Journal of Animal and Veterinary Advances 4 (6): 557-559, 2005

Evaluation of Roasted and Boiled Cotton Seed Meals in the Feeding of Clariid Catfish *Clarias gariepinus* Fingerlings

O.O. Fapohunda
Department of Forestry, Fisheries and Wildlife, Faculty of Agriculture, University of Ado, Ado-Ekiti, Nigeria

Abstract: The use of roasted or boiled cottonseed meal in the diets of *Clarias gariepinus* fingerlings were evaluated. Seven isoproteic and isocaloric diets were formulated to provide 40% crude protein in which fish meal in the reference diet was partially replaced by the following processed cottonseed meals; 30, 35 and 40% roasted and 30, 35 and 40% boiled cottonseed meals, respectively. Fish were fed to satiation in triplicate treatments for 56 days in plastic circular tanks. Nutrient composition analysis showed that processing methods of roasting and boiling influenced the nutrient density of cottonseed meal, with crude protein levels ranging between 41.00 and 34.60% for roasted and boiled cottonseed meal respectively. The result showed that growth performance and nutrient utilization of fish fed roasted cottonseed meal dietary inclusions (70% fish meal + 30% roasted cottonseed meal) was similar to fish fed the fish meal-based diet at 5% level of significance. However, fish fed the diet containing boiled cottonseed meal exhibited lower daily weight gain, protein efficiency ratio and specific growth rate. Generally, fish performed better when fed diets containing roasted cottonseed meals than boiled cottonseed meals and compared favourably with fish fed the fish meal-based diet.

Key words: Cottonseed meals, Roasted, Boiled, Fingerlings

Introduction

Cottonseed meal is an important source of dietary protein for domestic animals with a cost advantage over the conventional animal protein sources used in aquaculture feed production. The level of inclusion in fish diets depends mainly on the anti-nutritional content (gossypol) of the cottonseed meal. Low gossypol cottonseed meal (0.03%) was reported to be a good protein source for *O. mossambicus* (Jackson *et al*., 1982). It is therefore necessary to add the appropriate proportion of this important plant protein i.e. cottonseed meal either alone or mixed with other ingredients to avoid toxicity.

Clarias gariepinus belongs to the family Clariidae and is the second most important group of farmed fish in the world (FAO, 1983). In Africa, *C. gariepinus* is of great economic importance and an esteemed fish food with a higher dressing percentage and consumer preference than most cultured fish species in freshwater (Balogun and Fasakin, 1996). However, the provision of adequate, cheap and nutritive feed has hindered the development and profitability of catfish farming especially in developing countries (Olomola, 1990).

This study aimed at evaluating the nutrient density of processed cottonseed meals (roasted and boiled) and the effects when these are partially substituted for fishmeal in practical diets on growth performance, nutrient utilization and survival of *C. gariepinus* fingerlings.

Materials and Methods

Preparation of Cottonseed Meals: Raw cottonseeds were purchased from Divine Mills, Akure, Nigeria. The cottonseeds were separated into two equal batches. One batch was boiled at 60-90^0 C for 30 min and then sun-dried at ambient temperature for two weeks. The second batch was roasted. The practical feedstuffs were separated, milled, screened to fine particle size (<250µm) and triplicate samples were analysed for proximate composition (moisture, crude protein, crude lipid, crude fibre, total ash) according to AOAC (1990). Crude protein was determined using Kjeltec Auto 1030 Analyser after digestion with concentrated H_2SO_4 in a digester. Crude lipid was estimated by extracting in Chloroform: methanol (2:1) using a Soxtec extraction HT6 unit. Crude fibre was determined using a fibretec system 1020 Hot Extractor and ash content was determined by igniting at 550°C in a muffle furnace for 12 h. The nutrient composition of the feedstuffs is presented in Table 1.

Diet Formulation: Based on the nutrient composition of the feedstuffs (Table 1), seven isoproteic and isocaloric diets were formulated as presented in Table 2 and all diets satisfied the macronutrient requirements of *C. gariepinus*. A control diet (Diet 1) contained 100% fishmeal and six test feedstuff diets contained boiled cottonseed meal or roasted cottonseed meal as partial replacement for fishmeal in the control diet (Table 2) providing 30, 35 and 40% of total protein. Lipid content of all diets was adjusted with vegetable oil while gelatinized cornstarch was supplemented to adjust gross energy content. Carboxymethyl cellulose was added at 10 g kg^{-1} as a non-nutritive

binder. All the feedstuffs were blended in a Hobart A120 food processor and the resultant mash was moistened and pressed without steam through a 3-mm die. The resulting strands were oven-dried at 45°C for 24 h, broken into pellet lengths of 1cm and stored in airtight plastic containers at ambient temperature (25°C). Water stability of pellets was determined in triplicate samples (Wood, 1987).

