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(RESEARCH ARTICLE)

Growth performance and proximate composition of *Clarias gariepinus* (Burchell, 1822) fingerlings fed varying inclusion levels of ripe banana (*Musa Sapientum*) peel

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Abstract

The cost of fish feed is of great concern in fish farming. The growth performance and proximate composition of *Clarias gariepinus* fingerlings fed varying inclusion levels of ripe banana peels as a possibility of replacing soybean as a component of the fish feed were evaluated for a period of 12 weeks. 250 *C. gariepinus* fingerlings were acclimated for 2 weeks and fed to satiation morning and evening. Five isocaloric and nitrogenous diets were prepared from ripe banana peel thus: 0% (Control), 25% (T25), 50% (T50), 75% (T75) and 100% (T100) inclusion levels to replace equal weights of soybean, respectively. Some growth parameters such as standard length (SL), total length (TL) and weight were determined on weekly basis. The proximate compositions of the fish in each treatment and control were determined at the end of the experiment. The data generated were subjected to one way analysis of variance and considered significant at P≤0.05. From the results; the weight, SL and TL mean values measured in the control were significantly higher than other treatments in most of the weeks of the experiment. The highest weight in the control was 52.43±10.80g while the highest amongst other treatments was 30.67±6.69g obtained in T75 at the end of the 12 weeks. The ash content, crude fibre and fat contents were mostly significantly in T75 and T100. The highest moisture content (12.88±0.74%) was also obtained in T100. The crude protein content was significantly higher in the control than other treatments with 68.69±0.35% at the end of the 12th week. The results of this research has shown that banana peel can be included up to 75% level of inclusion as possible replacement for soybean in fish meal production and therefore, capable of reducing the cost of fish production incurred by farmer. For optimal performance, the crude protein content should be improved upon by inclusion of other cheap protein sources.

Keywords: Ripe banana peel; Growth parameters; Proximate composition; *Clarias gariepinus*; Soybean

1 Introduction

Clarias gariepinus is a large eel-like fish, usually dark gray or black colouration on the back fading to a white belly. Proper utilization of carbohydrates in the fish diet contributes to directing the use of proteins for fish growth, as well as reducing the elimination of nitrogenous residues (Ayinla, 2007). In addition, the use of carbohydrates, when balanced with proteins and lipids in fish diets, may reduce the amount of protein in the diet formulation (Ayoola *et al*., 2012), reducing feed cost, as protein is one of the most expensive dietary items in the fish diet. As a replacement for corn meal, previous studies have presented promising results regarding the inclusion of fruits in the fish diet, such as tambaqui (Eboh, 2014), camu (*Myrciaria dubia*) (Douglass, 2000) and banana in African catfish (*Clarias gariepinus*) (Nwanna *et al*., 2014). Fish is an important source of protein for diets in man. Smoked or dried fish is a traditional part of diet of a large sector of the world populations. However, the cost of rearing fishes is quite high, which brings about the idea of making affordable fish feed for farmers.

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Banana (*Musa sp*.) is produced by most tropical countries, being an important source of nutrients for the human population. Furthermore, it also has the potential to be used as a food ingredient in aquaculture. Brazil produced around 7 million tons in 2017 and it is one of the largest banana growers in the world (Leduc *et al*., 2018). According to FAO (2015) fruit and vegetable losses in South America are approximately 40–50 %. This high waste, when evaluated together with the high perishability of this fruit, demonstrates that there is a large supply of unused banana for human consumption that could be used as food in aquaculture. Banana peels are not known to contain anti-nutrient agents making it suitable for possible replacement of soybean component of fish meal. Many plant-based ingredients contain anti-nutritional factors (e.g. phenols, phytates, tannins, protease inhibitors and non- starch polysaccharides), which may impair fish nutrient metabolism and health (Balogh *et al*., 2007). One of the biggest problems when it comes to fish farming is the cost of fish feed. The high cost of feed sometimes makes the fish farming business a no go area for a lot of people. Banana peel left in the environment can lead to organic waste in the environment. In view of the increasing demand for fish and high cost of conventional feed ingredients, it is therefore necessary to investigate the replacement value of banana for soybeans meal in the diets of *C. gariepinus*. Thus, the inclusion of whole banana peel would be an economically viable alternative in practical fish diets at little or no extra cost and contribute to reducing the environmental impact of discarded banana waste especially if not properly disposed of. This study therefore, evaluated the growth performance and proximate composition of *Clarias gariepinus* fed with varying levels of ripe banana peel as a possible replacement for soybean meal in arriving at lower cost of fish feed in fish farming.

