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Nutritional value of Hydrothermally processed *Citrullus lanatus* seeds in the Diet of *Clarias gariepinus*

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Abstract This study was designed to investigate the nutritive value of hydrothermally processed watermelon seed (*Citrulus lanatus*) meals in the diet of *Clarias gariepinus*. Five diets of 35% crude protein containing watermelon hydrothermally processed for 0,10,20,30 and 40 minutes were formulated and fed to the experimental fish at 5% of their body weight for 56 days. The results obtained revealed that growth increased as the time of processing prolonged, it is concluded that hydrothermal processing of *Citrulus lanatus* for up to 40 minutes improve digestibility of the feed in the diet of *Clarias gariepinus*.
Keywords *Clarias gariepinus*; Digestibility; Antinutritional factor; Unconventional feed; Water melon

Introduction

Fish like any other organism; require nutrients for growth, development, reproduction and maintenance (Ejidike, 2004). Ingredients used for fish diets are chosen based on cost of nutrient content, availability and acceptability to fish (Eyo, 1997). Feed accounts for the highest proportion of the operational input in fish culture. Current researches in animal nutrition are focused on the use of alternative cheaper energy resources that could replaced cereals and supply the required nutrients in adequate amount (Adejumo, 2005). This is because the rising cost of some feed ingredients such as fish meal seems to hinder the economic relevance of fish culture.

Watermelon (*Citrullus lanatus*) is a creeping annual cash crop which belongs to the family Curcurbitaceae. It grows successfully in the tropics and in the subtropics (Mohr, 1989). Watermelon seed is rich in minerals, protein, vitamins, carbohydrate and fibre (Tarek and khaled, 2001; Alkhalifa 1996). The seed cake is the byproduct of the extracted seeds and used as a protein supplement for livestock. The experience with watermelon seed cake or meal in rations for animals, showed that watermelon seed cake is a good source of digestible protein, which is comparable to other oil seed cakes like cottonseed, linseed etc (Sen, 1985). The wider use of this legume has been limited by the presence of anti-nutritional factors like trypan inhibitors, tannins and cyanide (Tuleun, Patrick and Tiamiyu, 2009). Tiamiyu, Okomoda and Agbese. (2015) had reported that inclusion of raw *Citrullus lanatus* should not be more than 16.28 in the diet of *Clarias gariepinus* because beyond this point growth performance significantly reduce. Like most legumes, the anti-nutritional factors in watermelon seed could be removed or reduced by using the processing techniques such as soaking, toasting or roasting prior to inclusion into the fish feed (Tuleun, Solomon and Sham, 2007), however optimum time for processing needs to be determine as overheating denatures protein content of the feed stuff. This study was therefore design to determine the growth response of *Clarias gariepinus* fingerlings fed hydrothermally processed watermelon seeds

1 Materials and Method

The study was conducted at the research farm of the departmental of Fisheries and Aquaculture, University of Agriculture Makurdi, Benue State, Nigeria. Two hundred fingerlings of *Clarias gariepinus* were obtained from a homogeneous source and acclimatized for two weeks before distribution into various hapas. Three kilograms (3kg) of watermelon seeds were obtained from the environs of Makurdi, soybean meal, yellow maize meal, fishmeal, vitamin and mineral premises were obtained from the modern market makurdi, Soybeans were toasted to remove antinutritional factor in the feed, milled and stored at room temperature. Iso-nitrogenous diet of 35% crude protein were formulated with Fishmeal included at 25.72, Maize meal at 27.07, Soybeans meal at 25.72, vitamin/mineral premises at 1, salt at 0.50 while watermelon seed meal at 20.00. The five diets formulated were included with hydrothermally processed watermelon seed meal at 0, 10, 20, 30 and 40 minutes respectively at a constant temperature of 65^{0}C. All ingredients were sieved and weighed, mixed uniformly and mixed with hot water at 60℃ with continuously stirring until a dough was formed. The diets so formed were pelletized using a pelleting machine in the hatchery of the department of Fisheries and Aquaculture, using a 2mm die and then sun-dried. The diets were packaged, rapped and stored for use. Fish were hand-fed twice a day (08:00am and 06:00pm) at a rate of 5% of their body weight per day. The fingerlings were weighed weekly to determine weight gain after which feed were adjusted accordingly. The experiment lasted for eight weeks (56 days). Proximate composition of diet and carcass were determined according to the procedure described by AOAC (2000). Data collected were subjected to analysis of variance (ANOVA), where significant differences are observed between treatments ($P<0.05$), Fishers least significant difference were used to separate the mean.

