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EFFECT OF PHOTOPERIOD ON GROWTH PERFORMANCE, FEED UTILIZATION AND CARCASS COMPOSITION IN *CHANNA PUNCTATUS*

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ABSTRACT

To study the effect of photoperiod on growth performance in ***C. punctatus***, the fish were exposed to three combinations of day length *i.e.* LD 14:10, LD 12:12 and LD 9:15 at 25°C. Variables tested were weight gain, length gain, condition factor, FCR, body composition, VSI and HSI. Fish exposed to long photoperiod showed high growth performance followed by equal and short photoperiod. Significantly low concentration of ammonical nitrogen and orthophosphate in holding water were observed in fish exposed to LD 14:10 as compared to LD 12:12 and LD 9:15. VSI values were significantly high (P0.05) in group of fish exposed to LD 14:10, followed by LD 12:12 and LD 9:15. On the other hand, HSI was significantly decreased in fish exposed to LD 9:15, while HSI values under LD 14:10 and LD 12:12 were equal.

Figure : 01 References : 23 Tables : 03

KEY WORDS : *C. punctatus,* Growth performance, Photoperiod.

Introduction

The potential use of photoperiod control to delay or postpone gonadal development and reproduction in commercial fish, thereby increasing overall weight gain and allowing for storage of market size fish over the winter without weight loss, has obvious economic benefits. Manipulation of Photoperiod is a widely used technique in commercial aquaculture. Photoperiod influence endogenous rhythms in fish, which helps the fish farmers to the events such as reproductive timing, gonadal maturation and growth.

The fish in treatment LL and LD 9:15 exhibited the highest and lowest weights respectively[6]. Fish exposed to LD 24:0 had significantly higher specific growth rate (1.05% day') than those on LD N (0.98% day'). Fish exposed to LD 8:16 had the poorest growth (0.80% day'). The group on LD 8:16-24:0 (overall growth rate 0.94% day-') grew poorly at first but subsequently increased growth rate after having been exposed to continuous light[19].

The interaction of temperature and photoperiod on growth of Atlantic halibut *Hippoglussus hipoglussus,* and the studies have revealed that growth was faster under continuous light than under natural photoperiod irrespective of temperature[3]. The effects of extended photoperiod, mimicking the longest day of the year were studied in 1 and 2 year old gilthead seabream and the studies have revealed that long photoperiod cause delayed spawning and increased somatic growth in gilthead seabream[15].

Photoperiod manipulation significantly influenced growth and hypo-osmoregulatory ability in Atlantic Salmon smolt[13]. For some species, long photoperiods might indirectly modify growth by increasing an increased feed intake, developing muscle mass. Enhancing nutrient use efficiency and energy of fish was used for somatic growth rather than gonadal development[2,4,11,18].

By Increasing the perceived day length of farmed Atlantic Salmon through exposure to artificial light 24 hours a day in the autumn has resulted a significant increase in their overall growth by the end of May and significantly lowered the sexual maturation rates of both males and females[12].

Effect of photoperiod manipulation on the growth performance of juvenile lenok was studied[16]. Results showed that photoperiod manipulation could affect growth and a continuous dark regime could improve growth in lenok.

Regulated photoperiods as a 16L:8D or 12L:12D light/dark cycle significantly improved growth rate and food conversion ratio of wild carp *Cyprinus carpio* [10]. It was observed that long photoperiods (18L:6D and 24L:0D) induce the best growth, feed conversion ratio and protein efficiency ratios in Nile *Tilapia* fingerlings. However, manipulation of the photoperiod does not influence survival, the appearance of body deformations or gonadal

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TABLE-1 : Effect of long (LD 14:10), short (LD 9:15) and equal (LD 12:12) photoperiods at 25^0C on growth and feed efficiency in *C. punctus*-80 day treatment

