

The Carcass Composition and Haematological Indices of *Coptodon Guineensis* (Gunther, 1862) Fingerling Fed Varying Inclusion Level of Fermented *Momordica Charantia* Seed Meal

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ABSTRACT

This study examined the effects of fermented *Momordica charantia* seed meal (FMCSM) on the carcass composition and blood health of *Coptodon guineensis* fingerlings. The research spanned 84 days and involved feeding the fish five different diets, each with varying levels of FMCSM: D1 (0% control), D2 (10%), D3 (20%), D4 (30%), and D5 (40%). All diets were formulated to be isonitrogenous, containing 35% protein and 9.5% lipids. The *C. guineensis* fingerlings were raised in hapas (0.5 x 0.5 x 1 m³) placed within concrete tanks. At the end of the culture period, samples from each of the five treatment groups were randomly collected for both proximate and hematological analysis. Blood samples were taken from the fish at the beginning and end of the experiment to analyse various blood parameters. The results showed that including FMCSM in the diet significantly affected the fish's carcass composition and blood parameters. The crude protein content increased significantly in all FMCSM-fed groups (ranging from 47.59% to 51.34%) compared to the initial level (35.54%). The lipid content was highest in the D3 group (12.32%) and lowest in the control group D1 (11.60%). Significant differences were also observed in the moisture, ash, and crude fiber content across the treatment groups. Blood analysis revealed that the inclusion of FMCSM led to improved blood health. The red blood cell, hemoglobin, and white blood cell counts were all significantly higher in the fish that consumed the FMCSM diets. In conclusion, this study demonstrated that fermented *Momordica charantia* seed meal is a suitable and beneficial ingredient for the diet of *Coptodon guineensis*. Its inclusion did not have any detrimental effects and, in fact, improved the fish's carcass composition and overall blood health.

Keywords:

Momordica charantia,
Carcass composition,
Hematology,
Coptodon guineensis

INTRODUCTION

Coptodon guineensis, formerly known as *Tilapia guineensis*, is classified within the Class Actinopterygii, Order Cichliformes, and Family Cichlidae (GBIF 2023 and Froese and Pauly 2021). This species thrive in both freshwater and brackish water environment, these varying tolerate, provides a flexibility for farmers and allow for its cultivation in coastal and estuarine environment where other freshwater species could not survive such as *oreochromis species* (Kouamé, et al., 2025). *C. guineensis* are omnivorous species, feed on variety of food sources such as plankton, detritus and other small invertebrate (Adebayo et al., 2018). This makes its dietary need less species and potentially more cost-effective to meet there aquaculture need compared to carnivorous species. *C.*

guineensis has recently attracted attention due there biological and ecological attribute that make it suitable species for culture (FAO, 2021 and Kouamé, et al. 2025).

According Missouri Botanical Garden, The taxonomy and distribution of *Momordica charantia*: Kingdom: Plantae, Division: Magnoliophyta Class: Magnoliopsida, Order: Violales, Family: Cucurbitaceae Genus: *Momordica* and Species: *charantia*. The original home of the species is not known, other than that it is a native of the tropics. *M. charantia* (Bitter melon) grows in tropical areas, including parts of the Amazon, East Africa, Asia and the Caribbean (Matsumura et al., 2020). It is widely grown in India and other parts of the Indian subcontinent, Southeast Asia, China, Africa and

the Caribbean (Upadhyay *et al.*, 2015). Bitter melon fruits are a good source of carbohydrates, proteins, vitamins and minerals and have the highest nutritive value among cucurbits (Bakare, 2011 and Behera *et al.*, 2023). The vitamin C content of bitter melon varies significantly. Considerable variation in nutrients, including protein, carbohydrates, iron, zinc, calcium, magnesium, phosphorous and ascorbic acid has been observed in bitter melon. Moreover, the crude protein content of bitter melon fruits is higher than that of tomato and cucumber (Oyeleke *et al.*, 2023).

The development of robust health assessment indices is crucial for evaluating the well-being of fish populations within their environment. These indices integrate diverse physiological and behavioural parameters to provide a holistic assessment of fish health, encompassing both external environmental influences and internal physiological responses. Adeogun and Otitolaju (2020) developed an index specifically designed to evaluate the impact of pollution on fish populations. This index incorporates haematological, biochemical, and physiological parameters to provide a nuanced understanding of pollutant-induced stress. Its multi-parametric approach offers a more comprehensive assessment than single-parameter analyses. Otitolaju *et al.* (2016).

