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Impact of *Azolla* fed poultry excreta on water qualities and performance of common carp

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Abstract
An attempt was made to study the impact of excreta from poultry birds fed with different levels of *Azolla* on water quality and performance of common carp. Day old broiler chicks were reared and brooded for 14 days on commercial pre-starter diet and from 15th day broilers were supplemented with 2 and 4% *Azolla* in their basal feed. Excreta from these birds were collected, sun dried and mixed with basal diet of fishes in ratio of 50:50 (Basal diet: excreta). 60 fingerlings of common carp were procured from Government fish hatchery, Jammu, acclimatized for one month with basal feed and regular water exchange. Experimental water in tubs of 100 L capacity was treated in duplicates along with control for a period of 28 days. There were no mortality and adverse impact was observed in behaviour of experimental fish. No significant differences were observed in growth parameters of fishes which may be attributed to short duration of experiment. All the water quality parameters were found to be in permissible limits indicating that *Azolla* fed poultry excreta did not have any adverse impact on water quality and performance of fish. Based on the observation it is revealed that *Azolla* may be used as a supplementary feed ingredient under poultry fish integration system.

Keywords: Feeding, excreta, poultry, Azolla, fish

Introduction
Poultry industry has become one of the largest and fastest growing sectors of livestock production globally and in India. As per livestock censes 2011-12 (Annual report, Govt. of India, 2018) poultry has a population of 729.2 million with an increase of 12.39% over the previous census, 2007. Availability of quality feed at a reasonable cost is a key to successful poultry operation. Alternative feed sources are being studied to reduce the cost of feed in poultry sector without affecting its production (Basak *et al*., 2002) [4]. Poultry and fish can be integrated in many ways and benefit can be extend to both *i.e* recycling of wastes of poultry, additional source of income from same unit land, diversification of products and employment (Sharma *et al*., 1998; Kumar *et al*., 2012) [22, 14]. The feed given to the livestock is voided as excretory waste including non-digested feed, metabolic excretory products and residues resulting from microbial synthesis contains considerable amount of nutrients for fish production (Fashakin *et al*., 2002) [9]. Due to the short digestive tract of poultry, 80% of chicken manure includes undigested feed-stuff (Chen, 1981) with as high as 20-30% total protein (Pudadera *et al*, 1986) [18]. Thus, the type of feed ingredients fed to the poultry can affect the subsequent manure quality which if use in fish pond may affect the pond environment and productivity. Chicken excreta can be used either directly on-site, through the sitting of poultry houses over ponds, or after collection, storage and transport to the site of fish culture (Little and Satapornvanit., 1996) [15]. However, literature is lacking on such studies have been taken place on the utility of poultry droppings from birds fed with different feed ingredient for fish culture. Hence, the present study was designed to access the impact of excreta from *Azolla* fed poultry on water quality and growth performance of Common carp in poultry fish integration.

Materials and Method
28 days experiment was conducted during the month of September-October, 2017. The poultry was reared for 42 days including 14 days of brooding period with commercial diet. The birds were fed on experimental diet from 15th day on words till 42 days.

Birds and their management
Day old unsexed chicks were weighed and brooded for 14 days on deep litter system. After brooding chicks were randomly distributed to three treatment groups of similar body weight

range and average group weight with equal number of birds. All the treatments were in duplicate consisting of maize-soybean formulated basal diet to the Control (TC) while with 2% *Azolla* (TA1) and 4% *Azolla* (TA2) as feed supplement. Fresh fecal samples of birds from each groups were collected, sun dried for one day and then was incorporated in the fish feed.

Fishes and their management

A total of 100 fishes with average weight 50.23 g (range 45.5-60.5 g) and average length 15.33 cm (range 12.0-20.5 cm) were procured from Government fish hatchery, Jammu and acclimatized for 1 month in 1000 litre tank. During acclimatization fish were fed with oil cake and rice bran in 1:1 ration at 5% body weight and partial replacement of water daily. After acclimatization fishes were randomly distributed in three treatment groups having two replicates in each group. During treatment fishes were fed with @5% body weight twice a day. The treatment were Control (PC), PTA1 (50% basal diet+ 50 % excreta from 2% *Azolla* fed birds) and PTA2 (50% basal diet+ 50 % excreta from 4% *Azolla* fed birds). Water was changed twice per day during the experiment and was tested daily for temperature and pH, while dissolved oxygen (DO), free CO_2 and total solids were observed bi-weekly from each tub. All determinations were carried out according to the Standard Methods of American Public Health Association (APHA, 1998).

