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Effect of organic manure and inorganic fertilizer on the growth and proximate composition of common carp, *Cyprinus carpio*

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Abstract

The experiment was conducted to evaluate the effect of chicken manure and inorganic fertilizer (single super phosphate and urea) on growth performance viz. increase in wet body weight, length, specific growth rate (SGR), condition factor (CF), survival rate and proximate composition of *Cyprinus carpio*. Experimental water in tubs was treated in duplicates with low (PT_1) @8000 $kgha^{-1}$, medium (PT_2) @10,000 $kgha^{-1}$ and high (PT_3) @12,000 kg/ha doses of chicken manure and also with low, medium and high dose of inorganic fertilizer(urea + SSP) @ 104 $kgha^{-1}$ + 155 $kgha^{-1}$ (IT_1), @218 $kgha^{-1}$ + 310 kg/ha (IT_2) and 322 $kgha^{-1}$ +470 $kgha^{-1}$ (IT_3) respectively, along with control. At the end of the experiment, *C. carpio* showed maximum growth in PT_2 with significant higher SGR and CF. Survival rate ranged between 93.3 to 100 % in all the treatments. Level of crude protein and total fat were also highest in PT_2. Moisture and carbohydrate showed no significant changes while ash content changed significantly in all the treatments and control. These observations indicate that chicken manure alone was effective to stimulate productivity and growth of fish without affecting proximate composition of fish meat.

Key words

Chicken manure, Fish, growth, Inorganic fertilizer, Proximate composition

Introduction

Increasing attention has been paid towards recycling of various agricultural and animal wastes through aquaculture production process for enhancing fish yield in India. The major objective of utilizing wastes in fish farming system is to recycle different nutrient elements present in such wastes. Due to energy crisis, prohibitive cost of chemical fertilizers and poor purchasing power of marginal and small farmers, it is necessary to use organic manure/waste to its maximum potential with proper technology to meet the shortage of chemical fertilizer under sustainable fish pond ecosystem. Pond fertilization practices using animal wastes are widely used in many countries to sustain productivity at low costs (Gupta and Noble, 2001; Majumder *et al.,* 2002) since soluble organic matter supplied to ponds by using manure stimulate phytoplankton growth (Sevilleja *et al.,* 2001). Moreover, it also increases biomass of zooplankton and benthic organisms. Consequently, animal wastes lead to increased biological productivity of ponds through various pathways, which result in an increase in fish production (Dhawan and Kaur, 2002). Several studies showed that an organic supplements contributed to fish yield by supplying P, N_2 and C for algal growth and by stimulating detritus production and heterotrophic utilization. There are many kinds of fertilizers including organic and inorganic and these fertilizers fresh feed or both are manipulated in fish ponds to increase production (Ulikowski *et al.,* 2003; Guler *et al.,* 2008).

India has vast resource of livestock and poultry, which play a vital role in improving the socio-economic conditions of rural masses. Livestock wastes including animal manure and poultry by-products, which are a menace

to the environment, are sources of wealth creation in fish farming (Adewumi *et al.* 2011). Fertilization of fish pond is a management practice and most economical way of achieving better production by enriching pond productivity. Evaluation of fertilization value of different organic manure (cow, chicken and pig) has subject to research in aquaculture (Duda, 1994). The livestock wastes such as cow-dung, poultry and pig excreta, goat and sheep pellets in fish culture are useful in enhancing the production of fish food organisms as well as in cutting down the expenditure on costly feeds and fertilizers. Livestock manure as source of organic fertilizer for fish ponds and biogas production can help reduce cost of investment in purchasing inorganic fertilizers. With the present high cost of pelleted fish feeds, integrated fish farming with livestock stands to reduce the cost of feeding fish while simultaneously increasing the yield, leading to high economic returns Ogello (2013). Poultry production wastes have inherent qualities that make them particularly valuable for fish production compared to other livestock wastes. Poultry manure is a complete fertilizer, with characteristics of both organic as well as inorganic fertilizers.

