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Growth Performance of Heteroclarias Hybrid Fingerlings Fed Watermelon Seed Meal as a Replacement for Soybean Meal

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Abstract: The growth performance of heteroclarias hybrid fingerlings was studied using watermelon seed meal as substitute for soybean meal. The 4 different diets were formulated with watermelon seed meal replacing soybeans at 25% (X_2), 50% (X_3) and 100% (X_4) with (X_1) as the control (0%) at 35% crude protein inclusion. The 25 fingerlings were randomly distributed in replicate for each treatment in transparent plastic tanks and fed 5% body weight throughout the study period of 10 weeks with weekly weight measurement and proper feed adjustment. The mean weight gain, specific growth rate, protein efficiency ratio were highest in X_2 (10.41, 0.017 and 2.76 g, respectively) while lower values were recorded in X_4 (5.91, 0.012 and 2.08 g, respectively). Dominance of protein in soybean as well as anti nutrxitional factor present in the raw watermelon seed meal and high fiber contents of diet are seen as reasons for better performance of diet with lesser watermelon meal inclusion. Therefore, its inclusion should be limited to 20% for better growth performance of heteroclarias hybrid.

Key words: Heteroclarias, hybrid, growth performance, seed meal, fiber contents, protein

INTRODUCTION

The demand for fish is on the increase as a result of the increasing world population, higher living standards and the overall image of fish among consumers (Cahu *et al*., 2004). Fish is rich in protein and can be a major cure for malnutrition, especially in developing countries (Ashraf *et al*., 2011). Aquaculture practice is becoming more demanding, this is because production from capture fisheries is diminishing with each passing day (Gabriel *et al*., 2007). Jamu and Ayinla (2003) observed that feed management influence the viability of aquaculture as it accounts for at least 60% of the cost of fish production (Gabriel *et al*., 2007), therefore, the establishment of economically viable aquaculture production 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 increase in prices.

The basis to abundant fish production is availability of cheap and balanced feed. Aquaculture technology has changed the drive toward higher yield and fast growth which involves the enhancement or replacement of natural foods with prepared diets. Feed is the largest single cost item for livestock including fish production accounting for 60-80% of the total cost (Aduku, 1993). This has been attributed to the competition that exists between man and animal for available feed resources and the growing livestock production (Robinson and Singh, 2001). This has greatly reduced profit margin and placed a great limitation on the rate of expansion of the livestock industry including fish production in most of these industries (Oladunjoye *et al*., 2005). One of the best methods of alleviating this problem is the use of lesser known and unconventional feed ingredients. Conventional ingredients used in fish feed are in high demand for human consumption, hence, there is urgent need to get local materials, especially agricultural by-products of lower price to replace these costly and competitive feed materials. Non-Conventional Feed Resources (NCFRs) are non-competitive in terms of human consumption, very cheap to get, readily available in large quantities and may constitute nuisance as waste. The search for suitable NCFRs had focused on agricultural by-products of agro-processing industries. Several of these by-products available in Africa have been evaluated for their performance in poultry and livestock feed. However, only a few have been evaluated in fish nutrition.

To mitigate the effect of higher feed cost in fish culture, aqua culturists have always sought to replace fish meal and fresh oil components of the diet. Fish meal, known to be the most expensive component of the diet is usually replaced at least partially with other cheaper animal protein source. Other plant protein sources which have not been traditionally used in feeds are being assessed for the suitability in fish feed formulation. When

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suitable ingredients are found that have little value as nutrient sources for food, their cost will be less and this will enhance the profitability of the aquaculture enterprises (Ochang, 2008).

Watermelon seed meal is an agricultural by-product whose nutritive value has not been effectively harnessed. It is a creeping annual cash crop belonging to the family Curcurbitaceae. It grows successfully in the tropics and sub tropics (Mohr, 1986). Watermelon seed is rich in minerals, protein, vitamins, carbohydrate and fibre (Duke and Ayensu, 1985; El-Adawy and Taha, 2001) as well as oil (Mustafa *et al.,* 1972; Al-Khalifa, 1996). The seed oil has proven to be a good source of high quality edible oil with 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., hence, it can be safely incorporated in animal feeds.

In view of the increasing demand for fish and the high cost of conventional feed ingredients it is therefore, important to consider the replacement value of soybeans meal with watermelon seed meal in the diets of heteroclarias fingerlings.

MATERIALS AND METHODS

The fingerlings of heteroclarias hybrid for this study were obtained from the Hatchery Unit of Fisheries Department, Delta State Polytechnic, Ozoro. The experiment which lasted for 70 days was carried out also in the departmental hatchery unit using plastic tanks.

