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Parveen Kumari
M.F.Sc. Student, Department of Aquaculture, College of Fisheries, GADVASU, Ludhiana, Punjab, India

Abhed Pandey
Assistant Professor, Department of Aquaculture, College of Fisheries, GADVASU, Ludhiana, Punjab, India

Correspondence
Abhed Pandey
Assistant Professor, Department of Aquaculture, College of Fisheries, GADVASU, Ludhiana, Punjab, India

Effect of water hyacinth compost on pond productivity and gut content of rohu (*Labeo rohita*), fry

Parveen Kumari and Abhed Pandey

Abstract

The present study was conducted to evaluate the effect of water hyacinth compost on pond productivity and gut content of rohu (*Labeo rohita*), fry. The experiment was conducted on *L. rohita* fry in FRP tanks (1.5x1.0x0.75 m), consisted of 5 treatments (T1, T2, T3, T4 and T5) with 3 replicates each. T1 (control) with 10,000 kg/ha cow dung manure (CDM) and four other treatments (T2 to T5) were prepared by incorporating water hyacinth compost (WHC) @ 2500 kg/haWHC+7500kg/ha cow dung manure (CDM), 5000 kg/ha WHC+5000kg/ha CDM, 7500kg/ha WHC+2500kg/ha CDM and 10,000 kg/ha WHC respectively, for 150 days. Fishes were not given any supplementary feed during the study period. WHC alone (T5) did not affect pond productivity significantly ($P \leq 0.05$), however significantly ($P \leq 0.05$) higher chlorophyceae, cyanophyceae, bacillariophyceae, euglenophyceae and total phytoplankton and copepoda, rotifera, cladocera, protozoa, ostracoda and total zooplankton population were observed in T4 treatment as compare to control (T1). Whereas, gut content analysis revealed significantly high ($P \leq 0.05$) detritus content (56.20) in T1 and low (29.25) in T4 treatment, unidentified matter was recorded maximum (16.77) in T2 and minimum (11.31) in T4 treatment. Results revealed that water hyacinth compost improved pond productivity and recorded highest in T4 (CDM 25% + WHC 75%) which also confirmed through the gut content analysis. In developing countries like India, fish farmers are unable to buy costly fish feed and chemical fertilizers, water hyacinth compost form an abundant alternative natural un-utilized resource for less expensive manure to improve pond productivity.

Keywords: Water hyacinth compost, pond productivity, *Labeo rohita*, gut content

Introduction

Semi intensive aquaculture system involves use of various organic manures in the form of livestock wastes (cow dung, poultry waste, piggery waste etc.), aquatic weeds, leaves, sewage water, domestic wastes, night soil and dried blood meal are being utilized (Steinberg *et al.*, 2006) [16] to manure/fertilize the pond to improve fish production. These raw manures are either directly utilized by the fish or they enrich the aquatic ecosystem with autotrophic (plankton) and heterotrophic microbial communities (Muendo *et al.*, 2006) [10]. Phytoplankton and zooplankton often contain 40–60% protein on a dry matter basis and can support excellent fish growth (Wu, 2000) [18]. Organic manure if not decomposed completely before application in aquaculture pond, may deteriorate the water quality as they utilize oxygen during decomposition. Therefore, the amount of any organic matter to be added in the pond, mainly depends upon its biological oxygen demand (BOD), as their excessive use may cause severe oxygen depletion in the pond and results in production of toxic gases like CO_2, H_2S, NH_3 etc., and can spread parasitic diseases (Chakrabarty *et al.*, 2009) [3]. Hence, organic materials require pre-treatment (composting sun drying) before its application in fish ponds. Raw material can be decomposed in various ways to prepare those in the form of easily degradable compost form. Aquatic weed compost can be used as one of treated manure for enhancing the productivity of fish pond. Among aquatic weeds, water hyacinth (*Eichhornia crassipes*) contains an appreciable quantity of nutrients and minerals like nitrogen, phosphorus, magnesium, sulphur, manganese, copper, zinc and other constituents along with rich source of iron, calcium and potassium than terrestrial plants, but still it has not been commercially exploited because of mainly low level of dry matter. In order to obtain one ton of dry matter, 20 tons of this weed has to be harvested. On the other hand, it has at least 80% of the total nitrogen in the form of protein (Boyd, 1972) [2]. In India, this problem weed mostly remains underutilized and in fact depletes a major part of the nutrients present in the water for its own development and growth. Since water hyacinth is easily available, in bulk without any cost, its effective use as organic manure for fish production would be an interesting intervention to address related environmental issue as well. Water hyacinth compost (naturally processed manure) can be directly used in fish farming ponds. Although, very limited work has been done (Sahu *et al.*, 2002; Chakrabarty *et al.*, 2009) [15, 3] to evaluate utilization of water hyacinth compost as manure for fish rearing. Therefore, the present study was undertaken to evaluate the effect of water hyacinth compost on pond productivity and gut content of rohu (*Labeo rohita*), fry.

