Agrosearch (2014) Volume 14(1):54-61 http://dx.doi.org/10.4314/agrosh.v14i1.6

THE INFLUENCE OF REPLACING MAIZE WITH *CHRYSOPHYLLUM ALBIDUM* SEED MEAL ON GROWTH RESPONSE AND NUTRIENT UTILIZATION IN *CLARIAS GARIEPINUS*

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ABSTRACT

The study investigated the effect of replacing maize with *Chrysophylum albidum* seed meal on the growth performance and nutrient utilization in *Clarias gariepinus*. Five isonitrogenous diets containing maize which was replaced by *Chrysophylum albidum* at a rate of 0, 25, 50, 75 and 100% were formulated. Experimental diets were randomly assigned to the fish in tanks and each group of fish was fed 5% body weight in equal proportion per day. Significant variation ($P<0.05$) existed in weight gain, specific growth rate; feed conversion, and survival rate among the fish fed various dietary treatments. There was no significant difference ($P>0.05$) in all the aforementioned parameters between fish fed diet 75% and 100 *Chrysophylum albidum*. A decrease in growth and nutrient utilization parameters of fish fed various dietary treatments was observed as the level of *Chrysophyllum albidum* seed meal increased. Replacement of maize by *Chrysophyllum albidum* in the diets of *Clarias gariepinus* significantly reduce the growth and nutrient utilization by *Clarias gariepinus*

Keywords: *Chrysophyllum albidum, Clarias gariepinus,maize, fish feed ingredients and energy sources*

INTRODUCTION

Carbohydrates are the cheapest sources of dietary energy for fish and other livestock species (Shiau and Linn, 2001). Carbohydrates have the physical function of acting as a binder in the formulation of diets (Fagbenro *et al*., 2003). It is essential to ensure that adequate energy level is provided in fish diets so as to realize protein sparing effect and to ensure higher percentage of amino acids in protein being available for growth and other physiological function (Abu *et al.,* 2009). The digestibility of carbohydrates has been shown to vary with their complexity, treatment and levels of inclusion (Adeparusi and Jimoh, 2002). Maize is one of the major sources of metabolisable energy in most compounded diets for catfish as it is readily digestible by fish (Olurin *et al*., 2006). FAO (2005) reported that maize, which is predominantly used for human consumption in Nigeria, is not provided in sufficient quantities. The increasing prohibitive cost and scarcity of maize have necessitated the need to search for underutilized energy feed ingredients

Chrysophyllum albidum, from the sapotaceae family is commonly found in the Central, Eastern and Western parts of Africa (Adebayo *et al,* 2010; Amusa *et al*, 2003). It is widely distributed in Nigeria, Uganda, Niger, Cameroon and Cote d'ivoire (Adebayo *et al*, 2006) In Nigeria; it is known by several local names and is generally regarded as a plant with diverse ethno-medicinal uses (Amusa *et al* 2003). In south western Nigeria, the fruit is called "Agbalumo" and "Udara" in south–eastern Nigeria.

Work on the use of plant residues as energy feed ingredients in fish diets is well documented including; Coffee pulp (Fagbenro and Arowosoge, 1991a); plantain peel and yam peel (Fagbenro and Arowosoge, 1991b) Acha (Fagbenro *et al* 2001), sweet potato (Faturoti and Oyelese, 1989), sorghum (Ufodike and Ugwuzor, 1985). This work therefore seeks to study the growth response and nutrient utilization of *Clarias gariepinus* fed *Chrysophyllum albidum* as a replacement for maize.

MATERIALS AND METHODS

Seed Collection and Processing

Dried matured *Chrysophylum albidum* seeds were obtained from Bodija Market, Ibadan Oyo State. The seeds were boiled in water (100^{0}C) for 30 minutes. Thereafter, the seeds were grinded in a laboratory mill, mechanically defatted by the use of locally made screw press, sieved with a 200mm mesh size sieve, put in polythene bags and stored at 4^{0}C. The cake was analyzed for its proximate composition in accordance to the procedure of AOAC (1990). Fish meal, soybean meal and other feedstuffs obtained from commercial sources in Nigeria were separately milled and screened to fine particles size. Triplicate samples were analyzed for their proximate composition (AOAC, 1990). Based on the nutrient composition of the protein feed stuff (Table 1), a control diet and four test diets (40% crude Protein, 12% crude fat) were formulated. The control diet contained maize, which was replaced by cooked *Chrysophylum albidum* seed meal. The rate of substitution was 0, 25, 50, 75 and 100% coded as D1, D2, D3, D4 and D5 (Table 2).