It is well known that high fish yield can be achieved by higher abundance of plankton in pond (Jha *et al*., 2004). However, sustainable and successful freshwater fish culture depends upon scientific basis principally the use of adequate, economically viable and environmental friendly techniques. Among the techniques, manure usage at different rates and quality may significantly influence water quality and assist in defining optimal conditions for continuous culture of plankton. Although substantial amount of literature is available on nutrition and culture of carps (Keshavanath *et al.*, 2002; Manjappa *et al.*, 2002), growth and meat quality of the common carp in organically manured culture systems have not been well documented. The adoption of common carp for the present experiment is more promising because it leads to higher fish production, due to its fast growth and hardy nature. Moreover it keeps nutrients in suspension due to its burrowing nature. *C. carpio* has the ability to survive under various climatic conditions and is found to be the most suitable for many fish farming systems. In view of the above present study was undertaken to assess the effects of chicken manure and inorganic fertilizer (urea & single super phosphate) on growth and meat quality of *C. carpio.*

Materials and Methods

The fingerlings of common carp were procured from the Government fish farm, Jammu, India and were acclimatized in laboratory condition for one month before exposure to different treatment. The study was conducted in fourteen plastic tubs of 100 litres capacity. The experimental tubs were cleaned; Fresh soil was spread to a height of 5 cm in completely dried tubs. The soil was treated with quick lime at the rate of 250 $kgha^{-1}$. Three days after application of lime, the tubs were filled with water. Water depth was maintained at 40 ± 2 cm height during the experimental period. Water in the tubs was allowed to stabilize for two days prior to fertilization. To study the effect of different application rates of chicken manure and inorganic fertilizer on growth and proximate composition, fish were treated for 60 days with the following treatments Control: No fertilizer was offered. The ration treatment included the daily application of conventional feed i.e. rice bran and oil cake (1:1) @ 5% body weight. Treatment 1: Organic manure (chicken manure) was applied at three doses of low (PT_1) @8000 $kghayr^{-1}$, medium (PT_2) @10000 $kghayr^{-1}$ and higher (PT_3) @12000 $kghayr^{-1}$. Half of the total quantity was applied as basal dose 15 days prior to stocking of fingerlings. The remaining amount was applied in equal splits at bimonthly intervals. Treatment 2: Inorganic fertilizers in the form of urea (U) and single super-phosphate (SSP) were also added at the three different doses low (IT_1) (104 $kgha^{-1}$+155 $kgha^{-1}$), medium (IT_2) (218$kgha^{-1}$+310$kgha^{-1}$) and high (IT_3) (322$kgha^{-1}$ + 470$kgha^{-1}$) in 1:1 ratio, respectively in fortnightly doses as source of nitrogen and phosphorus.

Mean weight and length of experimental fish were measured initially and at the end of the experiment to determine specific growth rate and condition factor. Fish were also observed daily for any mortality to know the survival rate. For meat quality analysis, the samples of muscle tissue were collected initially before exposure and after 60 days at the end of the experiment. The muscle tissue samples were collected on ice bed and were immediately stored at -20^0 C till the analysis. Data were tested by using two-way ANOVA (analysis of variance). Significance was tested at 5% level. All the statistical analysis was performed via employing Tukey descriptive statistical methods.

Results and Discussion

Treatments with chicken manure and inorganic fertilizers caused greater changes in fish weight when compared to the same factor in control. Significant increase in final weight was recorded in all the treatments and gained maximum weight in PT_2 as compared to other treatments (Table 1). SGR and condition factor were also significantly higher in PT_2. SGR was also better in IT_2 and IT_3 (Table 1). The results showed that by the end of the experiment the increase in condition factor value was seen in PT_2 and PT_3, ie. from 4.28 to 4.86 and from 4.19 to 4.20. Rest of the treatments showed decrease in condition factor however changes were non-significant (Table1). As for the values of survival rate were concerned, the best survival rates 100% were seen in PT_1, PT_3 and IT_1 while it was recorded as 93.99% in C, PT_2, IT_2 and IT_3 respectively (Table1).