Parameters	Treatment		
	LD 14:10	LD 9:15	LD 12:12
Initial length (cm)	13.16	13.16	13.16
Final length (cm)	14.69	14.56	16.03
Initial live weight (g)	24.35	24.16	24.46
Final live weight (g)	42.35	37.28	40.96
Live weight gain (g)	18.00A+0.30	13.11C+0.02	16.49 B+0.20
Growth per cent grain in body weight	73.92A+1.21	54.28 C+0.49	67.42 B+0.11
Specific growth rate (SGR % d-1)	0.55A+0.01	0.43 C+0.03	0.51 B+0.00
Food consumption per day in percentage body weight	1.33B+0.003	1.30 C+0.03	1.36 A+0.01
Feed conversion ratio (FCR)	2.47C+0.03	3.04 A+0.02	2.70 B+0.01
Protein efficiency ratio (PER)	1.00A+0.01	0.81 C+0.05	0.92 B+0.004
Condition factor (k)	1.35A+0.02	0.93 C+0.01	1.20 B+0.01

Values are mean $\pm$ SE of mean of three observations. Means with the same letter/s in the same row are not significantly ($P<0.05$) different. Data were analysed by Duncan's multiple range test.

development. Aim of study was to determine the effect of long (LD 14:10), short (LD 9:15) and equal (LD 12:12) photoperiods at 25°C on growth, feed utilization and carcass composition in C. *punctatus*.

Material and Methods

Specimens of *C. punctatus* (BW 4.80-4.86) were obtained from fish dealers of Hissar. Fish were placed in transparent glass aquaria (60x30x30 cm) kept in laboratory where the temperature was maintained at 25^{0C}±1ºC and the lighting schedule at 12h of light (08°°-20°°h) alternating with 12h of darkness (20°°- 08°°). The average intensity of light inside the laboratory was approximately 1000 lux. Fish were acclimated in the laboratory for a minimum of seven days prior to the initiation of experimental treatments and were fed *ad libitum* on a feed containing 40% protein between 16°° and 19°°h. The water in the aquaria was renewed daily with water which had been previously equilibrated to the desired temperature (25°C).

Effect Of Photoperiod

After initial acclimation for 7 days under laboratory conditions (LD 12:12 at 25°C), the fish were divided into three groups and exposed to the following combinations of day length:

1. Long photoperiod LD 14:10 at 25°C
2. Equal photoperiod LD 12:12 at 25°C
3. Short photoperiod LD 9:15 at 25°C

Feed was given at 10 a.m. and 3 p.m. and left over feed was collected 4h post-feeding. Care was taken not to expose the fish of short photoperiod to extra lights after the lights were switched off. Fish in these experiments were fed on a diet containing 40 per cent protein.

Illumination and Temperature Arrangements

Specially constructed glass aquaria (60x30x30 cm) were used to expose the fish to different photoperiodic regimes. The outer surface of these aquaria was first given an undercoat of white paint on all sides to provide a white reflecting background and then painted with two coats of black paint. The top of each aquarium was covered with a wooden lid which was painted white inside the black outside to make the entire unit perfectly light-proof. Each

TABLE-2 : Effect of long (LD 14:10), short (LD 9:15) and equal (LD 12:12) photoperiods at 25^{0}C on nutrient retention, postparandial excretory levels of total ammonia (N-NH$_4^+$) and reactive phosphate O-PO$_4^-$ on *C. punctus*-80 day treatment

Parameters	Treatment		
	LD 14:10	LD 9:15	LD 12:12
Gross protein retention (GPR)	23.48 A+0.47	12.77 C+0.69	19.35B+0.35
Gross energy retention (GER)	18.88 A+0.12	8.39C+0.42	19.03 B+0.14
Apparent protein digestibility (APD %)	87.26 A+0.02	80.52C+0.60	86.85 B+0.05
N-NH+4 (mg kg-1 BW d-1)	15.95 C+0.48	63.70 A+1.75	30.02 B+0.82
O-PO4- (mg kg-1 BW d-1)	27.98 C+2.08	99.45 A+1.34	35.74 B+1.60

Values are mean ± SE of mean of three observation. Means with the same letter/s in the same row are not significantly (P<0.05) different. Data were analysed by Duncan's multiple range test.