The feed ingredients used in the feed formulation which includes fish meal, soybean meal, maize meal, vitamin and mineral premixes were purchased from Ozoro market, processed and grinded into meal for storage. Watermelon seeds were procured from an open market in Ozoro as well. 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% (X_1), 25% (X_2), 50% (X_3) and 100% (X_4) substitution levels (Table 1).

The diets formulated were pelletized using a pelleting machine after weighing appropriately and thorough mixing of the ingredients. The 25 heteroclarias hybrid fingerlings were evenly distributed in each of the plastic tanks. The daily feeding was done by hand at 5% of the cumulative body weight of each tank. Daily ration was divided into 2 feedings per day (8 am and 4 pm) and the

Table 1: Composition of experimental diet

Feed ingredient	X_1 (0%)	X_2 (25%)	X_3 (50%)	X_4 (100%)
Watermelon seed meal	0	15.20	28.15	56.30
Soya bean meal	56.30	41.10	28.15	0
Fish meal	30.30	30.30	30.30	30.30
Maize	10.40	10.40	10.40	10.40
Vitamin and mineral premix	0.50	0.50	0.50	0.50
Vegetable oil	0.30	0.30	0.30	0.30
Methionine	1.00	1.00	1.00	1.00
Lysine	0.50	0.50	0.50	0.50
Salt	0.20	0.20	0.20	0.20
Starch	0.50	0.50	0.50	0.50
Total	100	100	100	100

fingerlings were weighed weekly in order to adjust the feed using weight gained. An electronic digital scale was used to measure weights of fingerlings per week till the end of the experiment (10 weeks), growth performance were estimated as stated:

$$\text{Mean Weight Gain}(\text{MWG}) = \text{Mean final weight and intial mean weight}$$

$$\text{Feed Conversion Ratio}(\text{FCR}) = \frac{\text{Dry feed intake}}{\text{Wet weight gained}}$$

$$\text{Specific growth rate}(\%/\text{day}) = \frac{\log_{e(wt_2)} - \log_{e(wt_1)}}{t_2 - t_1}$$

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

$$\text{Protein efficiency ratio} = \text{Wet weight gain/Protein fed}$$

Where:

$$\text{Protein fed} = \%\,\text{Protein in diet} \times \text{total diet consumed} / 100$$

$$\%\text{Survival rate} = \text{Total number of fish-Mortality/Total number of fish} \times 100$$

Proximate compositions of watermelon 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

Growth performance of heteroclarias hybrid fed watermelon seed meal is shown in Table 2 and 3. The highest mean weight gain was observed in fingerlings fed 25% inclusion of watermelon seed meal. There was significant difference in the final weight of all the experimental diet. Specific growth rate was also highest in X_2 (25%) with a record of 0.017 while the lowest record was in X_4 (100%). Specific growth rate was significantly different in all the treatments. Food conversion ratio ranged between 1.86 and 2.63 with X_4 having the highest food conversion ratio and X_2 having the lowest value. Protein efficiency ratio ranged from 2.08-2.76 and the highest was at 25% inclusion level. There was an observed significant difference between the control diet and the other treatments.

Observation of growth and nutrient utilization shows that growth significantly reduced as watermelon meal is increased in the diet. However, since, there was no significant differences in the protein content of the diet (Table 2), the difference observed in the performance of the experimental fish may be connected to superiority of protein quality of soybeans which reduced as the level of replacement increased. Characteristic feed utilization efficiencies and the resultant growth rates has earlier been reported and attributed to dietary protein quality by Cho Sotolu and Faturoti (2008), however, reported that anti-nutritional factor in raw watermelon seed may also be the cause of significant reduction in growth. Watermelon seeds possess chemical compounds such as alkaloids, lectins and phenolic compounds such as lactones, tannins and flavonoids which function in the protection of seeds from microbial degradation until conditions are favourable for germination (Cai *et al.,* 2004; Komutarin *et al.,* 2004) which may have led to poor digestion in the gut of the fish. Tuleun *et al.* (2009) had stated that the wide use of legume as feedstuff alternatives have been limited by the presence of anti-nutritional factor like trypsin inhibitors tannins and cyanide. Fakunle *et al.* (2013) had also reported that the toxic component or anti-nutritional factors in most agricultural by-products may cause irritation of digestive tract capable of decreasing feed in-take and growth. Hence, inclusion beyond the tolerable level of the fish leads to adverse growth consequences. Many other researcher have similarly reported varied replacement level of about 50% (Babatunde *et al.*, 2001; Falaye *et al.*, 1998, 1999), 60 and 100% (Tiamiyu *et al.*, 2014) of waste and by-products with conventional feedstuff. 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 relationships have been established between growth and crude fibre content of diets. Falaye *et al.* (1998, 1999) reported a slower 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) further stated that high fibre content could be responsible for retarded growth. Similarly, Lovel and Leary (1990) pointed out that increasing fibre content beyond the basal level could cause reduce growth of fish as a result of poor digestion of cellulose. This is likely responsible for the poor growth performance of fish fed inclusions beyond 25% watermelon seed meal (X_2) containing high crude fibre. However, the result of the present study shows that heteroclarias hybrid cannot tolerate inclusion levels beyond 25% and fiber content beyond 5% (Fig. 1).

