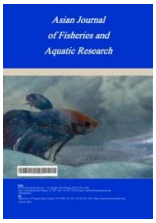

Asian Journal of Fisheries and Aquatic Research

9(2): 9-14, 2020; Article no.AJFAR.60907
ISSN: 2582-3760

Effect of Partial Replacement of Fishmeal with *Leucaena leucocephala* Leaf Meal on the Growth Performance of *Tilapia zilli* Fingerlings

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Authors' contributions

This work was carried out in collaboration between both authors. Author OAB designed the study, performed the analysis, wrote the protocol and wrote the first draft of the manuscript. Author FAF managed the analyses of the study. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJFAR/2020/v9i230154
Editor(s):
(1) Dr. Akeem Babatunde Dauda, Federal University, Nigeria.
Reviewers:
(1) Bruna Paula Tôrres Quinto, Universidade Federal Rural de Pernambuco, Brasil.
(2) Bambang Surya Adji Syahputra, Panca Budi University, Indonesia.
Complete Peer review History: http://www.sdiarticle4.com/review-history/60907

Short Research Article

Received 06 July 2020
Accepted 12 September 2020
Published 18 September 2020

ABSTRACT

Aims: A study was carried out to determine the effect of replacing fishmeal with *Leucaena leucoephala* leaf meal in the diet of *Tilapia zilli* fingerlings.
Study Design: Three hundred (300) *Tilapia zilli* fingerlings (9.5±0.5 g/fish, mixed sex) fed with diet containing *Leucaena leucoephala* leaf meal for 10 weeks at 0%, 2.5%, 5.0%, 7.5% and 10.0% level of inclusion, representing the replacement of fish meal at 0%, 25% 75% and 100% respectively.
Place and Duration of Study: A study was carried out in the wet laboratory of Fisheries Technology department of Lagos State Polytechnic, Ikorodu between July 2017 and October 2017.
Methodology: *Tilapia sp*. fingerlings were treated with five diets including a control experiment of which each treatment was replicated thrice, the total number of replicates was fifteen and the experiment was laid out in a completely randomized design.
Results: Statistical analyses revealed that there was no significant difference (*P*=05) in weight gain, feed conversion ratio and protein efficiency ratio.
Conclusion: *L. leucocephala* can be recommended in the diet of *Tilapia zilli* because of its economic in terms of cheapness and abundance especially in the tropical region and its nutritional values as a good source of plant protein.

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Keywords: Fishmeal; Leucaena leucocephala; growth; Tilapia zilli; fingerlings.

1. INTRODUCTION

In fish farming, nutrition is critical because feed represents 40-50% of the production costs [1]. Fish dietary compositions and balanced commercial fish feeds that support best fish growth and health have been progressive over the years. The development of genetically engineered species with scientifically formulated diet supports the aquaculture industry as it expands to meet increasing demand for affordable, safe, high quality fish and seafood product as reiterated by [2]. Tilapia culture in Nigeria is diversifying with different types of management and cultural practices ranging from homestead ponds to medium-scale aquaculture system for economic and foods security reasons [3]. Tilapia culture is believed to offer one of the solutions especially in view of the depletion of the existing fisheries resources [4].

Tilapia belongs to the family Cichlidae and are all herbivores, feeding on micro-invertebrate, bacteria and detritus materials. The individual specie may have preferences between these materials and are more or less efficient depending on specie and life stages in grazing on these feeds. One of the greatest advantages of tilapia for aquaculture is that they can be fed on a low trophic level as reported by [5] and cited by [6]. This provides an opportunity for fish farmer because Tilapia can be raised in both extensive and intensive systems of aquaculture with low cost of feed [3].

Tilapia can survive and grow well on plant protein with little of animal protein such as fishmeal and blood meal which are common source of animal protein fed to fish and other animals [7]. Therefore, the need for a research into cheaper, readily available and more acceptable plant protein sources should be carried out. Nonetheless, good nutrition in animal production systems is essential and economical in the production of a healthy and high quality product.

Leaf meals such as *Leucaena leucocephala* are the cheapest source of plant protein that can be used to alleviate the cost of feed problem in aquaculture industry if well incorporated in fish diets. Pan tropical forage legume has been widely used in the livestock industry for highly portentous leaves, seeds and pods but its leaves were rarely used as feed component in aquaculture [8]. *Leucaena leucocephala* are perennial leguminous evergreen plants and are among the multipurpose tress found throughout the tropics but originated from Central America. *Leucaena leucocephala* is spineless, free seeding evergreen plant easily established up to 15m. [9] reported that *L. leucocephala* has shown to be rich in crude protein Also, [10] conducted nutrients composition of *L. leucocephala* as shown Table 1 and the results agreed with the findings of [9] on the richness of it.

