



Proximate Composition of African Catfish (*Clarias Gariepinus*) Fingerlings Carcass fed with varying levels of Betaine/ β – Glucan Feed Additive

Ali Mark Eka^{1,4*}, Lumi Gambo Dauda², Abubakar Salamatu³, Ibeagi Macdavis Chukwuma¹

¹National Biotechnology Research and Development Agency, Billiri, Gombe State, Nigeria.

²National Biotechnology Research and Development Agency, Bogoro, Bauchi State, Nigeria.

³National Biotechnology Research and Development Agency, Abuja, Nigeria.

⁴Department of Fisheries, Modibbo Adama University, Yola, Adamawa State, Nigeria

*Corresponding author email:
mealikumbo@gmail.com

Received: 8th May, 2025

Revised: 24th June, 2025

Accepted: 27th June, 2025

Abstract

This study was designed to evaluate the proximate composition of African catfish (*Clarias gariepinus*) fingerlings carcass fed with varying levels of betaine/ β – glucan feed additive. Combination of betaine/ β – glucan feed additive was included into formulated feed with 40% crude protein at; 0.0g/100g (BBG0 i.e. control), 0.325g/100g (BBG1), 0.75g/100g (BBG2), 1.125g/100g (BBG3) and 1.50g/100g (BBG4) in triplicate, fed to *C. gariepinus* fingerlings (n = 300, 10.0 \pm 0.00g) in fifteen (15) plastic tanks (n = 20) at fixed feeding rate of 3% body weight twice daily for twelve (12) weeks. Carcass samples were collected from three (3) fish at commencement and also three (3) fish from each treatment and control at termination of feeding trial for proximate analysis. Data collected was statistically analysed using one - way analysis of variance (ANOVA) at P = 0.05. Crude protein values (67.87 \pm 3.5 – 69.85 \pm 4.7 %), crude lipid (14.00 \pm 1.20 – 14.55 \pm 2.40 %), crude fibre (0.38 \pm 0.01 – 0.45 \pm 0.02 %), moisture (1.42 \pm 0.21 – 1.62 \pm 0.14 %), ash (10.86 \pm 2.5 – 11.86 \pm 2.9 %) nitrogen - free extract (2.92 \pm 1.04 – 5.40 \pm 1.01 %) were recorded. Combination of betaine/ β – glucan feed additive at varying levels employed in this study did not result in statistically significant changes (p>0.05) in the values of crude protein, crude lipid, crude fibre, moisture, ash and NFE.

Keywords: Ash, Combination, Crude Fibre, Evaluate, Samples.

INTRODUCTION

Understanding the proximate composition of a fish carcass is essential for evaluating growth performance, protein quality, and its utilization, helping to determine whether the diet supports actual growth or merely leads to fat accumulation [1]. Proper nutrition is one of the essential factors that influence the ability of the fish to attain genetic potential, growth, reproduction and longevity [2]. The biochemical components of fish carcass are; crude protein, crude lipid, crude fibre, moisture and ash, while carbohydrates and non - protein compounds may be available in negligible amounts which are usually ignored in the process of routine analysis [3]. Feed types and feeding rate are considered as some of the important factors that determine the proximate composition and quality of fish carcass [4]. Fish is a high quality animal source of protein, vitamins, selenium, omega -3- fatty acids and other vital nutrients [5]. The inclusion of feed additives such as betaine and β - glucan improved the quality of the carcass proximate composition of fish [6]. Feed additives are quiddities which are included in very little quantity to diet or feed ingredients to maintain their nutritional status, accelerate ingredients circulation or feed pelleting, promote feed ingestion and suitability of the product to consumer or to provide the needed nutrients in cleansed forms [7]. Betaine is amino acid derivatives which is derive from amino acid glycine (is the trimethyl glycine), is a metabolite of plant and animal tissues, betaine is considered as a by - product of sugar beet processing, betaine has nutritional function commonly used as feed additive in animal, poultry and aquatic nutrition, betaine improve growth performance, health status, feed digestibility,

palatability, flesh quality and immune status of fish species [8].