Materials and Methods

The experiment was conducted in outdoor FRP tanks (1.5x1.0x0.75 m), two inch thick layer of soil was spread at the bottom of each pool to hasten the decomposition process and the bore well water was used for filling and maintaining the water level in the pools at the fish farm of College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana from November, 2016 to April, 2017. The experiment consisted of 5 treatments (T1, T2, T3, T4 and T5) with 3 replicates each. T1 (control) with 10,000 kg/ha cow dung manure (CDM) and other four treatments (T2 to T5) were prepared by incorporating water hyacinth compost (WHC) @ 2500 kg/haWHC+7500kg/ha CDM, 5000 kg/ha WHC+5000kg/ha CDM, 7500kg/ha WHC+2500kg/ha CDM and 10,000 kg/ha WHC respectively (Table 1). Each FRP tank was stocked with fry of rohu, *Labeo rohita* (average length and weight was 4.20 cm and 1.22g respectively) @ 20 fry/m³.

Table 1: Details of treatments

Treatments				
Treatment 1 (Control)	**Treatment 2**	**Treatment 3**	**Treatment 4**	**Treatment 5**
Cow dung manure (CDM) @ 10,000 kg/ha	CDM + water hyacinth compost (WHC) @ 7500+2500 kg/ha	CDM + WHC @5000+5000 kg/ha	CDM + WHC@ 2500+7500kg/ha	WHC@10,000 kg/ha

Preparation of water hyacinth compost

Water hyacinth compost was prepared from fresh water hyacinth and cow dung manure as described by Dolpadado (1976) [4] with modification, i.e. without the addition of city refuses. The water hyacinth harvested manually from the swampy areas and were spread for two days in the open air. The wilted weeds were spread into rectangular beds of 2x1:5 m size and heaped to a height of about 1.5 m. The heap was made with 4 layers of weeds, incorporating 2.5 cm thick cowdung–mud (1:1) mixture in between the layers. Finally the heap was covered all around with a thick layer (about 6 cm) of cow dung–mud mixture and left for 60 days. The resultant water hyacinth compost was used in the FRP tanks.

Pond productivity

Productivity in terms of plankton production (phytoplankton and zooplankton) was estimated. Plankton samples were taken in the morning hours at the time of water sample collection. The qualitative and quantitative analysis of phytoplankton was done by drop count method of Vollenweider (1971) [17] and zooplankton by Sedgwick Rafter Cell (S.R.C.) method (APHA, 1991) [1].

Gut content analysis

Fish stomach contents were examined and the individual food organisms sorted and identified. The number of stomachs in which each item occurred was recorded and expressed as a percentage of the total number of stomachs examined. The qualitative analysis was performed based on the complete identification of the organisms in the gut contents. Quantitative analysis performed based on frequency of occurrence method (O_i) (Hynes, 1950) [6] with the following formula

Frequency of occurrence = Ji/P

Where, Ji is the number of fish containing prey i and P is the number of fish with food in their stomach.

Statistical analysis

Statistical analysis of the data was performed with a statistical package SPSS 16.0. One way ANOVA was applied to work out of the effect of water hyacinth compost on pond productivity and gut content of fish ($P\leq0.5$), followed by Duncan's multiple comparison to determine significant differences among the treatments.

Results and Discussion

Plankton Productivity in different treatments

During the present study, qualitative and quantitative analysis of phytoplankton and zooplankton populations in all the treatments was carried out at fortnight intervals, to assess the plankton production trends and sustainability. The results are presented under the following heads.