Table 2: Proxmate composition of diet

Variable	X_1 (0%)	X_2 (25%)	X_3 (50%)	X_4 (100%)
Moisture	9.39	8.62	8.14	9.32
Protein	35.44	35.52	35.06	35.02
Fibre	15.11	5.26	10.63	8.41
Ash	9.43	8.72	9.61	10.01
Lipid	7.33	8.00	8.33	9.05

Table 3: Growth performance of heteroclarias fed watermelon seed meal based diet

Parameters	X_1 (0%)	X_2 (25%)	X_3 (50%)	X_4 (100%)
Initial length (cm)	3.12±0.00	3.12±0.00	3.12±0.00	3.12±0.00
Final length (cm)	8.22±0.11	9.42±0.31	8.80±0.05	6.47±0.02
Initial weight (g)	4.75±0.00	4.75±0.00	4.75±0.00	4.75±0.00
Final weight (g)	14.58±2.72	15.16±0.13	15.01±0.52	10.66±2.17
Weight gain (g)	9.83±2.25	10.41±0.23	10.26±0.88	5.91±1.81
S.G.R. (%/day)	0.014±0.17	0.017±0.31	0.016±0.20	0.012±0.11
F.C.R	1.95± 0.23	1.86±0.00	2.14±0.26	2.63±0.33
P.E.R	2.35±0.40	2.76±2.33	2.20±0.10	2.08±0.05
Survival rate (%)	100±0.00	100±0.00	100±0.00	100±0.00

Table 4: Proximate composition of carcass of heteroclarias hybrid fingerlings fed the experimental diet

Variables	Initial	X_1 (0%)	X_2 (25%)	X_3 (50%)	X_4 (100%)
Moisture	42.27±0.01	50.13±0.05	52.22±0/03	48.09±0.04	48.91±0.01
Protein	10.41±0.04	13.82±0.03	14.63±0.01	14.45±0.01	13.64±0.03
Fibre	2.03±0.00	1.88±0.03	2.38±0.08	1.31±0.03	2.63±0.01
Ash	1.64±0.01	1.91±0.02	2.02±0.00	1.52±0.02	1.81±0.04
Lipid	6.10±0.00	7.15±0.06	7.76±0.02	7.03±0.00	7.60±0.00

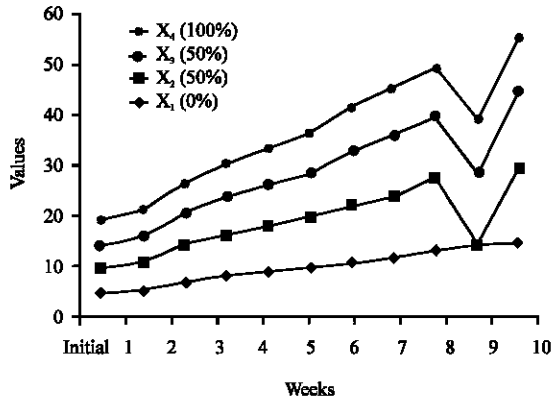

Fig. 1: Weekly variations in the weight gain (g) of heteroclarias fingerlings fed on the different experimental diets

Despite the significant effect observed in growth, survival of the fish fed the different diet were not affected, Basavarajah and Antony (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 Goswami (1996) pointed out that 100% survival rate of carp can be achieved under very minimal stress and well fed condition. Survival, likely depends 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 was higher in values than those recorded in the start of the study (Table 4). Protein retention was higher for the control and X_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 are oil seeds (Mustafa *et al.,* 1972; Abbass, 2007; 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.

CONCLUSION

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 assumed as reasons for better performance of diet with no or lesser watermelon meal inclusion. It is therefore, recommended that inclusion of raw watermelon should be limited to 20% for better growth performance of heteroclarias hybrid.

RECOMMENDATION

Further studies should be done to evaluate the nutritive potentials of processed watermelon seeds in the diet of fish.

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