lid was fitted with a 20-watt philips fluorescent cool daylight tube. When the lid was closed, the fluorescent tube was about 15 cm above the water surface. The light intensity above the surface of water was about 2000 lux. The transformer ballast was fitted outside the lid to minimize heating of the aquarium water. Each unit was tested for leakage of light before initiating the experiment. The duration of the photoperiod in each aquarium or chamber was regulated by time switches (AMF. VENNER, VENNERETTE, MKT1A T55). The aquaria were stacked in chambers provided with doors, the inside of which was painted black. Adequate provision was made for proper ventilation of the aquaria stacked in chambers. No external light reached the fish when the lids of the aquaria and the doors of the chambers were closed. During the light period, the doors of the chambers were kept open and the lids of aquaria were raised to ensure proper ventilation. The lids of the aquaria, as also the doors of the chambers were closed 30 min before the lights were scheduled to be switched off. The light and dark periods in the aquaria coincided with the day and night, respectively. Every morning at 08°°h, the time switches were checked for accuracy and the aquaria were inspected and dead fish, if any, removed.

Feeding Rate

Fish in each treatment were fed @ 3% body weight per day. Ration sizes were readjusted at every 15 days interval after weighing the fish. Feed was given twice at two intervals once in the morning then in the afternoon. Left over feed was collected 4h post feeding. Faeces were collected by siphoning the next morning. Samples were pooled and analysed for digestibility studies.

Weight Measurement

Individual weight of fish was recorded at the beginning and end of-the experiment and also at the 15 day interval with the help of a top pan electronic balance (Make, AFCOSET FX-1200). In order to maintain the optimum water quality, temperature, pH and Dissolved oxygen (DO) were regularly monitored. Water samples were collected 68 h post-feeding to determine N-NH$^+$ and O-PO-$_4$ levels from the holding water[1].

Multiple range test[5] was used to evaluate the differences among guoups exposed to different photoperiodic regimes at 0.05 level of significance.group mean were compared with student 't' test[20].

Results

Growth and feed utilization

Studies have revealed that feeding *C. punctatus* on a diet containing 40 percent protein and exposing the fish to LD 14:10, significantly enhanced (P<0.05) live weight gain (g), growth percent gain in body weight (Fig. 1A) and specific growth rate (SGR % d^{-1}) in comparison to the fish exposed to LD 9:15 and LD 12:12. Lowest value, however, in these parameters were observed in fish exposed to LD 9:15, while intermediate results were seen in fish exposed to LD 12:12. A significant (P<0.05) improvement in condition factor (k) was seen in groups exposed to LD 14:10 or LD 12:12, which decreased significantly (P0.05) in the group exposed LD 9:15. FCR was significantly (P<0.05) low in the fish exposed to LD 14:10, followed by fish exposed to LD 12:12 and LD 9:15. PER, GPR, GER and APD values were significantly (P<0.05) enhanced in fish exposed to LD 14:10 in comparison with other groups maintained under LD 9:15

TABLE-3 : Effect of long (LD 14:10), short (LD 9:15) and equal (LD 12:12) photoperiods at 25^{0}C on viscero-somatic index (VSI), Hepato-somatic index and carcass composition (% wet weight basis) in *C. punctus*-80 day treatment

Parameters	Initial value	Treatment		
		LD 14:10	LD 9:15	LD 12:12
Vascero-somatic index (VSI %)	3.04+0.05	4.54A+0.10	3.25 C+0.06	4.14 B+0.01
Hepato-somatic index (HSI %)	0.70+0.10	1.10 A+0.02	0.75 B+0.06	0.98A+0.03
Carcass composition (%)				
Moisture	79.25+0.02	74.47C+0.05	79.30 A+0.20	75.35 B+0.07
Crude protein	12.02+0.19	16.82 A+0.04	13.28 C+0.18	15.65 B+0.08
Crude fat	2.74+0.17	4.25 A+0.09	3.00 C+0.03	3.73 B+0.01
Ash	4.04+0.003	2.02 C+0.005	3.97 A+0.01	2.11 B+0.00
Phosphorus	0.56+0.00	0.74 A+0.01	0.56 B+0.001	0.73A+0.01
Energy (kJ g-1)	4.25+0.04	6.07 A+0.02	4.40 C+0.04	5.71 B+0.01

Values are mean $\pm$ SE of mean of three observation. Means with the same letter/s in the same row are not significantly (P<0.05) different. Data were analysed by Duncan's multiple range test.

orLD 12:12. While food consumption values were enhanced in groups exposed to LD 14:10 and LD 12:12 as compared to LD 9:15 (Tables 1 and 2).