Total phytoplankton

During the culture period, total phytoplankton population (no. x 10^6 l^{-1}) ranged between 51-154, 61-161, 59-194, 74-199 and 42-156 in T1, T2, T3, T4 and T5 respectively. Although, during the culture period significant changes ($P\leq0.05$) in total phytoplankton population were recorded within the treatments, and the differences among the treatments with respect to mean total phytoplankton population were also significant, being maximum (125) in T4 and minimum (93) in treatment T1 (T4≥T3≥T2=T5≥T1) (Table 2 and Fig. 1).

Table 2: Mean values of phytoplankton in different treatments during the culture period

Parameters	**Treatments**				
	T1	**T2**	**T3**	**T4**	**T5**
Total phytoplankton	93^{c} ±6.07	101^{bc}±5.29	117^{ab}±6.74	125^{a}±6.63	95^{bc}±5.75
Chlorophyceae	43 ^{b}± 2.15	47^{ab}±2.38	52^{a}±2.53	52^{a}±2.61	31^{c}±2.53
Cyanophyceae	30 ^{b} ±2.41	31^{b}±2.24	36^{a}±2.67	39^{a}±2.80	44^{a}±2.47
Bacillariophyceae	15 ^{b} ± 1.42	17^{b}±1.41	21^{a}±1.51	23^{a}±1.25	15^{b}±1.16
Euglenophyceae	6 ^{b} ± 8.01	6^{b}±6.31	9^{a}±8.52	10^{a}±1.22	6^{b}±7.07

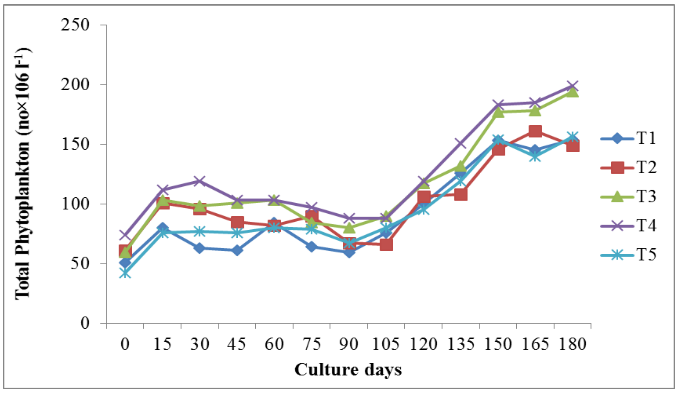

Fig 1: Changes in total phytoplankton population (no. x 10^6 l^{-1}) in different treatments during the culture period

Chlorophyceae (Green algae)

During the culture period, the Chlorophyceae population (no. x 10^6 l^{-1}) ranged between 22-66, 27-67, 29-80, 32-82 and 14-55 in treatment T1, T2, T3, T4 and T5, respectively. Although, during the culture period significant changes ($P \leq 0.05$) in chlorophyceae population were recorded within the treatments, and the differences among the treatments with respect to mean chlorophyceae (green algae) population were also significant, being maximum (52) in T3 and T4 and minimum (31) in treatment T5 (T3=T4≥T2≥T1≥T5) (Table 2).

Cyanophyceae (Blue green algae)

During the culture period, the cyanophyceae population (no. x 10^6 l^{-1}) ranged between 13-53, 18-56, 18-67, 19-69 and 24-63 in treatment T1, T2, T3, T4 and T5, respectively. Although, during the culture period significant changes ($P \leq 0.05$) in Cyanophyceae population were recorded within the treatments, and the differences among the treatments with respect to mean Cyanophyceae population were also significant, being maximum (44) in T5 and minimum (30) in treatment T1 (T5=T4=T3≥T2=T1) (Table 2).

Bacillariophyceae (Diatoms)

During the culture period, the bacillariophyceae population (no. x 10^6 l^{-1}) ranged between 5-32, 10-29, 8-35, 14-35 and 8-27 in treatment T1, T2, T3, T4 and T5, respectively. Although, during the culture period significant changes ($P \leq 0.05$) in bacillariophyceae population were recorded within the treatments, and the differences among the treatments with respect to mean bacillariophyceae population were also significant, being maximum (23) in T4 and minimum (15) in both treatments T1 & T5 (T4=T3≥T2=T1=T5) (Table 2).

Euglenophyceae (Flagellates)

During the culture period, the euglenophyceae population (no. x 10^6 l^{-1}) ranged between 2-14, 2-10, 5-18, 5-21 and 5-11 in treatment T1, T2, T3, T4 and T5, respectively. Although, during the culture period significant changes ($P \leq 0.05$) in euglenophyceae population were recorded within the treatments, and the differences among the treatments with respect to mean euglenophyceae population was significant, being maximum (10) in T4 (T4=T3≥T1=T2=T5) (Table 2).

