Brief Communication

Restricted feeding followed by re-feeding of Indian pompano (*Trachinotus mookalee*) fingerlings: A feeding management strategy

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Introduction

Development of appropriate feeding management strategies are necessary for the optimization of feed efficiency by reducing feed wastage, deterioration of water quality and thereby ensure profitability. Different fish feeding regimes are being practiced to develop feeding protocols that are economically sustainable and cause less environmental damage by minimizing fish feed and total operational costs. Restricted feeding without growth suppression is advantageous for economic and environmental reason; result in better final product quality (Reigh *et al.,* 2006). Moreover, such feeding schedule could improve management of personnel time and water quality, with reducing feed and labour costs. A feeding strategy resulted in compensatory growth can be one of the most effective fish culture methods to overcome unfavourable environmental condition, by improving feeding activity and accelerating growth rate of fish, by reducing feed and labour costs (Cho *et al.,* 2006). The growth parameters especially low FCR can be obtained by adopting suitable feeding strategies. The amount of daily feed ration, frequency and timing of the feeding and presentation of predetermined ration are the major factors of feed management strategies which affects growth and feed conversion (De Silva and Anderson, 1995). Indian pompano (*Trachinotus mookalee*) belonging to family Carangidae is a new candidate species for mariculture in India. This fish holds immense potential for the marine finfish aquaculture sector due to its fast growth rate, easy adaptability to culture environment, fast growth rate, quick acceptance to artificial feed, pleasant appearance, good meat quality and high consumer preference and high market demand. Breeding technology for the species was developed by Visakhapatnam Regional Centre of ICAR-CMFRI in 2016 and since then seeds were consistently produced with good survival (Ritesh *et al.,* 2018). Indian pompano has been identified as potential candidate species with its excellent growth characters, reproductive potential and nutritional qualities (Sekar *et al.,* 2021). Starvation study on Indian pompano juveniles resulted with compensatory growth and significant growth performance (Xavier *et al.,* 2023). The present study aimed to investigate the effect of restricted and full-feeding regimes on growth performance, feed utilization and body composition of Indian pompano (*Trachinotus mookalee*) fingerlings.

Indian pompano (*Trachinotus mookalee*) fingerlings produced at mariculture hatchery of Visakhapatnam Regional Centre of ICAR- CMFRI was used for the feeding experiment. Two hundred and seventy fingerlings (2.0 ± 0.01gm) were distributed randomly in 9 tanks of 1000L capacity and designated as three treatments in triplicate. The fingerlings were fed with commercial diet containing 45% crude protein and 10% lipid (Growel Pvt. Ltd.). The treatments followed were: fingerlings fed with 5% of biomass (control); fingerlings fed with 3% of biomass (T_1) and fingerlings fed with 1% of biomass (T_2). After this restricted feeding period (45days), the fingerlings of each treatment (T_1& T_2) re-fed with 5% of their body weight for another 30 days along with the existing control. According to the feeding schedule, the diet was given thrice a day (10.00, 12.00 & 15.00 hrs) and water exchange was carried out daily. Water quality parameters like temperature, pH, Dissolved Oxygen, free CO_2 and alkalinity, Total Ammonia Nitrogen (TAN), nitrite nitrogen (NO_2-N) were measured through multiparameter devices (YSI, model 55-12FT, YSI Corporation, USA) and salinity was measured with a refractometer (Atago S/Mill-E, Atago Co. Ltd, Tokyo, Japan). Duration of the trial was 75days. The first phase of the experiment lasted for 45 days and tested a restricted feeding regime.

Biological parameters of fish

Growth performance was measured by weighing of the fishes at fortnightly intervals. The fishes were starved of the first ration of the feed on the sampling day. After weighing, the second ration of the feed was given according to the feeding schedule of the experimental groups.

Specific growth rate per day (SGR/Day %) was calculated according to De Silva and Anderson (1995).

Relative weight gain (%), WG= 100 × (Final weight -Initial weight)/Initial weight.

Specific growth rate (% /day), SGR= ln (Final weight) – ln (Initial weight) / Experimental periods in days × 100

where 'ln' is the natural logarithmic value.