Effect on N-NH$^+_4$ excretion and O-PO$^-_4$ production

Significantly (P<0.05) low concentration of ammonical nitrogen (N-NH$^+_4$) and orthophosphate (O-PO$_4$) in the holding water were observed in fish exposed to LD 14:10, followed by equal (LD 12:12) and short photoperiod (LD 9:15) (Table-3).

Effect on VSI and HSI

VSI values were significantly (P0.05) high in group of fish exposed to LD 14:10, followed by LD 12:12 and LD 9:15. On the other hand, HSI was significantly decreased in fish exposed to LD 9:15, while HSI values under LD 14:10 and LD 12:12 were equal (Fig. 1B).

Proximate carcass composition

Carcass protein, fat, phosphorous and energy values were significantly enhanced on exposure of fish to LD 14:10. Intermediate result was obtained in fish exposed to LD 12:12, while significantly low values were detected on exposure the fish to LD 9:15. On the other hand moisture and ash contents were high in group exposed to LD 9:15 (Table-3 and Fig. 1C).

Discussion

Catfish and murrels are long day breeders and spawn during the monsoon (July-August) in the environs of Hisar. Present studies have clearly demonstrated that with increase in photoperiod (daylength) growth and digestibility in C. *punctatus* were acclerated. Since, these fish species are long day breeders, hence these results are not surprising[8,21,22]. Further, growth and digestibility appears to be negatively correlated with the excretion of NH$_4$-N and O-PO$_4$ in the holding water indicating their high retention in the body. Higher growth of the fish exposed to long photoperiod seems to be possibly due to a better feed conversion associated with longer days.

It was found that seasonal variations in activity of the thyroid gland of three year old brown trout *(Salrno trutta)* can be related to the day length. Peak activity at mid summer appeared to coincide with temperatures of 12-15°C. Plasma growth hormone concentration in the long day group in atlantic salmon was reported to be significantly higher than the fish exposed to LD 12:12[3]. Long photoperiod caused delayed spawning and increased somatic growth in gilthead seabream[15]. It was found that growth was significantly enhanced when the Nile tilapia were exposed to a long photoperiod[7]. Pineal

