African Journal of Biotechnology Vol. 11(33), pp. 8361-8366, 24 April, 2012
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB11.2530
ISSN 1684–5315 © 2012 Academic Journals

Full Length Research Paper

Effect of dietary protein, lipid and carbohydrate contents on the viscera composition and organ Indices of *Cyprinus carpio communis* fingerlings

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Accepted 4 November, 2011

This study aimed to determine a feed formulation with the best protein to energy ratio that would result in a better viscera composition and organ indices (OI) of *Cyprinus carpio communis*. Fingerlings having average weight of 1.64 ± 0.13 g and length of 5.26 ± 0.10 cm were fed on four different formulated feeds and a control feed (each in a triplicate set), 6% of their body weight, three times a day, during 90 days. Feeds were formulated using ground nut oil cake, mustard oil cake, rice bran, wheat bran, fish meal and soybean meal in order to suffice the balanced need of protein and energy of the common carp. Viscera composition and OI of fingerlings were measured. Results indicate that there was a significant increase in viscera lipid content with the increase in dietary carbohydrate level. The viscera lipid content was found highest in the fingerling fed on feed C and the least in the fingerlings fed on feed B. The eviscero-somatic index (EVSI) decreased significantly ($P<0.05$) with the increase in the dietary carbohydrate level, whereas the viscero-somatic and hepato-somatic indexes (HSI) increased significantly ($P<0.05$) with the increase in dietary carbohydrate level. The EVSI was the highest, whereas viscero-somatic index (VSI) and HSI were least in the fingerlings fed on the feed B. Moreover, the EVSI was the least, whereas viscero-somatic and HSI were highest in the fingerlings fed on feed C. This work concludes that feed B containing 40% protein, 9.31% lipid, 10.08% carbohydrate and having protein to energy ratio of 20.54 mg protein/kJ was the best feed for a more profitable and successful culture of the common carp.

Key words: Protein to energy ratio, carp production, viscera composition, organ indices.

INTRODUCTION

The dietary protein to energy ratio, in fish diets, is of great importance. Levels of dietary protein and energy not only influence the growth and body composition, but also digestive enzymes' activities and plasma metabolites in various fishes (Gangadhara et al., 1997; McGoogan and Gatlin III, 2000; Yamamoto et al., 2000; Yigit 2001; Wang et al., 2005; Zhen et al., 2009). Providing adequate energy through dietary lipids can minimize the use of more costly protein as an energy source (Van der Meer et al., 1997; Jantrarotai et al., 1998; Company et al., 1999; McGoogan and Gatlin III, 2000; Pedro et al., 2001).High-energy diets can also lead to excessive deposition of carcass lipids (Morais et al., 2001) and reduced growth rate (McGoogan and Gatlin III, 2000). Excess carcass lipid accumulation and reduced growth rate due to increased dietary energy have also been shown for juvenile rockfish (Lee et al., 2002) and Atlantic halibut (Hamre et al., 2003).

To reduce feeding costs in aquaculture, approaches to reducing dietary protein levels or improving protein utilization have been studied extensively. Most studies concentrated on increasing dietary energy levels or lowering the protein to energy ratio (P/E ratio), as well as to reduce the amount of protein in fish diets, and these have been confined mainly to studies of growth performance such as largemouth bass; grass carp; hybrid

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Abbreviations: OI, Organ indices; **HSI,** hepato-somatic indexes; **EVSI,** eviscero-somatic index; **VSI,** viscero-somatic index.

catfish, *Heterobranchus bidorsalis* × *Clarias anguillaris* and rainbow trout (Amoah et al., 2008; Du et al., 2008; Diyaware et al., 2009; Gumus and Ikiz, 2009).

The aim of the present study was to carry out orderly nutritional research with common carp by using different dietary protein, lipid and carbohydrate contents for determination of a feed formulation with optimum protein to energy ratio (P/E ratio) that would result in a better viscera composition and organ indices (OI) so as to make production of common carp economical.

