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GROWTH OF AFRICAN CATFISH (*Clarias gariepinus*) JUVENILES FED GRADED LEVELS OF ROASTED RICE CHAFF AS ENERGY SOURCE

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ABSTRACT
The high cost of Maize as energy source in fish feed has necessitated the need to search for low cost and locally available indigenous sources. A seven months feeding trial was conducted to examine the effects of replacing maize with roasted rice chaff as on the growth of juveniles of *Clarias gariepinus* using Completely Randomized block Design with five different treatments. The fishes were subjected to five different inclusion levels of roasted rice chaff meal (0%, 25%, 50%, 75% and 100%). The feeding trial was conducted in 15 plastic bowls (50litres capacity each) and 25litres of water was maintained in each of the bowl. The fishes were randomly selected and stocked at 10 juveniles per plastic bowl. Feeding was done initially at 3% body weight, but the quantity of feeds was adjusted based on the new weight gain. The measurements of the fishes were carried out biweekly according to standard methods and procedures. The Roasted rice chaff meal (RRCM) contains 5.93% crude protein, 14.53% crude fibre, 0.92% moisture content, while Ash content, crude lipid and carbohydrates had 19.98%, 3.28% and 55.36% respectively. Fishes fed 100% RRCM recorded the highest growth performance in body weight (435.10 ± 20.60gm), total length (45.30 ± 0.70cm), Specific growth rate (1.44 ± 0.01), Feed Conversion Ratio (2.50 ± 0.04) and Feed Intake (92.00 ± 3.40). While the least growth was observed in 0% RRCM. However, all the physico-chemical parameters measured are within the recommended range for fish culture. Therefore, the result obtained shows that roasted rice chaff can replace maize as a source of energy in *Clarias gariepinus*.juveniles diets.

Keywords: Roasted, Rice chaff, *Clarias gariepinus*, Juveniles, Growth.

INTRODUCTION

The consumption and demand for fish as a cheap source of protein is on increase in Africa, because of level of poverty in the land (Chiokwe and Solomon, 2017). Nutritionally, fish is the cheapest and direct source of protein and micro nutrients for several millions of Africans (Bene and Heck, 2005). Nigerian freshwater bodies are richly endowed with many species of fishes and these fishes serve enormous socio-economic importance (Nneji *et al*., 2018). However, Intensive fish production and high cost of imported feed has resulted in price increase of the conventional fish resources especially the Protein and energy sources. Therefore, research on low-cost and locally available indigenous feed resources is fundamental (Dan-kishiya *et al*., 2013).

However, African catfish (*Clarias gariepinus)* is the most cultured fish in some of the developing countries such as Nigeria because of its ability to feed on almost anything, high reproductive rate, ability to withstand disease and harsh environmental conditions (Agbabiaka, 2010).The major problem hampering production of catfish in some of the African countries such as Nigeria is high cost of fish feed. For the purpose of nutritional and economic benefits, previous researchers have made attempts at increasing the use of nonconventional plant and animal materials to replace conventional feed ingredients like maize and fish meal in fish feed ration (Oluwatosin and Solomon, 2017, Agbabiaka, 2010, Dan-kishiya *et al*., 2013). A number of agricultural waste like plaintain peels (Oluwatosin and Solomon, 2017) and Kunnu waste (Onu *et al*., 2017), has been investigated for their potential in supplementing or even replacing maize as a source of energy in fish feed. According to Olurin *et al*. (2006), Maize is the major source of metabolisable energy in most compounded diets for catfish species. This is because it is readily available and digestible.

Rice chaff is an agricultural waste. It is the dry, scaly, protective casing of the seed of rice (Wishart, 2018). It is indigestible by humans, but livestock can eat it and in agriculture it is used as livestock fodder. Consequently, Rice chaff contains 2.9 – 3.6% crude protein, 0.8 – 1.2 ether extract, 39 – 42% crude fibre and 15 – 22% ash content (Oyenuga, 2011). However, plant ingredients seem to be high in fibre content, but biodegradation of these plant ingredients can reduce the quantity of fibre content. However, biodegradation of rice chaff can lead to improvements in the nutritional compositions (higher crude protein; less fibre) than the untreated ones (Belewu and Okhawere, 2008). Traditionally, rice chaff has been used as ingredients in ruminant and poultry feeds but the problem of low digestibility, high ash content and abrasive characteristics are limiting factors to \\its utilization (Wishart, 2018). Different processing method has been used in reducing the fibre contents in rice chaff. This includes, soaking in hot water, irradiation, heating, ensiling, fermentation and use of enzymes and antibiotics (Aderolu *et al*., 2007). Hence, the aim is to study the growth performance of African catfish (*C. gariepinus*) juveniles fed graded levels of roasted rice chaff as energy source.

