PROXIMATE AND GROSS ENERGY COMPOSITION OF FORMULATED AFRICAN CATFISH FINGERLINGS FEED WITH DIFFERENT LEVELS OF CO – MIXED OF BETAINE/B – GLUCAN AS FEED ADDITIVE

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ABSTRACT
The proximate and gross energy composition of formulated African catfish fingerlings feed with different levels of co – mixed of betaine/β - glucan as feed additive was evaluated. Five (5) isonitrogenous and isocaloric feed was formulated, each feed with crude protein (CP) content at 40% CP, where co – mixed of betaine/β – glucan additive was incorporated as additives 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 was subjected to proximate analysis and gross energy estimation. Proximate analysis indicated that the formulation of African catfish fingerlings feed with co – mixed of betaine/β – glucan as additives at different levels had no significant ($p>0.05$) effects on the values of crude protein, crude lipid, crude fibre, moisture, ash and nitrogen – free extract of the feed, while at 0.75g/100g and 1.125g/100g feed inclusion levels it had a significant ($p<0.05$) effects by lowering the gross energy value of the feed. The co – mixed of betaine/β - glucan can be use as feed additive in the formulation of African catfish fingerlings feed in order to improve growth and stress resistance.
Keywords: Analysis, Crude Protein, Estimation., Isonitrogenous, Isocaloric.

INTRODUCTION

Feed is the key and most important inputs in intensive aquaculture system and approximately contributes to 70 – 80% of the variable cost of production and it directly affects the growth rate of the fish (Ali, 2022). High quality feed that meet fish requirements enhanced the growth of quality fish with the corresponding great market value (Jamabo *et al.,* 2019). Some naturally derived feed additives have been evaluated and found to have potential benefits as feed additives and supplements in aquaculture. These naturally derived additives include betaine and β – glucan (Abed Ali and Al – Faragi, 2017). These additives are administered into feed as an alternative to synthetic growth promoters which positively increase fish growth, stress resistance, enhance the immune system and general well – being of the fish. The application of feed additives into the diet of African catfish has been reported (Ali, 2022). Abed Ali and Al – Faragi (2017) reported that betaine and β – glucan is commercially beneficial to the aquaculture industry. This study elucidates the proximate and gross energy composition of formulated African catfish fingerlings feed with different levels of co – mixed of betaine/β – glucan as feed additive.

MATERIALS AND METHODS

The formulated feed contained; fish meal (FM), soybean meal (SBM), yellow maize meal (YMM), groundnut cake meal (GNCM) and co – mixed of betaine/β – glucan. All ingredients were grounded 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. Five (5) isonitrogenous and isocaloric feed was formulated, each feed with crude protein (CP) content at 40% CP as calculated according to Pearson's square method and gross energy content at 1,732kcal kg^{-1} respectively for African catfish fingerlings feed as recommended by Ali (2022) was formulated, where co – mixed of betaine/β – glucan additive was incorporated as additives 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) as shown in Table 1. Feed was subjected to proximate analysis as described by AOAC (2005) for crude protein, crude lipid, crude fibre, moisture, ash and nitrogen – free extract, while gross energy was estimated as described by Sogbesan (2014). Data collected were subjected to analysis of variance (ANOVA) at 95% probability level and where significant differences were detected, mean values were separated using Least Significant Difference (LSD).

Table 1. Ingredient % (g/100g) of Formulated Feed with Co – Mixed 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).

RESULTS

The results of the proximate and gross energy compositions of the formulated African catfish fingerlings feed with different levels of co – mixed of betaine/β - glucan as feed additive are presented in Table 2. Crude protein content of experimental diet's ranged from 40.03 – 40.17%; crude protein was highest in BBG2 (40.17%), while BBG0 had least crude protein (40.03%). Crude lipid content of experimental diet's ranged from 5.81 – 5.93%; crude lipid was highest in BBG2 (5.93%), while BBG0 had least crude lipid (5.81%). Crude fibre content of experimental diet's ranged from 2.82 – 3.01%; crude fibre was highest in BBG2 (3.01%), while BBG0 had least crude fibre (2.82%). Moisture content of experimental diet's ranged from 5.19 – 5.70%; moisture was highest (5.70%) in BBG0, while BBG2 had least moisture (5.19%). Ash content of experimental diet's ranged from 12.88 – 13.16%; ash was highest (13.16%) in BBG0, while BBG2 had least ash (12.88%). Nitrogen – free extract (NFE) content of experimental diet's ranged from 32.51 – 33.48%; NFE was highest (33.48%) in BBG0, while BBG2 had least NFE (32.51%). Gross energy (GE) content of experimental diet's ranged from 3,495 – 3,530 kcal /kg; GE was highest (3,530 kcal /kg) in BBG0, while BBG2 had least GE (3,4945 kcal /kg). However, there was no significant ($p>0.05$) difference in the values of crude protein, crude lipid, crude fibre, moisture, ash and nitrogen – free extract of the feed, while at 0.75g/100g and 1.125g/100g feed inclusion levels there was a significant ($p<0.05$) decreased in the gross energy value of the feed.