Relative abundance of phytoplankton populations in different treatments

In all the treatments, green algae (Chlorophyceae) and blue green algae (Cyanophyceae) dominated the phytoplankton population, constituting 46.24 and 32.25, 46.53 and 30.69, 44.44 and 30.76, 41.46 and 31.2, 32.63 and 46.32>% of the total phytoplankton population in T1, T2, T3, T4 and T5, respectively. Bacillariophyceae constituting 16.13, 16.83, 17.95, 18.4, 15.78% in T1, T2, T3, T4 and T5, respectively. Among the different phytoplankton groups, flagellates (Euglenophyceae) were least in number, constituting 6.45, 5.94, 7.69, 8 and 6.31% of the total phytoplankton population in T1, T2, T3, T4 and T5, respectively. Among different phytoplankton groups, significantly higher Cyanophyceae population was recorded in T5 (100% WHC), while differences with respect to mean total phytoplankton population were significant ($P \leq 0.05$) among treatments. Predominance of different phytoplankton groups in all the treatments was in order: Chlorophyceae/Cyanophyceae>Bacillariophyceae> Euglenophyceae.

Total phytoplankton population also enhanced with increased levels of water hyacinth compost except in T5, might be because of high amount of cyanophyceae population which might not have allowed the growth of other phytoplanktons as reported by Paerl and Tucker (1995) [12]. Although water hyacinth compost incorporation resulted in higher phytoplankton population in T3 and T4, but it did not alter the predominance order of different phytoplankton groups in any of the treatments (Table 3).

Table 3: Relative abundance of phytoplankton families (no.×10^6 l^{-1}) in the different the treatments during the culture period

Phytoplankton Mean population	Treatments				
	T1	T2	T3	T4	T5
Chlorophyceae	43^{b}±2.15 (46.24%)	47^{ab}±2.38 (46.53%)	52^{a}±2.53 (44.44%)	52^{a}±2.61 (41.46%)	31^{b}±2.53 (32.63%)
Cyanophyceae	30^{b}±2.41 (32.25%)	31^{b}±2.24 (30.69%)	36^{a}±2.67 (30.76%)	39^{a}±2.80 (31.2%)	44^{a}±2.47 (46.32%)
Bacillariophyceae	15^{b}±1.42 (16.13%)	17^{b}±1.41 (16.83%)	21^{a}±1.51 (17.95%)	23^{a}±1.25 (18.4%)	15^{b}±1.16 (15.78%)
Euglenophyceae	6^{b}±8.01 (6.45%)	6^{b}±6.31 (5.94%)	9^{a}±8.52 (7.69%)	10^{a}±1.22 (8%)	6^{b}±7.07 (6.31%)
Total phytoplankton population	93^{bc}±6.07	101^{bc}±5.29	117^{ab}±6.74	125^{a}±6.63	95^{c}±5.75

Better planktonic growth was recorded by the application of organic manure i.e., water hyacinth compost in ponds, agreeing with the reports published (Saha *et al.*, 1974, 1975; Murty *et al.*, 1978; Mishra *et al.*, 1987, 1988) [13, 14, 11, 8, 9]. The water hyacinth compost might have enriched the water, leading to increased plankton population.

Total zooplankton

During the culture period, total zooplankton population (no. l^{-1}) ranged between 190-589, 200-618, 273-774, 292-789 and 205-609 in T1, T2, T3, T4 and T5 respectively. Although, during the culture period significant changes ($P \leq 0.05$) in total zooplankton population were recorded within the treatments, and the differences among the treatments with respect to mean total zooplankton population was significant ($P \leq 0.05$), being maximum (457) in T4 and minimum (345) in treatment T1 (T4≥T3≥T2=T5=T1) (Table 4 & Fig. 2). In the present study, the result indicating that the water hyacinth compost has enhanced total zooplankton population in different treatments, T2, T3, T4 and T5 and resulted significantly high ($P \leq 0.05$) in T4 compared to cow dung alone treatment (T1).