MATERIALS AND METHODS

Cyprinus carpio communis fingerlings having average weight of 1.64 ± 0.13 g and length of 5.26 ± 0.10 cm were used for the experiment. Prior to the initiation of the feeding trail, fingerlings were acclimatized for one week. During this period, traditional mixture of mustard oil cake and rice bran (1:1) was fed to the fingerlings. Each formulated feed and control feed was fed to triplicate group of fingerlings for 90 days. 50 fingerlings were reared in each fiber glass tank. Water was supplied to each tank at the rate of 1 L min^{-1}. About 30% of water was replaced weekly with fresh-water to adjust water quality. Water analysis of the experimental tanks was done regularly to monitor any unusual changes. The tanks were aerated throughout the experiments with aquarium air pumps (RS-180, Zhongshan Risheng Co. Ltd., China). Biochemical analysis (dry matter, moisture, crude protein, crude lipid, carbohydrate and ash of feed ingredients, feeds and viscera) was determined by using standard procedures (AOAC, 1995). The energy content of feed ingredients and feeds were calculated calorimetrically.

Composition of control and formulated feeds experimented

Four feeds (feed A, B, C and D) were formulated using ground nut oil cake, mustard oil cake, rice bran, wheat bran, fish meal and soybean meal. The ingredients were selected so as to suffice the balanced need of protein and energy of the common carp. Feeds were formulated using "Pearson-Square method" with different protein, carbohydrate and lipid contents. Control feed consisted of 50% mustard oil cake and 50% rice bran. Feed A consisted of ground nut oil cake (15%), mustard oil cake (15%), rice bran (10%), wheat bran (10%), fish meal (25%) and soybean meal (25%). The combination was aimed at the supply of maximum protein component than energy. Feed B consisted of ground nut oil cake (18%), mustard oil cake (60%), rice bran (2%), wheat bran (8%), fish meal (4%) and soybean meal (8%). This combination, instead of having fish meal as a source of protein had mustard oil cake. Feed C consisted of ground nut oil cake (8%), mustard oil cake (12%), rice bran (40%), wheat bran (30%), fish meal (6%) and soybean meal (4%). This combination aimed at the use of carbohydrate rich diet for the growth and feed D consisted of the mixture of equal quantity (16.66%) of all the ingredients. In addition, vegetable oil (1.5 ml per 100 g of feed) and cod liver oil (1.5 ml per 100 g of feed) were incorporated in each formulated feed to ensure adequate supply of fatty acids of both n-6 and n-3 series, assumed to be essential for common carp. Vitamin - mineral mixture (2 g per 100 g of feed) was added to each formulated feed for the maintenance of fish health. Sodium alginate (5 g per 100 g of feed) was used as binder and oxytetracycline (500 mg per 100 g of feed) as antibiotic for control and formulated feeds. Composition of control and formulated feeds (% in dry weight basis) experimented are given in Table 2.

Dry ingredients were mixed for about 30 min in a Hobart mixer (Belle, Mini 150; England) to ensure that the mixture was well homogenized and then blended with oil for about 15 min. Water was added at 20 to 30% v/w to give a pelletable mixture. A pelleting machine (Hobart, model, A 200) was used to pellet the feeds. An appropriate die was used to form pellets of desired sizes (1.0 to 3.0 mm). Pellets were oven dried and fed to the fishes, 6% of the body weight, three times a day at 10 a.m., 2.0 p.m. and 5.0 p.m. every day.