Feed conversion Ratio = Feed given (dry weight) / Body weight gain (wet weight)

Feed intake (% /day) = 100 × (Feed consumption (g) / (average biomass (g)) × days

On completion of the experiment, number of fish in each tank was counted and the survival rate (%) was calculated by the following formula:

Survival (%) = Total number of fish present / Total number of fish stocked×100

Fulton's condition factor ($K = W \times 100/ L^3$; where W and L are observed weight and length) was estimated to assess the condition of the individual sampled fish.

At the end of the experiment, five fish from each tank was sacrificed to study proximate composition (AOAC, 1990). Moisture content was determined by drying the fishes in an oven at 105^0C till constant weight. The protein content of the moist free samples were determined using the Kjeldahl method after acid digestion. The crude lipid content was determined by Soxhlet method using petroleum ether as solvent. Ash content was determined by incinerating the moisture free sample in muffle furnace at 550 °C to constant weight. All analyses were performed in triplicate and statistical analysis was carried out using statistical software, SPSS 21. During the experimental period, the water quality parameters were in optimum range viz; salinity 30 ± 0.02ppt, dissolved oxygen 5.76 ± 0.03ppm; ammonia nitrogen 0.08 ± 0.002ppm; pH 7.72 ± 0.01; nitrite 0.006 ± 0.001ppm; temperature 28 ± 0.03^0C. There was no mortality recorded during the experimental period neither during the restricted feeding nor the re-feeding period. Initial fish body weights did not differ significantly; however, fish weights differed ($p<0.05$) among the feeding groups after 45 days of feed restriction and at the end of the experiment ($p<0.05$). Final fish weight and weight gain percentage increased in all groups by increasing feed ration from T_2–control. Control presented significantly ($p < 0.05$) highest final body weight and weight gain percentage compared with other 2 treatments during the restricted feeding period. Fingerlings of T_2 group presented a significantly ($p<0.05$) lower SGR compared with other 2 treatments, meaning that restricted ration of 1% of biomass had a severe effect on the fish growth. FCR also had similar effect as that of WG % (Table 1). During the re- feeding period the fingerlings maintained in different treatment groups, there was an improved growth performance when compared to control group irrespective of the number of feeding days. At the end of the first phase of re-feeding for 15 days (60 DOC) the growth performance of T_1 group was significantly ($p<0.05$) different from the control group and T_2 in terms of WG% (173.05±0.32). The fish weights in T_1 and T_2 groups were less than those in the control ($p<0.05$), suggesting only a partial compensation growth occurred. Whereas, during the re-feeding of fish for the consecutive 30 days followed by restricted ration, the fish in T_1 ($p<0.05$) group caught up (WG% 268.79±0.94 & SGR 1.74±0.01) with the weight of the control fish (DOC 75days). It showed complete compensation growth occurred in these fishes.

The results from analysis of condition factor of the fingerlings fed on different feeding regimes reveals that K value (Table 1) was always more than 1 irrespective of the feeding regimes. There was significantly ($p<0.05$) high K value was recorded in control (1.9±0.05) and the value was decreasing with the feeding ration during the restricted feeding. However, with the re-feeding period, the condition factor was improved in T_2 fed group, which was similar to control fed group ($p>0.05$).

Body composition analyses

Whole body composition of Indian pompano fingerlings on restriction as well as the re- feeding period is presented in Table 2. With respect to the body composition of the fish, no significant differences were found in the protein content between the different treatments. However, during the restricted feeding period, the lipid content of the fingerlings was performed a decreasing trend from control to T_2 and also inversely related to the moisture content. However, during the re-feeding period, both the control and T_1 fed group of fingerlings performed similar lipid content and which was different from T_2 fed group ($p<0.05$). Ash content was significantly increasing ($p<0.05$) with the treatments from control to T_2 during restricted feeding period with highest and lowest ash content was observed in T_2 and control fed group respectively. The ash content was significantly ($p<0.05$) reduced during the refeeding period

Table 1. Effect of feeding regime on growth and nutritive parameters (mean ±SE) of Indian pompano fingerlings during the experimental period.