Statistical analysis

The results were analysed statistically for analysis of variance and least significant difference test using the software of statistical package for social sciences (SPSS 16.0) and as per Snecdor and Cochran (1980) [23].

Results and Discussion

Temperature

Temperature has great effect on aquatic life as with the increase in temperature there is decrease in dissolved oxygen content, increase respiration and metabolic rate of aquatic life (Fishdoc, 2008; UNEP GEMS/Water Programme, 2006) [10]. Each organism thrives under a specific range of environmental temperature for its survival and beyond these limits, conditions can become lethal. As shown in table 1 and Figure 1 the mean values of water temperature in all the treatments was optimal for carp rearing throughout the period of this experiment. The water temperature did not show any significant changes among the treatments however with the progress of the experiment water temperature decreased due to decrease in the atmospheric temperature. Over all mean showed that the temperature of the treatments was in the range of 22.78 to 23.35ºC.These results are in line with Jhingran (1983) who observed that carps thrive well in the temperature range of 18.3-37.8°C. Bhatnagar *et al.*, (2004) [5] also suggested that the level of temperature at 28-32 ºC is conducive for tropical major carps.

Table 1: Mean ± SE values of water temperature (ºC) in different treatments during experimental period of 28 days

Week	PC	PTA1	PTA2
1st	25.61±0.04^{c}	25.14±0.00^{c}	25.75±0.11^{c}
2nd	23.71±0.14^{b}	23.67±0.31^{b}	23.71±0.00^{b}
3rd	21.18±0.04^{a}	21.64±0.21^{a}	21.62±0.46^{a}
4th	21.46±0.04^{a}	21.50±0.21^{a}	21.86±0.07^{a}
Total Mean ± SE	22.78±0.08	22.84±0.16	23.35±0.10

Mean ± SE with different superscript in rows differ significantly (P<0.05) for each treatment

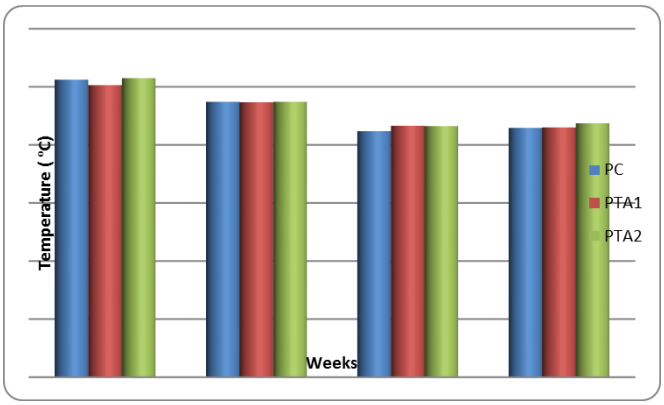

Fig 1: Mean ± SE values of water temperature (ºC) in different treatments during experimental period of 28 days.

Water pH (Hydrogen ion concentration)

pH is affected by processes such as dissolution of atmospheric carbon dioxide, acid rain, respiration, decay of organic matter, oxidation of compounds, photosynthesis, pollution etc. As shown in table 2 and Figure 2 the overall mean of pH in different treatments including control is ranged from 9.49 to 9.50 with no significant differences. The mean value of pH of water of the experiment site i.e. R.S. Pura, Jammu is in the range of 9.4 (water quality Data 2011, CPCB ENVS). Santhosh and Singh (2007) [20] reported that ideal pH level is between 7.5 and 8.5 and suitable pH range for fish culture is between 6.7 and 9.5, above and below is stressful to the fishes. As reported Ellis (1973) pH values ranged from about 6.5 to 9 at dawn are most suitable for fish production. It is revealed from the observations that experimental diets do not have any impact on water pH.

