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FULL PAPER TAM MAKALE

GROWTH PERFORMANCE OF *CLARIAS GARIEPINUS* FINGERLINGS FED *Citrullus lanatus* SEED MEAL AS A REPLACEMENT FOR SOYBEAN MEAL

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Abstract:

This study was designed to evaluate the growth performance of *Clarias gariepinus* fingerlings fed watermelon seed meal as substitute for soybean meal. Five diets of 35% crude protein were formulated with watermelon seed meal replacing soybeans at 25% (DT_2), 50% (DT_3), 75% (DT_4), 100% (DT_5) and control diet 0% (DT_1) had no inclusion of Watermelon seed meal. Twenty fingerlings were randomly allocated in replicate for each treatment in outdoor hapas and fed 5% body weight throughout the study period of 8weeks with weekly weight measurement and appropriate feed adjustment. The mean weight gain, specific growth rate, protein efficiency ratio were highest in DT_2 (5.05g, 0.019 and 0.96 respectively) while lower values were recorded in DT_5 (3.31g, 0.014, 0.80 respectively). Superiority of protein in soybean as well as anti-nutritional factor present in the raw watermelon seed meal and high fiber contents of diet are envisaged as reasons for better performance of diet with no or lesser water melon meal inclusion, hence it inclusion should be limited to 16% for better growth performance of *Clarias gariepinus*.

Keywords:

Proximate composition, Unconventional feed, Water melon

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Introduction

Aquaculture production is becoming more and more intensive; this is because production from capture fisheries has reached its maximum possible potential, as the catch is dwindling with each passing day (Gabriel et al., 2007). Jamiu and Ayinla (2003) had stated that feed management determines the viability of aquaculture as it accounts for at least 60 percent of the cost of fish production (Akinrotimi *et.al.,* 2007), therefore the establishment of economically viable fish-culture ventures requires the incorporation of agricultural wastes or by-products as feed ingredients or direct feed (Shang and Costa-Pierce 1983) to replace conventional feed stuffs whose dwindling supply has resulted into arbitrary hike in prices. Conventional ingredients used in fish feed are in high demand for human consumption and their yield are currently being affected by climate change, hence out of concern for and the implications for food security as well as water and land use, there is urgent need to get local materials especially agricultural by-products of lower price to replace these costly feed materials.

Agricultural by-products in the tropics are as abundant as there are wide arrays of plants and fruits. Today, more emphasis is been placed on substitution possibility of some of these by-products whose nutritive values have been ascertained. By-products of banana (Ogunsipe et al., 2010; Ekwe et al., 2011) and cashew (Edet et al., 2010; Omosulis et al., 2011) had already been successfully tested in animal husbandry, Cocoa pod husk meal has been shown to replace maize in the diet of cichlid, *O. niloticus* and catfish *Clarias isheriensis* (Fagbenro, 1992). Likewise, plantain peel meal has been shown to replace up to 25% of maize in the diet of *C. gariepinus* without adversely affecting the growth (Falaye and Oloruntuyi, 1998). These are locally available and are not consumed by man in most cases (Ibiyo and Olowosegun, 2004).

Watermelon (*Citrullus lanatus*) seed meal is one of such agricultural by-product whose nutritive potential has not been effectively taped in animal nutrition. Watermelon a creeping annual cash crop which belongs to the family Curcurbitaceae. It grows successfully in the tropics and sub tropics (Mohr, 1989). Watermelon seed is rich in minerals, protein, vitamins, carbohydrate and fibre (Duke and Ayensu, 1985, Tarek and khaled, 2001). Watermelon seeds are rich in oil and protein (Mustafa et al., 1972 and Alkhalifa, 1996). Watermelon seed oil proved to be good source of high quality edible oil characterized by low free fatty acid content (Mustafa et al., 1972). The experience with watermelon seed cake or meal in rations for animals, showed that it is a good source of digestible protein comparable to other oil seed cakes like cottonseed, linseed etc (Sen, 1985) hence can be safely incorporated in animal feeds (Sastry et al; 1972). 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 water melon seed meal for soybeans meal in the diets of *C. gariepinus* fingerlings.

