EFFECTS OF NEEM LEAFMEAL ON AFRICAN CATFISH GROWTH AND FLESH ACCEPTABILITY

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Abstract
Neem leaf meal has been efficaciously utilized in the several diets of aquaculture species either as immune stimulants, phytobiotics or fish feed replacement and there is an urgent need to derive distinct and tolerated dose on organism physiology, growth and acceptability to consumers. A total of 225 juveniles of African catfish (*C. gariepinus*) with mean weight of 0.071±0.02kg were fed with experimental diets of graded levels [0% (control), 0.5%, 1%, 1.5% and 2% as treatment 1 to 5 respectively] of neem leafmeal per 100kg of feed for a period of eight weeks. Growth of fish was monitored on weekly basis and mortalities from fish tanks were noted. Fish were subjected to sensory evaluation at the termination of the feeding trial. 15trained panelists were made to evaluate the texture, colour, flavor, sweetness and appearance of the steamed samples using a likeness code rated from 9-3. There is no significant difference ($P<0.05$) in the mortality rate of experimental fish in all treatments. However, this study revealed that neem leafmeal has a deleterious effect on the growth of fish when incorporated at a level higher than 1.0/kg in diet and also altered the taste and sweetness of fish, which in turn reduce their overall acceptability.

Keywords: Neem leafmeal, Catfish fish growth, flesh acceptability

Introduction

Aquaculture is the primary source of fish supply, as production from marine catch fisheries has been nearly stationary in recent years. The current expansion of fish industry in relation to growing, stocking density and excess feed use has resulted in stress in aquatic creatures, ultimately reducing immunity and growth. Chemotherapy has been the primary approach for the obstruction and cure of aquatic diseases up to this point. However, multiple studies have shown that chemical drugs have harmful effects on both the environment and humans. Because most bacterial strains develop drug resistance in the environment, antibiotics and their remains have a deleterious impact on the aquatic system. As a result, there has been a focus on ecofriendly and sustainable techniques of aquaculture disease management approaches.

Chemotherapy is the major method for obstructing and curing aquaculture disease outbreaks. Chemical treatment, on the other hand, has a number of hereditary negative impacts on both the environment and humans. In addressing the aforementioned issue, activation of the non-specific immune system is a preferable option for improving resistance and development in nurtured organisms. Phytobiotics are high in bioactive substances, which can stimulate the immune system. Furthermore, they represent a new aquaculture frontier region, and there is an urgent need to derive distinct and direct tolerated dose on the immune system, organism physiology and growth. Consumption of farmed fish with chicken is predicted to expand rapidly. The global fish production sector is currently confronting the task of increasing output in order to combat protein hunger and secure livelihood and nutritional security in the next years.
Since plant extracts include more diverse components than chemical medications, phytotherapies are more cost-effective, environmentally benign, and ecofriendly than conventional drugs. They are also less likely to evoke drug resistance. Due to their richness in bioactive substances such as alkaloids, terpenoids, tannins, saponins, glycosides, flavonoids, phenolics, steroids and essential oils, plant extracts have been utilized for several purposes such as anti-stress, growth promotion, appetite stimulant, immune system improvement, broodstock maturation, aphrodisiac, and antipathogenic.

Neem is a popular tropical multipurpose evergreen tree that grows quickly (Mridha and Al-Suhaibani, 2014). A variety of aquaculture species have effectively used Neem leaf meal in their diets. Some of these are channel catfish, the African catfish (*Clarias gariepinus*), blue tilapia (*Oreochromis aureus*), turbot (*Psetta maxima*), rainbow trout (*Oncorhynchus mykiss*) and Atlantic salmon (*Salmo salar*) (Kroeckel et al., 2012; Lock et al., 2014; St-Hilaire et al., 2007; Sealey et al., 2011)). The results of these feeding studies revealed that Neem leaf meal might partially

substitute fishmeal in the diets of these fish species. This study's goal is to discover the influence of *Azadirachta indica* leaf meal on development and sensory evaluation of *Clarias gariepinus* juveniles.