Table 2: Mean ± SE values of water pH in different treatments during experimental period of 28 days.

Week	PC	PTA1	PTA2
1st	9.55±0.004	9.53±0.019	9.52±0.008
2nd	9.50±0.02	9.53±0.018	9.50±0.009
3rd	9.45±0.023	9.45±0.038	9.50±0.025
4th	9.45±0.037	9.50±0.024	9.47±0.009
Total Mean ± SE	9.49±0.008	9.50±0.015	9.50±0.015

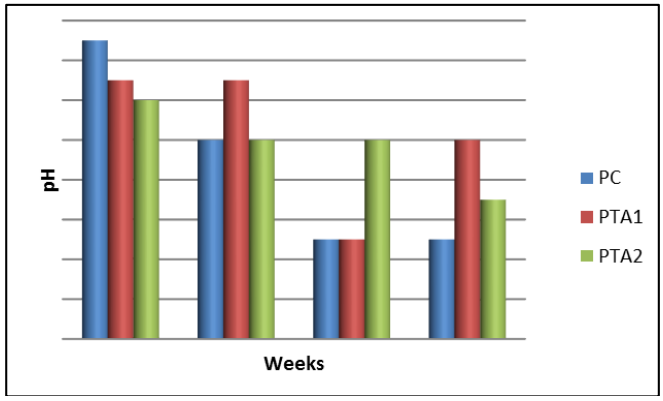

Fig 2: Mean ± SE values of water pH in different treatments during experimental period of 28 days

Dissolved oxygen (DO)

Dissolved oxygen (DO) is by far the most important chemical parameter in aquaculture (Swann, 1990). As depicted in table 3, figure 3 over all mean of DO ranged 6.23 to 6.24 with no

significant difference between the treatments. During 1st to 3rd week there was no significant difference in DO but in 4th week it was significant differences in C and TA1 due to negative co-relation of DO with temperature. The values of DO were within the safe limit as warm water fish requires DO ≥ 5 mg/l for good growth and reproduction (Swingle, 1969). The dissolved oxygen in integrated fish-poultry farming experimental ponds were recorded in the range of 6.6 to 9.9 was reported by Safi *et al*., (2016) [19]. Paul *et al*., (2018) [17] stated that DO ranged from 5.4 to 8.7 mg/l in small-scale poultry-cum-fish farming in homestead ponds was supportive for biological productivity.

Table 3: Mean ± SE values of Dissolved Oxygen (mg/l) in water from different treatments during experimental period of 28 days

Weeks	PC	PTA1	PTA2
1st	6.22±0.005[a]	6.22±0.008[a]	6.22±0.030[a]
2nd	6.24±0.040[a]	6.24±0.003[a]	6.23±0.020[a]
3rd	6.24±0.035[a]	6.26±0.005[a]	6.23±0.048[a]
4th	6.35±0.013[b]	6.32±0.015[b]	6.29±0.003[a]
Total Mean ± SE	6.23±0.003	6.24±0.005	6.23±0.021

Mean ± SE with different superscript in rows differ significantly (P<0.05) for each treatment

