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International Journal of Aquaculture and Fishery Sciences
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International Journal of Aquaculture and Fishery Sciences OPEN ACCESS JOURNAL

ISSN: 2455-8400 DOI: https://doi.org/10.17352/ijafs

Research Article

Nutrient utilization and growth performance of African Catfish (*Clarias gariepinus*) fed varying levels of Composite Meal (CM) in replacement of fishmeal

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Received: 10 May, 2022
Accepted: 27 May, 2022
Published: 28 May, 2022

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Keywords: Composite meal; Animal protein; Nutrient utilization; Growth performance; African Catfish

Abstract

This study evaluates the nutrient utilization and growth performance of African catfish (*Clarias gariepinus*) fed alternative animal protein composite meal for 42 days. The composite meal is composed of feather meal, blood meal, tilapia meal, and maggot meal each in a 25% proportion. Five isonitrogenous diets (T1, T2, T3, T4, and T5) containing 40% crude protein were formulated with the composite meal replacing fish meal at 0% control (T1), 25% (T2), 50% (T3), 75% (T4) and 100%(T5) respectively. The weight gain, protein intake, protein efficiency ratio, and specific growth rate in the 75% and 100% inclusion levels were not significantly different from the control diet. Fish survival ranged between 90-95% with the highest weight gain of 10.57g observed in the 100% inclusion level. The Feed conversion ratio varied between (1.17 and 1.37). The results from growth, feed utilization, and survival levels showed an overall good growth of the fish in the experimental diets, and this indicates that the composite meal is a potential replacement for fish meal in the diets of *Clarias gariepinus* fingerlings.

Introduction

With the annual increase in global population, there has been an increase in fish demand causing rapid growth in the aquaculture industry compared to other animal food production [1]. Sustainable aquaculture production however depends largely on the ability of farmers to formulate cost-effective feed to reduce the cost incurred on feeding which accounts for about 60% of the total aquaculture production cost [2]. For decades, fishmeal which is an important protein ingredient source has constituted a major part of fish feed formulation. In recent years, due to high demand and an increase in prices, the availability of fish meals has decreased significantly [3]. To meet up with rising fish demands, there is a need to find alternative and cheaper protein ingredient sources of plant or animal origin that can replace fish meal which will not affect the nutritional and growth performance of fish. . The availability of cheap feed that meets the protein requirement of African catfish (*Clarias gariepinus*) would go a long way in increasing its production and profitability [4].

Since fishmeal is an expensive feed ingredient, the use of non-conventional feedstuffs in the diets of catfish has been reported. Many Alternative Protein Sources (APS) have been used in the replacement of fishmeal in fish diets through feeding trials [5]. Animal and plant-based feed ingredients such as feather-meal [6], maggot meal [7], poultry offal [8], duckweed [9], brewer wastes [10], and wastes from other animal and plant sources for fish feed formulation have been credited for being cheap and not compatible with human consumption.

Feather meal is a poultry by-product with high protein content (80%-85%) and is commercially available. With some chemical treatment, feather meal can be a good source of sulfur-

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containing amino acids [11]. A dietary feather meal inclusion of not more than 25% in the diet of catfish fingerlings has been reported by Serwata and Davies [12]. When feather meal is hydrolyzed and mixed with chicken offal and maggot meal, the mixture was able to replace 50% of fish meal used in African catfish fingerlings' diets without causing any adverse effects on fish growth [13]. Maggot meal is high in biological value and contains ten essential amino acids [14] that are comparable to fish meal [15] and high in nutritive value. The biological value of maggot meal is equivalent to that of fish meal and maggot larvae contained no anti-nutritional or toxic substances found in alternative protein sources of vegetable origin [16].

In a preliminary survey conducted before this research, we observed that feathers generated from processing poultry birds and poultry droppings from which we produced maggot meal are available in large quantities across Nigeria mostly as farm waste and with a potential of being utilized as constituents of animal feed. In this study, we formulated a composite meal (comprising feather meal, blood meal, maggot meal, and tilapia meal) that can be used for partial or total replacement of fishmeal in the diets of *Clarias gariepinus*.

Materials and methods

Feed ingredients sourcing and processing

Composite Meal (CM) was produced from locally sourced non-conventional animal feed ingredients. Feather meal, blood meal, maggot meal, and tilapia meal each at a 25% proportion and were blended to form a composite diet. Feathers and cow blood were collected from poultry bird processors and abattoir at Bodija market, Ibadan. Feathers were processed according to the method described by Omitoyin, et al. [17]. Blood was processed as described by Eyongetta [18]. Maggot meal was produced following the method described by Fasakin, et al. [19] using poultry droppings collected from the University of Ibadan poultry farm and processed according to Calvert, et al. [20], and Balogun, et al. [20,21]. Other feed ingredients were purchased from a reputable feed mill in Agbowo Ibadan.