β - glucans are long chain complex carbohydrates which can be found in cereals, seaweeds, mushrooms yeast and some bacteria [9]. β - glucans as adjuvants, prebiotics or probiotics are the most popular immunonutrients used in aquaculture, which are promising for stimulating of non-specific immune response in fish and promoting growth [10]. Therefore, this study was designed to evaluate the proximate composition of African catfish (*Clarias gariepinus*) fingerlings carcass fed with varying levels of betaine/ β - glucan feed additive.

MATERIALS AND METHODS

Study Area

The study was carried out at Lay – Joy Fish Farm, Gombe – Yola road, Billiri local government area (LGA), Gombe State Nigeria. Billiri LGA lies within Lat. 9°50'N; 11°09'E and Long. 9.833°N 11.150°E. It covers an area of 737km² (285 sq. m) and is 50 km away from Gombe the State capital.

Experimental Fish

Three hundred (300) *C. gariepinus* fingerlings with mean initial weight (10.0±0.00g) were stocked at twenty (20) fingerlings per tank in triplicate per treatment after one (1) week of acclimatization, the study lasted for twelve (12) weeks.

Experimental Feed

The formulated feed contained; fish meal (FM), soybean meal (SBM), yellow maize meal (YMM), groundnut cake meal (GNCM) and a combination of betaine/ β -glucan. All ingredients were ground into a fine powder

using a hammer mill and sieved by a 0.25 mm sieve. Fish meal, soybean meal, groundnut cake meal and yellow maize meal were obtained from commercial suppliers in Gombe, the vitamin/mineral premix, fish oil and chromic oxide (Cr_2O_3) were purchased from TTS Integrated Farms Lagos, while the betaine powder naturally derived from sugar beets (*Beta vulgaris*) and the β -glucan (β -1,3/1,6 - D - glucan) powder naturally derived from baker's yeast (*Saccharomyces*

cerevisiae) were obtained from Bon - Amour. Pharmacy Limited, Lagos. Experimental feed was prepared by incorporating the combination of betaine/ β -glucan into formulated feed with 40% crude protein as recommended by [4] at 0.0g/100g (BBG0 i.e. control), 0.325g/100g (BBG1), 0.75g/100g (BBG2), 1.125g/100g (BBG3) and 1.50g/100g (BBG4) feed as shown in Table 1.

Table 1. Ingredient % (g/100g) of Formulated Feed with Combination of Betaine/ β -Glucan

Ingredients (%)	BBG0	BBG1	BBG2	BBG3	BBG4
Fish meal	20.00	20.00	20.00	20.00	20.00
Soybean Meal	21.50	21.50	21.00	21.00	21.00
GNC meal	23.00	22.625	22.75	22.375	22.00
Yellow maize	30.00	30.00	30.00	29.75	30.00
Betaine/ β -glucan	0.00	0.373	0.75	1.125	1.50
Fish oil	1.00	1.00	1.00	1.00	1.00
Vegetable oil	1.00	1.00	1.00	1.00	1.00
Starch	1.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
*Vitamin/premix	1.00	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50	0.50
Cr_2O_3	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00

Keys: BBG0 – Betaine/ β -glucan (0.0g/100g), BBG1 – Betaine/ β -glucan (0.375g/100g), BBG2 – Betaine/ β -glucan (0.75.g/100g), BBG3 – Betaine/ β -glucan (1.125g/100g), BBG4 – Betaine/ β -glucan (1.5g/100g).