Table 4: Mean values of zooplankton in different treatments during the culture period

Parameters	**Treatments**				
	T1	**T2**	**T3**	**T4**	**T5**
Total zooplankton	$345^{c} \pm 21.64$	$369^{bc} \pm 22.19$	$435^{ab} \pm 26.79$	$457^{a} \pm 26.79$	$355^{c} \pm 22.81$
Copepoda	$97^{b} \pm 6.54$	$108^{ab} \pm 6.88$	$120^{a} \pm 8.05$	$123^{a} \pm 8.24$	$101^{ab} \pm 7.03$
Rotifera	$75^{b} \pm 5.05$	$81^{b} \pm 5.63$	$103^{a} \pm 7.25$	$112^{a} \pm 7.03$	$81^{b} \pm 5.87$
Cladocera	$84^{b} \pm 5.11$	$88^{b} \pm 5.70$	$100^{ab} \pm 6.23$	$108^{a} \pm 6.54$	$85^{b} \pm 6.09$
Protozoa	$48^{b} \pm 3.40$	$52^{ab} \pm 3.12$	$57^{ab} \pm 3.65$	$61^{a} \pm 4.12$	$52^{ab} \pm 3.71$
Ostracoda	$41^{b} \pm 4.02$	$41^{b} \pm 3.79$	$56^{a} \pm 4.07$	$54^{a} \pm 3.72$	$36^{b} \pm 3.47$

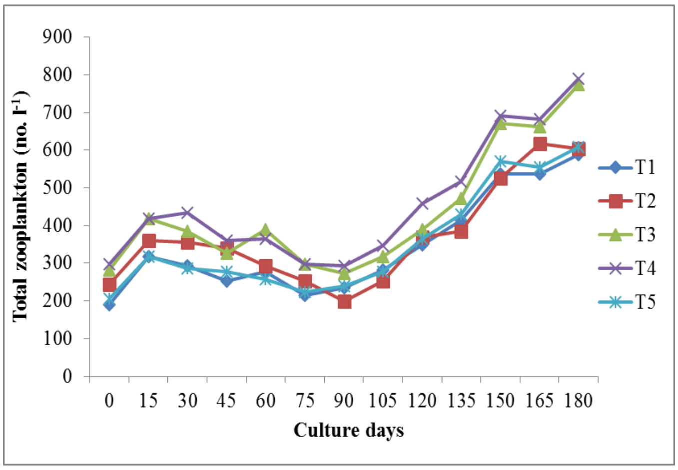

Fig 2: Changes in total zooplankton population (no. l^{-1}) in different treatments during the culture period

Copepoda

During the culture period, copepoda population (no. l^{-1}) ranged between 54-170, 49-177, 63-214, 58-219 and 54-161 in T1, T2, T3, T4 and T5 respectively. Although, during the culture period significant changes ($P \leq 0.05$) in copepoda population were recorded within the treatments, and the differences among the treatments with respect to mean copepoda population was significant ($P \leq 0.05$), being maximum (123) in T4 and minimum (97) in treatment T1 (T4=T3≥T2=T5≥T1) (Table 4). In the present study, the result indicating that the water hyacinth compost has enhanced copepoda population in different treatments, T2, T3, T4 and T5 and resulted significantly high ($P \leq 0.05$) in T3 and T4 compared to cow dung alone treatment (T1).

Rotifera

During the culture period, rotifera population (no. l^{-1}) ranged between 29-126, 44-143, 58-195, 73-195 and 39-141 in T1, T2, T3, T4 and T5 respectively. Although, during the culture period significant changes ($P \leq 0.05$) in rotifera population were recorded within the treatments, and the differences among the treatments with respect to mean rotifera population was significant, being maximum (112) in T4 and minimum (75) in treatment T1 (T4=T3≥T2=T5=T1) (Table 4). In the present study, the result indicating that the water hyacinth compost has enhanced rotifera population in different treatments, T2, T3, T4 and T5 and resulted significantly high ($P \leq 0.05$) in T3 and T4 compared to cow dung alone treatment (T1).

Cladocera

During the culture period, cladocera population (no. l^{-1}) ranged between 49-131, 54-151, 63-175, 63-180 and 49-146 in T1, T2, T3, T4 and T5 respectively. Although, during the culture period significant changes ($P \leq 0.05$) in cladocera population were recorded within the treatments, and the differences among the treatments with respect to mean cladocera population was significant, being maximum (108) inT4 and minimum (84) in T1 treatment (T4=T3≥T2=T5=T1) (Table 4). In the present study, the result indicating that the water hyacinth compost has enhanced cladocera population in different treatments, T2, T3, T4 and T5 and resulted significantly high ($P \leq 0.05$) in T4 compared to cow dung alone treatment (T1).