Feed formulation

All feed ingredients that will be used were milled and mixed into very fine homogenous particles. The feed ingredients were weighed using commercially available Camry scales and Camry EK4510 digital scales. Pearson square method was used to formulate five isonitrogenous diets with 40% crude protein using commercially available Danish fish meal. The fish meal was then replaced at 0%, 25%, 50%, 75%, and 100% with the composite meal. The diets were labeled T1 (100%FM, 0% CM), T2 (75%FM, 25% CM), T3 (50%FM, 50% CM), T4 (25%FM, 75% CM) and T5 (0%FM, 100% CM) respectively with T1 being the control while T2, T3, T4 and T5 are treatments. The ingredients were mixed, and diets were made into 2mm pellets using a pellet machine at the University of Ibadan fish farm, sun-dried for 48 h, and stored at room temperature. The feed ingredients, formulation, and proximate composition are presented in Table 1.

Table 1: Composition of experimental diets.

Feed materials	T1	T2	T3	T4	T5
	Values (kg)				
Maize	15	15	15	15	15
GNC	30	30	30	30	30
SBM	25	25	25	25	25
Fish meal	23	17	11	6	-
Composite meal	-	6	11	17	23
Bone meal and other minerals	4.5	4.5	4.5	4.5	4.5
Methionine	2	2	2	2	2
Lysine	1	1	1	1	1
Total	100	100	100	100	100

GNC = Groundnut cake; SBM = Soy Bean Meal

Experimental setup

A total of 150 African catfish (*Clarias gariepinus*) fingerlings with a mean initial body weight of 4g were purchased from a reputable fish farm hatchery in Ibadan, Oyo state. Before feeding trials, the fingerlings were acclimatized in fish harpers in a tank for two weeks. For the experiment, two rectangular tanks each with a dimension of 15ft (length) by 6 ft (width) by 4 ft (depth) were used. Each of the two concrete tanks was filled with water and the water level was maintained at 2/3 capacity in all the tanks throughout the experiment. 15 harpers anchored above the pond with dimensions 1ft by 1 ft and 1.5ft. were submerged into the water. After two weeks, the fingerlings were divided randomly and distributed into 15 harpers with ten fishes per harper. The fishes were fed twice daily (9 am and 4 pm) to satiation for 42 days with each of the diets in triplicate harper. The fish were weighed weekly and inspected daily for abnormal behaviour and mortalities. The amount of feed fed to the fish was adjusted every two weeks according to the last total body weight determined by weighing. Water temperature, pH, and ammonia were measured weekly using mercury in a glass thermometer and API freshwater test kits.

Analytical techniques and growth determination

The proximate analysis of the composite meal, experimental diets, and experimental fish was done using the method described by [22] methods and carried out in triplicates. The experimental fish growth performance and nutrient utilization were based on the following biological parameters.

Weight Gain (WG) = (Final weight – Initial weight)g

Percentage Weight Gain (PWG) = (Mean weight gain / Initial weight) X 100

Specific Growth Rate (SGR) = (ln final weight – ln initial weight)/days X 100

Protein Intake (PI) = Feed intake X percentage protein

Protein Efficiency Ratio (PER) = Weight gain (g)/ Protein intake

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Feed Conversion Ratio (FCR) = (Feed intake / Fish weight gain) g

Statistical analysis

Data collected from the feeding experiment were subjected to Analysis of Variance (ANOVA) for significant differences using (SPSS version 28). Variation in means was tested using Duncan Multiple range test [23] at $p < 0.05$

Results and discussion

The result of the proximate composition of the feed ingredients is presented in Table 2. The proximate composition of the composite meal compares favorably with the fish meal used in this experiment. The crude protein of the composite meal was 67.83% compared with 72% of the fish meal. The growth performance, feed utilization, and survival of African catfish (*Clarias gariepinus*) fed varying levels of composite meal inclusion are shown in Table 3. The mean weight gain ranged from 6.53 ± 0.11 in T3 to 10.57 ± 0.84 in T5. The feed intake and weight gain were significantly higher at 75% and 100% inclusion of composite meal. The observed growth could be due to a combination of high protein animal feed ingredient sources used in the composition of the composite meal [24]. Protein intake, PER, and SGR were lower in (T2) 25% and (T3) 50% composite meal inclusion levels compared with the higher values observed in the (T5) 100% and (T4) 75% composite meal inclusion levels. However, experimental fishes in T3 were observed to respond slowly when fed the experimental diets and this could have resulted in their low weight gain as observed in the result. The Feed Conversion Ratio (FCR) ranged from 1.17 ± 0.07 to 1.37 ± 0.03 but was significantly lower in diet T5. This indicates that the protein sources in the diets compared favorably in diets to flesh conversion. The higher SGR and PER found at higher inclusion levels suggest that the amino acid of maggot meal, tilapia meal, blood meal, and feather meal in the composite diet is similar to that of fish meal [15,25]. African catfish showed positive potential for growth with the use of the composite diet in replacement of fish meal with no observed health effects of the diets on the fish and water quality (Table 4).