2 Material and methods

2.1 Samples Collection, Acclimatization and Experimental set-up

Two hundred and fifty (250) *Clarias gariepinus* fingerlings (6 weeks old) were purchased from Private Fish Farm in New Bussa, Niger State. These fishes were carefully transported to the Laboratory of Animal Biology Department, Federal University of Technology, Minna, Bosso Campus in a 25 Litre container with water inside to reduce the risk of mortality. Minna is located between latitude $6^{0}3$ and $6^{0}45$ east of the equator. The fishes were acclimated for two weeks and fed control diet (0% content of ripe banana peel) to satiation, morning and evening. Subsequently, they were randomly assigned randomly to four (4) treatments, each with three (3) replicates. Each treatment contained 45 fishes each, from treatments 1 to treatment 4 including the control. That is, each trough contained 15 samples. The research ran for a period of 12 weeks.

2.2 Collection and Processing of Banana peel

The ripe banana peels (*Musa sp*) were collected from Kure market fruit vendors, Minna, Niger State. They were sun dried for 1 week, the dried banana peel were grinded into fine powder and analyzed for proximate composition according to the procedures of AOAC (2005). The values obtained are contained in the table below;

Table 1 Proximate composition of *Musa sapientum* used in the formation of fish feed

Parameter/contents	%Composition
Moisture content	61.22
Crude protein	5.52
Crude fibre	8.75
Crude lipid	6.12
Ash	9.76
Carbohydrate	8.63

Table 2 Proximate composition of soybeans (*Glycine max*)

Parameters	% composition
Protein	37.69
Fat/oil	28.20

Ash	4.29
Moisture	8.07
Crude fibre	5.44
Carbohydrate	16.31

Source: Etiosa *et al.*, 2018.

2.3 Formulation of Fish Feed with banana peel

From the proximate analysis of dietary ingredients carried out, five isocaloric and nitrogenous diets were prepared thus: 0%, 25%, 50%, 75% and 100% (as control, T_1, T_2, T_3 and T_4, respectively) inclusion of banana peel, to replace equal weight of soybean respectively, the control diet (0%) contained no banana peel. The weight was taken with triple beam balance (model 700). The meal produced (banana peel) was mixed with other feeding ingredients to formulate five iso-nitrogenous diet. The diets produced were passed through a pelleting machine die 2mm to produce pellets. Thereafter the pelleted feeds were sun dried to crispy solid form for four (4) days to prevent the growth of moulds and were packed in waterproof bags and labeled accordingly before storage at room temperature.

2.4 Growth Parameters

2.4.1 Total and Standard Lengths

Total and standard lengths of the *C. gariepinus* fingerlings in the different treatments were recorded from 2 randomly selected samples on a weekly basis using fish measuring board to the nearest 0.01cm. Standard length was determined separate from the total length by measuring the tip of the snout to the caudal lobe of the fish. The total length was measured from the tip of the snout to the tail end of the fish, usually measured with the lobes compressed along the mid-line.

2.4.2 Weight of the catfish (C. gariepinus)

The weight of the fish was determined from 2 randomly selected fish from each trough every week of the experiment. These were measured individually with minimal handling to reduce stress. This was determined by using a triple beam balance model 700.

2.5 Data Analyses

The data generated from the morphometric parameters and proximate compositions of *C. gariepinus* were subjected to one-way analysis of variance using SPSS (version 23) and considered significant at $P \leq 0.05$.

3 Results

3.1 Growth parameters of *C. gariepinus* fed varying inclusion levels of ripe banana peel

The weight of *Clarias gariepinus* fed varying inclusion levels of ripe banana peel showed that the mean values obtained in the control were significantly higher than other treatments in the 1st, 3rd, 4th, 5th, 6th, 10th, 11th and 12th weeks of the experiment. In the 2nd week only T_{75} was significant. In the 7th, 8th and 9th weeks, the T_{100} samples were significantly different from other treatments including the control. The highest weight (52.43±10.80g) was obtained in the control. The highest weight (30.67±6.69g) amongst the treatments was obtained in T_{75} at the end of the 12th week. (Table 3).