Organ indices (OI)

OI; eviscero-somatic index (EVSI), viscero-somatic index (VSI) excluding liver and hepato-somatic index (HSI) were calculated using the following formulae:

$$\text{EVSI (\%)} = \frac{\text{Weight of eviscerated fish (g)}}{\text{Body weight (g)}} \times 100$$

$$\text{VSI excluding liver (\%)} = \frac{\text{Weight of viscera excluding liver (g)}}{\text{Body weight (g)}} \times 100$$

$$\text{HSI (\%)} = \frac{\text{Weight of liver (g)}}{\text{Body weight (g)}} \times 100$$

RESULTS

Biochemical composition of fish feed Ingredients

Biochemical composition of fish feed ingredients (% in dry weight basis) used for the present research work is given in Table 1. The dry matter content of fish feed ingredients was highest (95.37% ± 0.17) in mustard oil cake and the least (91.55% ± 0.28) in rice bran, moisture content was highest (8.45% ± 0.21) in rice bran and the least (4.63% ± 0.13) in mustard oil cake, crude protein was highest (53.60% ± 0.21) in fish meal and the least (13.45% ± 0.13) in rice bran, crude lipid was highest (9.73% ± 0.19) in mustard oil cake and the least (3.37% ± 0.17) in rice bran and carbohydrate content was highest (19.61% ± 0.17) in rice bran and the least (4.33% ± 0.14) in fish meal.

More also, the ash content of fish feed ingredients is the highest (12.50 ± 0.16%) in rice bran and the least (4.12 ± 0.17%) in mustard oil cake while the energy content was the highest (4.92 ± 0.21 kcal/g) in mustard oil cake and the least (1.86 ± 0.22 kcal/g) in rice bran. Out of six ingredients, ground nut oil cake and mustard oil cake were used as the source of lipid to provide energy of 4.74 ± 0.13 and 4.92 ± 0.21 kcal/g, respectively. Fish meal and soybean meal were used as protein source, providing 53.60 ± 0.21 and 50.12 ± 0.17 % crude protein, respectively. Rice bran and wheat bran were used as the source of carbohydrate to provide instant energy of 1.86 ± 0.22 and 1.99 ± 0.26 kcal/g, respectively. There was no significant difference ($P > 0.05$) in the biochemical

Table 1. Biochemical composition of fish feed ingredients (% in dry weight basis).

S/N	Ingredient	Dry matter	Moisture	Crude protein	Crude lipid	Carbohydrate	Ash	Energy (kcal/g)
1	Ground nut oil cake	$95.09^{c} \pm 0.21$	$4.91^{a} \pm 0.18$	$42.21^{b} \pm 0.17$	$9.05^{c} \pm 0.28$	$8.62^{b} \pm 0.13$	$4.62^{a} \pm 0.21$	$4.74^{b} \pm 0.13$
2	Mustard oil cake	$95.37^{c} \pm 0.17$	$4.63^{a} \pm 0.13$	$39.56^{b} \pm 0.18$	$9.73^{c} \pm 0.19$	$7.32^{b} \pm 0.12$	$4.12^{a} \pm 0.17$	$4.92^{b} \pm 0.21$
3	Rice bran	$91.55^{a} \pm 0.28$	$8.45^{c} \pm 0.21$	$13.45^{a} \pm 0.13$	$3.37^{a} \pm 0.17$	$19.61^{c} \pm 0.17$	$12.50^{c} \pm 0.16$	$1.86^{a} \pm 0.22$
4	Wheat bran	$91.84^{a} \pm 0.23$	$8.16^{c} \pm 0.26$	$16.10^{a} \pm 0.12$	$4.58^{a} \pm 0.13$	$16.26^{c} \pm 0.19$	$11.92^{c} \pm 0.21$	$1.99^{a} \pm 0.26$
5	Fish meal	$93.82^{b} \pm 0.19$	$6.18^{b} \pm 0.16$	$53.60^{c} \pm 0.21$	$7.78^{b} \pm 0.26$	$4.33^{a} \pm 0.14$	$10.60^{b} \pm 0.20$	$3.92^{c} \pm 0.23$
6	Soybean meal	$93.63^{b} \pm 0.12$	$6.37^{b} \pm 0.15$	$50.12^{c} \pm 0.17$	$7.56^{b} \pm 0.24$	$4.72^{a} \pm 0.10$	$10.05^{b} \pm 0.18$	$3.63^{c} \pm 0.13$

Values are means ± SD. Means in the same column having different superscripts are significantly different ($P < 0.05$), while means in the same column with same superscript are not significantly different ($P > 0.05$). kcal, Kilo-calorie; SD, standard deviation.

composition of ground nut oil cake and mustard oil cake; rice bran and wheat bran; fish meal and soybean meal.