Table 1. Nutritional composition of *Leucaena leucocephala* leaf meal (%DM)

Composition	Fresh Leaves (%)
Moisture	7.50
Crude Protein	29.20
Crude Fibre	19.20
Ether Extract	2.05
Total Ash	10.50

Source: [10]

Michael [11] also reported that *Leucaena leucocephala* reduce cost of ration and that it provides quality pasture rich in calcium, vitamins and protein. *Leucaena leucocephala* leaves can be dried for use in concentrate feeds. It can be chopped and made into dehydrated meals. *Leucaena leucocephala* are planted and managed to suit the use of a forage harvester. Hand cutting and sun drying are possible in suitable climates where labour is readily available [12].

2. MATERIALS AND METHODS

The experiment was conducted in the wet laboratory of Fisheries Technology Department, Lagos State Polytechnic, Ikorodu Lagos in the year 2017. The experimental system consisted of five rectangular glass tanks filled with freshwater from overhead tank and each rectangular glass tanks measuring 0.9m x 0.45m x 0.9m consist of three compartments for each treatment. Three Hundred *Tilapia zilli* fingerlings sourced from credible fish farm at Ibadan, Oyo State of Nigeria were used for feeding trial and their initial weight were determined using electronic scale balance (Ohnaus Scout Pro Balances Models SP-601) before allotted to each unit at 20 fingerlings per replicate.

Leucaena leucocephala leaf meal used for the experiment was harvested from established pasture field of the School of Agriculture, Ikorodu campus, Lagos state polytechnic, Nigeria. The

Leucaena leucocephala foliage were soaked in fresh water for forty-eight hours and sundried for three days as prescribed by [13]. The dried *Leucaena leucocephala* leaves were then ground and weighed before mixing with other feed ingredients which include maize, wheat offal, GNC, Soyabean meal, blood meal, fish meal, Vitamin premix, salt and vitamin C. The milled feed ingredients were later bind together with starch and pelletized into 0.8mm in size.

A total number of five (5) experimental diets were prepared and the level of inclusion of *Leucaena leucocephala* leaf meal were at 0%, 2.5%, 5.0%, 7.5%, and 10.0% were laid out representing Diet 1, Diet 2, Diet 3, Diet 4 and Diet 5 respectively (Table 2).

The experiment was laid out in completely randomized design (CRD) with five treatments replicated thrice (3). Each replicates comprised of 20 *Tilapia zilli* fingerlings.

The tanks were filled with freshwater and aerated for twenty four hours prior to stocking with the *Tilapia zilli* fingerlings. The initial and subsequent water quality parameters before and during the experiment were determined using water test kit suite (Ezdo model PCT-407). The fishes were acclimatized to the laboratory environment for one week during which the fish were fed with the control diet. The experiment commenced after the acclimatization period.

The initial mean weights of the experimental fish were recorded before feeding. Weighing and recording of experimental fish and experimental diets were afterwards carried out fortnightly. A fixed feeding regime of 5% body biomass was adopted for the period of 10 weeks. The daily feed was divided into two equal halves and fed twice a day, 7:00 hours and 5:00 hours respectively. The uneaten food and feaces were siphoned daily prior to the next day feeding and water is being changed at every two days because of the fragility of Tilapia spp.

Data was collected fortnightly for feed intake and weight gain to compute the performance indices such as Feed conversation ratio (FCR), F.C.R – Average feed innate/average gain in body weight, Protein efficiency ratio (PER), P.E.R = Body weight gain/protein intake at the end of the experiment. Each treatment was statistically analyzed using one-way analysis of variance for mean weight gain, Food conversion ratio, feed intake, protein efficiency ratio, and specific growth rate and mortality ratio
[15].

Table 2. Composition of experimental diets

Ingredient	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Maize (kg)	14	14	14	14	14
W/Offal (kg)	16	16	16	16	16
GNC (kg)	25	25	25	25	25
SYM (kg)	26	26	26	26	26
Leucaena leucocephala (kg)	-	6.5	12.5	18.5	25
Fish meal (kg)	10	7.5	5	2.5	-
Blood meal (kg)	7	7	7	10	10
Salt (g)	0.25	0.25	0.25	0.25	0.25
Fish premix (g)	0.5	0.5	0.5	0.5	0.5
Vit. C (g)	0.25	0.25	0.25	0.25	0.25
Binder (starch) (kg)	1	1	1	1	1
Moisture (%)	10.50	11.45	11.02	10.55	11.22
Fibre (g)	5.60	5.28	5.81	6.82	6.20
Ether extract (g)	31.53	32.41	33.60	34.90	32.57
Ash (g)	8.52	8.37	8.79	8.52	10.86
Calculated Analysis					
Metabolizable Energy	2905	2975	6400	6399	5891
Crude protein	39.90	39.3	38.35	38.77	38.5

[14]

3. RESULTS AND DISCUSSION

Table 3 shows the growth performance of *Tilapia zilli* fingerlings fed with diet mixed with gradient levels of *Leucaena leucocephala leaf* meal. The dietary composition of the experimental diets indicated that the *Tilapia zilli* fingerlings on diet 4 (7.5% inclusion of *Leucaena leucocephala* Leaf meal) had the highest weight gain of (3.56 g), feed conversion ratio (2.25 g) and specific growth rate (1.02 g). The statistical analysis showed that there was no significant differences (*P*=05) in weight gain, food conversion ratio and Protein efficiency ratio.

