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Effect of Raw and Toasted Soya Beans Diets on Growth of *Clarias gariepinus*

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ABSTRACT

Comparing the effects of raw, toasted and amino acid enriched diets on the growth and nutrient utilization of *Clarias gariepinus* allocated in to eight different treatments with two replicates each with 10 Juveniles in 16 aquaria tanks. Eight different diets containing 40% crude protein each were compounded and fed to the fish at 5% body weight for 16 weeks. Diet T1 was the control while diet T2 was the conventional diet (coppens) purchased commercially. Diet T5 which had a 50% toasted soybean inclusion and contained 50 g yellow maize, 20 g toasted. soybean. 10 g fish meal, 13 g Groundnut cake, 2.5 g vegetable oil. 2.0 g starch and 0.5 g vegetable oil had the greatest growth rate which were significant higher ((P<0.05) than those fish fed on other diets. Diet T7 (100% raw soybean with methionine and lysine) containing 50 g yellow maize 30 g raw soybean. 13 g groundnut cake. 2.5 g vegetable oil. 2,0 g starch and 0.5 g vegetable oil followed diet T5. Average weight gain, Specific Growth Rate (SGR), Average daily weights gain, Protein Efficiency Ratio (PER), Feed Conversion Ratio (FCR) and Net Nitrogen retention were significantly higher (P<0.05) in fish fed diet T5 and diet T7 in the experiment. The results showed that fish fed toasted soybean-based diet had the highest average weight gain of 432.55 g, Specific Growth Rate (SCR) of 3.38%/day and food conversion ration 'FCR} of 5.78. The juveniles fed raw soybean gave the least growth performance. It could be concluded in practice that toasted soybean-based diet is optimal for growth of C. gariepinus juveniles, mortality rates recorded during the dietary trial ranged between 30% in fish fed diet Ts to 100% in fish fed diets T, 73. T4, T5 and T6. The results were discussed in relation to fish feed production and its implication for fish culture intensification in Nigeria.

Keywords: Raw toasted soya beans, Growth, Feed ingredients

INTRODUCTION

Aquaculture like other agricultural sectors has potential to contribute significant!) to the national economy. It has been recognized in most developing countries as a major avenue for improving the diet of the people and generating employment opportunity for rural dwellers. The practice is still at the subsistence level by private individual with very few achievements at commercial level and at pilot scheme by some government agencies despite. Nigeria like other developing countries is having as challenge, acute protein shortage as the daily intake falls far short of the recommended minimum.

Fish farming is increasing rapidly in Nigeria today and if this development is sustained, then aquaculture will create a great impact on the economy and provide protein as food for its populace fish is noted for high quality protein and its protein content can be high as 60% on dry matter basis. Lack of good quality feed for economic production of fish in Nigeria, adversely affects growth rate, survival rate, and total harvest. The deficiency of protein in human diets in Nigeria has been responsible for incidence of kwashiorkor in infants, general weakness of the human body which predisposes man to diseases. This has been so critical that Nigeria is now ranked among the group of nations characterized by deficiency of animal protein in their diets.

Soya bean is a leguminous crop that produces seeds containing 1400 to 2000 kg/hectare. It is cultivated in many areas of the world from the tropics to the temperate regions. Soya beans also contain high nutritional value compared to other oil seed species [1]. Its crude protein level ranges between. 44-50%, Nitrogen free extract (N F E) is 40%, Lipid is 15-20%and it is equal higher in essential ammo acid, fatly acids, vitamins and mineral. Fish meal has been the most used protein source in the production of feeds but due to its high cost and demand it becomes necessary to device different method on how best soya beans seeds can be processed to ensure high yield and good harvest in fish production.

Optimum protein level in fish diet is dependent on many factors. These include protein quality, energy source, physiological factors and economics. Dietary protein requirement for fish has been investigated by many workers reported that fish has a high dietary protein requirement. The catfish, *Clarias gariepinus* has a protein requirement of 30-36% estimated protein requirement of fingerlings of C. gariepinus as between 31-34%and of brood stock at 40%. Protein requirement of fish tends to change with the size of fish, water temperature and the balance of individual nutrient components in a given ratio. It is higher during the initial feeding stage of fry and then decrease in the age of the fish. A major problem in the development of complete artificial diets for aquaculture is the higher protein requirement of many species of fish, since it contributes a higher proportion of feed cost. Principally, quality of protein is dependent on its amino acid composition. Deficiency in any of the amino acid could cause retarded growth and loss of appetite. For optimum growth and development, total essential amino acid content of the feed ingredient must be balance to allow for maximum amount of amino acid in the diet.