Biochemical composition of control and formulated feeds experimented

Biochemical composition of control and formulated feeds experimented (% in dry weight basis) is given in Table 3. The highest dry matter content (94.01 ± 0.19%) was recorded in feed B and the least (92.73 ± 0.28%) in feed C, highest moisture content (7.27 ± 0.23%) was recorded in feed C and the least (5.99 ± 0.17%) in feed B and highest crude protein (42 ± 0.26%) was recorded in feed A and the least (25.98 ± 0.19%) in feed C. Moreover, the highest crude lipid (9.31 ± 0.25%) was recorded in feed B and the least (5.49 ± 0.18%) in feed C, highest carbohydrate content (34.63 ± 0.19%) was recorded in feed C and the least (10.08 ± 0.10%) in feed B, highest ash content (9.45 ± 0.16%) was recorded in feed B and the least (8.59% ± 0.26) in feed C, highest energy content (4.65 kcal/g ± 0.13) was recorded in feed B and the least (3.48 ± 0.16 kcal/g) in feed C while highest P/E ratio (22.64 ± 0.36 mg protein/kJ) was recorded in feed A and the least (17.18 ± 0.19 mg protein/ kJ) in feed C.

Viscera composition

Viscera composition (% mean wet weight basis) of the fingerlings fed on control and formulated feeds after 30 and 90 days of experiment is given in Table 4.

Moisture

The initial viscera moisture content of the fingerlings was recorded as 81.65 ± 0.24%. After 30 days, however,there was no significant difference ($P > 0.05$) in the viscera moisture content of the fingerlings fed on control feed, feed A, feed B, feed C and feed D. After 90 days, the highest viscera moisture content was recorded (78.68 ± 0.17%) in the fingerlings fed on feed B and the least (72.12% ± 0.27) in the fingerlings fed on feed C. There was no significant difference ($P > 0.05$) in the viscera moisture content of the fingerlings fed on control feed and feed C; feed A, feed B and feed D.

Crude protein

The initial viscera crude protein of the fingerlings was recorded as 12.16 ± 0.28%. After 30 days, there was no significant difference ($P > 0.05$) in the viscera crude protein of the fingerlings fed on control feed, feed A, feed B, feed C and feed D. After 90 days, the highest viscera crude protein was recorded (15.63% ± 0.16) in the fingerlings fed on feed B and the least (14.86% ± 0.17) in the fingerlings fed on feed C. There was, however, no significant difference ($P > 0.05$) in the viscera crude protein of the fingerlings fed on control feed, feed A, feed B, feed C and feed D.

Crude lipid

The initial viscera crude lipid of the fingerlings was recorded as 4.96 ± 0.18%. After 30 days, there was no significant difference ($P > 0.05$) in the viscera crude lipid of the fingerlings fed on control feed, feed A, feed B, feed C and feed D. After 90 days, the highest viscera crude lipid was recorded (9.16% ± 0.11) in the fingerlings fed on feed C and the least (6.76% ± 0.19) in the fingerlings fed on feed B. There was no significant difference (P

Table 2. Composition of control and formulated feeds experimented (% in dry weight basis).