There is continuous investigation into locally available and cost effective plant based feed ingredients to reduced dependant on the highly expensive fishmeal (Khan *et al.* (2024) and Agupugo *et al.*, 2022). Thus plant seed content numerous natural occurring compound that affect nutrient digestibility, absorption and metabolism in fish leading to negative effect on carcass quality and overall health of fish (Gopan *et al.*, 2021). However, processing method such as fermentation improved nutritional value, digestibility, protein content, and quality (Soltani *et al.* 2019 and Eshete, *et al.*, 2021). Also enhances bioavailability of minerals and vitamins, reduction of anti-nutritional factors, promote immune function, promote gut health, improved palatability, reduction in cost and sustainability (Neves *et al.*, 2024). Therefore, this study is aim at investigating the carcass composition and haematological indices of *Coptodon guineensis* fed varying inclusion level of fermented *Momordica charantia* seed meal.

MATERIALS AND METHODS

Experimental site and set-up

The experiment was carried out at the Department of Water Resources, Aquaculture and Fisheries Technology,

Old Teaching and Research Farm, Bosso campus and Departmental laboratory in Gidan Kwano campus, federal university of technology, Minna Niger State.

Sources of experimental fish/Feed Ingredients

A total of three hundred (225) *Coptodon guineensis* fingerling were used, and they sources from the Nigerian Institute for Oceanography and Marine Research, Lagos, Nigeria. The *Momordica charantia* seed was collected around New Bussa, Niger State while other ingredient were purchase from Engr. A. A. Kure Ultra-Modern market, Minna. These include fishmeal, soyabean, maize, vitamin and mineral premix. The soyabean was toasted to reduce the effect of anti-nutritional factors and then mill all ingredients separately.

Fermentation of *Momordica charantia* Seed

The fermentation of *Momordica charantia* seeds (FMCSM) was carried out by mixing the seeds with water in a 2:1 ratio (1 part seeds to 2 parts water). 0.25ml of cultured *Aspergillus niger* was collected from the Department of Microbiology Laboratory of Federal University of Technology Minna, was pipette and mixed with water. The mixture was packed in a plastic container, firmly sealed with cotton wool, before being kept in a room at an ambient temperature of 25 °C for five (5) days. The fermented sample was then washed and the water drained off utilising a local basket (oil palm bamboo) and the seeds were dried in an oven at 80°C for 4 hours at the Departmental Laboratory (Adesanya, 2022, Yakubu *et al.*, 2023).

Biochemical analysis

The major dietary ingredients (Fermented *Momordica charantia* seed meal, fishmeal, soybean meal, maize meal). Proximate composition analysis was conducted according to Association of Official Analytical Chemists (AOAC, 2024) procedures on dry matter basis. Moisture Content was determined by drying samples at 105±2°C until a constant weight was obtained. Dried samples were used for determination of crude fat, protein and Ash contents. Crude fat was measured by solvent extraction method in a soxhlet system where n-hexane was used as solvent. Crude protein content was calculated by using nitrogen content obtained by Kjeldahl method. A conversion factor of 6.25 was used for calculation of protein content (AOAC, 2024). The compositions is as displayed in (Table 1).

Table 1: Proximate composition of major ingredients used for the experimental diet

Parameters	FMCSM	SBM	MM	FM
Crude Protein	24.79	44.08	10.42	63.74
Lipid	18.75	19.32	5.13	11.72
Moisture Content	8.25	2.47	7.68	7.44
Ash content	7.32	4.66	2.09	10.31
Crude Fibre	24.69	7.10	3.45	0.00
Nitrogen Free Extract	16.20	22.37	71.23	6.79

Formulation of Experimental Diet

Based on the nutritional requirements of tilapia fingerling (NRC, 2011), five iso-nitrogenous diet were formulated at 35% protein and 9.5% lipids, containing 0-40% FMCSM

at varying level of inclusion and designated as D1 (0%: Control), D2 (10% FMCSM), D3 (20% FMCSM), D4 (30% FMCSM) and D5 (40% FMCSM) (Table 2)

Table 2: Gross Compositions of Experimental Diets for *Coptodon guineensis* Fingerlings g/kg.

