Nepalese Journal of Biosciences 9(1): 34-41 (2019) https://doi.org/10.3126/njbs.v9i1.51729

Growth performance of *Cyprinus carpio* (Linnaeus, 1758) on the basis of formulated feeds supply

Monisha Niroula, Jay Narayan Shrestha[*] and Bharat Raj Subba

Department of Zoology, Post Graduate Campus, T.U., Biratnagar, Nepal

[*]E-mail: jnshrestha545@gmail.com

Abstract

Growth of fishes, a sole production of aquaculture, depends upon the physico-chemical parameters of the pond as well as quality and quantity of supplementary feed supplied. This study was carried out from 6th May to 20th June, 2017 on eight glass aquaria (47cm x 31cm x 32cm) at a rate of 25 fries per aquarium providing formulated feeds with different protein levels i.e. 25%, 30%, 35%, 40%, 45% and 50% as well as commercial feed as control. The highest and lowest body weight gain were 26.03g (diet with protein level 40%) and 15.77g (diet with protein level 25%) respectively. Similarly, the highest and lowest growth rate (g/day) and body weight gain (%) were (0.57 and 0.35) and 410.6 and 128.6) respectively. The highest mortality (28%) was seen in a diet with protein level 25% and lowest (Nil) in a diet with protein level 50%. The highest average weight gain (13.65g) was observed in first fifteen days at diet 40% protein level and lowest (4.01g) was seen in 16th to 30th days at diet with 25% protein level. There was no significance difference between average body weight gain and physico-chemical factors (pH, DO and temperature). The better growth performance of *C. carpio* was seen in a diet with 40% protein level. So, it is recommended for fishermen to obtain maximum production in aquaculture. Further study especially about growth in relation to formulated diet up to table size and effects of micronutrients in diet on growth performance of *C. carpio* is recommended for other researchers.

Keywords: Common carp, mortality rate, protein level, supplementary feed.

Introduction

Nepal (26º22' to 30º27'N and 80º4' to 88º12' E) covers an area of 1,47,181 km^2 having east-west length 885 km and average width 193km from north to south (CBS Nepal, 2014). The three major rivers that originate from Himalayas are Karmali, Gandaki and Koshi. The Babai, the West Rapti, the Bagmati, the Kankai and the Kamala are the rivers originating from the Middle Hills. Others are Andhi Khola, Ridi, Rosi, Pikhuwa, East Rapti, Triyuga etc which originate from the Siwalik and flow though Terai. Out of total inland water resources, rivers, lakes and reservoirs collectively comprise 48.8% paddy fields, 49% swamps, irrigated fields1.4% and village ponds 0.8% (Shrestha, 1999). These resources are suitable for freshwater fishes inhabiting 231 fish species belonging to 37 families and 114 genera (Shrestha, 2008).

Aquaculture in Nepal has relatively short history initiated in the mid-1940s on a small scale in ponds with indigenous Indian major carp's seed from India. In recent times, the

improvement of fish farming was done with the help of international agencies like, ADB, UNDP, JICA, FAO etc. Further development began in the 1950s with the introduction of exotic species common carp (*Cyprinus carpio*), worldwide cultivated fish of temperate area especially south China and Europe. It breeds naturally in lakes having high fecundity and hatchability (Nathaniel and Edirisinghe, 2001). It can grow to the maximum length of 1.5 m and a maximum weight of over 37.5 kg (Panek, 2005). In a Polyculture system, it plays important role in seasonal reservoirs and ponds (Chakraborty et al., 1982). It is most favoured species in aquaculture because of their high growth rate, its ability to tolerance environmental stress, can reproduce easily and have high market demand (FAO, 2004).