The standard length of *Clarias gariepinus* fed varying inclusion levels of ripe banana peel indicated that the values obtained at the end of the 1st, 3rd, 4th, 6th and 12th weeks were significantly different in the control. The values of T_{50} and T_{75} were significantly different in the 2nd week. In the 5th and 8th weeks of the experiment, the values obtained in T_{75} were significantly higher than other treatments including the control. T_{100} value was significantly different in the 7th week. All the values were slightly different at the 10th week. The mean values in the control and T_{100} were significantly different in the 9th week. Likewise, values in the control and T_{75} were significantly different in the 11th week of the experiment. (Table 4).

The total length of *C. gariepinus* fed varying inclusion levels of *M. sapientum* peel for a period of 12 weeks indicated that with the exception of week 7 the mean values obtained in all the other weeks were significantly different in the control. The values obtained in the control and T_{100} were significantly higher than other treatments in the 7th week of the experiment. (Table 5).

Table 3 Weight measurement (g) of *C. gariepinus* fed varying inclusion levels of ripe banana (*Musa sapientum*) peel for a period of 12 weeks

WEEKS	Control	T_{25}	T_{50}	T_{75}	T_{100}
1	11.00±0.58^{c}	5.00±0.58^{a}	6.33±0.33^{b}	6.67±0.33^{b}	5.67±0.33^{a}
2	10.00±1.00^{c}	8.00±0.58^{a}	10.00±0.58^{cd}	11.00±1.53^{d}	9.00±0.58^{b}
3	12.67±1.20^{c}	9.33±1.45^{a}	10.33±1.45^{b}	11.00±0.20^{bc}	9.33±0.33^{a}
4	14.67±1.86^{d}	8.67±0.67^{a}	10.67±1.45^{b}	11.33±1.86^{c}	10.00±0.58^{b}
5	19.67±5.04^{b}	10.33±0.33^{a}	10.67±0.88^{a}	10.33±1.45^{a}	10.67±0.67^{a}
6	32.67±10.4^{c}	11.67±0.67^{a}	11.67±0.88^{a}	20.67±6.69^{b}	12.00±0.00^{a}
7	12.00±0.56^{b}	11.00±0.58^{ab}	10.33±0.33^{a}	16.99±0783^{c}	12.67±0.33^{bc}
8	14.00±1.70^{c}	11.26±0.58^{a}	13.00±0.58^{b}	15.00±1.07^{d}	16.00±0.58^{e}
9	13.12±1.22^{b}	10.33±1.45^{a}	14.33±1.45^{c}	19.00±0.34^{d}	19.33±0.33^{d}
10	17.97±1.87^{c}	13.67±0.67^{ab}	12.67±1.45^{a}	15.33±1.98^{b}	13.00±0.58^{a}
11	19.76±5.04^{c}	11.33±0.33^{a}	11.67±0.88^{a}	12.33±1.23^{ab}	13.67±0.67^{b}
12	52.43±10.8^{d}	13.67±0.67^{a}	14.67±0.88^{ab}	30.67±6.69^{c}	14.00±0.00^{a}

Mean ± Standard Error with different alphabets as superscript across the rows are significantly different from each other at P ≤0.05.

Table 4 Standard length (cm) measurement of *C. gariepinus* fed varying concentrations of ripe banana (*Musa sapientum*) peel for a period of 12 weeks

Weeks	Control	T_{25}	T_{50}	T_{75}	T_{100}
1	8.70±0.76^{c}	6.83±0.44^{a}	7.27±0.39^{b}	7.87±0.45^{b}	6.83±0.17^{a}
2	8.33±0.60^{a}	8.33±0.60^{a}	10.17±0.24^{b}	10.03±0.55^{b}	9.20±0.10^{ab}
3	11.67±0.09^{c}	8.93±0.58^{a}	8.97±0.90^{a}	9.23±0.66^{b}	9.17±0.34^{b}
4	10.50±0.05^{ab}	9.00±0.20^{a}	9.17±1.17^{a}	9.83±1.09^{ab}	10.00±1.26^{ab}
5	11.83±0.44^{bc}	8.70±0.48^{a}	10.83±0.33^{b}	12.67±1.42^{c}	10.17±1.42^{ab}
6	13.83±0.73^{c}	11.83±0.93^{b}	11.83±0.93^{b}	10.50±1.53^{a}	12.33±1.60^{bc}
7	8.70±0.15^{b}	6.77±0.56^{a}	8.77±0.44^{b}	7.67±0.45^{ab}	9.83±0.57^{c}
8	8.91±0.12^{b}	7.42±0.67^{a}	10.33±0.76^{c}	11.03±0.55^{cd}	10.20±0.12^{c}
9	11.67±0.43^{c}	8.53±0.78^{a}	9.97±0.80^{b}	9.78±0.66^{b}	11.17±0.56^{c}
10	10.50±0.55^{ab}	9.00±0.40^{a}	10.17±1.17^{ab}	10.3±1.09^{ab}	10.00±1.90^{ab}
11	12.54±0.77^{c}	8.70±0.60^{a}	11.83±0.33^{bc}	12.98±1.42^{c}	10.17±1.89^{b}
12	14.76±0.89^{d}	11.91±0.63^{a}	12.83±0.93^{b}	12.50±1.53^{b}	13.42±0.60^{c}