Table 1: Proximate Composition of the Feed Ingredients

Parameter	Fish meal	Soybean Meal	CSM	Corn Meal
Moisture	9.75	10.70	9.10	10.48
Crude protein	72.4	45.74	10.95	9.87
Crude fat	10.45	9.68	2.94	4.28
Crude fibre	-	5.10	13.06	5.78
Ash	8.32	4.48	2.12	6.73
NFE	-	30.00	61.83	62.35

CSM- *Chrysophyllum albidum* Seedmeal

Table 2: Gross Composition of Experimental Diets (g/100g) containing *Chrysophyllum albidum* Seedmeal Fed to *Clarias gariepinus*

	D1	D2	D3	D4	D5
Fishmeal	52.78	52.78	52.78	52.78	52.78
Corn meal	20.00	15.00	10.00	5.00	-
CSM	-	4.56	9.13	13.69	18.25
***Vit/min premix**	5.00	5.00	5.00	5.00	5.00
Fish Oil	5.00	5.00	5.00	5.00	5.00
Starch	17.22	17.66	18.09	18.53	18.97
Total	100	100	100	100	100

CSM- *Chrysophyllum albidum* Seedmeal

** Specification: each kg contains: Vitamin A , 4,000,000IU; Vitamin B, 800,000IU; Vitamin E, 16,000mg, Vitamin K_3, 800mg; Vitamin B_1, 600mg; Vitamin B_2, 2,000mg; Vitamin B_6, 1,600mg, Vitamin B_{12},8mg; Niacin,16,000mg; Caplan, 4,000mg; Folic Acid, 400mg; Biotin, 40mg; Antioxidant 40,000mg; Chlorine chloride, 120,000mg; Manganese, 32,000mg; Iron 16,000mg; Zinc, 24,000mg; Copper 32,000mg; Iodine 320mg; Cobalt,120mg; Selenium, 800mg manufactured by DSM Nutritional products Europe Limited, Basle, Switzerland.*

Culture Condition

Clarias gariepinus fingerlings of mean weight (4.4±1.3) were acclimated to experimental condition for 7 days prior to the feeding trial. Groups of 15 catfish fingerlings were stocked into aquaria comprising 60 litre-capacity rectangular plastic tanks. Each diet was fed to the catfish in triplicate tanks twice daily (09.00h, 16.00h) at 5% body weight for 56 days. Fish mortality was monitored daily, total fish weight in each tank was determined at two weeks intervals and the amount of diet was adjusted according to the new weight. Growth response and feed utilization indices were estimated following the method of Jimoh and Aroyehun (2011) as:

Mean weight gain= final mean weight –initial mean weight

Percentage weight gain= [final weight-initial weight_/initial weight] X 100

Specific growth rate= [In final weight-In initial weight] X 100

Feed conversion ratio=dry weight of feed fed /Weight gain (g)

Protein efficiency ratio=fish body weight (g)/ Protein fed

Net protein utilization= [protein gain/protein fed] X 100

Percentage survival = {(total number of fish- mortality)/total number of fish] X 100

Water temperature and dissolved oxygen were measured using a combined digital YSI dissolved oxygen meter (YSI Model 57, Yellow Spring Ohio); pH was monitored weekly using pH meter (Mettler Toledo – 320, Jenway UK). Eight catfish and 6 catfish per treatment were respectively sacrificed at the beginning and end of the feeding trial respectively and analyzed for their carcass composition (AOAC, 1990).

Statistical Analysis

Data obtained from the experiment were expressed in mean ± SD and it was subjected to one way Analysis of Variance (ANOVA) using SPSS 16.0 version. Where the ANOVA reveals significant difference (P<0.05) Duncan multiple range test was used to compare differences among individual treatment means.