Protein is considered as the main constituent of the fish body thus sufficient dietary supply is needed for optimum growth. The need to intensify the culture of the fish so as to meet the ever increasing demand for the fish has made it essential to develop suitable diets either in supplementary forms for ponds or as complete feed in tanks (Olukunle, 2006). Several studies have high potentials for supplying fish with require protein needed for their maximum productivity (Hasting, 1976). Neither excess nor the lack in the level of protein in the feed of fish is desirable, the excess results in wastage of the energy whereas the death results in poor growth of the fish (Singh et al., 2006). The micronutrients are vitamins and minerals, which are required in small proportions. Macronutrients are proteins, carbohydrates and fats required to repair damaged tissue and to synthesize new flesh (Wooton, 2009). Synthetic or supplementary feeds play a vital role in a semi-intensive and intensive aquaculture system, which is responsible for increasing fish growth (Pandey et al., 1996) resulting potential of aquaculture to be most profitable (Nasir and Hamed, 2016).

Mohapatra and Patra (2014) reported that higher protein level (more than 35%) was better for growth of common carp. The sodium chloride supplementation in diet plays important role in growth response of the fish. About 15% of NaCl in diet for common carp was sufficient to obtain good specific growth rate, food conversion ratio and protein efficiency ratio (Nasir and Hamed, 2016). Tiamiyu et al., (2016) carried out the study that the growth of fingerlings of *Cyprinus carpio* fed on diets containing hydrothermally processed *Citrullus lanatus* seed meal at 30 minutes boiling achieved well than other diets. Some workers like Ayisi et al. (2017) and Thobaitia et al. (2018) worked on the same field in different cultivated fishes. Nasir and Hamed (2016) and Tiamiyu et al. (2016) were worked on the common carp to find the diet for maximus achievement of specific growth rate, feed conversion ratio and protein efficiency ratio. The diet with protein level more than 35% was best in common carp (Mohapatra and Patra, 2014).

Materials and Methods

Study area

Fries of experimental fish (*Cyprinus carpio*; n = 200) were brought from Jeevan Bikash Fish Farm (26.47ºN and 87.32ºE), Katahari to Laboratory of Zoology Department, Post Graduate Campus, Biratnagar for experimental work. Biratnagar (26º28'60"N and 87º16'60"E), a metropolitan city of Nepal, is most populated city belongs in Morang district, Province no. 1, Nepal, 399 km east of Kathmandu (Nepal's capital) and 6 km north

of the border of the Indian state, Bihar. It is industrial city with a total area of 103.88 km^2 and population about 214663(NPHC 2011).

Source of ingredients and formulation of experimental diets

Food ingredients were local materials like dry fish and soybean as source of protein and wheat and maize as carbohydrate source. Feed having different protein levels (25%, 30%, 35%, 40%, 45% and 50%) for different treatments (A, B, C, D, E and F) were prepared using Pearson Square Method. Commercial diet was used for control treatments.

Feed formulation

Different feed ingredients were used in preparing fish meal in different treatments viz., treatment A (TA), treatment B (TB), treatment C (TC), treatment D (TD), treatment E (TE) and treatment F (TF) using protein level percentage (Table 1).

Table 1. Different ingredients used to prepare fish meal in different treatments.

Ingredients (gm)	TA (25%)	TB (30%)	TC (35%)	TD (40%)	TE (45%)	TF (50%)
Dry fish	37.90	30.50	23.06	15.60	8.17	0.73
Soybean	37.90	30.50	23.06	15.60	8.17	0.73
Maize	24.55	31.9	39.42	46.80	54.31	61.7
Wheat	24.55	31.9	39.42	46.80	54.31	61.7

Preparation of experimental aquaria

Seven rectangular glass aquaria, each of 47cm x 31cm x 32cm dimension fitted with aerators and 25 litres capacity, were selected for the experiment. The experimental aquaria were disinfected by using $KMno_4$ of 2 ppm for 10 minutes. After that the aquaria were washed properly with tap water. Each aquarium was filled by 20 litres of dechlorinated tap water and then aeration was done for 24 hours before stocking of the fries.