Mean ±Standard Error with different alphabets as superscript across the rows are significantly different from each other at P ≤0.05.

Table 5 Total length (cm) measurement of *C. gariepinus* fed varying concentrations of ripe banana (*Musa sapientum*) peel for a period of 12 weeks

Weeks	Control	T_{25}	T_{50}	T_{75}	T_{100}
1	11.83±1.20^{b}	7.83±0.33^{a}	8.00±0.29^{a}	9.20±0.35^{a}	7.50±0.12^{a}
2	11.40±0.80^{c}	9.10±0.70^{a}	10.53±0.78^{b}	10.00±0.50^{ab}	9.30±0.12^{a}
3	12.67±0.73^{c}	9.37±0.37^{a}	10.93±1.32^{ab}	10.50±0.79^{ab}	11.17±0.73^{b}
4	13.00±1.04^{c}	8.83±0.44^{a}	10.23±1.37^{b}	11.43±1.59^{bc}	10.83±1.33^{bc}
5	14.33±0.86^{c}	9.90±0.31^{a}	10.00±0.76^{a}	11.97±1.25^{b}	9.67±0.44^{a}
6	14.40±1.16^{b}	11.60±0.95^{a}	12.00±1.00^{a}	12.83±0.70^{ab}	12.45±0.27^{a}
7	11.73±1.30^{b}	10.33±0.13^{a}	12.40±0.49^{bc}	10.20±0.55^{a}	11.50±0.01^{b}
8	12.40±0.80^{c}	10.20±0.80^{a}	11.53±0.78^{bc}	11.00±0.50^{ab}	9.40±0.32^{a}
9	13.60±.073^{c}	10.37±0.38^{a}	12.93±0.32^{b}	12.50±0.79^{ab}	12.18±0.11^{ab}
10	13.10±1.54^{c}	9.43±0.90^{a}	11.23±1.47^{b}	12.43±1.59^{bc}	11.93±1.44^{b}
11	15.35±1.76^{c}	11.90±0.34^{ab}	11.00±0.36^{a}	12.67±1.35^{b}	10.57±0.44^{a}
12	15.70±0.16^{c}	12.60±0.85^{b}	12.20±1.10^{a}	12.93±1.70^{b}	11.55±1.33^{a}

Mean ±Standard Error with different alphabets as superscript across the rows are significantly different from each other at P ≤0.05.

3.1.1 Proximate composition of C. gariepinus fed varying inclusion levels of ripe banana (Musa sapientum) peel

The proximate composition *C. gariepinus* fed varying inclusion levels of ripe banana peel for a period of 6 weeks showed that the significantly higher percentage of moisture content (12.88±0.24%) was recorded in T_{100}. The highest crude protein percentage (67.89±0.34%) was obtained in the control. Slightly higher values (12.88±0.74% and 68.69±0.35%) of moisture content and crude protein percentages were also obtained in T_{100} and control, respectively at the end of the 12th week. Crude fat contents were significantly different in the T_{25} and T_{75} samples. T_{50} and T_{100} had higher values of the ash content. The fat and ash contents as well as NFE (Nitrogen Free Extract) were significantly high in T_{25} at the end of the 12th week. The crude fibre contents in T_{75} (in both 6th and 12th weeks) were significantly higher than other treatments including the control. The lowest value was obtained in the control. Similarly, low values of NFE were obtained in the control but significantly high in T_{25}. (Tables 6 and 7).