Experimental Design

The *C. gariepinus* fingerlings were cultured in fifteen (15) rectangular white plastic tanks (flow - through system) with a water holding capacity of one thousand litres (1,000L) each in a completely randomized design (CRD). Each tank was washed thoroughly with salt, filled to just a little over 1/3 (350 litre)

capacity and stocked with twenty (20) fingerlings of *C. gariepinus* with mean initial weight ($10.0 \pm 0.00\text{g}$). The *C. gariepinus* fingerlings were fed with the experimental feed at 3% body weight two (2) times daily between the hours of 8:00 – 9:00am and 4:00 – 5:00pm for twelve (12) weeks. The quantity of feed was adjusted accordingly after every two (2) weeks of sampling for growth

performance and survival rate (mean body weight and mortality). Water temperature, pH, dissolved oxygen, and ammonia were measured at the beginning of the experiment after which they were measured weekly throughout the period of the experiment. Water temperature, dissolved oxygen and pH were measured using Horiba U-22 XD multi - parameter water quality checker while ammonia was measured using freshwater aquaculture test kit (Model AQ-2, Code 3633-03, LaMotte U. S. A. Proximate analysis was carried out on a sample of the experimental fish at the beginning of the experiment and also at the end of the experiment, three (3) fish from each treatment were sacrificed and the carcass subjected to proximate analysis as described by [11]. The analysed biochemical components were crude protein, crude lipid, crude fibre, moisture, ash and nitrogen - free extract. These were determined in triplicate.

Determination of crude protein

The percentage crude protein was calculated by multiplying the total nitrogen by a factor of 6.25.

Total nitrogen (N) is given by:

$$N = \frac{\text{Vol. of acid} \times \text{molarity} \times 0.01 \times \text{dilution factor}}{\text{Weight of sample used}}$$

$$\% \text{ Crude protein} = N \times 6.25 \quad [11].$$

Determination of crude lipid

Lipid content was determined by subjecting the sample to a continuous extraction with petroleum ether using Gallenkamp Soxhlet equipment as described by [11]. The ether residue was the residue obtained from the evaporation of the solvent.

Determination of Crude fibre

The percentage crude fibre content was calculated as follows:

$$\text{Crude fibre content}(\%) = \frac{W_1 - W_2}{W_1} \times 100$$

Where; W_1 = Initial weight of sample (g) W_2 = final weight of sample (g) [11].

Determination of Moisture Content

Percentage moisture was calculated as follows:

$$\% \text{ Moisture} = \frac{W_1 - W_3}{W_1 - W_0} \times 100$$

Where, W_0 = weight of empty crucible

W_1 = weight of crucible plus sample (before oven drying)

W_3 = weight of crucible plus oven - dried sample [11].

Determination of Ash Content

The percentage ash was calculated from the formula below:

$$AC (\%) = \frac{\text{Weight of ash}}{\text{Original weight of sample}} \times 100 \quad [11].$$

Determination of nitrogen - free extract

The nitrogen - free extract (NFE) was determined by difference. This was done by subtracting sum of (% Moisture + % crude protein + % Ether Extract + % crude fibre + % Ash) from 100.

$$NFE = (100 - (\% M + \% CP + \% EE + \% CF + \% Ash)) \quad [11].$$

Statistical Analysis

Data obtained from the study was statistically analysed using one way analysis of variance (ANOVA) at $P = 0.05$, where significant

differences were detected, mean values were separated using least significant difference (LSD).

RESULTS AND DISCUSSION

Table 2. Proximate Composition of *C. gariepinus* Fingerlings Carcass Fed with Varying Levels of Betaine/β – Glucan Feed Additive