Materials and Methods

The fingerlings of *Clarias gariepinus* for this study were obtained from the research farm of the Fisheries Department, University of Agriculture Makurdi. The experiment which lasted for 56days was carried out also in an earthen pond at the departmental research farm. Hapas made from nets measuring 1x1x1 were mounted on a kuralon rope and set across the pond surface and properly staked to the dyke of the pond using bamboo sticks. Stones were attached to the four bottom corners of the hapas to serve as sinkers. This enables the bottom surface of the hapas to spread uniformly and to extend properly. The extension made easy inflow and outflow of water through each hapa and were immersed in the pond water half way to enable ease of access.

The feed ingredients used in the feed formulation which includes Fish meal, Soybean meal, Maize meal, Vitamin and Mineral premixes were purchased from the Makurdi Modern market, they were then processes and grinded into meal for storage. Water melon seeds were procured from an open market in Gombe State. The feed ingredients were processed and milled according to method described by Tiamiyu et al. (2014),

35% crude protein control diet was formulated using Pearson square method, the other experimental diet were formulated by simply substituting watermelon seed meal for soybeans meal at 0% (DT1), 25% (DT2), 50% (DT3), 75% (DT4), and 100% (DT5) substitution levels (Table 1). The diets so formed were pelletized using a pelleting machine after weighing appropriately and thorough mixing of the ingredients.

Fifteen *Clarias gariepinus* fingerlings were evenly distributed in each of the hapa. The daily feeding was done by hand at 5% of the cumulative body weight of each hapa. Daily ration was divided into two feedings per day (08:00 and 16:00) and the fingerlings were weight weekly so as to adjust the feed by virtue of weight gained. A Tefal electronic digital scale was used to measure weights of fingerlings per week till the end of the experiment (8 weeks), growth performance were estimated as stated below.

(a) Mean Weight Gain (MWG) = Mean final weight – Mean initial weight

(b) Feed conversion ratio (FCR) = $\frac{\text{dry feed intake}}{\text{wet weight gain}}$

(c) Specific Growth Rate (%/day) = $\frac{\log_e(wt_2) - \log_e(wt_1)}{t_2 - t_1}$

Where Wt_1= Initial weight gain

Wt_2= Final weight gain

T_2-T_1= Duration (in days) considered between Wt_2 and Wt_1

(d) Protein efficiency ratio = $\frac{\text{wet weight gain}}{\text{protein fed}}$

Where Protein fed = $\frac{\%\text{protein in diet} \times \text{total diet consumed}}{100}$

(e) % survival rate = $\frac{\text{total number of fish} - \text{mortality}}{\text{total number of fish}} \times 100$

Table 1. Gross composition of experimental diets for *Clarias gariepinus* fed processed watermelon seed meal

	DT1(100:0)	DT2(75:25)	DT3(50:50)	DT4(25:75)	DT5(0:100)
Fish meal	10.00	10.00	10.00	10.00	10.00
Soybean meal	65.10	48.83	32.55	16.28	0
Watermelon seed	0	16.28	32.55	48.83	65.10
Maize	11.70	11.70	11.70	11.70	11.70
Rice bran	11.70	11.70	11.70	11.70	11.70
Min/Vit premix	1.00	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50	0.50
Total	100	100	100	100	100
			Proximate composition of diet		
Moisture	8.52 ± 0.01^{b}	8.33 ± 0.00^{d}	8.37 ± 0.00^{c}	8.69 ± 0.01^{a}	8.39 ± 0.02^{c}
Protein	35.37 ± 0.00	35.14 ± 0.01	35.75 ± 0.01	34.69 ± 0.01	34.73 ± 0.01
Lipid	7.15 ± 0.00^{c}	8.30 ± 0.01^{b}	8.62 ± 0.02^{a}	8.64 ± 0.01^{a}	8.39 ± 0.02^{b}
Ash	8.19 ± 0.02^{b}	7.14 ± 0.01^{e}	7.52 ± 0.01^{d}	7.92 ± 0.01^{c}	8.28 ± 0.01^{a}
Fibre	$4.\ 19 \pm 0.01^{e}$	4.41 ± 0.01^{d}	5.26 ± 0.01^{a}	5.20 ± 0.01^{b}	5.10 ± 0.01^{c}
NFE	36.17 ± 0.03^{c}	36.68 ± 0.01^{a}	34.48 ± 0.03^{b}	34.86 ± 0.00^{e}	35.11 ± 0.02^{d}