Table 6 Proximate composition of *C. gariepinus* fed varying inclusion levels of ripe banana (*Musa sapientum*) peel at the end of 6 weeks

Treatments	Moisture (%)	Crude Protein (%)	Fat (%)	Ash (%)	Crude Fibre (%)	NFE (%)
T_{25}	9.89±0.35^{a}	49.24±1.91^{a}	16.31±0.61^{c}	5.58±0.53^{a}	1.33±0.16^{b}	16.37±1.25^{d}
T_{50}	11.83±0.19^{c}	52.49±0.58^{ab}	14.76±0.27^{b}	6.55±0.44^{b}	1.10±0.20^{b}	12.95±0.56^{b}
T_{75}	11.75±0.24^{c}	49.98±0.27^{a}	16.13±0.57^{c}	5.99±0.55^{a}	1.38±0.01^{b}	14.47±0.82^{c}
T_{100}	12.88±0.24^{d}	50.36±6.35^{a}	15.58±0.43^{ab}	6.63±0.36^{b}	1.37±0.04^{b}	14.32±0.60^{c}
Control	10.53±0.01^{ab}	67.89±0.34^{c}	7.75±0.25^{a}	6.00±0.50^{a}	0.40±0.00^{a}	7.44±1.09^{a}

Mean ±Standard Error with different alphabets as superscript along the Columns are significantly different from each other at P ≤0.05. NFE is the Nitrogen Free Extract.

Table 7 Proximate composition of *C. gariepinus* fed varying inclusion levels of ripe banana (*Musa sapientum*) peel for at the end of 12 weeks

Treatments	Moisture (%)	Crude protein (%)	Fat (%)	Ash (%)	Crude fibre (%)	NFE(%)
Control	11.53±0.31^{b}	68.69±0.35^{e}	6.86±0.28^{a}	7.00±0.10^{d}	1.40±0.01^{a}	6.44±1.00^{a}
T_{25}	10.89±0.14^{a}	48.23±1.81^{a}	15.31±0.61^{d}	7.58±0.12^{e}	1.33±0.11^{a}	14.37±1.25^{e}
T_{50}	10.83±0.57^{a}	50.49±0.57^{b}	13.16±0.27^{c}	5.55±0.49^{b}	1.10±0.45^{a}	11.95±0.43^{d}
T_{75}	10.75±0.58^{a}	59.98±0.29^{d}	12.11±0.57^{b}	4.99±0.97^{a}	1.38±0.20^{a}	9.47±0.92^{b}
T_{100}	12.88±0.74^{c}	52.36±6.30^{c}	13.58±0.43^{c}	6.63±0.31^{c}	1.37±0.06^{a}	10.32±0.40^{c}

Mean and standard errors with different superscripts along the columns are significantly different from each other at P≤0.05. NFE stands for Nitrogen Free Extract.

4 Discussion

Banana plants (*Musa sp*) are a type of tropical plants that are very much produced in Nigeria. They are widely consumed through-out the country in particular and Africa in general. Fish feed remains the biggest input in fish farming in terms of cost and profitability. As at 2004, there are over 2,600 fish farms and 215 feeds mills in the country with most of them located in the southern parts of Nigeria, and fish feeds account for about 60% of the input cost production in intensive system in Nigeria (Obe and Omodara, 2014). Proximate composition of the banana peel obtained in this research indicated that moisture content (61.22%) constitutes the highest. The crude protein, crude fibre and crude lipid constitute 5.525%, 8.75% and 6.12%, respectively. These low values could be attributed to the location and the type of soil constituents available to the plants during their growth. Hernawati and Anyayi (2007) reported higher proximate composition of ripe banana peels as 7.26% protein, 15.29% fat, and 24.13% crude fiber.

Growth is a change in size, length, or weight over time. Growth is closely related to feeding. Quality feed contains the right proportion of protein, fat, carbohydrates, minerals and vitamins. In the present study, the growth performance of *Clarias gariepinus* fingerlings fed with banana peel diet in terms of weight showed significant differences majorly in the control with slight improvements in the 75% (T_{75}) and 50% (T_{50}) inclusion levels. This is probably because the crude protein content of the banana peel was very low and was majorly made up of moisture content. Thus, the control samples with 0% level of inclusion of the banana peel and 100% soybean input performed better. The final weight of the fish in the control at week 12 was 52.43±10.80g compared to 30.67±6.69g in T_{75}. Olaniyi *et al.* (2013) in their study on 'growth performance and nutrient Utilization of *Clarias gariepinus* fed *Moringa oleifera* leaf meal' reported the highest weight gain (32.10g) in the treatments and attributed it to higher protein content of Moringa leaves (25.0%). However, the relatively high final weight (30.67±6.69g) in T_{75} probably indicates that banana peel could also serve as a supplementary feed for fish which can be improved upon by addition of any protein source. This is in line with the study of Oluwatosin and Solomon (2017) in their study on growth performance of the African catfish (*Clarias gariepinus*) fed soaked ripe plantain peel meal (*Musa paradisiaca*). They reported that soaked ripe plantain peel can replace maize as high as 100% inclusion level in the diet of *C. gariepinus* without compromising growth performance.