Experimental procedure

The experiment was carried out in seven aquaria with 20 litres water from 6th May to 20th June 2019 (45 days). The fries were collected from the farm one day prior to start feeding trials. They were acclimatized in the laboratory for one-day feeding with commercial diet twice daily. Fries were weighed and allotted at the ratio of 25 fries per aquarium into each of seven aquaria. They were fed by 5% of their body weight. Left over feed and waste excreta were removed whenever the food and waste deposited highly by siphoning with minimal disturbance to the fish. All fishes from each aquarium were collected, counted and weighed (nearest gm) for 45 days at the interval of 15 days. Similarly, physico-chemical parameters like water temperature was recorded using laboratory thermometer dissolve oxygen by Wrinkler's method, pH by pH meter and weight of the fish by electronic scale of model KERN 572 at each week. The experimental aquaria were inspected daily to remove dead fish if present.

Statistical analysis:

The parametric variables observed in this study were weight gain, specific growth rate, feed conversion ratio and survival rate. The data obtained were presented in tabulation and statistical analysis (correlation coefficient) was done with Microsoft Office Excel 2010.

Observation and calculation of variables

The weight of fish was measured every 15 days in all experimental units. These observational data were used to calculate fish survival, specific growth rate and the feed conversion ratio.

Specific growth rate was calculated using the formula SGR= (In Wt-In Wo)/T x 100

Where: SGR = specific growth rate (% day^{-1})

W^0 = average weight of the fish at the beginning of the study (g)

Wt = average weight of the fish at the end of the study (g) and

T = duration of experiment (day)

Feed conversion ratio was calculated by using the formula FRC=FI/(Wt-Wo) x 100

Where: FRC = Feed conversion ratio (%)

Wo = the weight of fish biomass at the beginning of the study (g)

Wt = the weight of fish biomass at the end of the study (g)

FI = the weight of feed consumed (g; dry weight)

The survival rate was calculated by using the formula SR=Nt / No x100

Where, SR = survival rate (%)

Nt = the number of fish that lived at the end of the study (individual)

No = the number of fish that lived at the beginning of the study (individual)

And mortality rate (MR) (%) = 100-SR

Results

Physico-chemical parameters

Weekly water quality parameters (pH, DO and temperature) showed the mean value of pH was highest in 1st week (8.43) and lowest in 3rd week (7.60) (Table 2). Similarly, highest and lowest dissolve oxygen (DO) was in 6th week (6.85) and 2nd week (4.03). Likewise, the mean value of water temperature was highest in 6th week (29°C) and lowest in 1st week (27°C). The mean value of room temperature was highest in 6th week (30°C) and lowest in 1st week (25°C).

Table 2. Water quality parameters of experimental aquaria.

Week	pH	DO (mg/l)	Water temp (°C)	Room temp (°C)
1st week	8.43	5.24	27	25
2nd week	7.61	4.03	27.5	28.5
3rd week	7.60	5.64	28	29
4th week	7.93	5.24	28	28
5th week	7.88	6.04	28	29
6th week	7.86	6.85	29	30

The correlation of physico-chemical parameters and average body weight gain every 15 days in different dietary treatments was given in table 3. The correlation coefficient between pH and average body weight gain in treatment A (TA), treatment B (TB), treatment C (TC), treatment D (TD), treatment E (TE) and treatment F (TF) were -0.10,0.12,0.02-0.01,0.14 and 0.17 respectively. The value of correlation coefficient in treatment control was 0.16. Similarly, the correlation coefficient between DO and average

body weight in treatment TA, TB, TC, TD, TE and TF were-0.13, 0.25, 0.76, -0.08 and -0.27 respectively. The value of correlation coefficient in control was -0.26. The correlation coefficient between temperature and average body weight gain in treatment TA, TB, TC, TD, TE and TF were-0.07, 0.47, -0.22, 0.14, 0.25 and 0.35 respectively. The value of correlation coefficient in control was 0.30. There is no significant difference between the physico-chemical parameter and average body weight gain, even though, some negative values of correlation coefficient indicated that the average body weight gain would be increased with decreasing value of that parameters.