	Restricted feeding (DOC 45days)			Re- feeding for 15days (DOC 60days)			Re-feeding for 30days (DOC 75 days)		
Growth Parameters	**Control**	**T_1**	**T_2**	**Control**	**T_1**	**T_2**	**Control**	**T_1**	**T_2**
Initial body weight(gm)	2.83±0.01	2.82±0.01	2.82±0.02	2.83±0.01	2.82±0.01	2.82±0.02	2.83±0.01	2.82±0.01	2.82±0.02
Final body weight (gm)	6.04±0.03^c	5.29±0.01^b	3.33±0.02^a	8.13±0.06^c	7.75±0.03^b	5.80±0.02^a	9.85±0.03^b	10.40±0.01^c	7.4±0.23^a
Condition factor	1.9±0.05	1.36±0.05	1.25±0.05	1.9±0.05	1.75±0.05	1.35±0.05	1.9±0.05	1.9±0.05	1.5±0.05
Average WG/fish(gm)	3.22±0.01^c	2.49±0.01^b	0.52±0.01^a	5.3±0.03^c	4.93±0.01^b	2.98±0.03^a	7.10±0.06^b	7.60±0.01^c	4.58±0.02^a
Daily feed intake	3.22±0.01^c	2.10±0.001^b	0.73±0.001^a	3.64±0.01^a	2.59±0.01^b	1.2±0.01^c	4.36±0.01^a	3.16±0.01^b	2.26±0.03^c
WG (%)	116.04±1.17^c	87.94±1.04^b	17.79±1.23^a	187.74±0.61^c	173.05±0.32^b	106.93±0.18^a	251.42±2.6^b	268.79±0.94^c	148.41±0.62^a
FCR	2.71±0.05^b	2.01±0.02^a	2.18±0.15^b	2.52±0.01^c	1.84±0.01^b	1.04±0.01^a	2.74±0.03^c	1.95±0.01^b	1.70±0.02^a
SGR	1.71±0.02^c	1.40±0.01^b	0.36^a±0.01^a	1.76±0.01^c	1.67±0.01^b	1.21±0.01^a	1.68±0.01^b	1.74±0.01^b	1.21±0.03^a

Values (Mean of triplicate ± SE) in the same column sharing different superscript letters are significantly different ($p<0.05$).T_1: Restricted feeding@ 3% biomass; T_2: Restricted feeding @ 1% biomass

Table 2. Body composition of Indian pompano fingerlings subjected to different feeding regimes during 75 days of rearing

	Restricted feeding (45 days)			Refeeding (30 days)		
Body composition	**Control**	**T_1**	**T_2**	**Control**	**T_1**	**T_2**
Moisture	67.57±0.05	68.70±0.05	69.10±0.05	67.37±0.05	69.10±0.05	69.15±0.05
Protein	18.34±0.09	18.38±0.09	18.38±0.09	18.27±0.08	18.26±0.09	18.07±0.07
Lipid	10.04±0.09^c	8.68±0.05^b	8.10±0.05^a	10.14±0.07^a	10.13±0.05^a	9.18±0.05^b
Ash	2.16±0.01^a	2.93±0.01^b	3.28±0.01^c	2.16±0.01^b	2.01±0.01^a	2.30±0.01^c

Values (Mean of triplicate±SE) in the same row sharing different superscript letters are significantly different (<0.05)

with lowest content in T_1 fed group of pompano fingerlings followed by control fed group.

The effect of restricted feeding followed by re-feeding on growth performance, feed utilization and body composition of Indian pompano (*Trachinotus mookalee*) fingerlings were studied in the present experiment. Results demonstrated that, during the restricted feeding, the body weight of fingerlings were less compared to the normal fed group (control) of fingerlings. However, during the re-feeding period of first 15 days, fingerlings were nearing to compensation and followed by next 15 days, complete compensation was observed. Fingerlings changed from restricted to re- feeding after 45 days showed a trend toward increase in specific growth rate accompanied by increase in feed consumption. The present study also confirms the result that hyperphagia in pompano fingerlings during the refeeding period after the feed restriction. The health condition of fingerlings is not affected when following feeding regime of restricted ration followed by full feeding. Proximate composition results from our study reveals that moisture, crude protein and ash showed no significant differences among the groups. However, the body lipid content of fingerlings showed reduction during the restricted feeding period, may be due to the utilization of lipid for the protection of basal metabolism and survival during the period.

It can be concluded that the best group from our study in terms of compensatory growth, and feed utilization Indian pompano fingerlings fed with 3% of biomass for 45 days followed by full feeding for another 30 days. This feeding strategy can be practically applied in grow out culture of Indian pompano especially when cultured in high stocking density with minimum feeding for long duration followed by normal feeding for short duration which will reduce the cost of production for pompano during culture.

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