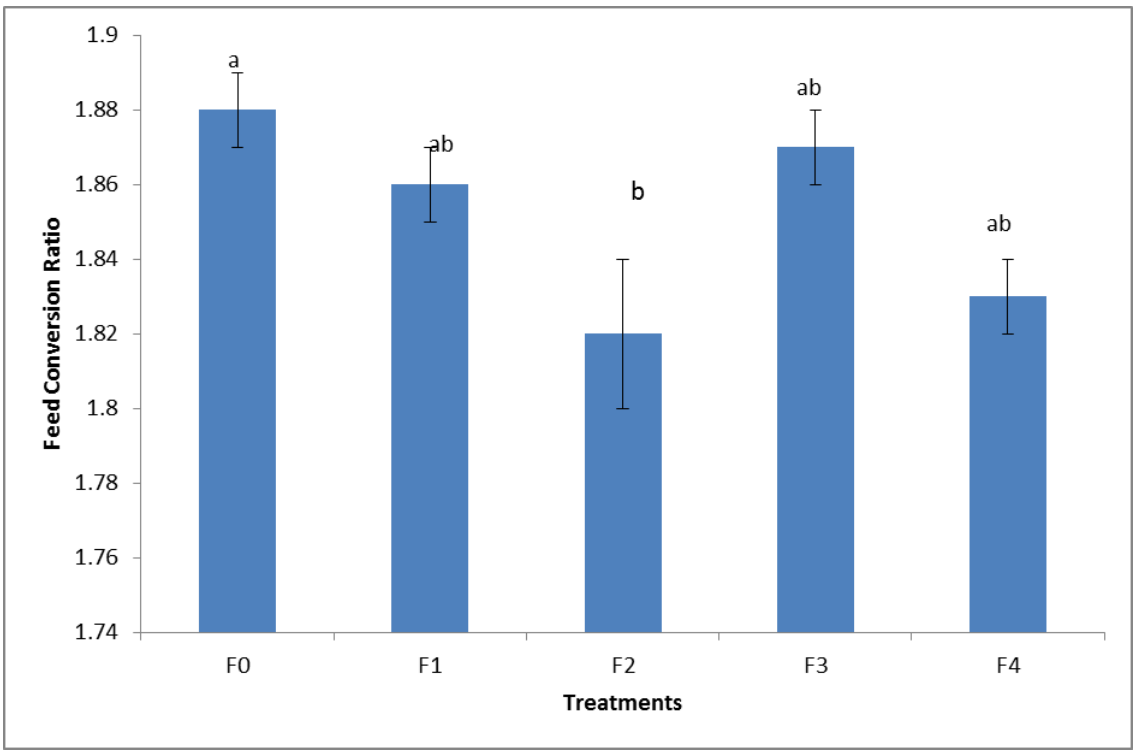

Fig 3: Feed conversion ratio observed in the experiment

4. Conclusion

Among the tested doses of ginger powder, 10 g/kg ginger powder incorporated diet showed better growth response in terms of higher weight gain and specific growth rate in striped catfish, *Pangasianodon hypophthalmus.*

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