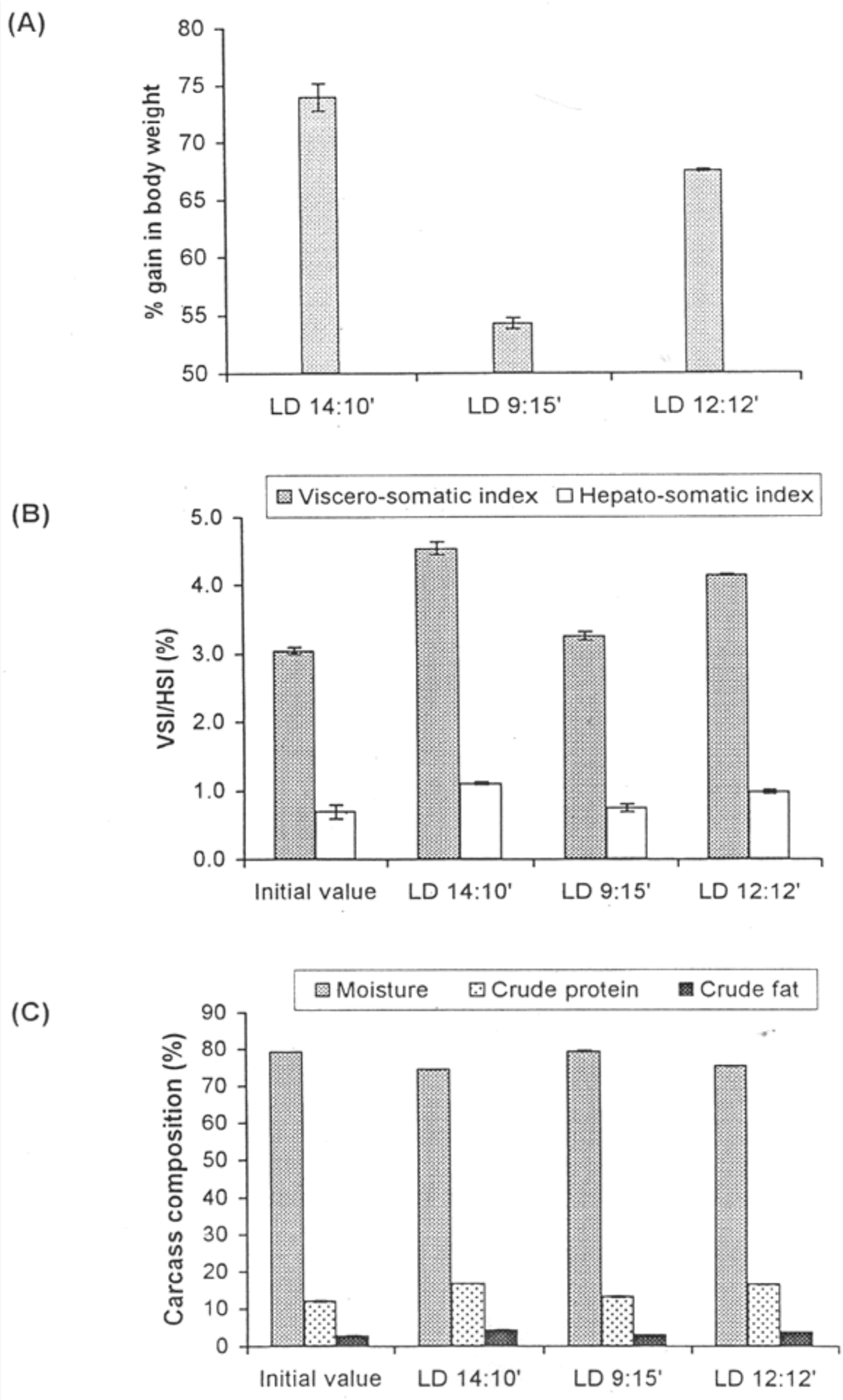

Fig. 1 : Effect of different combination of photoperiod at 25^{0}C (LD 14:10, LD 9:15, LD 12:12) on per cent gain in body weight (A), viscero-somatic index (VSI) and hepato-somatic index (HI) (B), proximate carcass moisture, crude protein and fat (C) in *C. punctatus*-80 day treatment

gland a neurochemical transducer of photoperiodic information is known to repress the activity of pituitary, thyroid, adrenal and other peripheral glands[17] and fish exposed to long photoperiod is considered to be effectively pinealectomized[9]. Therefore, it is expected that the secretion or the release of hormone from these glands is also controlled by the pineal and occurs in fish in response to long photoperiod, which perhaps is responsible in the accleration of food intake, growth and digestibility. Fish exposed to LD 9:15 and LD 12:12 produced intermediate results on growth and digestibility parameters. This may indicate the suppression of the activity of the endocrine glands, involved in nutrition and metabolism or in other words the accleration of the activity of the pineal gland which effectively suppresses the activity of the pituitary.

Conclusion

Exposure of fish to different photoperiodic regimes revealed that significantly ($P<0.05$) highest growth, digestibility, protein deposition in carcass and low excretion of total ammonia and $O\text{-}PO^{+}_{4}$ was observed in C. *punctatus* exposed to LD 14:10 at 25°C, followed by LD 12:12 at 25°C and LD 9:15 at 25°C.

1. These studies indicate that : Effect of daylength on growth indicates that without any chemical treatments, growth and food conversion efficiency of fish can be enhanced.
2. The food conversion efficiency is also improved which is an important factor considering that the cost of food is the largest single factor in aquaculture.

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