Ingredient	Control	Feed A	Feed B	Feed C	Feed D
Ground nut oil cake	Nil	15	18	8	16.66
Mustard oil cake	50	15	60	12	16.66
Rice bran	50	10	2	40	16.66
Wheat bran	Nil	10	8	30	16.66
Fish meal	Nil	25	4	6	16.66
Soybean meal	Nil	25	8	4	16.66
Sodium alginate (g)	5	5	5	5	5
Vitamin[1] mineral mixture (g)	Nil	2	2	2	2
Vegetable oil (ml)	Nil	1.5	1.5	1.5	1.5
Cod liver oil[2] (ml)	Nil	1.5	1.5	1.5	1.5
Oxytetracycline (mg)	500	500	500	500	500

[1]Supplevite-M (Sarabhai Chemicals, India); [2]Cod liver oil (Sea cod, M/S Universal Medicare Ltd. Mumbai),

Table 3. Biochemical composition of control and formulated feeds experimented (% in dry weight basis).

Biochemical composition	Control	Feed A	Feed B	Feed C	Feed D
Dry matter	$92.89^{a} \pm 0.17$	$93.77^{b} \pm 0.21$	$94.01^{b} \pm 0.19$	$92.73^{a} \pm 0.28$	$93.44^{b} \pm 0.16$
Moisture	$7.11^{b} \pm 0.21$	$6.23^{a} \pm 0.16$	$5.99^{a} \pm 0.17$	$7.27^{b} \pm 0.23$	$6.56^{a} \pm 0.19$
Crude protein	$26.50^{a} \pm 0.31$	$42.00^{c} \pm 0.26$	$40.00^{b} \pm 0.21$	$25.98^{a} \pm 0.19$	$34.75^{ab} \pm 0.17$
Crude lipid	$5.80^{a} \pm 0.26$	$8.94^{b} \pm 0.19$	$9.31^{b} \pm 0.25$	$5.49^{a} \pm 0.18$	$8.22^{b} \pm 0.16$
Carbohydrate	$32.95^{b} \pm 0.18$	$12.92^{a} \pm 0.16$	$10.08^{a} \pm 0.10$	$34.63^{b} \pm 0.19$	$15.07^{a} \pm 0.22$
Ash	$8.68^{a} \pm 0.21$	$9.39^{b} \pm 0.19$	$9.45^{b} \pm 0.16$	$8.59^{a} \pm 0.26$	$9.15^{b} \pm 0.15$
Energy (kcal/g)	$3.66^{a} \pm 0.15$	$4.44^{b} \pm 0.11$	$4.65^{b} \pm 0.13$	$3.48^{a} \pm 0.16$	$4.26^{b} \pm 0.19$
P/E (mg protein/kJ)	$17.33^{a} \pm 0.22$	$22.64^{c} \pm 0.36$	$20.54^{b} \pm 0.21$	$17.18^{a} \pm 0.19$	$19.53^{ab} \pm 0.15$

Values are means ± SD. Means in the same row having different superscripts are significantly different (P < 0.05), while means in the same row with same superscript are not significantly different (P > 0.05). mg protein/kJ, Milligram protein/ kilo-Joule; SD, standard deviation.

> 0.05) in the viscera crude lipid of the fingerlings fed on control feed and feed C; feed A, feed B and feed D.

Organ indices

EVSI, VSI excluding liver and HIS of fingerlings fed on control and formulated feeds after 30 and 90 days of experiment are given in Table 5.

Eviscero-somatic index (EVSI)

The initial EVSI of the fingerlings was recorded as 93.18% ± 0.16. After 30 days, there was no significant difference (P > 0.05) in the EVSI of the fingerlings fed on control feed, feed A, feed B, feed C and feed D. Moreover, after 90 days the EVSI was recorded the highest (91.57 ± 0.19%) in the fingerlings fed on feed B and the least (88.25 ± 0.21%) in the fingerlings fed on feed C. There was no significant difference (P > 0.05) in the EVSI of the fingerlings fed on the control feed and feed C; feed A, Feed B and feed D.