Table 2: Proximate composition of the feed ingredients.

Feed Ingredient	%Crude Protein	%Ash	%Ether Extract	%Crude Fiber	%Dry Matter	%Moisture Content	NFE	ME
Feather meal	73.44	1.78	9.32	7.29	94.8	5.2	2.97	3466.55
Blood meal	69.73	3.78	2.29	2.58	90.81	9.19	12.43	3070.25
Maggot meal	61.8	15.31	5.23	6.21	93.87	2.13	9.32	2933.75
Tilapia meal	54.26	27.8	8.29	0.4	94.9	5.1	4.15	2749
Composite meal	67.83	11.59	5	5.01	93.07	4.93	5.64	2996.45
Maize	8.39	1.59	3.69	1.8	90.01	9.99	74.54	3216.2
Soybean meal	44.26	7.2	1.99	5.79	89.99	10.01	30.75	2794.5
GNC	42.54	5.62	8.8	22.8	94.27	5.73	14.51	2744.75

Table 3: Proximate composition of the experimental diets.

Proximate composition	T1	T2	T3	T4	T5
Crude Protein	40.29	40.3	40.33	40.35	40.36
Ash	6.45	6.7	6.85	9	11
Ether Extract	2.35	4.13	3.02	4	3.5
Crude Fat	3.07	3.33	4.03	4.08	4.1
Dry Matter	90.14	90.54	89.19	89.72	91.28
Moisture Content	9.86	9.46	10.81	10.28	8.72
NFE	37.98	36.08	34.96	32.29	32.32
ME (Kcal/Kg)	3000.4	2956.35	2977.7	2889.2	2892.3

ME = Metabolized Energy; NFE = Nitrogen Free Extract.

In this study, there were no significant differences in the weight gain and feed intake of the experimental fishes in the 75%, 100%, and control groups (T1). In addition, increasing the composite meal inclusion rate did not affect the fish survival rate as well as the water quality. This showed that it is safe to use the composite meal at the various inclusion levels. In a similar study by Adewolu, et al. [13], the author replaced fishmeal with 50% of animal meal mixture comprising feather meal, chicken offal meal, and maggot meal and concluded that animal protein mixtures are well utilized for optimal growth and that essential amino acids were available to support growth. Bureau, et al. [26] suggested the use of two or three protein sources in fish feed formulation to reduce the negative effects of nutrient imbalance, lower digestibility of nutrient contents, excessive levels of anti-nutritional factors, or lower palatability which are usually nutritional factors that cause depression in performance of fish fed lower levels of fish meal.

The result of the carcass composition of the experimental fish fed the experimental diets is presented in Table 5. The highest crude protein was obtained in T5 (16.12 ± 0.11) while the T3 had the lowest crude protein content. Lipid content was highest in the fish fed the control diet and lowest in T3. The ash content of the fish was not significantly different in the control and among all treatments. In general, the carcass composition of the catfish fed the experimental diets was not affected by the substitution of the fishmeal with the composite meal. This is similar to what was reported by Abdel-Warith, et al. [27] and Fasakin, et al. [19]. The similarity observed in the carcass composition of the experimental fish could be a result of the use of different protein source ingredients in the composite meal and feed formulation. The cost of producing a kilogram of the composite meal locally ranged from N300 to N400 which is low compared with the cost of imported 72% Danish fish meal of N950. This indicates that the use of composite meal in replacement of fish meal can help reduce the cost of production.

Conclusion

In conclusion, the protein content of the composite meal and the result from this study shows that the Composite Meal (CM) can serve as a replacement for fish meal in the diet of African catfish (*Clarias gariepinus*) without affecting growth and survival while also reducing cost in a developing country like Nigeria.

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Table 4: Growth performance and nutrient utilization of African catfish fingerlings fed experimental diets.