RESULTS

Proximate composition of the experimental diets

Table 3 shows the proximate composition of the experimental diets. There was no significant difference (p > 0.05) in the crude protein and crude lipid content of the diet. All the fish responded well to the dietary treatment given to them.

Table 3: The proximate composition of experimental diets containing *Chrysophyllum albidum* seed meal fed to *Clarias gariepinus*

Parameter	D1	D2	D3	D4	D5
Moisture	9.24±0.11	9.20±0.03	9.16±0.13	9.12±0.10	9.23±0.06
Crude Protein	40.23±0.05	40.20±0.08	40.25±0.15	40.23±0.06	40.20±0.12
CrudeLipid	12.17±0.09	12.20±0.05	12.15±0.12	12.16±0.08	12.20±0.13
Crude Fibre	4.59±0.45	4.15±0.11	4.16±0.10	4.16±0.05	4.13±0.05
Ash	4.48±0.06	4.60±0.45	4.50±0.32	4.33±0.40	4.37±0.31
NFE	29.29±0.31	29.71±0.51	29.80±0.50	29.10±0.40	29.93±0.30

Carcass composition

Table 4 shows the carcass composition of *Clarias gariepinus* fed diet containing *Chrysophyllum albidum* seed meal. The carcass protein of fish used at the beginning of the experiment was significantly different (P<0.05) from the carcass protein of fish fed the different dietary treatments. At the end of the experiment, fish fed diet 2 had the highest carcass protein which is not significantly different (P>0.05) from the fish fed diet 1 and fish fed diet 3. Fish fed diet 1 had the highest crude lipid, while the fish fed diet 5 had the lowest crude lipid. There was no significantly difference (P>0.05) in the carcass lipid of fish fed diet 1 and fish diet 2. The highest carcass ash was recorded in fish fed diet 2 while the fish fed diet 4 had the lowest ash content. These existed no significant variation (P>0.05) in the ash content of fish fed varies dietary treatments.

Table 4: Carcass compositions of *Clarias gariepinus* fed diets containing *Chrysophyllum albidum* seed meal

	Initial	D1	D2	D3	D4	D5
Moisture	77.66±0.06^{a}	75.22 ± 0.0^{c}	74.79±1.74^{c}	76.03±0.23^{bc}	76.73±0.10^{ab}	76.73±0.1^{ab}
Crude protein	15.20±0.01^{c}	17.46±0.04^{ab}	17.94±0.18^{a}	16.79±0.02^{ab}	16.19±0.02^{bc}	16.17±0.02^{bc}
Crude lipid	3.11± 0.02^{de}	3.21±0.02^{a}	3.18±0.01^{ab}	3.15±0.02^{bc}	3.13±0.02^{cd}	3.09±0.02^{e}
Ash	4.04±0.03	4.11±0.01	4.09±0.02	4.02±0.23	3.95±0.14	4.00±0.14

a, b, c, d means having different superscripts along the same row are significantly different (P< 0.05)

Growth and Nutrient Utilization

Table 5 shows the growth and nutrient utilization of *Clarias gariepinus* fed diets containing *Chrysophyllum albidum* seed meal. There was no significant difference (P>0.05) between initial weights of the fish used for the experiments. However, significant variation (P<0.05) existed in weight gain, percentage weight gain, specific growth rate, feed conversation ratio, survival among the fish fed various dietary treatments. There was no significant difference (P>0.05) in all these parameters between fish fed diet D4 and diet D5. A decrease in growth and nutrient utilization parameters of fish fed various dietary treatments was observed as the level of *Chrysophyllum albidum* seed meal increased.

Table 5: Growth and nutrient utilization of *Clarias gariepinus* fed diets containing *Chrysophyllum albidum* seed meal