MATERIALS AND METHODS

Study Area

This study was carried out in the Department of Biological Sciences Garden in University of Abuja permanent site which is 1200m from Giri junction along Gwagwalada-Airport road (figure 1). It has a population of approximately 50,000 people and is located between longitude 7º00′04″ E and 7º10′00″ E and latitude 9º00′00″N and 9º10′00″ N of Nigeria (Muhammed *et al*., 2015). There are two seasons (Dry and Wet seasons), the dry season starts in October and ends in March while the wet season starts in April and ends in September. The average annual temperature of the area ranges from 30 - 37ºC, with the highest temperature experienced in the month of February and a total rainfall of approximately 1650 mm per annum.

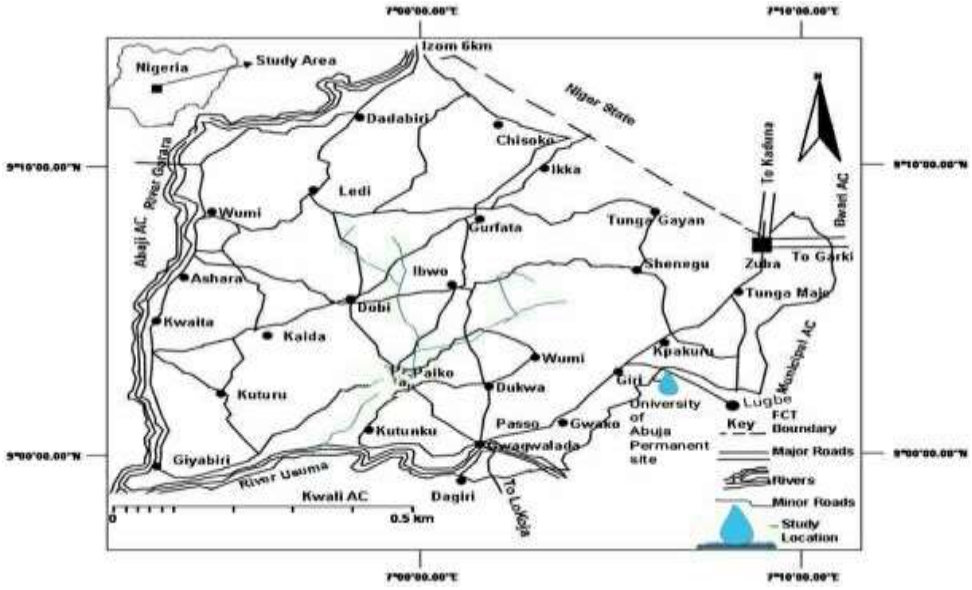

Fig 1. Map of Gwagwalada, FCT Abuja showing the study location (Muhammed *et al*., 2015)

Experimental Design

This research work was conducted for the period of 7 months (April to October 2019). The experimental design adopted was Completely Randomized block Design. There are five different treatments. The experimental set up consists of 15 plastic bowls of 50litres capacity each and 25 litres of water were maintained throughout in the whole bowls. Each of the treatment was triplicated in such a way that three (3) plastic bowls were allocated to each treatment.

Experimental fish

A total of 150 Juveniles of *Clarias gariepinus* was obtained from Green Farm enterprise, New Kutunku, FCT-Abuja. They were transported to the Department of Biological Sciences, University of Abuja, in a 50 litres plastic bowl. They were acclimatized for two (2) days and were fed with a commercial diet. At the end of acclimatization period, they were randomly selected and stocked at 10 juveniles per plastic bowl and were fed at 3% of their body weight (Agbabiaka, 2010). Before stocking the juveniles, they were starved for 24hrs in other to prepare their appetite for the new feed.