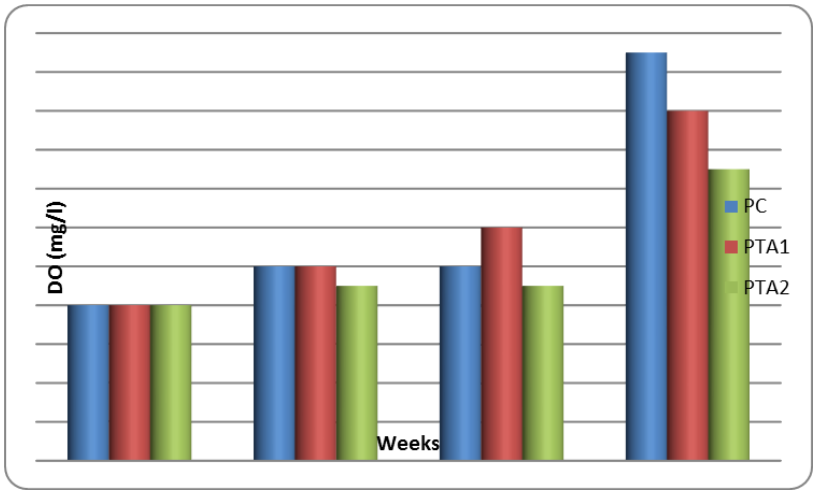

Fig 3: Mean ± SE values of Dissolved Oxygen (mg/l) in water from different treatments during experimental period of 28 days

Free CO_2

CO_2 is not considerably toxic to fish as most species will survive for several days in water containing up to 60 mg/L, provided oxygen is plentiful. The value of free CO_2 level in this experiment was 10.53 in all treatments as depicted in table 4, Figure 4. No significant differences were found between the treatment and control. According to Ekubo and Abowei (2011) [7] tropical fish can tolerate CO_2 levels over 100 mg/L but the ideal level of CO_2 in fish ponds is less than 10 mg/L. Bhatnagar *et al*., (2004) [5] suggested 5-8 ppm is essential for photosynthetic activity, 12-15 ppm is sub lethal to fishes and 50-60 ppm is lethal to fishes.

Table 4: Mean ± SE values of Free CO_2 (mg/l) in water from different treatments during experimental period of 28 days

Weeks	PC	PTA1	PTA2
1st	10.57±0.580	10.56±0.005	10.55±0.023
2nd	10.52±0.000	10.53±0.005	10.53±0.013
3rd	10.51±0.023	10.53±0.008	10.53±0.003
4th	10.51±0.035	10.48±0.040	10.51±0.005
Total Mean ± SE	10.53±0.016	10.53±0.013	10.53±0.008

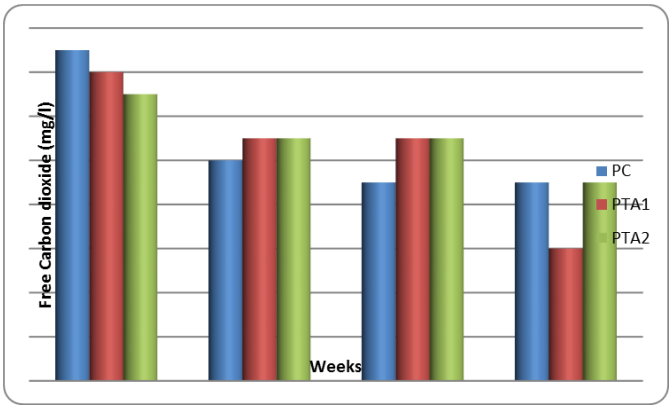

Fig 4: Mean ± SE values of Free CO_2 (mg/l) in water from different treatments during experimental period of 28 days

Total Solids

The total solids contents of fresh waters usually range from 20 mg/L to 1000 mg/L. In present investigation as depicted in Table 5, Figure 5 over all mean of total solids ranged to 63.00 to 63.17 with no significant differences in the treatments and control in both experiments. Sayeed *et al*. (2007) [21] and Afzal *et al*. (2007) [1] also suggested that basic macro and micro nutrient in pond sediments can be enhanced by the application of combined application of organic and inorganic fertilizer. Lower level of total solids in treatments and control was due to no use of fertilizer and manure or may be low level of photosynthetic activity as chicken excreta was given only as feed to the fishes. The total dissolved solid fluctuated between 71- 274mg/l in different levels of poultry droppings on growth performance of Indian major carps as reported by Safi *et al*., (2016) [19].