Table 3. Correlation with physico-chemical parameters and average body weight gain every 15 days

Correlation between	Coefficient of correlation						
	TA(25%)	TB(30%)	TC(35%)	TD(40%)	TE(45%)	TF(50%)	Control
1. pH and ABWG	-0.10	0.12	0.02	-0.01	0.14	0.17	-0.16
2. DO and ABWG	-0.13	0.25	0.76	-0.08	-0.27	.41	-0.26
3. temp and ABWG	-0.07	0.47	-0.22	0.14	0.25	0.35	0.30

(ABWG = Average body weight gain)

Growth response

The growth performance of the fish with different feed application rate was presented in table 4. The highest body weight gain (26.03gm;378.34%) was observed in the fish fed with TD followed by (22.22 gm; 355.52%) at TE whereas the lowest growth was observed in TA (15.77 gm; 128.62%). Growth rate (g/a day) was seen highest in TD i.e. 0.57 and lowest in TA or TC i.e. 0.35. The highest specific growth rate was observed in TD i.e.57.84 and lowest was observed in TA i.e., 35.04. The best feed conversion ratio i.e. 12.29 was observed in TD, diet with 50% protein level (Table 4).

Table 4. Growth performance of *Cyprinus carpio* fed with different feed ingredients.

Parameters	Protein level in different treatment						
	TA(25%)	TB(30%)	TC(35%)	TD(40%)	TE(45%)	TF(50%)	Control
MWS (gm)	12.26	5.81	6.34	6.88	6.25	5.25	9.78
MWH (gm)	28.03	23.71	22.72	32.91	28.47	26.81	31.21
BWG (gm)	15.77	17.9	15.93	26.03	22.22	21.56	21.42
GR (gm/day)	0.35	0.39	0.35	0.57	0.49	0.47	0.47
BWG (%)	128.62	308.08	251.26	378.34	355.52	410.66	218.90
SGR (% /day)	35.04	39.77	35.4	57.84	49.37	47.91	47.62
FCR(%)	20.29	17.87	20.08	12.29	14.40	14.84	14.93
SR (%)	72	76	80	96	88	100	87
MR (%)	28	24	20	4	12	0	13

(MWS = Mean weight of stocking, MWH = Mean weight of harvest, BWG = Body weight gain, GR = Growth rate, SGR = specific growth rate, FCR = feed conversion ratio, SR = survival rate, MR = mortality rate.)

The average weight gains of the fish at every 15 days in various treatments showed that growth of the fishes was more in 1st and last 15th days whereas middle 15th days had slow growth rate (less weight gain) (Table 5).

Table 5. Average weight gain of fish every 15 days in varying level of treatments.

BWG(gm)	1st to 15th day	16th to 30th day	31st to 45th day
TA	4.96	4.01	6.80
TB	6.10	6.00	5.80
TC	4.73	4.50	7.60
TD	13.65	4.88	7.50
TE	7.66	6.66	7.90
TF	8.20	5.46	6.90
Control	7.2	5.96	8.20

Discussion

Experimental diets of different protein levels (25%, 30%, 35%, 40%, 45% and 50%) were formulated from locally available materials such as dry fish, soybean, maize and wheat. During experiment pH ranged from 7.8 to 8, DO from 5.38 mg/l to 6.15 mg/l and the temperature from 27ºC to 27.9ºC. Among six different treatments, treatment D (diet with 40% protein level) showed best growth performance.

The correlation coefficient between pH and average body weight gain per week in treatment D was negative (-0.10) and that of DO was also negative (-0.08). The correlation coefficient of temperature with the average body weight was 0.014. They indicate that the physico-chemical factors (pH, DO and temperature) have no significant difference with average weight gain per week.