Collection and Processing of the ingredients

The Rice chaff were collected at Rice mill in Gwagwalada, FCT, Abuja and was roasted for 45 minutes at 80ºC using an electric oven (model: 340) and allowed to cool. They were crushed using mechanical grinder and stored in a container prior to proximate analysis. However, other ingredients used in formulating the diets were procured from Gwagwalada market.

Experimental diets and Feed Formulation.

The experimental diets with crude protein of 40% were formulated using Pearson square method as in Agbabiaka (2013). The maize meal was gradually replaced with Rice chaff at five different varying levels (0%, 25%, 50%, 75% and 100%). The appropriate quantities of the ingredients used were measured using weighing balance. They were thoroughly mixed until they became homogenous. The different diets were pelleted using 2mm pelleting machine and sundried for 24hours to ensure constant dry weight. They were stored in a container at room temperature prior to proximate analysis. The proximate

analysis was conducted following the methods of A.O.A.C (2012).

Measurement of Physico-Chemical Parameters.

Water quality parameters such as Temperature, pH, Conductivity and Dissolved Oxygen were measured in situ throughout the period of the research using automatic temperature-pH meter (Model: 51-new Japan), portable electronic conductivity meter (Model: LF90) and Dissolved oxygen meter (Model: HI 9142) respectively.

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Statistical analysis

Data obtained were expressed as Mean of the duplicate ± Standard Deviation. The data was further presented in Tables and Figures. The mean were also subjected to least significance difference test and was further analyzed using two-way Analysis of Variance (ANOVA) at 0.05% significant level. The mean were also subjected to Duncan Multiple range test.

RESULTS

Proximate composition of Raw and Roasted rice chaff.

The proximate composition of raw and roasted rice chaff is shown in Table 1. The raw rice chaff contains 6.77% crude protein, 35.29% crude fibre, 2.60% moisture content, while ash content, crude lipid, and carbohydrates had 19.04%, 6.71%, 29.59% respectively. However, roasted rice chaff was found to contain 5.93 % Crude protein, 14.53% crude fibre, 0.92% moisture content, while Ash content, crude lipid and carbohydrates had 19.98%, 3.28% and 55.36% respectively.

Compositions of the experimental diets.

The compositions of the different inclusion levels of the roasted rice chaff meal (RRCM) in the fish diets is shown in Table 2. The quantity of maize meal and roasted rice chaff varies across the treatments, in other words, as the quantity of maize meal decreases across the diets, the quantity of roasted rice chaff increases. However, other ingredients such as fishmeal, groundnut cake, premix and binder remain constant across the five different treatments.

Table 1: Proximate composition of Raw and Roasted rice chaff meal

Constituents	Raw rice chaff	Roasted rice chaff
Crude Protein	6.77%	5.93%
Crude fibre	35.29%	14.53%
Moisture content	2.60%	0.92%
Ash content	19.04%	19.98%
Crude lipid	6.71%	3.28%
Carbohydrates	29.59%	55.36
Total	100%	100%

Table 2; Percentage inclusion levels of ingredients used in the experimental diets.

Ingredients	**0% RRCM**	**25% RRCM**	**50% RRCM**	**75% RRCM**	**100% RRCM**
Maize meal	28.40	21.30	14.20	7.10	0.00
Roasted rice chaff	0.00	7.10	14.20	21.30	28.40
Fish meal	39.04	39.04	39.04	39.04	39.04
Groundnut cake	23.00	23.00	23.00	23.00	23.00
Premix	1.55	1.55	1.55	1.55	1.55
Binder	8.00	8.00	8.00	8.00	8.00
Total	100.00	100.00	100.00	100.00	100.00

RRCM = Roasted Rice Chaff Meal.

Growth Performances and Survival Rate

The growth performance and survival rates of juveniles of African catfish, *Clarias gariepinus* fed with different percentages of the experimental diets were shown in table 3. The highest mean weight gain was recorded in the fishes fed with 100% RRCM (435.10 ± 20.60g) followed by 75% (384.60 ± 23.50g) while the lowest mean weight gain was recorded in fish fed with 0% (252.30 ± 21.80g). There is significant difference ($P<0.05$) in the mean weight gain but, there is no significant difference ($P>0.05$) in mean final total length in all the juveniles fishes fed the experimental diets in all the treatments.