Viscero-somatic index (VSI)

The initial VSI of the fingerlings was recorded as 5.61 ± 0.19%. After 30 days, there was no significant difference (P > 0.05) in the VSI of the fingerlings fed on control feed, feed A, feed B, feed C and feed D. After 90 days, the VSI was recorded the highest (8.56% ± 0.21) in the fingerlings fed on feed C and the least (6.80% ± 0.27) in the fingerlings fed on feed B. There was no significant difference (P > 0.05) in the VSI of the fingerlings fed on control feed and feed C; feed A, feed B and feed D.

Hepato-somatic index

The initial HSI of the fingerlings was recorded as 1.21 ± 0.17%. After 30 days, there was no significant difference (P > 0.05) in the HSI of the fingerlings fed on control feed, feed A, feed B feed C and feed D. After 90 days, the highest HSI was recorded (3.19% ± 0.14) in the fingerlings fed on feed C and the least (1.63% ± 0.21) in the fingerlings fed on feed B. There was no significant difference (P > 0.05) in the HSI of the fingerlings fed on

Table 4. Viscera composition (% mean wet weight basis) of fingerlings fed on control and formulated feeds after 30 and 90 days of experiment.

Parameter (%)	Initial	Control	Feed A	Feed B	Feed C	Feed D	± SEM
Observations after 30 days of experiment							
Moisture	81.65 ± 0.24	$78.86^a \pm 0.17$	$79.92^a \pm 0.16$	$80.16^a \pm 0.19$	$78.71^a \pm 0.14$	$79.43^a \pm 0.10$	0.19
Crude protein	12.16 ± 0.28	$13.32^a \pm 0.21$	$13.58^a \pm 0.16$	$13.64^a \pm 0.13$	$13.27^a \pm 0.23$	$13.46^a \pm 0.22$	0.22
Crude lipid	4.96 ± 0.18	$5.63^a \pm 0.17$	$5.18^a \pm 0.11$	$5.08^a \pm 0.14$	$5.78^a \pm 0.12$	$5.27^a \pm 0.21$	0.16
Observations after 90 days of experiment							
Moisture		$72.56^a \pm 0.37$	$78.21^b \pm 0.21$	$78.68^b \pm 0.17$	$72.12^a \pm 0.27$	$77.51^b \pm 0.10$	0.24
Crude protein		$14.92^a \pm 0.30$	$15.48^a \pm 0.12$	$15.63^a \pm 0.16$	$14.86^a \pm 0.17$	$15.16^a \pm 0.20$	0.22
Crude lipid		$8.96^b \pm 0.31$	$6.98^a \pm 0.21$	$6.76^a \pm 0.19$	$9.16^b \pm 0.11$	$7.12^a \pm 0.15$	0.19

Values are means ± SD of five replications (d.f. 5, 35). Means in the same row in the same block having different superscripts are significantly different ($P \leq 0.05$) and means in the same row in the same block with same superscript are not significantly different ($P \geq 0.05$). SEM, Standard error of mean, SD, standard deviation.

Table 5. Eviscero-somatic index (EVSI), viscero-somatic index (VSI) excluding liver and hepato-somatic index (HSI) of fingerlings fed on control and formulated feeds after 30 and 90 days of experiment.

Parameters (%)	Initial	Control	Feed A	Feed B	Feed C	Feed D	± SEM
Observations after 30 days of experiment							
EVSI	93.18 ± 0.16	$92.01^a \pm 0.14$	$92.64^a \pm 0.19$	$92.75^a \pm 0.21$	$91.87^a \pm 0.16$	$92.46^a \pm 0.18$	0.16
VSI	5.61 ± 0.19	$6.36^a \pm 0.18$	$5.99^a \pm 0.16$	$5.93^a \pm 0.15$	$6.41^a \pm 0.21$	$6.08^a \pm 0.17$	0.17
HSI	1.21 ± 0.17	$1.63^a \pm 0.16$	$1.37^a \pm 0.19$	$1.32^a \pm 0.13$	$1.72^a \pm 0.12$	$1.46^a \pm 0.11$	0.14
Observations after 90 days of experiment							
EVSI		$88.50^a \pm 0.31$	$91.43^b \pm 0.17$	$91.57^b \pm 0.19$	$88.25^a \pm 0.21$	$91.27^b \pm 0.14$	0.20
VSI		$8.43^b \pm 0.16$	$6.85^a \pm 0.21$	$6.80^a \pm 0.27$	$8.56^b \pm 0.21$	$6.92^a \pm 0.19$	0.23
HSI		$3.07^b \pm 0.24$	$1.72^a \pm 0.16$	$1.63^a \pm 0.21$	$3.19^b \pm 0.14$	$1.81^a \pm 0.21$	0.18