Among cultural fish in Nigeria freshwater are tilapia species, *Cyprinus carpio* (Common Carp], *Clarias species, Heterotis niloticus and Heterobrancus bidosariis* These species of fish are been produced on

small scale. Clarias gariepimta is of paramount importance to Nigeria as it is to other western world because of its rapid growth rate and high prolific-ness.

Objectives of the study

The main aim of this study is to determine the effect of soyabean inclusion in practical diets on the growth performance and nutrient utilization of *Clarias gariepinus*. In order to achieve this, the following specific objectives arc determined:

- To investigate the effect of diets totally substituted with variously processed soyabean on the growth of Juvenile C gariepinus
- To investigate the effect of soya bean meal on the carcass composition of *Clarias gariepinus*.
- To determine the cost analysis of the experiment diet.

MATERIALS AND METHODS

Feed ingredients

Ingredients used for the diet formulations are yellow maize, groundnut cakes, soybean, fishmeal (produced from whole small Alestes) sourced from brigade market Kano; fishmeal was dried in an oven set at 60"C for 24 hours milled using a small grinder and stored in the freezer until required other ingredients include palm oil, vitamin premix which was brought from the phed agrovet stores in kano town.

Processing of soya bean

Raw soya bean was toasted at 100°C for 10 minutes in an electronic oven; it was later grinded in a milling machine to a fine texture and sieve with 0.1 mm mesh opening.

Processing of other feed ingredients

Groundnut cake was purchased from the local oil milling industry. Maize was prepared by grinding the maize into a fine powder with the hammer mill, while the vitamin mineral premix was purchased commercially from the shop in town.

Feed formulation

The weighed ingredients were later mixed with starch of cassava origin and water as binder. Mixing of ingredients and premixes was-done with the hands in a plastic bowl. The dough was pelleted using a screw type pelletizer to 2mm diameter sizes, the pelleted collected were air dried for 2 days and stored in plastic containers sample were taken for analysis.

Fingerling procurement

C/arias gariepimts Juveniles were purchased from Baeauda fish farm located 60 km Southeast of Kano town; they were transported in a 100-liter plastic can (cut at the top to provide aeration) which were later placed into two plastic tanks for 48 hours before stocking into experimental tanks.

The juveniles were acclimatized for forty-Eight hours (48 hours) before feeding commenced. They were fed twice daily at 5% (percent) of their body weight for sixteen weeks.

Feeding regime

The experimental diets were offered to the fish in the experimental tanks twice daily at 8 am and 5 pm. feeding rate to be adopted was 5% body weight per day divided into two equal portions; usually, the fish ate almost all the feed offered to them. The left-over feed was removed the next day before another feed was given. The feeding trials will last for 120 days with the feeding trial commencing from 2nd January 2018 to 30th April 2018.The fish were fed on experimental diets compounded at 40% crude protein with varying levels of processed soybean. The diet with zero level soybean inclusion served as the control while other diets contained 50% and 100% dietary inclusion of soya bean, the control diet was compounded with 30 g of fishmeal, 50 g of yellow maize, 13 g of Groundnut cake, 2.0 g of Vit. Premix 2.0 g of starch, 0.5 g salt × 2.5 g of vegetable oil; the ingredients were poured into a large plastic and it was properly mixed, water is added before pelletizing.

Fish holding facility and husbandry protocol

Rectangular plastic aquarium tanks 30 cm × 15 cm were used during the experimental regime. They were filled with water sourced from the borehole at the Department of Biological Sciences; water was poured up to 75% of the capacity of the aquarium and left for 24 hours before socking with fish. Daily water temperature, pH was measured, oxygen level was measured weekly, complete water change was affected daily to ensure good water quality for fish growth and dietary utilization. The daily water temperature was measured using mercury in glass thermometer; it was inserted in the water and then the reading was taken to ascertain the water temperature. The pH was measured using a pH metre model 3150 the meter was standardized and then the was ¬electrode was submerged inside the water samples and the reading was taken. *Clarias gariepinus* of initial weight ranging from 7-8 gm were stocked 10 per tank in duplicate. Fish were weighed out of the water in a Basket using the weight balance available at the department's aquarium; each experiment was conducted for 16 weeks.