2 Results and Discussion

Watermelon seeds are one among the underutilized fruit by-products (FAO STAT, 2009) despite their nutritive component. The proximate composition of the experimental diets of this study revealed that all the diets met the targeted crude protein requirement for *Clarias gariepinus*. Abowei and Ekubo. (2011) had reported that high ash content of feed reduces digestibility of other ingredients in the diets hence resulting in poor growth fish. Despite the higher levels of ash in the diets than what were observed in the control, the growth of the experimental fish was instead significantly better; this is likely due to the heat treatment given at different time interval for the diets. This treatment according to Bell, Erushe and Peterson. (1980) renders feedstuff more palatable and digestible, destroying bacteria and anti-nutritional factor in the feed. Udensi, Ekwu and Isinguzo. (2007) had reported that boiling cowpea seeds in water for 15 to 45 min reduced antinutritional factors. Similarly, Wang, Hatcher and Gawalko, (2009) reported that hydrothermally treatments (boiling and soaking) resulted in reductions of antinutritional factors in flours made from different lentil varieties. Reduction observed in fibre may be as a result of shrinkage making it softer and loosed.

This study observed that mean weight gain of the experimental fish increased with increasing hydrothermal processing duration (Table 1-3). This agrees with the report of Kaankula (1998) who reported that the nutritive value of legume seeds is improved when subjected to heating. This finding is similar to that report by Ejidike and Ajileye (2007) that diets formulated for *Clarias gariepinus* using thermally processed breadfruits seed meal has great potential in providing adequate nutritional feeds and at a reduced cost. Tuleun and Igba (2008), also reported that toasting alone recorded significantly improvement on the efficiency of feed utilization compared to the raw watermelon diet when fed chicken. However Tamminga, Egan and Chritensen, (2004) had stated that boiling of protein supplement may results in decreased animal’s performance for reasons of protein destruction. Ullah, (1982) also reported that heat treatment will affect the nutritional value of legumes through destruction or inactivation of present factors as well as some impairment in the protein value, because over heating may result in damaging the protein quality by lowering digestibility (denaturation) and causing the loss of sulphur amino acids. This study however as shown that boiling *Citrullus lantanus* up to 40 minute is not lethal to protein of water melon seed nor feed utilization of *Clarias gariepinus* feed diet with inclusion levels of this diet, as growth was far better and survival rate in all the treatments, still remain at 100 %. Furthermore EL Adawy and Taha (2001) had reported that watermelon seeds are rich in nutrients that promote growth and health hence might have been the reason for good nutrient utilization and survival rate attained in this study.

In addition the present study revealed that the proximate analysis of the carcass fish fed the experimental diets were affected in terms of crude protein and fat content by the hydrothermally processed watermelon seed meal. Both the crude protein and lipid content of the fish carcass increase as hydrothermal processing time increased and were higher

Table 1 Proximate composition of the experimental diets containing hydrothermally processed watermelon seeds

Parameters	DT1	DT2	DT3	DT4	DT5	P-Value
Moisture	7.87 + 0.01[a]	5.95 + 0.01[e]	6.19 + 0.01[d]	6.52 + 0.01[c]	6.69 + 0.02[b]	0.001
Protein	35.69 + 0.01	35.81 + 0.01	35.48 + 0.01	35.59 + 0.02	35.71 + 0.01	0.134
Fat	5.74 + 0.00[a]	4.84 + 0.01[d]	5.72 + 0.01[a]	5.81 + 0.01[b]	5.18 + 0.01[c]	0.001
Fibre	7.72 + 0.01[a]	6.96 + 0.01[b]	6.14 + 0.00[d]	6.07 + 0.02[e]	6.25 + 0.01[c]	0.001
Ash	8.16 + 0.01[d]	9.68 + 0.01[b]	8.81 + 0.01[c]	10.89 + 0.01[a]	9.65 + 0.01[b]	0.001
NFE	34.82 + 0.01[d]	36.76 + 0.02[b]	37.66 + 0.00[a]	35.12 + 0.02[c]	36.52 + 0.02[b]	0.001

Note: Mean values in the same column with different superscripts differ significantly (P<0.05)

Table 2 Growth performance and nutrient utilization of *Clarias gariepinus* fed hydrothermally processed watermelon seed meal