Indices (%)	Initial	BBG0	BBG1	BBG2	BBG3	BBG4
CP	58.19±2.3 ^b	67.87±3.5 ^c	68.50±4.7 ^c	69.85±3.4 ^c	68.90±2.3 ^c	68.10±2.4 ^c
CL	13.23±1.01 ^a	14.00±1.20 ^a	14.10±1.04 ^a	14.55±2.40 ^a	14.15±1.70 ^a	14.06±1.09 ^a
CF	0.40±0.01 ^a	0.45±0.02 ^a	0.41±0.01 ^a	0.38±0.01 ^a	0.42±0.02 ^a	0.44±0.01 ^a
Moisture	1.64±0.20 ^a	1.42±0.21 ^a	1.45±0.20 ^a	1.44±0.30 ^a	1.62±0.14 ^a	1.61±0.15 ^a
Ash	17.02±3.0 ^c	10.86±3.0 ^b	10.92±2.7 ^b	10.86±2.5 ^b	11.05±2.7 ^b	11.86±2.9 ^b
NFE	9.52±1.06 ^b	5.40±1.01 ^a	4.62±1.09 ^a	2.92±1.04 ^a	3.86±1.10 ^a	3.93±1.09 ^a

Mean values in each row with similar superscripts are not significantly different (p>0.05).

Keys: BBG0 – Betaine/β – glucan (0.0g/100g), BBG1 – Betaine/β – glucan (0.375g/100g), BBG2 – Betaine/β – glucan (0.75g/100g), BBG3 – Betaine/β – glucan (1.125g/100g), BBG4 – Betaine/β – glucan (1.5g/100g), CP – Crude protein, CL – Crude lipid, CF – Crude fibre and NFE – Nitrogen free extract.

Initial crude protein value of the fish carcass before commencement of the experiment was 58.19±2.3 %. At the end of the experiment, it increased in all the fish fed diet with combination of betaine/β – glucan and control diet (BBG0) final values. Crude protein values ranged from 67.87±3.5 – 69.85±4.7 %. Initial crude lipid value was 13.23±1.01 %. It increased in all diet with combination of betaine/β – glucan and the control diet (BBG0) final values. Crude lipid values ranged from 14.00±1.20 – 14.55±2.40 %. Initial crude fibre value was 0.40±0.01 %. It increased in diets BBG1, BBG3, BBG4 and the control diet (BBG0), while it decreased only in diet BBG2. Crude fibre values ranged from 0.38±0.01 – 0.45±0.02 %. Initial moisture value was 1.64±0.20 %. It decreased in all diet with combination of betaine/β – glucan and also control diet (BBG0). Moisture values ranged from 1.42±0.21 – 1.62±0.14 %. Initial ash value was 17.02±3.0 %. It decreased in all diet with combination of betaine/β – glucan and

The proximate composition of African catfish (*C. gariepinus*) fingerlings carcass fed with varying levels of betaine/β – glucan feed additive is presented in Table 2.

control diet (BBG0). Ash values ranged from 10.86±2.5 – 11.86±2.9 %. Initial nitrogen - free extract (NFE) value was 9.52±1.06 %. It decreased in all diet with combination of betaine/β – glucan and control diet (BBG0). NFE values ranged from 2.92±1.04 – 5.40±1.01 %. Therefore, there was no significant difference (p>0.05) between the crude protein, crude lipid, crude fibre, moisture, ash and NFE values of the *C. gariepinus* carcass.

The carcass final crude protein values, 67.87 – 69.85 %; recorded from this study were comparable with the values, 62.57 – 70.69 % reported by (2018) [12] for catfish fingerling fed varying inclusions of toasted tamarind tree seed meal and significantly higher than the values, 42.30 – 61.50 % reported by [13] for *C. gariepinus* fingerlings fed turmeric (*Curcuma longa*) supplemented diets. This observation was in consistent with the findings of [14] who reported that effective utilization of bambara groundnut at varying