Table 1.: Effect of low, medium and high doses of chicken manure and inorganic fertilizer (SSP and urea) on growth parameters of *Cyprinus carpio* during 60 days of experiment

	Treatments						
Parameters	**C**	**PT_1**	**PT_2**	**PT_3**	**IT_1**	**IT_2**	**IT_3**
Initial weight (g)	25.27^{a} ± 0.50	27.25^{a} ± 0.80	30.00^{a} ± 0.50	30.17^{a} ± 0.49	31.30^{a} ± 0.15	25.91^{a} ± 0.18	30.00^{a} ± 0.35
Final weight (g)	25.75^{a} ± 0.09	29.59^{b} ± 0.75	35.10^{c} ± 0.30	31.18^{b} ± 2.44	32.31^{bc} ± 0.88	28.11^{b}.± 0.48	32.25^{bc} ± 1.0
Initial length (mm)	87.6^{a} ± 0.11	84.50^{a} ± 0.02	87.70^{a} ± 0.02	83.10^{a} ± 0.14	85.40^{a} ± 0.08	82.10^{a} ± 0.20	82.6^{a} ± 0.28
Final length (mm)	89.20^{a} ± 0.17	86.00^{a} ± 0.49	88.4^{a} ± 0.48	84.30^{a} ± 1.28	86.8^{a} ± 0.15	83.00^{a} ± 0.14	84.2^{a} ± 0.15
Specific growth rate(%	0.058^{a} ± 0.11	0.099^{a} ± 0.23	0.231^{c} ± 0.53	0.074^{a} ± 0.44	0.063^{a} ± 0.21	0.182^{b} ± 0.34	0.154^{b} ± 1.00
Initial condition factor (K)	4.15^{a} ± 14.92	4.44^{a} ± 22.0	4.28^{a} ± 8.15	4.19^{a} ± 8.03	4.51^{a} ± 11.83	4.37^{a} ± 15.93	4.21^{a} ± 21.22
Final condition factor (K)	4.14^{a} ± 33.0	4.36^{a} ± 21.34	4.86^{b} ± 11.78	4.20^{a} ± 13.75	4.44^{a} ± 15.30	4.27^{a} ± 25.00	4.21^{a} ± 27.11
Survival rate (%)	93.33	100.00	93.33	100.00	100.00	93.33	93.33

Mean ± S.E bearing similar superscript with small alphabet in the row do not differ significantly with each other.

Table 2.: Effect of low, medium and high doses of chicken manure and inorganic fertilizer (SSP and urea) on proximate composition of *Cyprinus carpio* after 60 days of experiment

		Treatments						
Parameters	**Initial**	**Control**	**PT1**	**PT2**	**PT3**	**IT1**	**IT2**	**IT3**
Moisture (%)	80.83^{a}± 0.05	81.08^{a} ± 0.15	81.01^{a} ± 0.41	80.24^{a} ± 0.24	80.91^{a} ± 0.23	81.43^{a}± 0.41	80.13^{a}± 0.10	80.21^{a} ± 0.04
ash (%)	1.24^{a} ± 0.00	1.34^{ab}± 0.05	1.40^{ab} ± 0.02	1.37^{ab} ± 0.01	1.37^{ab} ± 0.01	1.38^{ab} ± 0.06	1.43^{ab} ± 0.01	1.54^{ab} ± 0.04
Total fat (%)	1.06^{a} ± 0.00	1.10^{a} ± 0.10	1.36^{b} ± 0.06	1.42^{b} ± 0.02	1.26^{b} ± 0.01	1.33^{b} ± 0.01	1.33^{b} ± 0.01	1.35^{b} ± 0.15
Crude protein (%)	16.06^{a}± 0.00	15.20^{a} ± 0.00	15.82^{a} ± 0.43	16.97^{a} ± 0.25	15.88^{a} ± 0.26	15.78^{a}± 0.44	15.76^{a} ± 0.24	15.43^{a} ± 0.11
Carbohydrates (%)	0.19^{a} ± 0.00	0.04^{a} ± 0.00	0.04^{a}± 0.22	0.09^{a} ± 0.04	0.03^{a} ± 0.25	0.07^{a} ± 0.05	0.03^{a} ± 0.02	0.17^{a} ± 0.04

Mean ± S.E bearing similar superscript with small alphabet in the row do not differ significantly with each other.