	D1	D2	D3	D4	D5
Initial Weight	4.41± 0.24	4.24 ± 0.19	4.37 ± 0.30	4.45 ± 0.43	4.4 ± 0.43
Final Weight	28.11±0.21[a]	12.24±0.06[b]	9.20±0.02[c]	6.54 ± 0.08[d]	6.39 ± 0.02[d]
[1]**MWG**	23.71±0.37[a]	8.00±0.20[b]	4.83±0.32[c]	2.09 ± 0.51[d]	1.95 ± 0.42[d]
[2]**PWG**	539.31±36.5[a]	188.94±13.4[b]	111.21±14.92[c]	48.15±17.06[d]	44.82±14.50[d]
[3]**SGR**	3.31±0.01[a]	2.48±0.01[b]	2.193±0.01[c]	1.85 ± 0.02[d]	1.83 ± 0.00[e]
[4]**FCR**	1.16±0.06[d]	1.39±0.03[c]	1.43±0.02[bc]	1.46 ± 0.03[ab]	1.50 ± 0.04[a]
[5]**PER**	2.15±0.11[a]	1.80±0.04[b]	1.75±0.03[bc]	1.71±0.04[bc]	1.66±0.05[c]
[6]**NPU**	20.64±0.96[a]	61.17±33.1[b]	58.01±4.47[b]	83.67±17.78[b]	85.33±16.33[b]
[7] **% Survival**	91.10±10.18	75.55±30.78	86.87±17.65	86.67±17.78	86.67±13.33

a, b, c, d e means having different superscripts along the same row are significantly different (P< 0.05)

DISCUSSION

Adverse effect on the growth of *Clarias gariepinus* fed *Chrysophyllum albidum* based diets recorded in this study was also reported for fish fed coffee pulp (Baynet *et al.,* 1976; Fagbenro and Arowosoge, 1991). The present study showed a significant decrease in the growth parameters of fish fed test diets when compared to that of fish fed control diets. Similar trends of results were reported by Lawal *et al* (2011) who fed *Clarias gariepinus* with ripe and unripe banana based diets replacing maize.

Possible explanation to this result could be attributed to the reduced feed in-take by *Clarias gariepinus* with increasing inclusion of test feed ingredients; an indication of poor palatability of the feed ingredients (Glencross *et al*., 2007). Domingues *et al*. (2003) reported that one of the difficulties observed when alternative sources of feedstuffs are used in fish diets is its acceptance. High fibre contents of the diet and its anti-nuitritional factor could lead to poor palatability hence reduced feed intake by *Clarias gariepinus* fed *Chrysophyllum albidum* based diets. Aderolu and Oyedokun (2009) reported that high fibre in diets limits the rate of digestion and nutrient absorption. It was also reported that high fibre in diets could result in increased weight of excreta and reduced nutrient absorption (Keembiyeethy and Desilva, 1993). More so Adeparusi and Jimoh (2002) reported the digestibility of carbohydrates to vary with their complexity treatment and levels of inclusion. *Clarias gariepinus* is known to have poor handling of high fibre in its diets.

Furthermore Akaneme (2008) reported that tannins, flavonoids, terpenoids and resin are the known antinutrients present in *Chrysophyllum albidum.* The lowered growth performance of fish fed *Chrysophyllum albidum* based diets when compared to that of fish fed control diets could be attributed to the presence of these anti nutritional factors. Same observation was made by Fagbenro and Arowosoge, (1991) and Moreau *et al.,* (2003); Lawal *et al* (2011); Orire and

Abubakr (2011). Francis *et al* (2001) better explains this phenomenon by saying that fish have compensatory mechanism in their body system that can absorb the negative effect of anti-nutrients when the quantity is below certain threshold levels. Contrary to this, Faturoti and Oyelese (1989) found sweet potato as good energy source in the *Clarias gariepinus*. Similarly Aderolu *et al* (2011) fed biscuit waste as a replacer of maize to *Clarias gariepinus* and recorded a good result.

The presence of tannins and some other polyphenols in fish feed reduces total protein digestibility, inhibits the activity of various enzymes system including amylase and possibly lipases (Oluwalana, 2007). Tannins like other polyphenols are known to interfere with certain essential biochemical processes which may impair apparent carbohydrates utilization (Waghorn, 1990). This explains why at higher level of inclusion of test ingredients, poorer growth and nutrient utilization were recorded by *Clarias gariepinus.*

CONCLUSION AND RECOMMENDATION

In conclusion, the replacement of maize by *Chrysophyllum albidum* in the diets of *Clarias gariepinus* significantly reduced the growth and nutrient utilization by *Clarias gariepinus.* It is recommended that other processing techniques should be employed in removing the antinutrients in *Chrysophyllum albidum* so that its nutritional potentials can be exploited.

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