Methodology

The Area of study

The experiment was carried out at the Agricultural Technology Research and Training Farm of The Federal Polytechnic, Ilaro, Ogun State. Ilaro is a popular town found in Yewa South Local Government Area, Ogun State, South Western Nigeria,Nigeria.

Leafmeal and feed preparation

Neem (*Azadirachta indica*) plant leaves were obtained fresh from undamaged matured trees in the main campus of The Federal Polytechnic, Ilaro. The collected leaves were dried for 21 days, grounded into fine powder using disc mill and was stored in a plastic container until needed for use. Five different diets were produced using Pearson's square method of fish feed formulation. The 3mm sinking pelletized fish feed was packed inside bags and labelled according to their treatment. The five experimental diets with 40% crude protein consist of varying level of Neem leaf meal are added thus; 0% Neem leafmeal for the first treatment (which also stand as the control), treatment 2 has 0.5% Neem leafmeal, treatment 3 with 1%, treatment 4 with 1.5% and treatment 5 has 2% Neem leafmeal per 100kg of feed. The composition of the experimental feeds are shown in the table below

Table 1: Feed Diet Formula

Ingredients	T1 control	T2 (0.5%)	T3 (1.0%)	T4 (1.5%)	T5 (2.0%)
Fish meal	4.00	4.00	4.00	4.00	4.00
GNC	4.00	4.00	4.00	4.00	4.00
Soya bean	4.00	4.00	4.00	4.00	4.00
Corn	0.91	0.91	0.91	0.91	0.91
Premix	0.30	0.30	0.30	0.30	0.30
Oil	0.45	0.45	0.45	0.45	0.45
Salt	0.15	0.15	0.15	0.15	0.15
Binder	1.2	1.125	1.05	0.975	0.90
Neem	-	0.075	0.15	0.225	0.30

Experimental Fish Sampling

A total of 225 juveniles of African catfish (*C. gariepinus*) of mixed sex with mean weight of 0.071g±0.02 were utilized for the experiment. Fish juveniles were purchased from a reputable fish hatchery within Ilaro metropolis and transported early in the morning to The Federal Polytechnic Farm. Fish were acclimatized for two weeks and fed with commercial fish feed before the commencement of experiment. Fish juveniles were randomly distributed into tanks and fed with the experimental diets for a duration of eight weeks. The five experimental diets were randomly assigned in triplicates to fifteen rectangular plastic tanks. The juveniles were fed twice daily and tanks cleaned every three days prior to feeding. Fishes were observed every morning and mortalities from each tank were noted. The number of fish in each replicate was weighed and rate of growth of the experimental fish were recorded on weekly basis for a period of eight weeks.

Sensory evaluation

In sensory evaluation and analysis, interpretation of panelists' reaction to the incorporation of neem leaf meal was done. The experimental fish was slaughtered, cleaned and moved to the kitchen of the Department of Nutrition and Dietetics for the commencement of the sensory processes. The fish in each treatment was seasoned with salt only and steamed for 15mins respectively. After steaming, panelists were made to evaluate the texture, colour, odour, taste and appearance of the steamed samples using a likeness code rated from 9-3, with 9 rated "like extremely", 8 "like moderately", 7 "like slightly", 6 "neither like nor dislike", 5 "dislike slightly", 4 "dislike moderately" and 3 "dislike very much".

Data Analysis

Data collected was subjected to Analysis of Variance (ANOVA) and Duncan Multiple Range Test (DMRT) to further separate significance among means at P<0.5 using the statistical package for social science (SPSS), IBM SPSS 25.0.

Results and discussion

Growth Rate of Experimental Fish

Table 2 below shows the weight gained by catfish juveniles fed graded level of neem leaf meal and rate of survival of experimental fish per treatment.

