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Impact of an Eco Friendly Biomaterial, Chitosan Supplemented Diets on Growth Parameters of an Indian Walking Catfish, *Clarias batrachus* (Linnaeus)

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Abstract: ***A 60 days experiment was conducted to assess the impact of an eco friendly biomaterial, chitosan supplemented diets on growth parameters of Clarias batrachus. Six diet plans were set up with various extent of chitosan. Insignificant variations in physical and chemical parameters of experimental water side from pH scale were found. Studies revealed an ascent in final weight contrasted to initial weight in all treatments. An increasing pattern from D2 to D5 following a slight decline in D6 chitosan supplemented diets was calculated in percentage of weight gain, daily weight gain, specific growth rate, feed efficiency ratio and survival rate however food conversion ratio lessened an incentive with the expansion in the extent of chitosan in experimental diets. The distinction of these parameters contrasted with control was found significant. In spite of the fact that, the protein content of chitosan was more than control feed. The work is one among the benchmark data for directing more exploration on the locally accessible feed fixing like chitosan especially with Indian walking catfish, Clarias batrachus.***

Keywords: Chitosan, Growth parameters, *Clarias batrachus*

1. Introduction

Accomplishment of aquaculture by and large depends upon the capacity of fish farmers to characterize restoratively balanced weight control designs that will meet the enhancement necessities of their refined species at lower cost. Fish meal has been a significant wellspring of protein in fish goes without food considering its high protein quality and acceptability.

Impressive research efforts have been made in the progressing past towards replacement of fish supper by conservative elective plant fixings sources. The fittingness of this supplement replacement is uncommonly factor among fish species and raising conditions.

Chitosan has been reported to have a various utilitarian properties that make it useful in nutrition (Gallaher et al., 2002). It is one of the non-toxic biocompatible, biodegradable, eco friendly biopesticide, eco friendly biomaterial as well as eco friendly biofungicide used in development of nanomaterials and bioadhesives (Shukla et al., 2013). Past investigations demonstrated that chitosan has insusceptible invigorating properties in various types of fish (Dautremepuits et al., 2004, Cha et al., 2008). *Clarias batrachus* (walking catfish) is an air-breathing fish having in India and Shahabad district of Bihar. Therefore, an endeavor to assess the impact of chitosan supplemented diets on growth parameters of *Clarias batrachus*. The work will help in picking the perfect improves return of this fish.

2. Materials and Methods

Specimens of *Clarias batrachus* (Linnaeus) (12-16 body weight, 12-14cm total length) were gotten from neighborhood market, Arrah (Bhojpur), Bihar. They were adjusted for a fortnight in Departmental Laboratory. During acclimatization, fishes were taken care of with trash fish.

Powder of Chitosan (Mahatani Chitosan Pvt. Ltd., Veraval, Gujarat, India) and commercial fish feed was chosen as an eco friendly biomaterial for the experiment. The fish meal was used as the control diet (D1) with no chitosan whereas diet D2, D3, D4, D5 and D6 consisted of chitosan and fish meal in the proportion of 2, 4, 6 8 and 10g/kg individually. Before get ready pellet feed, ingredients were finely powdered, mixed and then sieved. Proximate compositions of the ingredients used in the formulated diets were analyzed following AOAC (2005) methods and presented in Table 2. In experimental diets, amounts of protein range from 41.23 to 41.10 in D1 and D6 individually.

Physico-chemical parameters of water were resolved during the experimental period following standard methods (APHA, 2005). Fishes were taken care of at the pace of 5% of the body weight in test period in two installments.

Growth was observed in regard to body weight and length (Yaji & Auta, 2007). Various growth parameters namely final weight, weight gain, percentage of weight gain, daily growth co-efficient, total feed fed/fish, food conversion ratio, protein efficiency ratio and apparent protein digestibility were determined observing standard techniques (Cowey, 1992; Castell & Tiews, 1980). All observed data collected were subjected to ANOVA followed by Duncan's multiple range tests (Duncan, 1955) to test the distinction between means.

3. Results and Discussion

Water quality boundary has critical job in Aquaculture. Fish are staying in harmony with possible creatures and their

condition. Mean estimations of studied parameters of water aside from dissolved oxygen and ammonia were within the admissible range (ICMR, 1975). These qualities with the exception of pH were statistically insignificant to each other at 5% level of significance (Table 1). The present findings showed that supplementation of chitosan significantly improved the quality of the water by increasing the pH concentration of the water. These findings concur with that of Wang & Li (2011) and Udo et al., (2018) who reported improved water quality because of chitosan and chitosan nanoparticles supplementation in the diet of *Oreochromis nilotica* and *Clarias gariepinus* individually.