During experiment, body weight gain, growth rate and specific growth rate were highest in diet with protein level 40% and lowest in diet with protein level 25%. The highest feed conversion ratio (20.29) was in diet with 25% protein level and lowest (12.29) in diet with 40% protein level. The survival rate ranged from 72% to 100%. The growth of the fries in 15 days was good but later the growth was slow and steady. This might be because of the deprivation of the natural habitat, where they consume larvae of small insects and aquatic plants and might be because of absence of micronutrients like vitamins, minerals, antibiotic etc., in the formulated feed and high concentration of uneaten foods and faeces which may increase the bacterial activities and leads to depletion of oxygen level in water. Growth rates appeared to increase protein level up to 40% though further incease in protein level (45%) diet did not show significant result in common carp. Dupree and Huner (1984) reported that weight gain in fish is directly proportional to the protein level of diet which does not exceed 50%. This study supports that finding i.e., best weight gain in diet with crude protein level 40% in the present experiment. Renukaradhya and Vargese (1986) reported the best growth results for feed containing 30% and 40% crude protein in carps. Their findings showed that more than optimum level of protein in feeds had an adverse effect on growth. Their findings supported the present study i.e. maximum growth rate on diet with 40% crude protein level. Jader and Al-Sulevany (2012) recorded the highest growth in 30% protein diet, which did not corroborate the finding of the present study. The feed conversion ratio was best in a diet with protein level 35% with a value of 20.08, similar to report of ADCP (1993), which stated that the best growth rates and feed conversion were achieved with diet containing 35%-42% crude protein.

The survival rate in the present study ranged from 72% to 100%, which is nearby the report of Carvalho et al. (1997) stated the survival rate of common carp ranges from 71% to 97%. The best growth performance was recorded the present study at pH 7.85 which is similar to the report of Naerls (1996) and Heydarnejad (2012). They reported best growth performance of carp to have occurred at pH ranging from 7.5 to 8. According to Nasir and Khalil (2016) the optimum water temperature for common carp growth is between 25ºC-30ºC. This result was also occurred in the present experiment as highest growth rate with water temperature at 27.1ºC.

This study conclude that water parameters affected the growth and body composition of *Cyprinus carpio*. Fish reared in the diet with crude protein level 40% showed better growth performance than other diets.

Recommendations

Fish feed should be prepared from locally available materials like dry fish, soybean, wheat, maize using formula. The present experiment studies significance of the growth performance of *C. carpio* fries on different diets during only their early stages i.e. 45 days. So further studies are recommended to determine the growth trend of common carp fed on the same diet up to maturity. The analysis of experimental fish diets is also required to determine other micronutrients like vitamins, minerals and their effects on the growth rate of fish.

References

ADCP 1993. Fish feeds and feeding in developing countries. *An interim report on the ADCP feed development programme, Rome, Italy.* FAO-ADCP/REP/83/18:97.

Ayisi, C.L., Z. Jinliang & J.R. Emmanuel 2017. The growth performance, feed utilization, body and fatty acid composition of Nile tilapia (*Oreochromis nilotica*) fed diets containing elevated levels of palm oil. *Aquaculture and fisheries* 2: 67-77.

Carvalho, A.P., A.M. Escaffre, A. Oliva Teles & P. Bergot 1997. *Aquaculture International* 5: 361-367.

Central Bureau of Statistics 2014. *Statistical pocket book of Nepal*. Government of Nepal, National Planning Commission Secretariat, Kathmandu, Nepal.

Chakraborty, R., M. Haag, ADCP, N. Ryman & G. Stahl 1982. Hierarchical gene diversity analysis and its application to brown trout population data. *Hereditas* 97(1): 17-21.

Dupree, H. K. & J. V. Huner 1984. Nutrition, feeds, and feeding practices. In: *Third Report to the Fish Farmers. U.S. Deparment of interior, fish and wildlife service*. Pp. 141-157.

FAO. 2004. *Aquaculture production*. Book of Fishery Statistics of the United Nations, Rome, Italy, 96/2.

Hasting, W.H. 1976. *Nutritional requirements and field technology in advances in aquaculture*, paper presented at the F.A.O. Technical Conference on Aquaculture, Kyoto, Japan.

Heydarnejad, M.S. 2012. Survival and growth of Common carp (*Cyprinus carpio* L.) exposed to different water pH levels. *Turkish journal of Veterinary and Animal Science* 36(3): 245-249. DOI: 10.3906/vet 1008-430.