	T1	T2	T3	T4	T5
IW	3.98 ± 0.01	3.99 ± 0.02	3.94 ± 0.06	3.90 ± 0.07	3.95 ± 0.06
FW	13.36 ± 0.76[c]	12.05 ± 0.85[b]	10.57 ± 0.18[a]	13.51 ± 0.63[c]	14.52 ± 0.77[c]
WG	9.38 ± 0.76[c]	8.07 ± 0.86[b]	6.53 ± 0.11[a]	9.60 ± 0.70[c]	10.57 ± 0.84[c]
PWG	235.87 ± 18.92[bc]	202.36 ± 21.72[ab]	165.65 ± 5.37[a]	246.26 ± 22.17[c]	268.03 ± 26.93[c]
SGR	2.88 ± 0.13b[c]	2.63 ± 0.17[b]	2.35 ± 0.05[a]	2.95 ± 0.16[c]	3.10 ± 0.17[c]
FI	11.43 ± 0.48[bc]	10.77 ± 0.22[b]	8.98 ± 0.16[a]	11.44 ± 0.13[bc]	12.40 ± 1.69[c]
PI	0.65 ± 0.03[bc]	0.61 ± 0.01[b]	0.51 ± 0.01[a]	0.65 ± 0.01[bc]	0.71 ± 0.10[c]
FCR	1.22 ± 0.11[ab]	1.35 ± 0.15[ab]	1.37 ± 0.03[b]	1.20 ± 0.10[ab]	1.17 ± 0.07[a]
PER	2.06 ± 0.18[ab]	1.88 ± 0.21[ab]	1.82 ± 0.04[a]	2.10 ± 0.17[ab]	2.14 ± 0.14[b]
% Survival	90	90	95	90	95

IW = Initial weight, FW = Final weight, WG = Weight gain, PWG = Percentage weight gain, SGR = Specific Growth Rate, FI = Feed Intake, PI = Protein intake, FCR = Feed conversion ratio, PER = Protein efficiency ratio

Table 5: Carcass analysis of fish fed experimental diets.

	T1	T2	T3	T4	T5
MC	75.33 ± 0.49	76.24 ± 0.14	78.16 ± 0.11	74.54 ± 0.11	76.16 ± 0.11
CP	15.83 ± 0.07	14.45 ± 0.17	14.07 ± 0.09	15.19 ± 0.09	16.12 ± 0.11
Ash	4.33 ± 0.03	4.59 ± 0.04	4.51 ± 0.16	4.77 ± 0.05	4.39 ± 0.06
Lipid	3.62 ± 0.04	3.32 ± 0.11	3.12 ± 0.04	3.50 ± 0.02	3.33 ± 0.06

MC = Moisture content; CP = Crude protein

Acknowledgment

The authors wish to acknowledge the University of Ibadan Fish farm for providing facilities for fish culture