Mean in the same row with different superscripts differ significantly ($P < 0.005$)

KEYS:

DT 1 – 100% soybean meal: 0% water melon seed

DT 2 – 75% soybean meal: 25% water melon seed

DT 3 – 50% soybean meal: 50% water melon seed

DT 4 – 25% soybean meal: 75% water melon seed

DT 5 – 0% soybean meal: 100% water melon seed

Proximate compositions of water melon seed meal, diets formulated, initial and final carcass of fish were determined according to standard methods by AOAC (2000). However Nitrogen free extracts in samples were determined by difference. The analyses were conducted in triplicate and all reagents were of analytical grade.

The data obtained from the study were analyzed using Gen stat® discovery edition 4 and Minitab® 14, descriptive statistics were done and mean gotten were subjected to analysis of variance, where significant differences were obtained (P<0.05), means were separated using Duncan's least significant difference (LSD).

Results and Discussion

Although no weight loss were recorded in the present study compared to the weight at initial, observation on growth and nutrient utilization reveals that growth significantly reduced as watermelon is increased in the diet. However since there was no significant differences in the protein content of the diet, differences in performance of experimental fish may be linked to superiority of protein quality of soybeans which reduced as level of replacement increase, Characteristic feed utilization efficiencies and consequent growth rates has earlier been reported and attributed to dietary protein quality by Cho et al. (1974), Sotolu & Faturoti, (2008), however, antinutritional factor in raw watermelon seed may also be implicated as possible cause of significant reduction in growth. Borchardt et al. (2008) had earlier stated that watermelon seeds posses chemical compounds such as alkaloids, lectins and phenolic compounds such as lactones, tannins and flavonoids which probably function in the protection of seeds from microbial degradation until conditions are favourable for germination (Cai et al., 2004; Komutarin et al., 2004), hence may have lead to prevention of digestion in the gut of the fish. Tuleun et al. (2007) had stated that the wide use of legume as feedstuff alternatives have limited by the presence of antinutritional factor like trypsin inhibitors tannins and cyanide. Fakunle *et al* (2013) had also reported that that toxic component or anti-nutritional factors in most agricultural by-products may cause irritation of digestive tract which is capable of decreasing feed intake and growth. Hence inclusion beyond the tolerable level of the fish lead to adverse growth consequences. Many other authors have similarly reported varied replacement level of about 50 % (Babatunde et al. 2001, Falaye et al. 1999), 60% (Olubamiwa et al. 2000) and 100% (Tiamiyu et al 2014) of waste and by-products with conventional once. It can be correctly inferred then that replacement of convention feeds by alternate sources of plant and animal origin, depends on the nature and composition of the unconventional feedstuffs, inclusion levels, anti-nutritional factor of feed ingredients, method of processing and the tolerance levels of the experimental fish species