Proximate composition analysis

Moisture content was determined by drying the samples in an oven. The samples were dried in the oven for twenty minutes to evaporate the moisture in the Petri-dish and place in the desiccator to cool. After cooling, weight of Petri-dishes was recorded 5 gm of the sample was placed in to the Petri-dishes. The weight of the dish together with the sample were dried for 6 hours at a temperature of 700°C. The Petri-dishes removed, cooled in the desiccator and reweighed until a constant weigh was-obtain.

Crude Fiber Estimation (CFE)

This-was determined by subjecting the residual feed from ether extraction (lipids) to successive treatments with boiling acid and alkali of defined concentration. 2 g of the dried free sample was weighed into a 600 ml beaker, 200 ml of hot sulphuric acid was, added and heated to boiling within 1 minute.

After boiling for 30 minutes, the mixture was filtered through porous crucible and wash with boiling water 1% hydrochloric acid and then again with boiling water. It was then washed twice with alcohol, dry overnight at 100°C cool and weigh. Ash at 500°C for 3 hours, cool and weighed. The weight of fibre was calculated by the difference in weights. Lipid extraction was by soyhlet extraction method, using petroleum ether on the dry sample gotten from the moisture free sample. The solvent was-removed by evaporation and the residue of fat wag- weighed. Dry residue from the determination of moisture was transferred into extraction thimbles. The thimbles were placed in the extraction and a weighed flask containing 100 ml petroleum ether was connected. The extractor was connected to a reflux condenser, and was extracted under a reflux on a steam bath for 8 hours [2]. The petroleum ether was evaporated up to the extent of drying.

Crude protein estimation

Protein content was determined using the microkjeldahl method, sulphuric acid was used 10 digest the samples with copper used as a catalyst. This was done to convert organic nitrogen into ammonia ions. Sodium hydroxide was added and the liberated ammonia was distilled in the boric acid solution. Determination of ammonia absorbed in boric acid was done by titrating the distillate with hydrochronic acid 0.5 gm of copper sulphate and 15 gm of potassium were put in kjedahl flask, 2 g of the sample was weighed using filter paper, this was also added into the acid in the kjeldahl flask, 25 ml of concentrated sulphuric acid was added to the content of the flask and mixed gently**.**

Bacteriological analysis

One gram (Ig) of the feed sample was added to 25 ml of buffered peptone water and the mixture was weighed aseptically into a sterile jar. The feed was blended and the food homogcnatc was mixed by shaking and 1.0 ml was pipetted into a tube containing 9ml of buffered peptone water. This was mixed with a fresh pippete. This was repeated using a 3rd, 4th, 5th tube. One milliliter (1.0 ml) of the food homogenate, of each dilution of the homogenate will be pipetted into each of the appropriately marked dishes. 10-15 mi of plate count agar (kept at 450°C+10°C in a water bath) was poured into each Fein-dish within 15mins of the time of original dilution. The sample dilution and agar medium were mixed thoroughly and allowed to solidify. The prepare dishes was inverted and incubated at 30+ 10°C for 72 hours. After incubation, all the colonies on the dishes containing 30-300 colonies were counted and the result recorded per dilution.

Water quality parameters

The water temperature of the experimental tanks was taken by a mercury-in-glass thermometer and the mean temperature during the experimental period was 25-300°C.

Hydrogen ion concentration (pH)

The pH values were read off a pH meter after standardizing the meter, the meter electrode was. Submerged inside the water samples and the reading taken. D.O and the water conductivity were-measured weekly using an oxygen metre of model HANNA HI 9146 OXYGEN BENCHMETER.

Evaluation of growth performance

Specific growth rate is the actual weight gain during the fish life or during the feeding trial. It has the following formula.

Statistical analysis

The Biological data arising from the treatment were subjected to descriptive analysis and differences in means were determined using the least significant correlation. All statistical analysis, the sum, the mean, standard deviation and the range (Minimum-Maximum) were done using the software SPSS version 15.1.

Proximate composition of the experiment diets

Diets T1 and T2 have the highest crude proteins; they are the control and conventional feeds, followed by T5 and T7 which are 50% inclusion of toasted soybean and 100% inclusion of Raw soybean with methionine and lysine. Diet T4, with 100% Raw soybean inclusion has the least crude protein. The lipids content is highest in Diet T2, while Diet T5 has equal amount of lipid content with the control diet T1, Diets T7 and T8 have equal lipid contents. Diet T8 has the highest Ash percentage 24.78 while diets T3 and T4 have the lowest percentage Ash. The highest crude fiber content of 9.00 percent was obtained in diet T3 and T4 while the least 7.00 percent in T4 and T7.