References

1. FAO. The state of world fisheries and aquaculture. Report of the fisheries and aquaculture department, Rome Italy, 2016.
2. Daniel N. A review on replacing fish meal in aqua feeds using plant protein sources. Int J Fish Aquat Stud. 2018; 6(2):164-179.
3. Hung LT, Truc LTT, Huy HPV. Case study on the use offarm-made feeds and commercially formulated pellets forpangasiid catfish culture in the Mekong Delta, VietNam. FAO Fisheries Technical Paper. 2007; 497:363.
4. Solomon SG, Okomoda VT, Omirenya S. Nutritional value of toasted pigeon pea, Cajanus cajan seed and its utilization in the diet of Clarias gariepinus (Burchell, 1822) fingerlings. Aquaculture reports. 2017; 7: 34-39
5. Sogbesan AO, Ugwumba AAA. Nutritional Evaluation of Termite (Macrotermes subhyalinus) Meal as animal protein Supplements in the Diets of Heterobranchus longifilis Fingerlings Turkish J Fish Aquatic Sci. 2008; 8: 149-157.
6. Chor K, Leong-Seng L, Rossita S. Evaluation of Feather Meal as a Dietary Protein Source for African Catfish Fry, Clarias gariepinus. Journal of Fisheries and Aquatic Science. 2013; 8: 697-705.
7. Christianah O, Salau B. Utilization of maggot meal in the nutrition of African catfish. African Journal of Agricultural Research. 2013; 8: 4604-4607.
8. Falaye AE, Omoike A, Ajani EK, Kolawole OT. Replacement of FishmealUsing Poultry Offal Meal in Practical Feeds for Fry of the African Catfish. The Israeli Journal of Aquaculture – Bamidgeh. 2010; 542: 1-6.
9. Thomas I, Hameed A. Fisheries and Aquaculture Journal Utilization of Treated Duckweed Meal (Lemna pausicostata) as Plant Protein Supplement in African Mud Catfish (Clarias gariepinus) Juvenile Diets. Fisheries and Aquaculture Journal. 2015; 6.
10. Bini Z, Kevin F, Robert C, Glenn D. Evaluation of Brewer's Waste as Partial Replacement of Fish Meal Protein in Nile Tilapia, Oreochromis niloticus, Diets. Journal of the World Aquaculture Society. 2008. 39: 556-564.
11. Bertsch A, Coello N. A biotechnological process for treatment and recycling poultry feathers as a feed ingredient. Bioresour Technol. 2005 Oct;96(15):1703-8. doi: 10.1016/j.biortech.2004.12.026. PMID: 16023573.
12. Serwata R, Davies SJ. Relative value of Hydrolyzed feather meal as a fish meal substitute in diets of African Catfish Clarias gariepinus. Book of Abstracts of the World Aquaculture Society, Baton Rouge, LA., Pages: 164.
13. Adewolu MA, Ikenweiwe NB, Mulero SM. Evaluation of an animal protein mixture as a replacement for fishmeal in practical diets for fingerlings of Clarias gariepinus (Burchell, 1822). Isr J Aquacult Bamidgeh. 62: 237-244
14. Akpodiete OJ, Ologhobo AD. Biological evaluation of maggot larvae meal on the growth and sexual maturity of replacement pullets. 1999; Trop J Anim Sci. 1(2): 45-51.
15. Adebayo OT, Quadri IC. Dietary protein level and Feeding rate for Hybrid ClaridCatfish, Clarias gariepinus x Heterobranus bidorsallis in homestead tanks. Journal of Applied Aquaculture. 2005; 17(1): 97-106.
16. Johnny O, Toor RS, Schulz C, Kloas W. Growth performance, nutrient utilization of Nile tilapia Oreochromis niloticus fed housefly maggot meal (Magmeal) diets. Turkish Journal of fisheries and aquatic sciences. 2008; 8: 141-147
17. Omitoyin BO. Utilization of poultry by products (feathers and offals) in the diet of African catfish Clarias gariepinus (Burchell). P.hD thesis, University of Ibadan, Nigeria. 1995; 219.
18. Njieassam E. Effects of using Blood Meal on the Growth and Mortality of Catfish. Journal of Ecosystem & Ecography. 6: 2018.
19. Fasakin EA, Balogun AM, Ajayi OO. Nutrition implication of processed maggot meals; hydrolyzed, defatted, full-fat, sun-dried and ovendried, in the diets of Clarias gariepinus fingerlings. Aquaculture Research. 2003; 9(34): 733-738.
20. Calvert CC, Martin RD, Morgan NO. Housefly pupae as food for poultry. Journal of Economic Entomology. 1969; 62: 936-939.
21. Balogun AM, Fasakin EA, Owolanke D. Evaluation of fish silage/soybean meal blends as protein f feedstuff for Clarias gariepinus (Burchell, 1822) fingerlings. Journal of Applied Animal Research. 11: 15-22.
22. AOAC. Official method of analysis. 18th edition, Association of Officiating Analytical Chemist, Washington DC, Method 935.14 and 992.24. 2005.

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23. Duncan DB. Multiple range and multiple F tests. Biometrics. 1955; 11:1-42.

24. Phonekhampheng. On-farm feed resources for catfish (Clarias gariepinus) production in Laos. Diss. (sammanfattning/summary). Uppsala Sveriges lantbruksuniv., Acta Universitatis Agriculturae Sueciae 2008.

25. Sarmwatanakul A, Bamrongtum B. Aquarium Fish Nutrition. Extension paper No. 1/2000. Ornament Fish Research and Public Aquarium. Bangkok. 2000.

26. Bureau DP, Harris AM, Bevan DJ, Simmons LA, Azevedo PA, e al. Feather meals and meat and bone meals from different origins as protein sources in rainbow trout (Oncorhynchus mykiss) diets. Aquaculture. 2000; 181: 281–291.

27. Abdel-Warith AW, Younis el-SM, Al-Asgah NA. Potential use of green macroalgae Ulva lactuca as a feed supplement in diets on growth performance, feed utilization and body composition of the African catfish, Clarias gariepinus. Saudi J Biol Sci. 2016 May;23(3):404-9. doi: 10.1016/j.sjbs.2015.11.010. Epub 2015 Nov 24. PMID: 27081367; PMCID: PMC4818333.

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