Ingredients	D1-0%	D2-10%	D3-20%	D4-30%	D5-40%
FCMSM	0.00	10.00	20.00	30.00	40.00
Yellow Maize	7.00	7.00	7.00	7.00	7.00
Fishmeal	25.00	25.00	25.00	25.00	25.00
Soybean meal	41.60	35.98	30.35	24.73	19.10
Dextrinised starch	0.22	0.22	0.22	0.22	0.22
Vegetable oil	4.33	3.51	2.69	1.87	1.06
Vitamin premix	2.50	2.50	2.50	2.50	2.50
Mineral premix	2.50	2.50	2.50	2.50	2.50
Cellulose	16.85	13.29	9.74	6.18	2.62
Total	100.00	100.00	100.00	100.00	100.00
Kcal / 100 g (dry)	280.43	280.42	280.37	280.36	280.40

Experimental Design

A completely randomised design (CRD) was used. The 225 fingerling were allocated randomly into the five dietary treatments with each treatment having three replicates with 15 fingerling per replicate, making a total of 45 per treatment and overall total of 225 fingerlings

Management Experimental Tank and Fingerlings

Hapa of 0.5m x 0.5m x 1m size was suspended in outdoor concrete ponds (8mx5mx1.5m) with the aid of kuralon twine tied to plastic poles. The concrete ponds were filled to 85% of its volume (40m³) with filtered and dechlorinated tap water for the rearing of *Coptodon guineensis*. The experiment lasted for 84 days the fish were fed twice a day at about 9:00am and 5:00pm) at the rate of 5% of their body weight. Feeding rates were adjusted biweekly for 12 weeks based on the new weight gain of each treatment group.

Blood collection and Haematological analysis

The fish blood samples were collected at the beginning (initial) and end (final) of the experiment from each treatment and replicates following the procedures of Mallett, (2024). These samples were then transported to the Laboratory of the Department of Biochemistry, Federal University of Technology, Minna, for haematological analysis. Clear plasma samples were pipetted into clean, sterilised bottles for haematological parameters analysis (Prajapati, 2025). Erythrocyte values (packed cell volume

(PCV), haemoglobin (Hb), and red blood cell (RBC) count) and absolute erythrocyte indices (mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were measured and calculated. White blood cell counts were analysed as described by Bake *et al.*, (2016)

mean corpuscular volume (MCV):

$$\frac{\text{PCV}}{\text{Erythrocyte count}} \times 10 \quad (1)$$

corpuscular haemoglobin (MCH)

$$\frac{\text{Haemoglobin}}{\text{Erythrocyte count}} \times 10 \quad (2)$$

mean corpuscular haemoglobin concentration (MCHC)

$$\frac{\text{Haemoglobin}}{\text{PCV}} \times 100 \quad (3)$$

Statistical analysis

Data collected were expressed as mean $\pm$ standard errors. Statistical analysis was conducted by subjecting the data to one-way analysis of variance (ANOVA) using SPSS V 23 statistical software. Comparison between treatment means was done by using Turkey's multiple range test and the level of significant was tested at $P \leq 0.05$.

RESULTS AND DISCUSSION

The results in (Table 3) for the determination of the proximate composition of *C. guineensis* is essential to ensure that they meet the requirement of food regulations and commercial specification (Emmanuel *et al.*, 2011; Sabeeha and Nimisha, 2025). The inclusion of FMCSM did significantly affect the body crude protein content of the fish carcass, but was higher compared to the initial, D4 exhibiting the highest crude protein value (51.34%). This indicates that the fermented seed meal contributed substantially to the fish's protein increment (Gana *et al.*, 2020). The results in this study does not align with the results reported by Obasa *et al.* (2013), as significant

differences were observed across the treatment means in body crude protein, ash and lipid content. Arbex *et al.* (2015) established the importance of dietary protein for human health, noting that lipid content contributes to both energy density and the provision of essential fatty acids. Ash content values from this study differed significantly from those reported by Kasozi *et al.* (2014), with the latter exhibiting considerably higher levels. The variations may be attributed to the inherent differences in the fish species and processing methods. Fish ash content serves as a significant indicator of mineral content and overall nutritional quality (Shabir *et al.*, 2018 and El-Sheakh and El-Kott, 2022).

Table 3: Carcass Composition of whole body of *Coptodon guineensis* (Dried basis) Fingerlings Fed Varying Inclusion Levels of Fermented *Momordica charantia* Seed Meal for 84 Days

Parameters	Initial	D1-0%	D2-10%	D3-20%	D4-30%	D5-40%
Crude protein	35.54±0.31	47.59±2.38 ^a	48.27±1.96 ^a	49.39±2.58 ^a	51.34±0.95 ^a	49.51±1.76 ^a
Lipid	9.16±0.08	11.60±0.63 ^a	11.72±0.48 ^a	12.32±0.59 ^a	12.13±0.15 ^a	11.75±0.66 ^a
Moisture	7.37±0.06	8.10±0.69 ^{ab}	9.26±0.15 ^a	9.44±0.39 ^a	8.48±1.11 ^b	8.59±0.56 ^b
Ash content	14.12±1.41	14.77±1.35 ^a	14.93±0.83 ^a	13.64±1.54 ^a	15.10±1.39 ^a	13.50±0.51 ^a
Crude fibre	4.83±0.16	4.60±0.17 ^a	4.06±0.40 ^a	4.70±0.24 ^a	3.88±0.40 ^b	4.16±0.05 ^a
Nitrogen free extract	28.98±1.32	13.35±2.85 ^a	11.76±0.82 ^a	10.51±1.62 ^a	9.07±0.94 ^a	12.49±2.39 ^a