In the present experiment, growth of *C. carpio* in medium dose of chicken manure treatment was higher that of inorganic treatments and control, reflecting the ability of common carp fingerling to extensively feed on the available natural food and convert it into flesh and favourable physio-chemical parameter for survival and growth. Vohra *et al.* (2011) found similar results for *C. carpio* treated with poultry manure. The present study findings agreed with Jha *et al.* (2004) who used low dose (10 $kgpond^{-1}$) of cow dung manure and poultry excreta to study the effect of manures on water quality and fish growth of *C. carpio* and they found chicken manure was optimum for both water quality and fish growth parameters. Suresh Babu *et al.* (2013) also observed significantly higher growth of *Catla catla* when cultured in a manured pond with feed supplementation compared to fish cultured in the unfertilized pond. This increase in growth parameters seems to be due to the application of artificial feed and organic manures together in earthen ponds as compared to artificial feed alone. According to Azim *et al.* (2002) major carps showed higher growth rate in fertilized pond with the provision of supplemental feed. Study of Suresh Babu *et al.* (2013) also indicated that enhancing natural food through manuring fish pond resulted in higher contribution in fish nutrition and reduced the amount of supplemental feed requirement. Mc Nabb *et al.* (1990) reported that fertilization of fish pond increases the production of phytoplankton in pond and more food items are available for fish. Abd *et al.* (2001) reported that organic fertilizer with supplementary feed had higher fish yield in comparison to chemical fertilization or organic fertilization treatments alone.

At the end of the experiment, meat samples of exposed as well as control fish were collected from experimental tubs to investigate the influence of organic

manure and inorganic fertilizer on meat quality for its proximate composition. Table 2 shows the proximate composition of *C carpio* at initial and at the end of the experiment i.e. 60 days. Proximate analysis of fish meat revealed that chicken manure and inorganic fertilizer changed the level of crude protein and fat in treated fish under different treatments, crude protein and fat both being lowest in control and highest in PT2 treatment (Table 2). However, there was no significant difference in the moisture level among the treatments and control. This is indicative of protein accretion and true growth involving an increase in the structural tissue such as muscle (Fafioye *et al*., 2005). The high nutritional value of fish meat is reflected in favourable content of proteins, carbohydrates, minerals and vitamins (Ćirković *et al.*, 2002). Chemical composition of fish varies greatly from one species and one individual to another, depending on age, feed, environment and season Ćirković *et al* (2011). Alasalvar (2002) and Pei-Song (2013) also reported that the discrepancy in nutritional quality between the muscles of the different fish was closely linked with diet, physical conditioned, living environments, expressional levels of genes, and so on. Under the six treatments, PT1 came up with the best treatment containing maximum protein and total fat However, both the protein and fat content of control fish were lower than all the treatments because of slow growth under this treatment and a long period of restricted food supply because of its omnivorous feeding habit as *C. carpio* not completely depends on supplementary feed. The energy value of fish meat is directly proportional to fat content *Buchtova et al.,* 2007; *Zakes et al*., 2010). Fatty acids produced by heating fat are indispensable components of flavour. High levels of PUFA may significantly increase the flavour, and to some extent make the muscles juicier (Mao and Zhao, 2007). Codier *et al.,* 2002 observed that the fatty acid composition of the 2 species was closely related to fat in food sources, season, water temperature, physical and chemical factors of the water, light, etc. Ash content (Table 2) was significantly changed in both controls as well as different treatment in comparison to initial values attributed to higher level of fiber in poultry manure and planktons. A non-significant decline was observed in carbohydrate content in control and treatment in comparison to initial value (Table 2).

Miroslav *et al.* (2012) reported that organic fertilization with livestock manure is a very cheap and effective method of increasing practically all nutrient components in fish pond ecosystems. Indeed, rearing of fish in poly-culture on natural food with fertilization results in satisfactory fish production with a preferable fatty acid composition (*Steffans and Wirth*, 2007). So it may be concluded that fish rearing on natural food with the use of livestock manure achieved satisfactory results in terms of final weight and their nutritive composition.

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