Protozoa

During the culture period, protozoa population (no. l^{-1}) ranged between 19-78, 25-78, 34-97, 34-107 and 24-88 in T1, T2, T3, T4 and T5 respectively. Although, during the culture period significant changes ($P \leq 0.05$) in protozoa population were recorded within the treatments, and the differences among the treatments with respect to mean protozoa population was significant, being maximum (61) in T4 and minimum (48) in treatment T1 (T4≥T3=T2=T5≥T1) (Table 4). In the present study, the result indicating that the water hyacinth compost has enhanced protozoa population in different treatments, T2, T3, T4 and T5 and resulted significantly high ($P \leq 0.05$) in T4 compared to cow dung alone treatment (T1).

Ostracoda

During the culture period, ostracoda population (no. l^{-1}) ranged between 19-88, 24-83, 29-93, 34-88 and 5-68 in T1, T2, T3, T4 and T5 respectively. Although, during the culture period significant changes ($P \leq 0.05$) in ostracoda population were recorded within the treatments, and the differences among the treatments with respect to mean ostracoda population was significant, being maximum (56) in T3 and minimum (36) in treatment T5 (T3=T4≥T2=T1=T5) (Table 4). In the present study, the result indicating that the water hyacinth compost has enhanced ostracoda population significantly ($P \leq 0.05$) in T3 and T4 compared to cow dung alone treatment (T1).

In all the treatments, copepods dominated the zooplankton population, constituting 28.12, 29.26, 27.58, 26.91 and 28.45% of the total zooplankton population in T1, T2, T3, T4 and T5, respectively. Among the different zooplankton groups, ostracods were least in number, constituting only 11.88, 11.11, 12.87, 11.81 and 10.14% of the total zooplankton in T1, T2, T3, T4 and T5, respectively. Among different zooplankton groups, significantly higher ($P \leq 0.05$) rotifera more recorded in T4 (WHC 75%). Mean total zooplankton population was also higher in all the WHC treated groups. Predominance of different zooplankton groups was in order: Copepod > Rotifera > Cladocera > Protozoa > Ostracoda (Table 5). The results reveal that water hyacinth compost incorporation did not alter the predominance order of different zooplankton groups in any of the treatments.

Table 5: Relative abundance of zooplankton groups (no. l^{-1}) in the different treatments

Zooplankton Mean population	Treatments				
	T1	T2	T3	T4	T5
Copepoda	97^{b} ± 6.54 (28.12%)	108^{ab} ± 6.88 (29.26%)	120^{a} ± 8.05 (27.58%)	123^{a} ± 8.24 (26.91%)	101^{ab}±7.03 (28.45%)
Rotifera	75^{b} ± 5.05 (21.73%)	81^{b} ±5.63 (21.95%)	103^{a} ± 7.25 (23.67%)	112^{a} ± 7.03 (24.50%)	81^{b}± 5.87 (22.81%)
Cladocera	84^{b} ± 5.11 (24.34%)	88^{b} ± 5.70 (23.85%)	100^{ab}±6.23 (22.98%)	108^{a} ± 6.54 (23.63%)	85^{b} ±6.09 (23.94%)
Protozoa	48^{b} ± 3.40 (13.91%)	52^{ab} ± 3.12 (14.09%)	57^{ab} ±3.65 (13.10%)	61^{a} ± 4.12 (13.34%)	52^{ab} ± 3.71 (14.64%)
Ostracoda	41^{b} ± 4.02 (11.88%)	41^{b} ± 3.79 (11.11%)	56^{a} ± 4.07 (12.87%)	54^{a} ± 3.72 (11.81%)	36^{b}± 3.47 (10.14%)
Total zooplankton population	345^{c}±21.64	369^{bc}±22.19	435^{ab}±26.79	457^{a}±26.79	355^{c}±22.81

Edwards *et al*. (1985) [5] observed better growth and feed utilization efficiency in tilapia, *Oreochromis niloticus* fed pelleted diets formulated with 75% composted water hyacinth. Chakrabarty *et al*. (2009) [3] reported wide variation of *Cyprinus carpio* yield in a trial arranged in concrete cisterns (100 L) receiving water hyacinth compost (1952kg/ha), diammonium phosphate (3080 kg/ha), and vermicompost (3970 kg/ha) as direct application fertilizer and manure for 90 days and reported highest production of fish with vermicompost followed by diammonium phosphate and water hyacinth compost. Whereas, Sahu *et al*. (2002) [15] reported better planktonic growth and higher productivity by the application of water hyacinth fertilizer in ponds. Water hyacinth fertilized pond (WFP) presented a higher abundance of planktonic organisms, like Rotifera.