Growth performance of the experimental fish fed with different levels of soybean inclusions

The growth response of Gloria's gariepinus juveniles fed with the different diets. The result showed that diet T2 (conventional diet) had the highest Average weight gain - This was followed closely by diet T5 (50% Toasted Soybean) and diet T7 and T6. There is no significant different ($P>0.05$) between diet T2 and T5 in weight gain while diet T6 and T7 are significantly different from diets T2 and T5. Based on the average weight gain diet T5 with 50% Toasted soybean performed better and diets T7 and T6 (100% Raw soybean and 100% toasted soybean) followed closely.

Percentage weight gain:

Diet T2 gave the highest percentage weight gain of 470.2% while diet T5 with 432.55% ranked second. The poorest percentage weight gain was obtained in fish fed with diet T3 Percentage weight gain of the groups of fish were also significantly different ($P<0.05$) from each other. Diet T2 performed best followed closely by diet T5 and both are not significantly different ($P>0.05$) from each other. Diet T7 and T6 which ranked third and fourth are significantly different from diet T3 (with the lest value).

Specific growth rate

The lowest specific growth rate of the experimental fish was obtained in fish fed with diet T^ with a value of 2.88 while the highest S.G.R value of 3.48 was obtained in diet T2 which was followed by diet T, (50% toasted soybean) then diet TI (which is the control). Diets to and T7 have a value of 3.08 while diet T8 have a value of 3.02. There is no significant difference (P>0.05) between diet T2 diet T5, Diet T1 diet T6 and diet T7. Diet T4 has a value of 2.98 [3].

Percentage survival

The highest percentage survival were those fish fed on diets, T1, T3, T4, T5, and T6 with 100 percentage each. Diet T2 ranked second with 95 percent, diet T7 has the least percentage survival with a value of 30 percent survival rate.

Nutrient utilization of *Clarias gariepinus* juveniles fed on the different diets

The nutrient utilization data are presented the protein efficiency ratio (PER) was highest in fish fed with diet T2 followed closely with diet T5 with a value of 10.81, there is no significant difference in diet. T2 and diet T5. Diet T7 has a PER of 7.86 which was followed by diet T6 with a value of 7.62. This show that diet T6 and T7 are significantly different (PO.05) to diet 12 and T5. Diet T1 (control diet) has a protein efficiency ratio of 7.2 and there is a significant difference (PO.05) in comparison to diets T2, T3, T7. Diet T3 has the least PER with value of 6.11.

The lowest Feed Conversion Ratio (FCR) value of 5.32 was seen in diet T2 while the highest FCR was obtained in diet T8. While diet T1, (control diet) is significantly different (P<0.05) from diet T2, and diet T5; The value obtained in diet T3, T4, T6, T7, and T8, is not significantly different (P<0.05) from diet T2 with the lowest FCR. The net nitrogen retention value presented in table 4.3 showed that the fish fed on diet T3 showed the highest net nitrogen retention value of 64.75 while the least valve was obtained from diet T2 with value of 56.14. The net nitrogen retention valve did not vary greatly between the treatments it ranged from 56.14%-64.75% and did not show any clear trend in the variation.

Carcass analysis of the flesh of c. gabrielinos juveniles fed with different diets

The result of the proximate composition of the initial and final muscle tissues of C. gariepinm juveniles fed on the different diets is presented m Table 6: The highest protein value in the muscle was obtained from the fish fed on diet T2 closely followed by fish fed on diet T5 while the lowest muscle protein value was obtained from fish fed on diet T3. Final carcass protein did not vary significantly (P<0.05) between treatments. Fish fed on diet T2 showed the highest value of crude fat followed by fish fed on diet Ts while least crude fat value was recovered from fish fed on diet T8. The difference in carcass ash in the treatments was minimal while the least crude fiber was discovered in the carcass of the fish fed with diet T5 the highest crude fiber was diet.

Analysts of the diets

Diet TI coasted N42.00 per kg and N42,000 per ton feed. Diet T2 per kg feed is N350.00 and N350 000 per ton - Diet T3 cost N28.5, diet T4 N15, diet T5 N28.50, diet T6 Nl5.00 while diets T7 and T8 costN17.00, Diets T4 and diet T6 are the cheapest in terms of cost of production while diet T7 and T8 are second in terms of feed cost, diet T3 and T5 cost N28,50k each Diets T3 and T5 could be termed cheapest in production cost when the relationship of weight gain and feed intake is calculated, especially when the protein efficiency ratio and its lowest feed conversion ratio is strictly considered.