Assurance of the feeding rate is one of the troublesome errands in aquaculture activity. The fish promptly expended the feed and the level of adequacy of all diet plans was pretty much equivalent. Fish were discovered pretty much solid all through the investigation time frame. The growth responses and food use of fingerlings under various dietary treatments are depicted in Table 3.

Despite the fact that LC_{50} of chitosan in fish has not been determined at this point, it has been concentrated in mice. LD_{50} of chitosan in mice has been found higher than 16 g/kg body weight (Singla & Chawla 2001). Chitosan oligomers up to 10 g/kg has been end up being protected with no clinical indications of harmfulness after a solitary oral organization in male and female Kunming strain mice (Qin et al., 2006). From these observations, it might be assessed that a portion of 100-160g/kg body weight of chitosan can be utilized in various groups of fishes.

During this work, the exploratory feeds D2, D3, D4 and D5 with chitosan (2, 4, 6 and 8g/kg) performed better than trial feed D6 with 10g/kg chitosan in *Clarias batrachus*. No outside clinical indications were seen in any treatment during the entire period of the experiments.

Final weight of 169.33±5.70g *Clarias batrachus* in controlled (D1) group increased from 172.65±6.66g in D2 to ideal of 184.00±8.16g in D5 yet somewhat diminished to 180.92±8.49g in D6 treated fish after 60days of feeding of chitosan supplemented diets. Udo et al., (2018) found that in a 91 days experiment, chitosan supplementation significantly ($p<0.05$) improved daily weight gain of *Clarias gariepinus* fingerlings. Fadl et al., (2020) also observed that feeding of 3 or 5 g chitosan/kg diet increased the growth rate of *Oreochromis niloticus.*

Specific growth rate of 1.35±1.17% *Clarias batrachus* in controlled (D1) group also increased from 2.06±1.52% in D2 to ideal of 2.16±1.27% in D5 however marginally diminished to 2.14±2.05% in D6 treated fish after 60days of feeding of chitosan supplemented diets. Kiruba et al., (2013) studied the effect of T0, T1, T2, T3 and T4 (0, 0.5, 0.75, 1 and 1.25g/kg chitosan) for 90 days on *Labeo rohita* and found that T3 gave the highest significant increment in specific growth rate. Nazir & Chauhan (2018) assessed the impact of T0, T1 (2.5g of *Allium sativum*, *Curcuma longa*, *Tinospora cordifolia* and *Withania somnifera*), T2 (0.25g Vitamin C) and T3 (2.5g chitosan) for 102 days on *Cyprinus carpio haematopterus* and observed that T3 gave the best significant increase in specific growth rate.

On the other hand, feed Conversion ratio of 2.33±0.17 *Clarias batrachus* in controlled (D1) group diminished from 2.26±0.55 in D2 to ideal of 2.08±0.25 in D5 however increased to 2.29±0.58 in D6 treated fish after 60days of feeding of chitosan supplemented diets. Kiruba et al., (2013) contemplated the effect of T0, T1, T2, T3 and T4 (0, 0.5, 0.75, 1 and 1.25g/kg chitosan) for 90 days on *Labeo rohita* and found that T3 gave the highest significant increase in feed conversion ratio. Chen et al., (2014) assessed impacts of dietary chitosan on *Carassius auratus gibelio* and got better lessening of feed conversion ratio with diets having 1.8, 4.0 and 7.5g/kg chitosan than the diets with 10.0 and 20.0g/kg chitosan.

Further, feed efficiency ratio of 39.78±9.0% *Clarias batrachus* in controlled (D1) group expanded from 40.88±8.07% in D2 to ideal of 44.30±8.86g in D5 but slighly diminished to 43.52±9.48% in D6 treated fish after 60days of feeding of chitosan supplemented diets. The highest feed efficiency ratio in *Mugil cephalus* were seen by Akbari & Younesi (2017) in the diet containing 10 g/kg chitosan which had a significant difference compared with other treatments ($P<0.05$).

Higher survival rate was found in chitosan enhanced *Clarias batrachus* than in the control diet. For the most part, survival rate was improved in this investigation by chitosan consolidation. This is in concurrence with the findings of Kiruba et al., (2013), who reported diminished mortality in *Labeo rohita* because of chitosan supplementation in diet.

The observations of the current study was on the line that the chitosan was effective in increasing weight gain and growth parameters of *Clarias batrachus*, which was in concurrence with the consequences of prior workers like Chen et al., (2014) and Fadl et al., (2020).