Inverse relationship have been established between growth and crude fibre content of diets. Falaye et al (1999) reported a lower digestibility coefficient with increased cocoa husk in the diets and linked observations to elevated crude fibre resulting from the complex polysaccharides of the husk. More so, Fagbenro (1992) associated the digestibility in *C. Isheriensis* fed cocoa husk rations with cellulose activity in the fish gut. Gatlin (2010) indicated that cellulose and other fibrous carbohydrate are found in the structural component of plant and are indigestible to monogastric animals including fish. Oladunjoye et al. (2005) furthermore stated that high fibre content could be responsible for growth depression. Similarly, Lovel and Leary (1990) pointed out that increasing fibre content beyond the basal level could cause reduce growth of fish owing to poor digestion of cellulose. Hence, this is likely to be responsible for the poor growth performance of fish fed inclusions beyond 16% watermelon seed meal (25% replacement) containing high crude fibre. However the result of the present study show that *Clarias gariepinus* cannot tolerate inclusion levels beyond 16% and fiber content beyond 5% as negate the recommendations of Sawaya et al. (1986) who stated that watermelon seed should not be included at levels higher than 20%, because these levels brings up the fiber content of the ration over 10%, which reduce feed intake. Despite the significant effect observed in growth, survival of the fish fed the different diet were not affected, Basavarajah and Anthony (1997) had reported a survival rate of 98% for common carp fry fed conventional feed and 100% for fry fed supplementary feed for a 35 days feeding trial. Similarly Singh and Dhawan (1996) pointed out that 100% survival rate of carp can be achieved under very minimal stress and well fed condition, survival likely depend strongly on tolerance level of different fish species to the nature and level of anti-nutritional factor in the feedstuff. Carcass composition of the fish fed the experimental diets were higher in values than the those recorded in the start of the study, protein retention was higher for the control and Diet 2 suggesting that the protein to energy ratio used in the feed was at the right level and as a result, there was no sparing of protein for energy. The lipid content increase in this study is likely due to the fact that both soybeans and watermelon seeds oil seeds (Mustafa et al., 1972), Abbas (2007) and Manjappa *et al,* (2011) had opined that better nutrients utilization in fish carcass fed high lipids diets is related to both the dietary protein level and availability of non-protein energy sources.

Table 2. Growth performance and nutrient utilization of *clarias gariepinus* fed watermelon seed as a replacement for soybean meal.

	DT_1	**DT_2**	**DT_3**	**DT_4**	**DT_5**
MIW	2.75± 0.00	2.75± 0.00	2.75± 0.00	2.75± 0.00	2.75± 0.00
MFW	7.32 ± 0.04^{b}	7.80 ± 0.06^{a}	7.48 ± 0.05^{b}	6.47 ± 0.10^{c}	6.06 ± 0.02^{d}
MWG	4.57 ± 0.04^{b}	5.05 ± 0.06^{a}	4.73 ± 0.05^{b}	3.72 ± 0.10^{c}	3.31 ± 0.02^{d}
SGR	0.017 ± 0.00^{b}	0.019 ± 0.00^{a}	0.018 ± 0.00^{b}	0.015 ± 0.00^{c}	0.014 ± 0.00^{d}
FCR	2.68 ± 0.01^{b}	2.65 ± 0.03^{b}	2.77 ± 0.02^{b}	3.19 ± 0.11^{a}	3.36 ± 0.01^{a}
PER	0.95 ± 0.00^{a}	0.96 ± 0.01^{a}	0.92 ± 0.01^{a}	0.84 ± 0.03^{b}	0.80 ± 0.00^{b}
ANPU	0.47 ± 0.00^{b}	0.50 ± 0.00^{a}	0.32 ± 0.00^{c}	0.28 ± 0.00^{d}	0.17 ± 0.00^{e}
% survival	100.00 ± 0.00	100.00 ± 0.00	100.00 ± 0.00	100.00 ± 0.00	100.00 ± 0.00

Mean in the same row with different superscript differ significantly ($P< 0.05$)

KEYS:
MIW: Mean initial weight **MFW:** Mean final weight **MWG:** Mean weight gain
SGR: Specific growth rate **FCR:** Feed conversion ratio **PER:** Protein efficiency ratio
ANPU: Apparent net protein utilization