Values are means ± SD of five replications (d.f. 5, 35). Means in the same row in the same block having different superscripts are significantly different ($P \leq 0.05$) and means in the same row in the same block with same superscript are not significantly different ($P \geq 0.05$). SEM, Standard error of mean, SD, standard deviation.

control feed and feed C; feed A, feed B and feed D.

DISCUSSION

Viscera composition

After 90 days, the viscera crude lipid of the fingerlings increased significantly ($P < 0.05$) and viscera moisture content of the fingerlings decreased significantly ($P < 0.05$) with the increase in dietary carbohydrate level from 10.08 to 34.63%, whereas the viscera crude protein did not vary significantly ($P > 0.05$) among the fingerlings fed on control and formulated feeds. The viscera lipid content was found highest in the fingerling fed on feed C and the least in the fingerlings fed on feed B. The higher viscera lipid content in fingerlings fed on feed C and control feed was due to the inability of the common carp to utilize excess dietary carbohydrate level (above 15%) due to omnivorous feeding habit, which get converted into viscera lipid and is not desirable for economic production of fish. The least lipid content in the viscera of the fingerlings fed on feed B was due to the optimum dietary carbohydrate level (10.08%) required for common carp, which does not result in accumulation of lipid in viscera. The findings of Yigit (2001), Stone (2003), Vielma et al. (2003) and Zhen et al. (2006) who reported the increase in viscera lipid content with the increase in dietary carbohydrate content supported to present observation.

Organ indices

After 90 days, the EVSI decreased significantly ($P<0.05$) with the increase in the dietary carbohydrate level from 10.08 to 34.63%, whereas the VSI and HSI increased significantly ($P<0.05$) with the increase in dietary carbohydrate level from 10.08 to 34.63%. The excess carbohydrates got deposited in the liver and viscera as fat, hence VSI and HSI increased and EVSI decreased with the increase in dietary carbohydrate level in the present study. The EVSI was the highest, whereas viscero-somatic and hepato-somatic indexes were least in the fingerlings fed on the feed B. Furthermore, the EVSI was the least, whereas VSI and hepato-somatic index were highest in the fingerlings fed on feed C. The results of the present finding are similar to those of Lee et al. (2002), Nandeesha et al. (2002) and Kumar et al. (2010) who reported the lowest VSI and HSI in *C. carpio* fed on higher crude protein and lower carbohydrate diets. Other authors who reported the same trend also include Hamre et al. (2003), Krogdahl et al. (2005) and Gumus and Ikiz (2009).

Conclusion

Based on viscera composition and organ indices, this work concludes that a diet containing 40% protein, 9.31% lipid, 10.08% carbohydrate and having P/E ratio of 20.54 mg protein/kJ is the best for a more profitable and successful culture of the common carp.

ACKNOWLEDGEMENTS

The authors thank Prof. Pradeep Shrivasthava, Head of the Department of Zoology and Applied Aquaculture, Barkatullah University, Bhopal, Madhya Pradesh (M.P.), and Director, Indian Institute of Soil Sciences, Bhopal, for providing the laboratory facilities. The first author (Muzaffar Ahmad) thanks the University Grants Commission (UGC), New Delhi, for providing Maulana Azad National Minority Fellowship (No.F.40-14(M)/ 2009(SA-III/MANF).

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