degrees was responsible for the various higher levels of the final carcass protein content of *Heteroclinus* fingerlings than the initial value. The carcass final crude lipid values, 14.00 – 14.55 %; recorded from this study were comparable with the values, 14.11 – 14.67 % reported by [15] for *C. gariepinus* fed commercial feed and significantly higher than the values, 9.43 – 10.31 % reported by [12] for *C. gariepinus*. The increase in the values of crude lipid recorded from the final carcass sample of *C. gariepinus* fed diets with the combination of betaine/β – glucan and control diet (BBG0) in this present study was in agreement with the findings of [4] who reported a similar increase in the final values of crude fat in the carcass sample of *C. gariepinus* fingerlings fed different levels of maca (*lepidium meyenii*) root powder as phyto – additive. The carcass final crude fibre values, 0.38 – 0.45 % recorded from this study were higher than the values, 0.31 – 0.35 % reported by [16] for *C. gariepinus* and significantly lower than the values, 2.18 – 2.69 % reported by [1] for *C. gariepinus* fingerlings fed various inclusion levels of processed water melon (*Citrullus lanatus*) seed cake diets. The carcass final moisture values, 1.42 – 1.62 % recorded from this study were lower than the values, 2.35 – 5.68 % reported by [12] for *C. gariepinus*. The reduction in final carcass moisture values observed from this study was in agreement with the findings of [4] who reported a reduction in final carcass moisture values compared with the initial value for *C. gariepinus*. The carcass final ash values, 10.86 – 11.86 % recorded from this study were lower than the values, 12.81 – 13.56 % reported by [1] for *C. gariepinus*. The lower final carcass ash values recorded at the end of this experiment were in agreement with the report of [17] who observed a decrease in

final carcass ash values for masculinized *C. gariepinus*. The carcass final NFE values, 2.92 – 5.40 %, recorded from this study were higher than the values, 2.04 – 3.71 % reported by [3] for *C. gariepinus*. The reduction in the final carcass NFE values of fish fed diets with combination of betaine/β – glucan additive and the control diet (BBG0) observed at the end of the experiment could be attributed to the increase in protein content of the fish carcass at the end of the experiment which was in support with the study of [4] on *C. gariepinus* fingerlings.

CONCLUSION

Findings from this study indicated that the inclusion of betaine/β – glucan feed additive into the feed of *C. gariepinus* fingerlings did not result in statistically significant changes ($p>0.05$) in the crude protein, crude lipid, crude fibre, moisture, ash and NFE values of the *C. gariepinus* carcass. Further research should be carried out on other feed additives on their efficacy in determining the proximate composition of *C. gariepinus* carcass.

CONFLICT OF INTEREST

Authors declared no conflict of interest.

FUNDING

There was no funding received for this work.

ETHICAL STATEMENT

This work required no ethical statement.

References

[1] Babale MY. Growth performance at various growth stages of *Clarias gariepinus* (Burchell, 1822) fed various inclusion levels of processed water melon (*Citrullus lanatus*,

mansf.) seed cake diets. Ph.D. Thesis, Department of Biological Sciences, Ahmadu Bello University Zaria, Zaria, Nigeria, 2016; pp 164.

[2] Elezuo KO. Growth performance of *Clarias gariepinus* juveniles fed processed almond (*Terminalia catappa* L.) kernel meal. Ph.D. Thesis, Department of Aquaculture and Fisheries Management, University of Ibadan, Ibadan, Nigeria, 2016; pp 197.

[3] Anyanwu DC, Offor JI, Anyanwu HO, Mbachu M. Carcass composition and organoleptic assessment of *Clarias gariepinus* fingerlings fed varied levels of *Telferia occidentalis*. *International Journal of Research in Pharmacy and Biosciences*, 2015; 2 (4): 26–29.

[4] Ali ME, Danba EP, Sani T, Danzaria A. Evaluation of the carcass proximate composition of *Clarias gariepinus* (Burchell, 1822) fingerlings fed different levels of maca (*Lepidium meyenii*, Walp.) root powder as phyto – additive. *African Journal of Agricultural Science and Food Research (AJASFR)*, 2024; 15(1): 107–117.

[5] Suleiman AM, Orire AM, Sadikus OE. Impact of *Moringa oleifera*, *Lannea barteri* and oxytetracycline on the body composition of *Clarias gariepinus* fingerlings. *Proceedings of the 34th Annual Conference of the Fisheries Society of Nigeria (FISON)*, 2019; pp. 105 - 107.