Similarly, the growth performance of *Clarias gariepinus* fingerlings fed with banana peel diet in terms of significant increase in standard and total lengths in the control in substantial parts of the period of the experiment with significant differences in T_{50}-T_{100} in very few instances probably buttress the importance of high protein content of fish feed since, a diet should supply all essential nutrients and energy in tune with the animal's needs for the maintenance of vital physiological functions such as growth, reproduction and health (Akinrotimi *et al*., 2011). Oluwatosin and Solomon (2017) reported excellent growth performance in standard length among fish fed with soaked ripe banana (*Musa paradisiaca*) diet.

Proximate composition such as proteins, lipids and moisture contents are the major constituents, which had been considered in evaluating the nutritional value of the fishes studied (Adeniyi *et al*., 2012). All the fishes examined for proximate composition showed appreciable amount of nutritional constituents. For the moisture content, the highest (12.88±0.24%) was obtained in T_{100}. The high moisture content recorded could indicate that *C. gariepinus* just like other fishes is highly perishable (Olayemi *et al*., 2011). The crude protein percentage ranged from 49.24% to 67.89% in T_{25} and control, respectively at the end of the 6th week. Slightly higher values (12.88±0.74% and 68.69±0.35%) of moisture content and crude protein percentages were also obtained in T_{100} and control, respectively at the end of the 12th week.The protein contents of the control and the lowest inclusion level are high probably because they contain relatively right nutritional proportions of the feed that are rich in protein and also, likely that the fishes have succeeded in adapting

to the feed available to them as duration of the research increased leading to the slight changes in terms of lower values of the crude protein contents in treatments with higher inclusion levels of the ripe banana peel observed. This probably suggests the high adaptability and capacity of cat fish in utilizing and converting the peel to protein for their healthiness. The high percentage of crude protein obtained from the fishes could also indicate that *C. gariepinus* is an excellent source of protein and could be included in human diet (Louka *et al*., 2014). They also reported that compared to other sources of protein, fish are well known to be excellent sources of protein which can be seen from amino acid composition and protein digestibility. However, lower crude protein values (34.67% to 35.68%) were reported by Oluwatosin and Solomon (2017).

Crude fibre content aid in digestion, absorption of water from the body and bulk stool, and also prevents constipation (Ayoola and Adeyeye, 2009). The crude fibre percentage of the fish ranged from 0.40% and 1.38% in the control and $T_{75,}$ respectively. That is, the fibre content increased with increasing level of inclusion up to 75%. The ash contents were also very low. This is lower than the crude fibre percentage (3.69 – 3.87%) reported by Oluwatosin and Solomon (2017). For the nitrogen free extract (NFE), the percentage ranged from 7.44% to 16.73% at control and $T_{25,}$ respectively. This is far lower than the percentages (34.99% to 36.82%) reported by Oluwatosin and Solomon (2017) given the fact that this research used the peels for the inclusion levels in the feed.

5 Conclusion and Recommendations

This study on the varying inclusion levels of ripe banana peel (*Musa sapientum*) as a possible replacement for soybean in the diet of *Clarias gariepinus* displayed slight improvement in the growth parameters of the fish especially at 75% level of inclusion in terms of weight, standard and total lengths among the treatments. However, the control diet still had a better growth performance than the other treatments.

The result of the proximate analysis showed variations among the proximate compositions of *Clarias gariepinus.* The highest crude protein, moisture and fat contents obtained in the control, 100%, 25% and 75%, respectively indicating the quality of the flesh of the fish at the end of a period of 12 weeks.

The outcome of this research has indicated that banana peel can be included up to 75% level of inclusion to replace soybean in fish meal production thereby reducing the cost of fish production incurred by the farmer. For optimal performance, the crude protein content should be improved upon by inclusion of other cheap protein sources.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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