Experimental Fish and Systems: Hatchery bred fingerlings of *C. gariepinus* 4.02±0.01g were procured from the Agriculture Development Project (ADP), Akure, Nigeria and randomly allotted to 15 plastic circular tanks (50-litre capacity) at 20 fingerlings per tank. The fish were acclimated to experimental conditions in the tanks for seven days and starved for 24 h prior to the feeding trial. Water from a borehole was passed through a circulatory filtration system before entering the experimental tanks. Water quality analysis followed the methods outlined by APHA (1980). Water temperature and dissolved oxygen were measured daily using a combined digital YSI dissolved oxygen meter (YSI Model 57 YSFI; Yellow Springs, Ohio); pH was monitored weekly using a pH meter (Metler Toledo-320, Jenway, UK). Each diet was fed to *C. gariepinus* fingerlings in triplicate tanks per treatment to apparent satiation twice daily (0.900 and 16.00 h) for 56 days. Fish mortality was monitored daily. Individual fish in each tank was weighed at the start and every 14 days to monitor growth and feed utilization using the appropriate indices (Steffens, 1989).
All data obtained were subjected to one-way ANOVA test ($P<0.05$). When ANOVA revealed significant differences, Duncan's multiple-range test (Zar, 1996) was applied to characterize and quantify the differences between treatments using Statgraphics 5 Plus package for Windows (Manugistics Inc. and Statistical Graphics Corp, Maryland, US).

Results and Discussion

Data for proximate composition of cottonseed meals subjected to different processing methods are shown in Table 1. Crude protein content of cottonseed meals ranged between 34.60% and 41.00% in boiled and roasted cottonseed meals respectively. The result showed that boiled cottonseed meals had lower dietary protein when compared with the roasted cottonseed meal. The inactivation of gossypol content present in cottonseed by direct heat certainly increased protein availability.

Table 1: Proximate Composition (%) of Feedstuffs

	Fish meal	Maize	Roasted cottonseed	Boiled cottonseed
Crude Protein	64.69	9.13	41.00	34.60
Crude Lipid	13.10	2.70	12.07	11.32
Crude fibre	0.00	2.42	19.72	22.30
Ash	4.34	3.61	3.52	3.04
Moisture	6.60	7.24	6.15	7.51
NFE	11.27	74.90	17.54	21.23

Table 2: Ingredient Composition of the Experimental Diets Test feedstuff Diets

	Control	Boiled cottonseed			Roasted cottonseed		
	Diet I	Diet II	Diet III	Diet IV	Diet V	Diet VI	Diet VII
Fish meal	57.0	26.0	36.9	42.0	26.0	36.9	42.0
Cottonseed meal	-	20.5	18.1	18.0	20.5	18.1	18.0
Maize	33.0	43.5	35.0	30.0	43.5	35.0	30.0
Vit-premix	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Bone meal	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Veg. Oil	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Carboxymethyl cellulose	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Starch	3.0	3.0	3.0	3.0	3.0	3.0	3.0

Diet I: 100% fish meal (menhaden)
Diet II: 70% fish meal + 30% boiled cottonseed meal
Diet III: 65% fish meal + 35% boiled cottonseed meal
Diet IV: 60% fish meal + 40% boiled cottonseed meal
Diet V: 70% fish meal + 30% roasted cottonseed meal
Diet VI: 65% fish meal + 35% roasted cottonseed meal
Diet VII: 60% fish meal + 40% roasted cottonseed meal

Table 3: Growth and nutrient utilization of *C. gariepinus* fingerlings fed on processed cottonseed meal dietary inclusion for 56 days