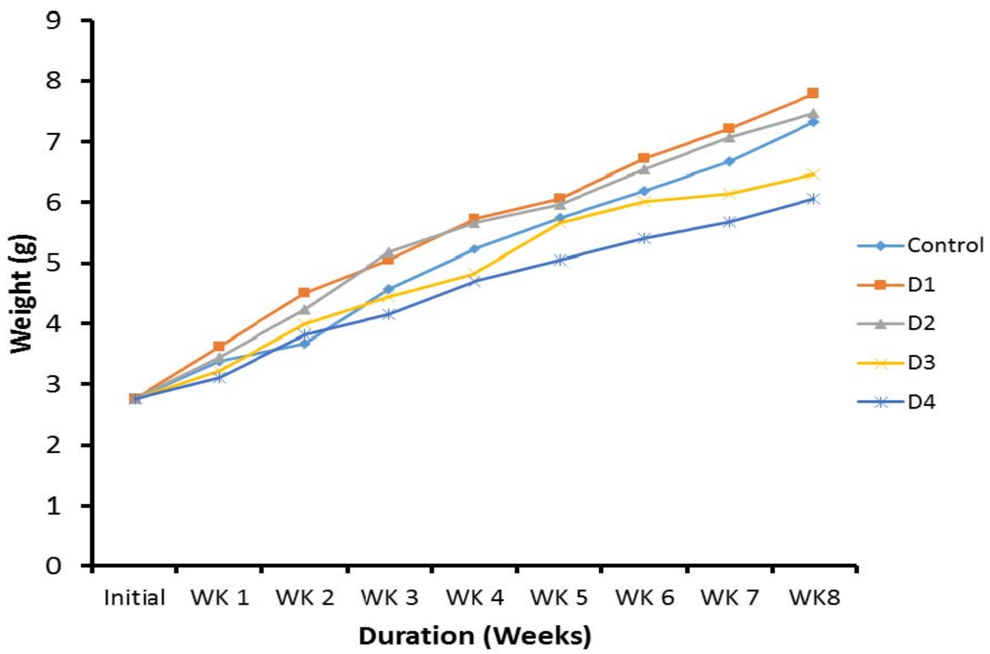

Figure 1. Weekly growth performance of *clarias gariepinus* fed the experimental diets

Table 3. Proximate composition of carcass of *clarias gariepinus* fingerlings fed the experimental diets

	Initial	DT_1 (control)	DT_2	DT_3	DT_4	DT_5
Moisture	55.13 ± 0.01^{f}	65.12 ± 0.01^{b}	65.27 ± 0.01^{a}	64.98 ± 0.01^{c}	64.22 ± 0.01^{c}	64.69 ± 0.01^{d}
Protein	12.44 ± 0.03^{e}	14.71 ± 0.03^{d}	15.41 ± 0.04^{a}	15.09 ± 0.03^{b}	14.69 ± 0.04^{c}	14.45 ± 0.01^{e}
Lipid	5.22 ± 0.00^{f}	7.20 ± 0.01^{c}	7.66 ± 0.01^{a}	6.55 ± 0.03^{e}	7.14 ± 0.02^{d}	7.54 ± 0.04^{b}
Ash	1.89 ± 0.04^{c}	2.00 ± 0.00^{b}	2.02 ± 0.02^{b}	1.79 ± 0.05^{d}	2.14 ± 0.01^{a}	2.00 ± 0.00^{b}
Fibre	1.63 ± 0.01^{d}	1.87 ± 0.04^{c}	2.00 ± 0.02^{b}	1.60 ± 0.07^{d}	2.10 ± 0.01^{a}	2.01 ± 0.01^{b}
NFE	23.69 ± 0.01^{a}	9.10 ± 0.04^{f}	7.64 ± 0.02^{d}	9.99 ± 0.07^{b}	9.71 ± 0.01^{c}	9.31 ± 0.01^{e}

Means in the same Column with different superscripts differ significantly ($p<0.05$)

Conclusions

In conclusion the Superiority of protein in soybean as well as anti-nutritional factor present in the raw watermelon seed meal and high fiber contents of diet are envisaged as reasons for better performance of diet with no or lesser water melon meal inclusion, It is therefore recommended that inclusion of raw watermelon should be limited to 16% for better growth performance of *Clarias gariepinus*. Further studies should be done to evaluate the nutritive potentials of processed water melon seeds in the diet of fish.

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