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(RESEARCH ARTICLE)

Comparison of Fish and Soybean Meals on Growth Rate and Feed Efficiency of Fish Nile Tilapia (*Oreochromis niloticus*) Through the Use of Biofloc Technology

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Abstract

Using biofloc technology, this study compared the effects of fish and soybean meals on the development rate and feed efficiency of fish Nile tilapia (Oreochromis niloticus) at the Fisheries Research and Training Institute (FR&TI) Manawan, Lahore. Three hundred and sixty (360) O. niloticus fingerlings were split up into four groups, each consisting of thirty fingerlings: A Control, B, C, and D. In contrast to the other three groups (B, C, and D), which received feed containing various combinations of fish and soybean meals, such as 30% fish meal, 30% soybean meal, and 15% fish meal+15% soybean meal, respectively, the control group (A) received regular feed devoid of fish and soybean meals. Fish samples were weighed and measured for length and weight at 14, 30, 45, and 60 days. The physio-chemical characteristics of each glass aquarium's water, such as pH, temperature, and dissolve oxygen, were measured every day and every two weeks for the duration of the 60-day study. With average values of 18.99±0.312, 23.51±0.261, 21.58±0.305, and 27.23±0.632 for groups A (Control), B, C, and D, respectively, weight gain varied substantially ($p < 0.05$), with group D's fingerlings gaining the most.

Likewise, there was a significant difference ($p < 0.05$) in the length growth of fingerlings between groups, with average averages of 13.11±0.315, 14.18±0.200, 13.68±0.152, and 14.76±0.172 for groups A (Control), B, C, and D, respectively. Group D's fingerlings had the highest gain. Similarly, there was a significant difference ($p < 0.05$) in the feed conversion ratio between groups A (Control), B, C, and D, with the fingerlings in group D having a higher FCR. The values for these groups were 2.03, 1.57, 1.33, and 1.17, respectively.Overall, the findings demonstrated that the fingerlings fed a mix of 15% fish and 15% soybean meals outperformed Group A (Control) and another mix of feed given to Groups B and C in terms of weight increase, length gain, and feed efficiency ($P<0.05$). Additionally, there was a significant difference in the outcomes across groups ($P<0.05$). Additionally, the data showed that fingerlings fed 30% fish meal feed performed better than those fed 30% soybean meal feed.

Keywords: Fish; Soybean meals; Biofilm Technology; Growth rate; Feed efficiency.

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1. Introduction

One of the fishes most commonly raised in aquaculture is Oreochromis niloticus, sometimes referred to as tilapia. Tilapia farming is presently experiencing a period of rapid global expansion in order to satisfy the demands of both domestic and foreign consumers and to provide an affordable source of animal protein. Despite the fact that several tilapia species are kept in captivity worldwide, the Nile tilapia is the most popular fish. It takes 8 to 10 months for Nile Tilapia to reach harvest size, which is 1-2 kg.(Yáñez, Joshi, & Yoshida, 2020)."Fishmeal" is a phrase used to describe a nutrient-rich feed ingredient with a crude protein level of 60%-92%. Fishmeal, often the primary source of protein in the diets of shrimp and fish, is the preferred source of animal protein for farm animals(Boyd, McNevin, & Davis, 2022).Soybean meal, which is typically marketed according to its protein level, is one of the primary sources of protein for animal feed. Exposed soybean meal should have a higher protein content than non-exposed soybean meal, while non-exposed soybean meal usually has more than 6% fiber and may even approach 7% (Ismail et al., 2020).

The main focus of expanding the aqua-culture must to increase aqua-culture product production without considerably rising the use of the basic natural sources of land and water (Panigrahi et al., 2019). Biofloc technology (BFT) represent a recent development in aquaculture that minimizes water exchange while maintaining high stocking densities. In such systems, the carbon and nitrogen sources play a major role as nutrient, once the C: N reaches 15:1, forcing the organisms raised in the water to utilize the accumulated nitrogenous waste, which result in the formation of agglomerations known as flocs (Khanjani, Mohammadi & Emerenciano, 2022). These microbes, containing different species of bacteria show interactions with other organisms in the community by performing different functions. Biofloc Technology (BFT) is an innovative approach to aquaculture that effectively addresses several critical challenges faced by traditional fish culture practices. BFT enhances fish productivity while simultaneously improving water quality and minimizing environmental degradation, making it an environmentally sustainable option for aquaculture (Sharma et al., 2023; Ahmad et al., 2017).Additionally, the sustainability of BFT extends to water quality management.

By maintaining a controlled and healthy aquatic environment, BFT often allows for minimal or no water exchange systems. This has substantial implications for reducing water scarcity and preventing eutrophication—a common issue in traditional aquaculture systems due to excess nutrient runoff Emerenciano et al., 2017; Ahmad et al., 2017

The biofloc technology has a number of advantageous aspects including the ability to control water quality, produce feed on-site, and even add some other features. Aquaculture now has a sustainable tool in the form of biofloc technology to handle its economic, social, and environmental problems as it expands. Researchers are tasked with improving this method, and farmers are challenged to use it in aquaculture systems.