Table 5: Mean ± SE values of total solids (mg/l) in water from different treatments during experimental period of 28 days

Week	PC	PTA1	PTA2
1st	64.77±0.048	65.00±0.510	64.22±0.500
2nd	63.20±0.090	63.44±0.420	63.37±0.550
3rd	62.70±0.470	62.97±0.043	63.47±0.018
4th	61.32±0.240	61.28±0.068	61.58±0.480
Total Mean ± SE	63.00±0.480	63.17±0.520	63.16±0.400

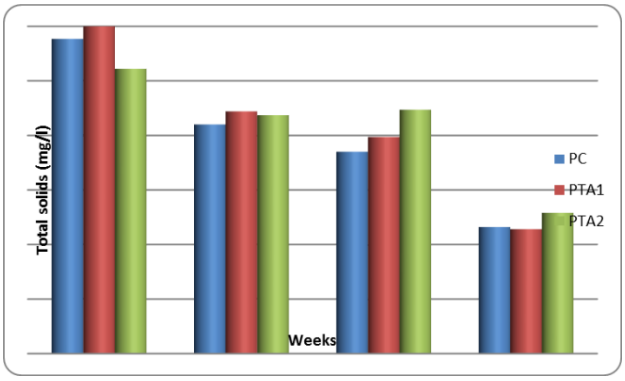

Fig 5: Mean ± SE values of total solids (mg/l) in water from different treatments during experimental period of 28 days

Growth parameters

The results of growth parameters are showed in table 6 Figure 6. No significant changes were found in the initial and final length as well as initial and final weight of fishes in all treatments as the time period of experiment was only 28 days. However, insignificant increase in the weight gain was found in treatment groups as compared to control. The present study findings agreed with Jha *et al*. (2004) [11] used low dose (10 kg/pond) of cow dung manure and poultry excreta to study the effect of manures on water quality and fish growth of *C. carpio* and found that the chicken manure is optimum for both water quality and fish growth parameters. As reported by Osman *et al*. (2008) [16] chicken manure and inorganic fertilizers can replace 100% of pellet feed in the first 30 days of culture without adverse effects on growth of tilapia.

Table 6: Mean ± SE values of length and weight of *C. carpio* from different treatments initially and at the end of experimental period (28 days)

	PC	PTA1	PTA2
Initial weight(g)	44.155±1.31	48.88±1.75	51.635±4.12
Final weight(g)	44.160±1.31	48.89±1.75	51.645±4.12
Initial length(mm)	144.00±1.00	147.90±7.10	158.05±7.05
Final length(mm)	144.00±1.00	147.90±7.10	158.05±7.05
Weight gain (%)	0.75±0.25	1.00±0.00	1.00±0.00

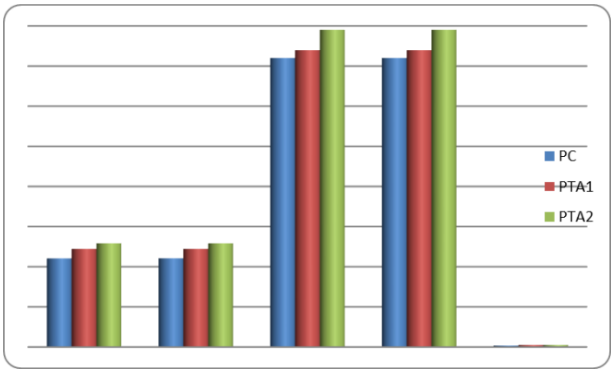

Fig 6: Mean ± SE values of length and weight of *C. carpio* from different treatments initially and at the end of experimental period (28 days)

The observation on fish behavior and mortality are presented in Table 7. No mortality was observed during the experimental period which is in agreement with the findings of Kang'ombe (2004). Behavior and the body color were also normal in all the treatments including control.

Table 7: Fish Behavior and mortality from different treatments during experimental period of 28 days

Treatments	Mortality	Behavior	Body Color
PC	Nil	Normal	Normal
PTA1	Nil	Normal	Normal
PTA2	Nil	Normal	Normal

Conclusion

From the present study it may be concluded that the *Azolla* may be supplemented in poultry feed to reduce the cost as well as to enhance the nutritive value of feed and excreta of poultry. Excreta of the poultry may be further used as feed in fish pond without any adverse impact on water quality and performance of fish under poultry fish integration. However, further long term study is needed to reveal the effect on different parameters including growth, survival and sensory qualities of fish etc. in field condition.

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