Gut content analysis (%)

In different treatments, gut content (%) of fish were analysed, phytoplankton and zooplankton were observed maximum (40.08 and 15.34% respectively) in T4 and minimum (25.19 and 6.76% respectively) in T1 treatment. Detritus was maximum (56.20) in T1 and minimum (29.25) in T4 treatment, unidentified matter was maximum (16.77) in T2 and minimum (11.31) in T4 treatment and the difference among the treatments were significant ($P \leq 0.05$) (Table 6). In the present study, water hyacinth compost enhanced phyto and zooplankton production and subsequent consumption by fish in treatment T4 followed by T3, T2 and T5 as compared to cow dung manure treatment (T1), which was observed in the gut content analysis of the fish. Whereas, in cow dung manure treatment (T1), detritus matter was observed more in gut content of the fish, as compared to other treatments. Kangombe *et al*. (2006) [7] worked on the effect of using different types of organic animal manure on plankton abundance and on growth and survival of *Tilapia rendalli* in ponds and concluded that the gut contents analysis of the fish were variable, depended on the type of manure used. The fish cultured in the no manure treatment had a significantly higher amount of detritus (51.1%) in their stomachs followed by fish cultured in pig manure (41.1%), cattle manure (39.1%) and lastly those in chicken manure, which had a significantly lower amount of detritus (17.7%).

Table 6: Gut content analysis (%) of fish in different treatments at the end of experiment

Treatments	Gut content (%)			
	Phytoplankton	Zooplankton	Detritus	Unidentified matter
T1	25.19^{d}±0.34	6.76^{d}±0.23	56.20^{a}±0.29	11.83^{b}±0.29
T2	35.52^{c}±0.55	10.01^{c}±0.15	37.68^{c}±0.73	16.77^{a}±0.12
T3	38.70^{b}±0.84	12.10^{b}±0.20	36.23^{c}±0.19	12.95^{b}±0.38
T4	40.08^{a}±0.42	15.34^{a}±0.12	29.25^{d}±0.90	11.31^{b}±0.36
T5	33.17^{bc}±0.32	10.24^{bc}±0.38	41.14^{b}±0.38	15.43^{a}±0.19
Mean value	34.53^{a}±0.65	10.89^{b}±0.31	40.1^{a}±1.10	13.66^{b}±0.22

In the present study, water hyacinth compost has enhanced total phytoplankton population in different treatments as percentage of water hyacinth compost increased progressively in T2, T3 and T4 and resulted significantly high ($P \leq 0.05$) in T4 compared to cow dung alone treatment (T1). Although nutrient content in T5 treatment (100% water hyacinth compost) were highest but it lead to development of filamentous algae and cynobacteria (blue-green algae) which might have consumed all the available nutrients in high amount. Whereas, water hyacinth compost has enhanced total zooplankton population in different treatments, T2, T3, T4 and T5 and resulted significantly high ($P \leq 0.05$) in T4 compared to cow dung alone treatment (T1). Water hyacinth compost enhanced phyto and zooplankton production and subsequent consumption by fish in treatment T4 followed by T3, T2 and T5 as compared to cow dung manure treatment (T1), which was also observed in the gut content analysis of the fish. Whereas, in cow dung manure treatment (T1), detritus matter was observed more in gut content of the fish, as compared to other treatments. Results revealed that water hyacinth compost improved pond productivity and recorded highest in T4 (CDM 25% + WHC 75%) which also confirmed through the gut content analysis. In developing countries like India, fish farmers are unable to buy costly fish feed and chemical fertilizers, water hyacinth compost form an abundant alternative natural un-utilized resource for less expensive manure to improve pond productivity. It can be concluded from the present study that water hyacinth compost mixed with cow dung manure at 3:1 ratio improves pond productivity. The study will be helpful in enhancing fish farmer's income.

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