Table 3: Growth performance of *Clarias gariepinus* fed with different inclusion levels of Roasted rice chaff meal.

Parameters	0% RRCM	25% RRCM	50% RRCM	75% RRCM	100% RRCM
MIW (g)	10.10±2.40^{a}	10.40±1.50^{a}	9.50±1.20^{a}	9.90±0.40^{a}	9.60±0.50^{a}
MFW (g)	262.40±23.40^{a}	327.80±9.20^{bc}	352.80±0.90^{c}	394.50±23.50^{d}	444.70±20.60^{e}
MWG (g)	252.30±21.80^{a}	317.40±8.00^{bc}	343.30±1.20^{c}	384.60±23.50^{d}	435.10±20.60^{e}
MITL (cm)	10.70±0.30^{a}	11. 00±0.50^{a}	11.20±0.70^{a}	10.90±2.90^{a}	10.10±0.30^{a}
MFTL (cm)	38.00±0.60^{a}	40.70±1.10^{a}	41.00±1.20^{a}	42.60±1.20^{a}	45.30±0.70^{a}
MISL (cm)	9.30±0.30^{a}	9.80±0.20^{b}	10.10±0.70^{c}	9.70±0.50^{b}	9.00±0.30^{a}
MFSL (cm)	35.30±0.60^{a}	37.80±1.10^{ab}	38.30±1.10^{b}	39.80±1.10^{c}	42.20±0.80^{d}
SGR (%)	1.31±0.02^{a}	1.38±0.01^{b}	1.39±0.01^{b}	1.42±0.01^{c}	1.44±0.01^{c}
FCR (%)	3.60±0.50^{a}	3.50±0.30^{a}	3.30±0.60^{a}	2.70±0.10^{b}	2.50±0.04^{b}
PER	8.40±0.70^{a}	10.40±0.20^{b}	10.30±0.10^{b}	14.90±0.90^{c}	15.60±0.70^{d}
FI	38.40±6.30^{a}	49.70±3.70^{b}	57.10±10.60^{c}	78.70±7.10^{d}	92.00±3.40^{e}
SR(%)	70.00±9.40^{a}	76.70±30.90^{a}	73.30±8.60^{a}	100.00±0.00^{b}	100.00±0.00^{b}

Legend: MIW = Mean Initial Weight; MFW = Mean Final Weight; MWG = Mean Weight gain; MITL = Mean Initial Total Length; MFTL = Mean Final Total Length; MISL = Mean Initial Standard Length; MFSL = Mean Final Standard Length; PER = Protein Efficiency Ratio; FI = Feed Intake; SR = survival rate. (Mean values followed by same letter (s) within same row are not significantly different (P>0.05).

The highest specific growth rate was recorded among fishes fed with 100% RRCM (1.44 ± 0.01%), followed by 75% RRCM (1.42 ± 0.01%), While the lowest specific growth rate was recorded among fishes fed with 0% RRCM (1.31 ± 0.02%). There is no significant difference (P>0.05) between fishes fed control diets and other treatments but, there is significant difference (P<0.05) between fishes fed 25 and 50% as well as 75 and 100% respectively.

The best feed Conversion ratio (FCR) was recorded in fishes fed 100% RRCM (2.50 ± 0.04%), followed by 75% RRCM (2.70 ± 0.10%), while the lowest was recorded in 0% RRCM (3.60 ± 0.50%).There is no significant differences (p>0.05) between the fishes fed control diet with 25 and 50%. But there is significant difference (P<0.05) between fishes fed control diet and those that were fed 75 and 100%.

The highest PER was recorded in fishes fed with 100% RRCM (15.60 ± 0.70), followed by 75% RRCM (14.90 ± 0.90), while the least was recorded in fish fed with 0% RRCM (8.40 ± 0.70). There is significant difference (P<0.05) between fishes fed control diet with all the other treatments but, there is no significant difference between fishes fed 25 and 50%.