2. Materials and methods

The study was carried out in Manawan, District Lahore, at the Fisheries Research and Training Institute (FR&TI). Fresh water was added to sixteen (16) glass aquariums (50 L) for the experiment. Thirty fingerlings of Nile tilapia (Oreochromis niloticus) were placed in each aquarium. In a 50L tank, molasses and probiotics were added at a rate of 250 mg/L and 5 mg/L, respectively, to create a biofloc solution. In accordance with the protocol outlined by Zemor, Wasielesky, Fóes, and Poersch (2019), the aquarium was properly aerated and maintained for 72 hours in order to produce an appropriate Biofloc, which was used as an inoculum for the other experimental aquarium.Fish fingerlings of the same size, Nile Tilapia (Oreochromis niloticus), acquired from the Central Fish Seed Hatchery Manawan, Lahore, were used in an eight-week feeding trial.

As stated by Khanjani, Alizadeh, and Sharifinia (2021), all fingerlings' initial weight and length were noted prior to their introduction into the proper aquarium. In order to keep the water's dissolved oxygen content at the ideal level, maximum aeration was applied. Temperature, pH, ammonia, electrical conductivity, total dissolved solids, salinity, carbon sources, and soluble oxygen were among the physicochemical characteristics that were examined over the course of the 60-day experiment.

Four experimental groups (each with three replicates) were constituted. One group(A) served as the control while other three groups were considered as treatment groups (B, C and D). The detail of feed ingredients of control and treatment/groups is shown at Table-1 as per the procedure described by (Abid, & Ahmed, 2009). The feed samples of all feeding groups were tested for protein, fat, moisture and ash from quality control labs of the said institute. The results were statistically analyzed using the ANOVA as explained by Khanjani & Sharifinia, 2020.

Table 1 The Ingredients and their Percentages used

Sr. No.	Feed Ingredients	Group A	Group B	Group C	Group D
		(Control)			
1	Groundnut oil cake	25%	15%	15%	15%
2	Wheat flour	25%	15%	15%	15%
3	Black gram flour	25%	20%	20%	20%
4	Rice bran	20%	15%	15%	15%
5	Cod liver oil	3%	3%	3%	3%
6	Trace minerals & vitamin premix	1.50%	1.50%	1.50%	1.50%
7	Salt	0.50%	0.50%	0.50%	0.50%
8	Fish meal	---	30%	---	15%
9	Soyabean meal	---	---	30%	15%
	Total	100%	100%	100%	100%

3. Results and discussion

3.1. Growth Rate

By the end of the trial, the average total weights of the four groups (A (Control), B, C, and D) were 18.99g, 23.51g, 21.58g, and 27.23g, respectively. The average initial body weight and length of the Tilapia fingerlings were 6.1g and 7.1cm, respectively. All four groups (A (Control), B, C, and D) had average total lengths of 13.10 cm, 14.18 cm, 13.68 cm, and 14.76 cm, respectively. All groups had a 100% survival rate throughout the trial period.

Table2 Growth performance of Nile Tilapia (*O. niloticus*) fingerlings fed on diets of different percentages of fish and soybean meals for 60 days.

Parameters	Column1	Experimental groups	Column2	Column3
	Group-A			
	(Control)			
		Group-B	Group-C	Group-D
		(T1)	(T2)	(T3)
Average Initial weight (g)	6.10±0.177	6.16±0.202	6.12±0.179	6.30±0.173
Average Initial Length (cm)	7.05±0.091	7.06±0.111	7.02±0.0116	7.12±0.138
Final Average weight	18.99±0.312	23.51±0.261	21.58±0.305	27.23±0.632
(g)				
Final Average Length (cm)	13.11±0.315	14.18±0.200	13.68±0.152	14.76±0.172

Trial values are expressed as mean± standard error of mean and n=15.

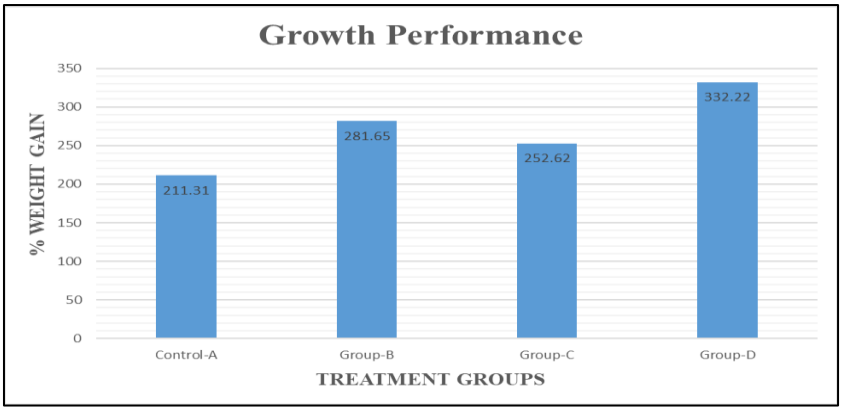

Figure 1 Percentage weight gain of *O. niloticus* fed on different diets of fish and soybean meals alone and in combination for 60 days.