Values in the same row with different superscripts are significantly different (p<0.05) from each other

The results in (Table 4) reveal there were significant differences (p<0.05) among the treatment means in packed cell volume, white blood cell and red blood cell. The fish fed D2 recorded the lowest value in haemoglobin and differ significantly from other treatment means. The haematological profiles serve as valuable indicators of health status in farmed aquatic species, facilitating the assessment of stress and disease within aquaculture systems (De *et al.*, 2019 and, Fazio 2019). The packed cell volume, haemoglobin and red blood cell counts were significantly higher in the treatment groups compared to the initial control group. This suggests that the inclusion of FMCSM in the diet led to an increase in red blood cell

production or improved oxygen-carrying capacity of the blood (Etim *et al.*, 2014 and Mingazova *et al.*, 2020). According to Adekole and Akangbe (2015), the increase in white blood cells compared to the initial may be due to increase in immune mechanism of *Coptodon guineensis* fingerlings. The mean corpuscular volume showed variations across groups, while the mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration also varied across treatment means, indicating that the increase in these parameters was primarily due to increased red blood cell numbers rather than changes in cell size or haemoglobin content (Ford, 2013, and Fazio, 2019).

Table 4: Haematological Indices of *Coptodon guineensis* Fingerlings Fed Varying Inclusion Levels of Fermented *Momordica charantia* Seed Meal for 84 Days

Parameters	Initial	D1-0%	D2-10%	D3-20%	D4-30%	D5-40%
PCV (%)	18.72±0.09	27.23±4.15 ^a	23.83±2.20 ^b	26.52±1.18 ^a	25.91±1.87 ^a	26.94±1.41 ^a
WBC (×10 ⁹ /l)	1.24±0.02	2.66±0.69 ^a	2.09±0.36 ^b	2.54±0.20 ^a	2.44±0.31 ^a	2.61±0.23 ^a
RBC (×10 ⁹ /l)	3.19±0.02	4.61±0.69 ^a	4.04±0.37 ^b	4.49±0.20 ^a	4.39±0.31 ^a	4.56±0.24 ^a
Hb (g/dl)	6.97±0.03	9.81±1.38 ^a	8.67±0.73 ^b	9.57±0.39 ^a	9.37±0.62 ^a	9.71±0.47 ^a
PLC (×10 ⁹ /l)	88.91±2.22	204.83±30.21 ^a	206.14±30.76 ^a	195.10±11.88 ^a	190.31±14.40 ^a	120.41±2.27 ^b
MCHC (%)	37.23±0.02	36.16±0.48 ^b	36.46±0.31 ^a	36.10±0.12 ^b	36.18±0.20 ^b	36.06±0.14 ^b
MCH (Pl)	21.87±0.01	21.36±0.23 ^b	21.50±0.15 ^a	21.33±0.06 ^b	21.37±0.09 ^b	21.32±0.07 ^b
MCV (fl)	58.74±0.01	59.08±0.15 ^a	58.99±0.10 ^b	59.10±0.04 ^a	59.08±0.06 ^a	59.11±0.04 ^a

Values in the same row with different superscripts are significantly different (p<0.05) from each other

PCV = Packed cell volume, Hb = Haemoglobin, RBC = Red blood cell, WBC = White blood cell, PLC = Platelet count, MCV = Mean corpuscular haemoglobin volume, MCH = Mean corpuscular haemoglobin, MCHC = Mean corpuscular haemoglobin concentration

CONCLUSION

The study found that FMCSM inclusion notably affected the crude protein and lipid content of the fish carcass. A clear trend emerged, showing that increasing the optimal inclusion level of FMCSM contributed significantly to fish protein accretion. This suggests that FMCSM serves as a valuable protein source for the fish. Analysis of the fish's blood showed a significant difference across treatments. The inclusion of FMCSM led to improved red blood cell, hemoglobin, and white blood cell counts in the *C. guineensis* fingerlings. These improvements indicate a positive effect on the fish's immune function without any detrimental effects on their overall blood health.

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