The highest total feed intake was recorded in the fishes fed with 100% RRCM (92.00 ± 3.40), then followed by 75% RRCM (78.70 ± 7.10), while the lowest feed intake was recorded in fishes fed diet containing 0% RRCM (38.40 ± 6.30). However, there is significant difference (P<0.05) in the fishes fed control and all the other diets.

The highest Survival rate was recorded in fishes fed with 100% RRCM (100.00±0.00%) and 75% RRCM (100.00±0.00%).

Physico-chemical Parameters of Water.

The mean monthly physico-chemical parameters of water are shown in table 4. The highest mean temperature was recorded in the month of April (27.90^{o}C), followed by the month of September (27.40^{o}C) while the least was recorded in the month of June (26.10^{o}C). The highest pH was observed in the months of May, July and August (6.70), followed by the months of April, June and September (6.60) while the least was recorded in October (6.50).

Table 4: Mean monthly Physico-Chemical parameters of water measured from April to October, 2019.

Month	Temperature (^{o}C)	Ph	Dissolved Oxygen (Mg/L)	Conductivity (ms/cm)
April	27.90 ± 0.10	6.60 ± 0.01	4.10 ± 0.10	82.40 ± 1.00
May	27.30 ± 1.00	6.70 ± 0.30	4.20 ± 0.10	81.40 ± 0.40
June	26.10 ± 0.20	6.60 ± 0.04	4.80 ± 0.01	81.60 ± 0.30
July	27.00 ± 0.08	6.70 ± 0.10	4.50 ± 0.20	81.20 ± 0.70
August	26.90 ± 0.80	6.70 ± 0.08	4.70 ± 0.09	81.70 ± 1.00
September	27.40 ± 0.20	6.60 ± 0.14	4.30 ± 0.40	80.90 ± 0.80
October	27.10 ± 0.80	6.50 ± 0.10	4.50 ± 0.10	81.30 ± 0.10

The highest Dissolved Oxygen was found in the month of June (4.80mg/l), followed by the months of August (4.70mg/l) while the lowest was found in the month of April (4.10mg/l). Also, the highest water Conductivity was observed in the month of June (82.10ms/cm), followed by the month of August (81.70ms/cm) while the lowest was recorded in the month of September (80.90ms/cm).

DISCUSSION

The result of proximate analysis conducted on raw and roasted rice chaff shows that the protein and fibre contents of raw is higher when compared to the roasted rice chaff. This might be due to the heating effect which might have reduced the protein and fibre contents of the roasted rice chaff. It shows that different processing methods will impact positively on the proximate composition of plant materials. This has been reported by other researchers (Iyayi and Aderolu, 2004; Aderolu and Oyedokun, 2008).

The growth and nutrient utilization increases as the quantity of roasted rice chaff meal increases across the five different treatments. The increased in weight was attributed to the processing method which has increase the carbohydrate and reduce fibre contents with an aroma that makes the feed palatable which increase feeding rates. Similar results were reported by other researchers (Ramachandran *et al*., 2005; Aderolu and Oyedokun, 2008).

Also in the present study, SGR, FCR, PER and FI were greatly improved at high inclusion levels of the RRCM. This was attributed to the reduction of fibre in the RRCM and palatability of the feed which might have resulted to nutrients utilization by the fish as also observed by other researchers (Onu *et al*., 2017; Ponigrahi and Powel, 2011; Mukhopadhyay and Ray, 2009; Aderolu and Oyedokun, 2008).

The high survival rate of fishes at high inclusion levels simply implies that roasted rice chaff meal does not pollute the water that may result to high mortality. Similar results was obtained by Aderolu and Oyedokun (2008) when they fed the juveniles of *C. gariepinus* with fermented rice husk and also by Onu *et al*. (2017) when they fed fingerlings of *C. gariepinus* with Kunnu waste.

However, all the physico-Chemical parameters measured in the present study are within the range for fish culture as reported by other researchers (Auta *et al.,* 2013; Dan-kishiya and Chiaha, 2012).

CONCLUSION

The result obtained from this study showed that roasting of rice chaff could lead to increase in carbohydrate, decrease in fibre and a good aromatic feed that is palatable to juveniles of catfishes. Thus, the study concludes that RRCM can efficiently replace maize as energy source at 100% inclusion level with an increase on growth, nutrients utilization and survival of the fishes.

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