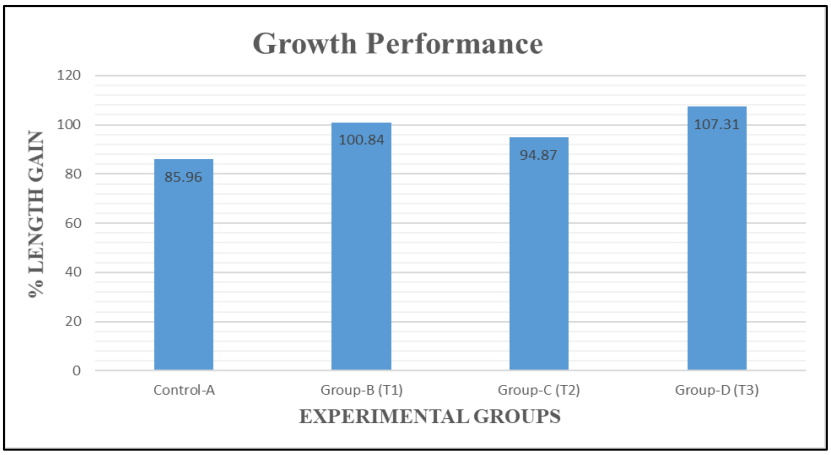

Figure 2 Percentage length gain of *O. niloticus* fed on different diets of fish and soybean meals alone and in combination for 60 days.

The data from the statistical analysis of the feed utilization efficiency/feed conversion ratio at the end of the trial revealed that, in comparison to the control and other treatments (2.03, 1.57, and 1.33), the fingerlings of Group-D fed 15% fish and 15% soybean meals along with other feed ingredients had the highest feed efficiency ratio (1.17g). Both among treatments and in comparison to the control group, the change was significant ($P<0.005$).

Table 3 Feed efficiency of fish samples between control and treatment groups.

	Control-A	**Group-B**	**Group-C**	**Group-D**
		(T1)	(T2)	(T3)
Weight Gain(g)	12.89	15.46	17.35	20.93
Length Gain(cm)	7.01	8.02	7.56	8.46
Feed consumption(g)	26.16	24.27	23.07	24.48
FCR	2.03	1.57	1.33	1.17
FCE	49.27%	63.70%	75.20%	85.49%

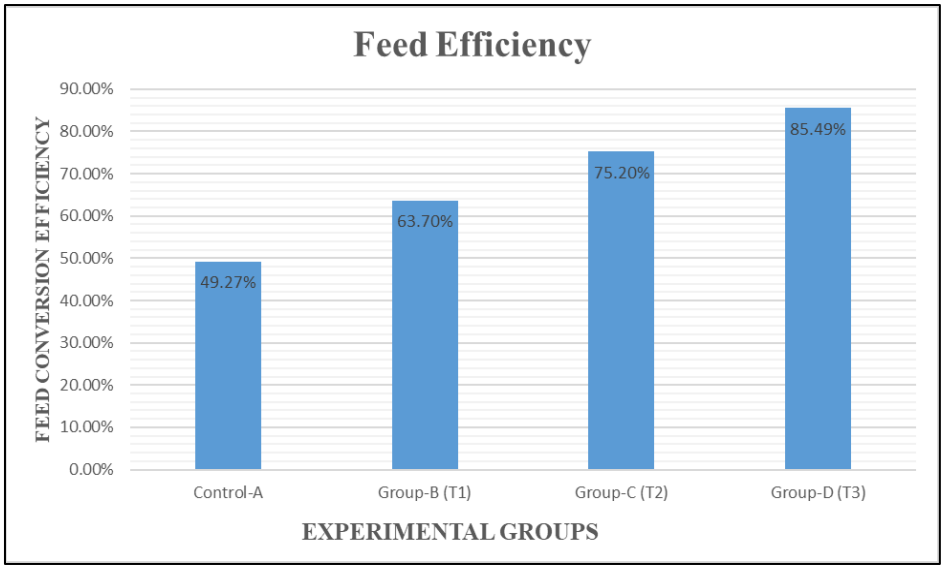

Figure 3 Feed conversion ratio of *O. niloticus* fish fed on different diets of fish and soybean meals alone and in combination for 60 days.

4. Conclusion

The findings of this study showed that feeding fish and soybean meals at rates of 15% and 30%, respectively, along with other feed ingredients, such as biofloc, improved growth and feed efficiency performance when compared to other common feed ingredients. This suggested that both fish and soybean meals are effective protein sources for promoting growth rate and feed efficiency in tilapia fish.The study's findings were in line with numerous earlier investigations that compared the growth performance and feed efficiency of these meals in a variety of fish species, including tilapia. The decision between fish and soybean meal, which are both good choices for feeding Nile Tilapia, depends on a number of criteria, including availability, cost, and nutritional makeup.When comparing various combinations of fish and soybean meals, a 15.15 percent mix of both meals produced greater feed efficiency and weight increase outcomes than other combinations. To recommend the ideal mix of these two ingredients for fish feed formulations, more research on these protein sources is required.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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