Parameters	DT1	DT2	DT3	DT4	DT5	P-Value
MIW(g)	3.51 + 0.00	3.51 + 0.01	3.52 + 0.01	3.52 + 0.01	3.52 + 0.01	0.123
MFW(g)	7.44 + 0.02[e]	7.56 + 0.01[d]	7.89 + 0.01[c]	7.99 + 0.01[b]	8.07 + 0.01[a]	0.001
MWG(g)	3.93 + 0.02[e]	4.05 + 0.02[d]	4.37 + 0.02[c]	4.47 + 0.01[b]	4.55 + 0.00[a]	0.001
Growth rate	0.072 + 0.00[d]	0.072 + 0.00[d]	0.078 + 0.00[c]	0.079 + 0.00[b]	0.081 + 0.00[a]	0.001
SGR	1.34 + 0.01[e]	1.37 + 0.01[d]	1.44 + 0.01[c]	1.46 + 0.01[b]	1.48 + 0.01[a]	0.001
Feed Fed	17.45 + 0.03[e]	17.92 + 0.02[d]	18.53 + 0.02[c]	18.78 + 0.02[b]	18.93 + 0.02[a]	0.001
FCR	4.44 + 0.01[a]	4.43 + 0.01[a]	4.24 + 0.02[b]	4.19 + 0.01[c]	4.16 + 0.04[d]	0.001
FCE	22.54 + 0.06[d]	22.58 + 0.07[c]	23.59 + 0.09[c]	23.81 + 0.06[b]	24.03 + 0.03[a]	0.001
PER	0.112 + 0.01[e]	0.116 + 0.01[d]	0.125 + 0.01[c]	0.128 + 0.00[b]	0.130 + 0.00[a]	0.001
ANPU	11.91 + 0.09[e]	13.87 + 0.04[d]	19.89 + 0.06[c]	20.70 + 0.02[b]	24.79 + 0.10[a]	0.001
%SURVIVAL	100.00 ±0.00	100.00 ±0.00	100.00 ±0.00	100.00 ±0.00	100.00 ±0.00	0.123

Note: Mean in the same column with different superscripts differ significantly (P<0.05)

Table 3 The proximate composition of carcass of *Clarias gariepinus* fingerlings fed thermally processed watermelon seed meal

Parameters	Initial	DT1	DT2	DT3	DT4	DT5	0.001
Moisture	71.22 + 0.02[a]	61.12 + 0.02[e]	68.71 + 0.01[b]	62.31 + 0.01[d]	63.13 + 0.03[c]	61.13 + 0.03[e]	0.001
Protein	9.43 + 0.03[f]	13.63 + 0.03[e]	14.32 + 0.02[d]	16.42 + 0.02[c]	16.71 + 0.01[b]	18.14 + 0.04[a]	0.001
Fat	5.01 + 0.01[f]	5.42 + 0.02[e]	5.62 + 0.03[d]	7.45 + 0.05[c]	7.63 + 0.03[b]	9.71 + 0.01[a]	0.001
Fibre	2.01 + 0.01[e]	2.41 + 0.01[b]	2.12 + 0.02[d]	2.21 + 0.01[c]	2.14 + 0.01[d]	2.71 + 0.01[a]	0.001
Ash	2.67 + 0.02[b]	2.71 + 0.01[a]	2.03 + 0.03[e]	2.23 + 0.03[c]	2.12 + 0.03[d]	2.71 + 0.03[a]	0.001
NFE	9.66 + 0.06[b]	10.51 + 0.06[a]	7.40 + 0.00[e]	9.38 + 0.04[c]	8.27 + 0.04[d]	5.60 + 0.08[f]	0.001

Note: Mean in the same column with different superscripts differ significantly (P<0.05)

than the control diet. This is an indication of protein addition and true growth involving an increase in the structural tissues such as muscles (Fafioye, Fagade, Adebisi, Jenyo and Omoyinmi, 2005). Reinitz and Hitzel (1980) reported that the type of feed ingested and their nutritional quality is known to be one of the main factors affecting fish carcass composition. Increase in lipid observed in this study is in line with the reports of Chou and Shiau (1996); Ahmadi (2004) and Pei, Xie, Lei, Zhu and Yang. (2004). The differences in lipids is at variance with the study of Izquierdo, Obach, Arantzamedi, Mentorol, Robaina and Rosenwind, (2003), who however reported that lipid deposition in either liver or muscle of Seabass or Seabream did not differ significantly using the experimental diet. Also according to El- Marakby (2006) no change in total lipid and ash content was observed in fish fed different oil sources. This study has demonstrated that 40minute hydrothermal treatment of watermelon seed meal increase digestibility in the diet of *Clarias gariepinus* (Figure 1).

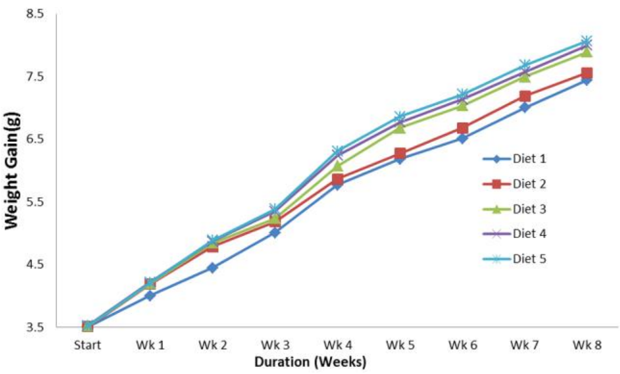

Figure 1 Weekly weight gain of *Clarias gariepinus* fed thermally processed watermelon meal diets for 8weeks

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