[6] Leong-Seng L, Ahmad RJ, Audrey-Daning T, Rossita S, Gunzo K. Acceptability to betaine as a feed enhancer in the brown - marbled grouper (*Epinephelus fuscoguttatus*) at grow - out stage. *Songklanakarin Journal of Science and Technology*, 2019; 41(3): 490 – 493.

[7] Anene A, Okorie EO, Johnson GC. Assessment of the growth performance and proximate quality of fingerlings of *Clarias gariepinus* (Burchell, 1822) fed diets containing varying levels of onions powder (*Allium cepa*) as phyto - additive. *Proceedings of 34th Annual Conference of Fisheries Society of Nigeria (FISON)*, 2019; pp 136–138.

[8] Abed Ali HH, Al-Faragi JKA. Efficiency of betaine and β - glucan as feed additives on the growth performance and survival rate of common carp (*Cyprinus carpio* L.) fingerlings. *Journal of Entomology and Zoology Studies*, 2017; 5(4): 27–31.

[9] Vetvicka V, Vetvickova J. Glucan as prebiotic or probiotic? *International Clinical Pathology Journal*, 2016; 2(2): 34–35. DOI: 10.15406/icpjl.2016.02.00035

[10] Ahmad MH, El-Mousallamy A, Zein N, Abd El-Naby AS, Mohamed SZ. Evaluation of prebiotic as natural additives on growth performance and blood biochemistry for Nile tilapia (*Oreochromis niloticus*). *Middle East Journal of Applied Sciences*, 2015; 5(2): 526–533.

[11] AOAC. Official methods of analysis. In: H. Horwitz (ed.), *Official methods of analysis of the association of Official analytical chemists*. Association of Official Analytical Chemists Inc., Arlington, V.A. USA, 2005.

[12] Orire AM, Ogbu NI. Nutrition evaluation and growth performance of catfish fingerling fed varying inclusions of toasted tamarind tree seed meal. *Proceedings of 33rd Annual Conference of Fisheries Society of Nigeria (FISON)*, 2018; pp 557–561.

[13] Akinde AO, Joda OA, Ibidapo-Obe EO. Growth performance, haematology and intestinal microflora of *Clarias gariepinus*

(Burchell, 1822) fingerlings fed turmeric (*Curcuma longa*) supplemented diets. *Proceedings of 35th Annual Conference of Fisheries Society of Nigeria (FISON)*, 2020; pp 97–102.

[14] Alegbeleye WAO. Growth performance and haematological profile of *Oreochromis niloticus* (Linn. Trewavas, 1983) fingerlings fed differently processed cottonseed (*Gossypium hirsute* Linn. 1735) meal. Ph.D. Thesis. Department of Wildlife and Fisheries Management. University of Ibadan, 2005; pp 213.

[15] Umar R, Abdullahi SA, Bolorunduro PI, Abolude DS. Evaluation of carcass characteristics of lyophilized bull and goat testes in masculinized *Clarias gariepinus* fed commercial feed. *Proceedings of 31st Annual Conference of Fisheries Society of Nigeria (FISON)*, 2016; pp 104–107.

[16] Agwu SC, Oko AO, Ayo-Olalusi CI, Jibrin H. Effect of partial replacement of fishmeal with *Moringa oleifera* leaf meal on the growth and carcass composition of *Clarias gariepinus* juveniles. *Proceedings of 32nd Annual Conference of Fisheries Society of Nigeria (FISON)*, 2017; pp 64–67.

[17] Umar R, Abdullahi SA, Bolorunduro PI, Abolude DS, Yusuf A. Carcass proximate composition and amino acid profile of masculinized *Clarias gariepinus* (African catfish). *FUW Trends in Science and Technology Journal*, 2018; 3(1): 117–120.