Table 2: Growth performance of catfish fed graded level of neem leaf meal

Parameters	T1	T2	T3	T4	T5	SEM	P-Values
Initial body weight (g)	0.068	0.073	0.068	0.069	0.076	0.0023	0.864
Final body weight (g)	0.125^{a}	0.118^{ab}	0.117^{ab}	0.091^{b}	0.099^{ab}	0.0047	0.045
Daily body weight gain (g)	0.002^{a}	0.0016^{a}	0.0017^{a}	0.0008^{b}	0.0008^{b}	0.0002	0.002
Mortality (%)	0.00	0.01	0.00	0.00	0.02	0.0005	0.004

There is no significant difference (P>0.05) between the daily body weight gained for treatments 1, 2 and 3 but significantly differs (P<0.05) from that of treatments 4 and 5. The final body weight gained is significantly same (p<0.05) for T2, T3 and T5 except for T1 and T4. Treatment 1 which is the control has the highest final and daily mean body weight gained withTreatment 4 having the least body weight gain. This is in conflict with the outcome of Ubiogoro et al. 2019 who fed juvenile catfish with 3.5% and 7.0% neem extract infused in commercial feed and fed to fish bi-weekly. The mean weight gained for the neem fed fishes was higher than the control. Decrease in body weight gained with increase in addition of neem recorded in this study corresponds with studies conducted by Obikaonu (2012) who discovered that the weight gained by broiler chicken, fed varying diets of neem leafmeal, reduced significantly(P<0.05) with a rise in level of incorporation of neem in feed.

Obaroh and Achinonye-Nzeh, 2011 also reported variation in the growth parameters of *Oreochromis niloticus* fed crude extracts of neem leaves at different levels. It was concluded that crude extract of neem leaf improve the weight gain of Oreochromis to a level of 1.0g/kg diet while inclusion at a level higher than this reduces the weight gain of fish. This study also reveals that fish feed with neem leafmeal does not have a deleterious impact on the development of fish when incorporated at a level not higher than 1.0/kg diet of fish. Damaging effect on growth of catfish at a higher dose may be ascribed to the high fibre content of neem leaf meal which resulted in poor conversion ratio of the experimental feed by aquatic animals (Obaroh and Achinonye-Nzeh, 2011).

Table 3: Percentage Survival Rate of Fish per Treatment

LABEL	TOTAL FISH	NO OF MORTALITY	TOTAL NO OF SURVIVAL	% SURVIVAL
T1	45	1	44	97.78
T2	45	3	42	93.33
T3	45	1	44	97.78
T4	45	2	43	95.56
T5	45	4	41	91.11

Treatment 1 and 3 has the highest survival rate with one mortality recorded each (Table 3) while the treatment with least survival is treatment 5. Low value recorded for survival may have no correlation with the inclusion of neem leafmeal in the diet. Treatments 2 and 4 have 93.33% and 95.56% survival rate respectively. There is no significant difference (P<0.05) in the mortality rate of experimental fish in all treatments. (Table 2)

Sensory Evaluation

Sensory evaluation is a key method to access the taste, sweetness, colour, aroma, appearance and texture of food samples because it measures what the panelist analyze. It is all about panelists using their sense of seeing, smelling, touching and tasting.