Table 2: Proximate and Gross Energy Composition of Formulated Feed with Co – Mixed of Betaine/β – glucan

Proximate composition (%)	BBG0	BBG1	BBG2	BBG3	BBG4
Crude protein (%)	40.03^{a}	40.09^{a}	40.17^{a}	40.08^{a}	40.04^{a}
Crude lipid (%)	5.81^{c}	5.90^{c}	5.93^{c}	5.92^{c}	5.60^{c}
Crude fibre (%)	2.82^{b}	2.97^{b}	3.01^{b}	2.91^{b}	2.94^{b}
Moisture (%)	5.70^{e}	5.62^{e}	5.19^{e}	5.58^{e}	5.63^{e}
Ash (%)	13.16^{d}	12.96^{d}	12.88^{d}	13.00^{d}	13.13^{d}
Nitrogen - free extract (%)	33.48^{a}	33.23^{a}	32.51^{a}	32.62^{a}	32.66^{a}
Gross energy (Kcal/kg)	$3,530^{e}$	$3,526^{e}$	$3,495^{d}$	$3,503^{d}$	$3,528^{e}$

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

DISCUSSION

Crude protein content ranged from the values, 40.03 – 40.17%, although aimed at 40.0%. The crude protein content values, 40.03% – 40.17% of the experimental diets with co – mixed of betaine/β – glucan additive and the control diet recorded from this study were similar with the values, 40.31 – 40.82% reported by Fakunle *et al.* (2014). The variation seen from these values often exists during the process of chemical analysis of experimental diets as reported by Alegbeleye (2005). This might be due to the fact that each diet had different inclusion level of co – mixed of betaine/β – glucan additive. Crude lipid content values, 5.81% – 5.93% recorded from this study were comparable with the values, 4.79 – 7.06% reported by Agbabiaka *et al* (2016) but significantly lower than the values, 7.30 – 8.27% reported by Sotolu *et al.* (2016). There was irregular increased in the values of crude lipid from the least 5.81% for control diet to the highest 5.93% for diet BBG2. This is in consistent with the result of Abed Ali and Al - Faragi. (2017) who reported a directly proportional increase in crude lipid values with inclusion of the co – mixed of betaine/β – glucan additive in diet at optimum rate. Crude fibre content values, 2.71% – 3.01% recorded from this study were comparable with the values, 2.45 – 3.34% reported by Elezuo (2016).

The crude fibre contents values increased with irregular pattern in all diets with co – mixed of betaine/β – glucan additive and could be as a result of the incorporation of co – mixed of betaine/β – glucan into the diets. The crude fibre values recorded from all diets with co – mixed of betaine/β – glucan additive and control diet are within the recommended range for *C. gariepinus* diet. Moisture content values, 5.19% – 5.70% recorded from this study were lower than the values, 5.97 – 8.81% reported by Agbabiaka *et al* (2016). Moisture content values, 5.19 – 5.70% of diets with co – mixed of betaine/β – glucan additive and control diet recorded from this study were within the recommended level (<10.0%) for *C. gariepinus* diet. The reduction in the moisture content values observed from all diet with co – mixed of betaine/β – glucan additive might be as a result of co – mixed of betaine/β – glucan additive incorporated into diet. Ash content values, 12.88 – 13.16% recorded from this study were comparable with the values, 12.85 – 13.20% reported by Elezuo (2016). The reduction in the ash content values recorded from all diet with co – mixed of betaine/β – glucan additive recorded from this present study could be as a result of the incorporation of co – mixed of the betaine/β – glucan additive into diets. Nitrogen – free extract (NFE) values, 32.51 – 33.48% recorded from this study were comparable with the values, 29.97 – 33.63% reported by Agbabiaka *et al* (2016) and 30.81– 33.58% reported by Elezuo (2016) respectively.

The NFE values of diets with co – mixed of betaine/β – glucan additive decreased with incorporation of co – mixed of betaine/β – glucan additive at various inclusion levels compared with that of control diet this could be as a result of incorporation of co – mixed of betaine/β – glucan additive into diets. Gross energy (GE) content values, 3,495 kcal/kg – 3,530 recorded from this study were slightly higher than the values, 3001.58 kcal/kg – 3132.21 kcal/kg reported by Sotolu (2008). The GE content values decreased in all diets with co – mixed of betaine/β – glucan additive which indicated that incorporation of co – mixed of betaine/β – glucan additive to fish diet decreased GE content value of diet. The difference in GE values is likely due to differences in inclusion levels of co – mixed of betaine/β – glucan additive into the diets.

CONCLUSION

The co – mixed of betaine/β – glucan as additives at different levels had no significant ($p>0.05$) effects on the values of crude protein, crude lipid, crude fibre, moisture, ash and nitrogen – free extract of the feed, while at 0.75g/100g and 1.125g/100g feed inclusion levels it had a significant ($p<0.05$) effects by lowering the gross energy value of the feed.

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