Aerobic mesophilic bacterial counts of the feeds

Table 8: shows the bacterial load contained in the treatments the colonies formed in each of the treatment shows that they are less than thirty (<30) - there is no significant difference (P>0.05) in the different feeds in respect to the bacterial load; therefore the values obtained are within the acceptable values according to FAO, this shows that the feeds were not contaminated and is within the acceptable level for the fish consumption.

Water Quality Records

Dissolved oxygen contents of water in the various treatments were relatively similar and never got below 5.60 mg/L. water temperature ranged between 25°C to 25.5°C while pH was between 7.5 and 7.8 these records were within the limits of good water quality for aquaculture as recommend.

RESULTS AND DISCUSSION

The relatively chapter cost of soybean in comparison to animal protein sources could lead to the rapid promotion of fish culture intensification in Nigeria and other developing countries. Results of the present research have shown that use of soybean in fish feed (Partial inclusion or fully substituted) in feed for catfish C. gariepinus gave good growth rate, good food conversion ratio and good protein utilization compared to the control diet.

Reported that partial replacement) 40% of fishmeal) by soybean meal in pond trails of carp required only supplement of methionine at 50% level in order to attain the same growth, protein and energy utilization as that with the control ration that had fish meal as the main protein supplement. When most of the fish meal was replaced by soybean meal, supplement of methionine and 0.4-0.5% lysine was necessary to achieve gains, protein efficiency ratio retention equal to those of the control fish meal ration. In this stud}', total replacement of fishmeal with soybean did not appear to significantly affect FCR and PER stressed that soybean protein has one of the best amino acids profile of all protein rich plan; feeding stuffs to meet essential amino acid requirements of fish. There was no significant difference (PO.05) in weights of the fish in all the groups this indicates that the different diets produce similar effect on growth of fishes. In this study, the best growth rate was obtained in fish fed on diet T3 and diet T5 followed by diet T7. The diets are relatively higher in quality and quantity of the ingredients

used in the formulation of the diets [4]. The finding of this study agrees with the work. Who claimed success in feeding rainbow trout a diet based almost entirely on raw materials of vegetable origin containing 80% roasted soybean.

Observed no significant difference in growth performance and diet utilization in O. niiiticus fed a diet where all the protein was supplied by herring meal and 75% of the herring meal was replaced by full fat soybean cake supplemented by methionine. Also found no significant difference in growth performance and diet utilization in tilapia, fed a diet where 25% of a control diet was replaced by soybean meal, although complete replacement resulted in 27-33% growth depression. Other parameters such as Specific Growth Rate (SGR), Protein Efficiency Ratio (PER), food conversion ratio followed the same pattern as that of weight gain values (Tables 4 and 5). Feed ingredients of plant origin have shown to contain various anti-nutritional factors, for instance, soybean contains, groundnut has aflatoxin, wheat offal has high fiber and low amino acid content. However, some of these defects in these plants' product can be ameliorated by heat and chemical treatment. Heat is known to improve digestibility of polysaccharides and metabolization energy in addition to inactivation of trypsin inhibitors the inactivation of trypsin inhibitors would certainly lead to increased protein digestion. Treatment 5 (T5) with 50% inclusion of toasted soybean gave a very good performance than the control diet, also T6 (100% inclusion of toasted soybean) gave a very good performance in comparison to the control; this is as earlier reported by who confirmed that toasted soybean gave the best growth performance to Clarias anguillids fingerlings compared to raw soybean. Although the performance of the fish fed with the totally substituted fishmeal gave a good result it can be said that it produced to the nearest optimum: for the best result a partially substituted feed in fish some level of the fishmeal is substituted with the fishmeal will yield to a very satisfying yield as in diets T5.

In these experiments when catfish *Clarias gariepinus* juveniles were fed 40% protein from differently processed soybean FCR of 5.32-10.22 was obtained. In this study, no depression in growth was observed between treatment group on the experimental diets. Fish fed on diets T1. T3, T4, T? and T6 recorded the highest percentage of survival each. This could be attributed to acceptability of the diets and a high level of nutrient utility in the fish [5]. The low percentage survival offish in diet T8 may be an indication of their non-acceptability of the artificial diet also the low percentage survival offish in diet T8 could as a result pollution of the water (when water was left for 4 days before replacement) foul smell (pollution) resulted. It is certain that too much nutrients in culture medium results in pollution and Joss of fish if adequate precautions are not taken.