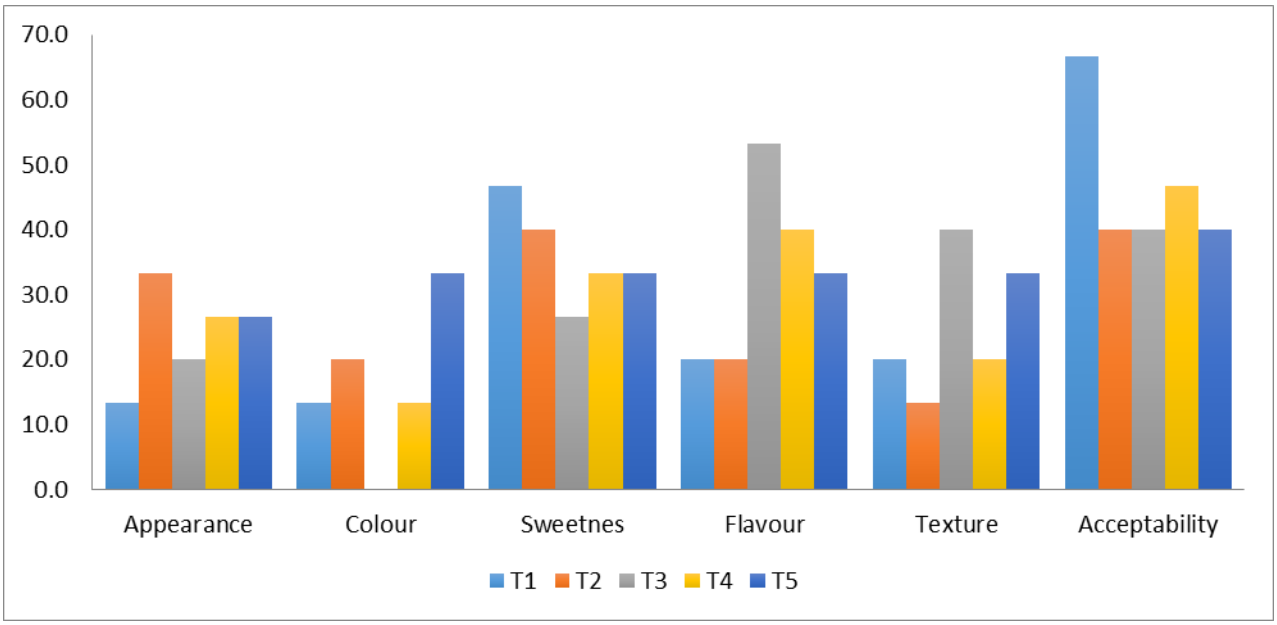

Fig. 1 Organoleptic analysis of fish samples rated "like extremely"

The sensory evaluation of the experimental fish was done in order to determine if the bitter taste of *Azadirachta indica* will alter the taste or have a deleterious impact on the quality of the catfish flesh. This research showed that there is no huge difference in sensory parameters tested by panelists, although T1 is highly rated for overall acceptability. In terms of appearance, T2 was most preferred by the panelists with T5 in terms of colour. T1 has 66.7% overall acceptability and 46.7% of the panelist extremely like its sweetness. All the fish samples receive the "like extremely" rating in terms of flavor, sweetness, appearance and overall acceptability except for T3 where none of the panelists like it extremely in terms of colour.

A likeness score of 7 or more on the sensory evaluation sheet usually symbolize high acceptable sensory quality. Thus, a treatment with such score could be boldly used as a good indicator of 'target' quality. On this premise, treatments showing panelists' preferences illustrate the sensory qualities that realistically represents the consumers' acceptance limits. It can be seen from the table that the incorporation of neem leaf meal slightly alter the sweetness and acceptability of fish flesh, which are both major factor in taste and acceptability determinacy.

In a study conducted on sensory quality of broiler chicken fed *Azadirachta indica* by Girma et al., 2021, it was discovered that *A. indica* seed powder added at 1% inclusion level in chick diet does not affect the taste and overall acceptability of meat quality. The result of Girma et al., 2021 is also at par with that of Ubiogoro et al., 2019 who stated that there is no significant difference ($P>0.05$) in the taste, flavor and overall acceptability of the control and treatment groups of Clarias juveniles fed 3.5 and 7% neem leaf extract . The result of this study negate both findings as the control group, with no neem inclusion is most preferred by panelists. Rodriguez et al., (1996) also discouraged the use of feed substitute with unpalatable taste as this may have some negative effect on the fle.sh of the consuming animal.

Conclusion

This research showed that fish feed with crude neem extract embedded in it, does not have a deleterious impact on the development of fish when incorporated at a level not higher than 1.0/kg diet of fish. When used at a higher dose regularly, it may negatively affect the growth and physiology of fish. Also, there is no huge difference in sensory parameters tested by panelists. However, there is higher preference for Treatment 1 in terms of sweetness and overall acceptability. It can thus be concluded that neem crude extract altered the taste and sweetness of fish in whose diets it was added, which in turn reduce their overall acceptance.

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