Table 4 indicated the mean values of essential physico-chemical parameters during the study period and there was no significant difference (P>5) among all the treatments. The measured water quality parameters were in the range of tolerance for *Tilapia zilli* cultured in the pond [16].

Cost on fish food is always the main budget item on fish farming venture. Therefore, dependable indices are necessary to determine the growth performance of the fish fed with formulated feed. The parameter such as feed conversion ratio, weight gain, feed consumed and protein efficiency ratio are relevant examples of such indicators that reflects how effective a feed fed to the fish can be in order to evaluate the profitability of a fish farm

The present study demonstrated the use of plant protein, *Leucaena leucocephala* leaf meal to replace animal protein in the diet of *Tilapia zilli* fingerlings in order to reduce competition between man and animal which often times precede the scarcity and over prizing of it as emphasized by [9]. Generally, Tilapia spp are herbivorous fish that thrives on vegetation and other plant protein source which are cheaper than fishmeal [7]. Feeding habit in Tilapia as an herbivores gave a positive response in growth parameters when *Leucaena leucocephala* leaf meal are added to the diet. *Leucaena leucocephala* leaf meal is rich in crude protein (29.20%) as shown in the nutritional analyses carried out by [10].

The growth parameter in the result shows good response of *Tilapia zilli* to experimental diets, this is an indication that all the fishes in the experiment accept the various gradient levels in their feed. This agreed with the report of [9]. On isonitrogenous feeding trial on *Clarias gariepinus* juveniles using *Leucaena leucocephala* Leaf meal. Also, weight gain increased significantly with increase in dietary protein intake support the report of [17] on growth response of *Oreochromis niloticus* fingerlings fed with fermented *Parkia biglobosa* diets as plant protein source.

Table 3. Growth characteristics of *Tilapia zilli* fingerlings fed with partial replacement of fishmeal with *Leucaena leucocephala* leaf meal in the diet

Parameter Indices	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM
Number of weeks	10	10	10	10	10	
Initial Mean Weight (g)	9.50	9.70	9.40	10.0	9.0	0.017
Weight Gain (WG) (g)	3.30	3.50	2.81	3.56	3.29	0.132
Final weight (g)	12.80	13.20	12.21	13.56	12.29	0.390
Feed intake (g)	7.86	8.11	7.09	8.00	8.25	0.203
Feed conversion ratio	2.62	2.32	2.50	2.25	2.51	0.067
Specific growth rate (% per day)	0.94	1.00	0.80	1.02	0.94	0.086
Protein efficiency ratio	0.08	0.09	0.07	0.09	0.09	0.004
Survival rate (%)	95.1	95.4	95.0	94.5	95.5	0.176

Table 4. Mean values of essential water quality characteristics

Treatments	pH	D.O (mg/l)	Temp (^{o}c)	NH_3 (mg/l)	NO_2- (mg/l)	NO_3-(mg/l)
1	6.70	5.17	27.59	0.43	0.03	0.04
2	6.68	5.10	27.60	0.42	0.02	0.03
3	6.78	5.25	27.55	0.45	0.03	0.03
4	6.19	5.23	27.60	0.44	0.03	0.04
5	6.79	5.15	27.58	0.43	0.03	0.04
SEM	0.112	0.027	0.009	0.005	0.0025	0.003
F.A.O standard	6.5	≥6.0	40	4	≤ 4	17

D.O (Dissolved oxygen) ** Temp (Temperature) * NH3 (Ammonia) **** NO_2 (Nitrite)***** NO_3 (Nitrate) ***** F.A.O Standard*

The statistical insignificant difference (P>0.05) in the growth parameters in the feeding trial corroborates the works of [9] in the utilization of *Leucaena leucocephala* Leaf meal on growth performance of *Clarias gariepinus*. However, the observable increase in weight gain and specific growth rate with increase in dietary protein intake could be as a result of high crude protein content in *Leucaena leucocephala* Leaf meal [19.20% (DM)] in the diet as reported by [10].

The survival rate recorded in the experiment could be credited to good management practices in the feeding and water quality management by monitoring the water quality characteristics during the experimental periods. Water quality parameters measured were within the range of tolerance for *Tilapia zilli* fingerlings. This supports the publications of [18] and [19] on the importance of good water quality on the performance and growth characteristics of aquatic life.

4. CONCLUSION

The varying levels of inclusion of *Leucaena leucocephala* leaf meal in the diet of *Tilapia zilli* fingerlings showed an improved performance from the view point of specific growth rate, weight gain and feed conversion ratio The effect of using *Leucaena leucocephala* leaf meal in this study established that it could be used at recommended level of inclusion in the diet of *Tilapia zilli.* This level of inclusion buffers fish meal in the diet which Is very expensive. *Leucaena leucocephala* leaf meal is hereby recommended to be included in the diet of *Tilapia zilli* at 7.5% level of inlusion. This experiment should be repeated in ponds to see if better results could be obtained outside laboratory for *Tilapia zilli* and other fish spp.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/60907