4. Conclusion

The current investigation presumes that chitosan based diets gave higher growth rate indices and less food conversion ratio in comparison to fish meal based diets. The work might be one of the gauge information for leading further examination on the chitosan likewise locally such accessible feed fixings with catfish like *Clarias batrachus* and different fishes.

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Table 1: Physical and chemical features of experimental water

Experimental water	D1	D2	D3	D4	D5	D6
Temperature (°C)	32.0 ± 1.9	32.0 ± 1.9	32.0 ± 1.1	32.0 ± 1.2	32.0 ± 1.7	32.0 ± 1.8
pH	7.12 ± 0.23	7.18 ± 0.91	7.22 ± 0.60	7.47 ± 0.32	7.62 ± 0.71	7.74 ± 0.62
DO (mg L^{-1})	6.53± 1.32	6.62 ± 1.34	6.61 ± 1.40	6.64 ± 1.55	6.79 ± 1.19	6.67 ± 1.29
Total Alkalinity (mg L^{-1})	362.09 ± 8.99	361.36 ± 9.79	355.27 ± 7.90	350.45 ± 6.79	350.09 ± 7.88	355.00 ± 8.57
Hardness (mg L^{-1})	148.66 ± 3.63	146.00 ± 1.31	129.33 ± 6.59	141.00 ± 7.09	146.00 ± 8.33	140.33 ± 4.07
Ammonia (mg L^{-1})	0.38 ± 0.12	0.40 ± 0.11	0.39 ± 0.11	0.38 ± 0.11	0.37± 0.11	0.39 ± 0.10

Table 2: Ingredients and proximate composition of experimental diets

Ingredient (g/kg)	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**
Fish meal	400	400	400	400	400	400
Soybean Flour	200	200	200	200	200	200
Mustard oil cake	150	150	150	150	150	150
Wheat flour	130	130	130	130	130	130
Rice bran	100	100	100	100	100	100
Minerals and Vitamins	20	20	20	20	20	20
Chitosan	0	2	4	6	8	10
Proximate (%) composition						
Ash	9.10	9.20	9.27	9.28	9.30	9.33
Fat	9.92	9.90	9.94	9.82	9.72	9.82
Fibre	7.26	7.34	7.28	7.50	7.50	7.60
Moisture	7.78	7.95	6.82	8.37	8.04	6.31
Dry matter	93.69	93.18	92.22	92.05	91.96	93.63
Protein	41.23	41.20	41.15	41.14	41.12	41.10
Nitrogen free extract	38.55	38.37	38.40	38.37	38.37	38.38

Table 3: Growth of *Clarias batrachus* (n = 40 and number of replicates = 3) fed with different doses of Chitosan for 60 days

Parameters	Diets and Dose of Chitosan (g/kg)					
	D1(0)	D2(2)	D3(4)	D4(6)	D5(8)	D6(10)
Initial weight (g)	50.00±2.83	50.00±2.67	50.20±2.88	50.10±2.89	50.30±3.80	50.10±2.65
Final weight (g)	169.33±5.70	172.65±6.66	176.75±10.92	178.72±9.45	184.00±8.16	180.92±8.49
	F value (c=5 and r=2) c=24.60*** and r =114.7***					
Weight gain (g)	119.33±2.87	122.65±3.99	126.55±8.04	128.62±6.56	133.70±4.36	130.82±5.84
Weight gain (%)	238.66±1.01	245.30±1.49	252.09±2.79	256.73±2.27	265.80±1.15	261.12±2.20
Daily weight gain (g)	1.99±0.05	2.04±0.07	2.11±0.14	2.14±0.11	2.23±0.07	2.18±0.10
Specific growth rate (%)	1.35±1.17	2.06±1.52	2.10±2.22	2.12±1.97	2.16±1.27	2.14±2.05
	F value (c=5 and r=2) c=01.54^{NS} and r =89.94***					
Feed Conversion ratio	2.33±0.17	2.26±0.55	2.19±0.35	2.14±0.48	2.08±0.25	2.29±0.58
	F value (c=5 and r=2) c=0.98^{NS} and r =33.93***					
Feed Efficiency ratio (%)	39.78±9.0	40.88±8.07	42.12±7.68	42.79±8. 37	44.30±8.86	43.52±9.48
	F value (c=5 and r=2) c=19.41*** and r =1013***					
Survival rate (%)	40.0±2.0	48.0±4.0	54.0±4.0	58.0±2.0	70.0±0	66.0±2.0