Jader, F.A.M. & R.S. Al-Sulevany 2012. Evaluation of common carp *Cyprinus carpio* L. performance fed three commercial diets. *Mesoptamia Journal of Agriculture* 40: 20-26.

Mohapatra, S.B. & A.K. Patra 2014. Evaluation of nutritional value of water lettuce (*Pistia stratiotes*) meal as partial substitution for fish meal on the growth performance of *Cyprinus carpio* fry. *International Journal of Agricultural Science and Research* 4(3): 147-153.

Naerl, S. 1996. *National Agricultural Extension and Research Liaison Services Water Quality Management in Fish Culture*. Extension Bulletin No. 98, Fisheries Series No. 3.

Nasir, M. & M. Khalil 2016. The effect of natural filter on the growth, survival and water quality in ornamental goldfish (*Cyprinus carpio*) culture. *Acta Aquatica* 3(1): 33-39.

Nasir, N.A. & Q. Hamed 2016. Growth development of young common carp *Cyprinus carpio* through dietary sodium chloride supplementation. *Mesopotamia Environmental Journal* 2(2): 12-18.

Nathaniel, S. & U. Edirisinghe 2001. Abundance and aspects of the reproductive biology of common carp (*Cyprinus carpio*) in an upland reservoir in Srilanka. *Asian Fisheries Science* 14: 343-351.

National Population and Housing Census (NPHC) 2011 (National report) 2012. Government of Nepal, National Planning Commission Secretariat, Central Bureau of Statistics, Kathmandu, Nepal, 1. pp 270.

Olukunle, O. 2006. Nutritive potential of sweet potato peel meal and root replacement value for maize in diets of African catfish (*Clarias gariepinus*) advanced Fry. *Journal of Food Technology* 4(4): 289-293.

Pandey, B.N., M.D. Fasihuddin & J. Kumari 1996. Studies on supplementary feeding and their influence on the growth of an air breathing Siluroid fish, *Clarias batrachus* (Linn.). *Journal of Freshwater Biology* 8(2): 109-112.

Panek, F.M. 2005. Epizootics and disease of coral reef fish in the Tropical Western Atlantic and Gulf of Mexico. *Reviews in Fisheries Science* 13(1): 1-21.

Renukaradhya, K.M. & T.J. Vargese 1986. Protein requirement of the carps, *Catla catla* (Hamilton) and *Labeo rohita* (Hamilton). *Animal Sciences* 95:103-107.

Shrestha, J. 1999. Coldwater fish and fisheries in Nepal. *FAO Fisheries Technical Paper* No. 385: 13-40.

Shrestha, T.K. 2008. *Ichthyology of Nepal; A study of fishes of the Himalayan water*. Himalayan Ecosphere, Kathmandu. pp 390.

Singh, P.K., S.R. Gaur & S.P. Tiwari 2006. Growth response, survival, feed conversion and protein utilization in fingerlings of Rohu, *Labeo rohita* (Hamilton) to diets of different protein levels. *Journal of Fisheries and Aquatic Science* 1: 97-101.

Sultana, S.M., M. Das & S.C. Chakraborty 2001. Effect of feeding frequency on the growth of common carp (*Cyprinus carpio* L.) fry. *Bangladesh Fisheries Research* 5(2): 149-154.

Thobaitia, A., K. Ghanima, Z. Ahmeda, E.M. Sulimana & S. Mahbooba 2018. Impact of replacing fish meal by a mixture of different plant sources on the growth performance in Nile Tilapia (*Oreochromis niloticus* L.) diets. *Brazilian Journal of Biology* 78(3): 525-534.

Tiamiyu, L.O., V.T. Okomoda & A. Aende 2016. Growth performance of *Oreochromis niloticus* fingerlings fed *Moringa oleifera* leaf as replacement for soybean meal. *Journal of Aquaculture Engineering and Fisheries Research* 2(2): 61-66

Wooton, R.J. 2009. *Fish Ecology*. Springer (India). pp. 98-131.