The inferior growth rate observed for C. gariepinus juveniles in diet T1 with zero percent inclusion of soybean could be a manifestation of the high crude fiber content and low protein content of the diet shown by proximate analysis.

The physico-chemical parameters value is shown in these parameters arc within those recommended fish culture. The cost analysis of the diets was calculated based on the cost per kilogramme of feed

stuffs at the period of the experiment. The analysis showed the feed with least cost was revealed in diet T4 and T6 soybean is relatively cheaper in comparison to animal source protein (Tables 1-4).

Table 1: Weekly average water quality parameters.

Treatment								
Parameters	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Temperature	25.5	25	25	25.5	25	25	25.5	25
pH	7.8	7.8	7.8	7.8	7.8	7.5	7.8	7.8
Dissolve 02 (mg/ht)	5.5	5.6	5.5	5.5	5.55	5.5	5.55	5.5
Conductivity	2.3	2.3	2.3	2.3	2.3	2.3	2.3	

Table 2: Gross Composition of Experimental Diets.

100 Grammes								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Fish meal	30	-	10	-	0	-	-	-
Raw soyabean meal	0	-	20	30	-	-	-	-
Yellow maize	50	-	50	50	50	50	50	50
Groundnut cake	13	-	13	13	13	13	13	13
V.T Premix Vitamin Premix	2	-	2	2	2	2	2	2
Starch	2	-	2	2	2	2	2	2
Toasted soyabean	-	-	-	-	20	30	-	-
Raw soyabean meal with methionine (0.04g) and lysine (0.02g)	-	-	-	-	-	-	30	-

Table 3: Proximate composition of the formulation diets used in the experiments.

Nutrient contents	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Crude protein %	45.40^b	44.97^b	39.24^b	39.20^d	42.00^d	40.10^d	42.10^b	41.20^d
Crude fat %	2.50^b	2.65^b	2.30^c	2.25^c	2.50^b	2.45^b	2.40^b	2.40^b
Crude ash %	21.59^a	20.81^a	19.00^b	19.50^b	21.59^a	20.49^b	23.80^c	24.78^c
Crude fibre %	8.00^b	8.97^d	9.00^d	7.00^a	8.00^b	9.00^d	7.00^a	8.40^c
Moisture %	9.81^d	9.99^d	8.90^c	8.80^c	9.40^d	9.63^d	9.13^d	8.40^d
Nitrogen free Extract % (NFE)	15.53^a	19.34^b	21.60^c	21.63^c	15.20^a	15.28^a	20.64^c	20.50^c

Table 4: Nutrient utilization of *Clarias gariepinus* juveniles fed on the different diets.

Growth Parameters	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Average daily gain (g)	0.024	0.039	0.019	0.021	0.036	0.025	0.026	0.024
Average protein efficiency ratio (PER) (g)	7.2d	11.80c	6.11a	6.40a	10.81c	7.62d	7.86d	7.10d
Average feed conversion ratio (FCR) (g)	8.68	5.23	10.22	9.8	5.78	8.2	7.95	8.86
Net Nitrogen retention	57.42	56.14	64.75	63.48	56.24	61.37	58.93	58.44

CONCLUSION

The results from this study showed that 50% inclusion of toasted soybean - performed better than the zero percent inclusion of soybean (control). This was closely followed by diet T7 which is 100% raw soybean with methionine and lysine (included). The cost rate of diet T5 and diet T7 is minimal compared

to diet T1 and diet T2 which is the conventional feed (coppens). The cost rate is cut down up to 50-80% per kilogramme feed.

Base on the growth performance, nutrient utilization parameters and cost effectiveness of the eight diets at varying inclusions of soybean in the practical diet for C. gariepinus in this study, and the superiority of 50% and 100% inclusion of toasted soybean (in addition to methioninc and lysine) the following recommendations are suggested:

- That toasted soybean should be embraced by fish farmers as the most preferred treatment for soybean used in fish feed.
- That in order to maximize profit animal protein can be substituted partially or fully with soybean provided the essential amino acid (methionine and lysine) are added to improve feed.
- That in the toasting of soybean, it should be done in a sufficient way so as to reduce the effect of inhibitors and also provides a flavor to the feed**.**

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