Dietary Treatments Parameters	Diet I	Diet II	Diet III	Diet IV	Diet V	Diet VI	Diet VII
Initial mean weight (g)	4.02^{b}	3.93^{ab}	4.09^{b}	4.04^{b}	3.88^{a}	4.07^{b}	3.97^{ab}
Final mean weight (g)	11.70^{c}	9.40^{a}	9.75^{ab}	10.15^{b}	10.46^{b}	10.40^{b}	10.09^{ab}
Mean weight gain (g)	7.68^{c}	5.47^{a}	5.66^{a}	6.11^{ab}	6.58^{bc}	6.33^{b}	6.12$_{ab}$
Body weight increase (g)	291.04^{c}	239.19^{a}	238.39^{a}	251.24^{ab}	269.59^{b}	255.53^{ab}	254.16^{ab}
Total feed intake (g)	3.91^{b}	2.28^{a}	2.76^{a}	2.92^{ab}	3.66^{b}	3.56^{b}	3.24^{ab}
Protein intake	0.29^{c}	0.22^{a}	0.21^{a}	0.25^{b}	0.28^{c}	0.27b^{c}	0.26^{b}
Protein effic-iency ratio	1.70^{c}	1.32^{ab}	1.26^{a}	1.20^{a}	1.68^{b}	1.67^{b}	1.66^{b}
Specific growth rate	0.83^{c}	0.68^{a}	0.67^{a}	0.71^{ab}	0.77b^{c}	0.73^{b}	0.72^{b}
Feed gain ratio	2.25^{a}	3.52^{b}	2.66^{d}	2.60^{c}	2.31^{a}	2.40^{b}	2.58^{bc}
Survival %	98.00^{bc}	96.00^{b}	99.00^{bc}	92.00^{a}	95.00^{b}	100.00^{c}	96.00^{b}

Growth performance and nutrient utilization of fish fed on processed cottonseed meal dietary inclusion are summarized in Table 3. The responses of fish to the different diets show that growth and nutrient utilization were significantly ($P \leq 0.05$) influenced by the processing methods.

Fish fed diets containing boiled cottonseed meals were associated with lower body weight increase, total feed intake, protein efficiency ratio and specific growth rate and were significantly different ($P \leq 0.05$) from the control diet.

The fish performance indices in this study show that differences existed in the protein quality of the processed cottonseed meals. This is evidenced in the proximate composition of the major protein sources in the experimental diets (Table 1). From Table 3, it could be seen that the best growth response was obtained in *C. gariepinus* fingerlings fed the control diet (Diet I). *C. gariepinus* fingerlings fed with diets V, VI, VII gave comparative response to Diet I, although lower. This conformed to the work of Ofojekwu and Ejike (1984) and Robinson *et al.* (1984) which reported lower growth rates and feed efficiency in *O. niloticus* and *O. aureus* fed cottonseed cake and cottonseed meal-based diets. However, good performance of fish fed diets containing roasted cottonseed meal may be due to improved processing technique of roasting as against boiling to remove antinutrients, which probably influenced nutrient availability, palatability and utilization of the meals.

The results of the body weight increase, total feed intake, protein efficiency ratio and specific growth rate attest to the superior quality of roasted cottonseed meals in the fish diets. *C. gariepinus* fingerlings became accustomed to the diets within the first week.

Survival was high (>90%) in all diet treatments (Table 3) and morphological defects were not seen in all *C. gariepinus* fingerlings. The results of this study demonstrate that roasted cottonseed meals can replace fishmeal when incorporated as a sole plant protein source in nutritionally balanced diets for *C. gariepinus* fingerlings without compromising growth and fish health. The reduction in growth performance of fish fed boiled cottonseed meals appeared to result from other factors such as palatability, protein digestibility and quality of amino acids available for protein synthesis. These factors are possible research areas for effective utilization of boiled cottonseed meals in fish feed formulation.

References

AOAC, 1990. Official Method of Analysis, 15th edn. Association of Official Analytical Chemists, Arlington, VA.

American Public Health Association (APHA), 1980. Standard methods for the examination of water and wastewater. 15th Edn. APHA, American Water Works Association and Water Pollution Control Federation, Washington, DC., Pp: 1134.

Balogun A. M. And E.A. Fasakin, 1996. Flesh yield and aspects of chemical composition of flesh of some commercially important freshwater fish species in Nigeria. J. Agric. Technol., 4: 33-40.

FAO, 1983. Fish Feeds and Feeding in Developing Countries- An Interim Report on the ADCP Feed Development Programme. United Nation Development Programme, FAO, Rome.

Jackson, A.I., A.J. Matty and B.S. Capper, 1982. Evaluation of some plant protein in complete diets for the Tilapia *Sarotherodon mossambicus*. Aquaculture 27: 97-109.

Robinson, E.H., R.P. Wilson and W.E. Poe, 1984. Growth and feed conversion of catfish fed cottonseed meal as the sole plant protein source. Aquaculture, 66: 291-299.

Ofojekwu, P.C. and C. Ejike, 1984. Growth response and feed utilization in the tropical cichlid *Oreochromis niloticus* (Linn.) fed on cottonseed-based diets. Aquaculture, 42: 27-36.

Wood, J.F., 1987. The functional properties of feed raw materials and their effect on the production and quality of feed pellets. Animal Feed Sci., Technol., 18: 1-17.

Zar, J.H., 1996. Biostatistical analysis 3rd Edn, Prentice-Hall, Upper Saddle River, NJ, pp: 662.