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GROWTH PERFORMANCE AND FEED UTILIZATION EFFICIENCY OF JUVENILE CATFISH *CLARIAS GARIEPINUS* FED HEAT PROCESSED AND DEHULLED *JATROPHA CURCAS* MEAL

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ABSTRACT: *The growth performance and feed utilization efficiency of juvenile Clarias gariepinus fed heat processed and dehulled Jatropha curcas kernel meal (JCKM) was investigated using 150 pieces of fish with an average weight of 8.9g which were randomly distributed into five experimental diets in replicates of ten (10) fish per tank for 42days. The processed JCKM used were: Sand roasted, Autoclaved, Boiled and Raw defatted meal in replacement of Soya-bean meal at 33.33% per diet. The diets were fed to C. gariepinus of juvenile at 5% body weight. The highest growth performance (170.07±11.12) and feed utilization efficiency (1.36±0.06) was recorded for fish fed with diet of no JCKM replacement followed by sand roasted JCKM based diet(45.03±10.30, 0.42±0.11). There was no significant difference between the two diets at p>0.05. The low fed utilization efficiency observed in fish fed boiled(0.05±0.03), autoclaved(-0.1±0.05) and raw defatted (0.04±0.03) JCKM leads to decrease in growth performance which can be due to high concentration of anti-nutritional factors such as Phorbol esters, Saponins and Curcin. Therefore, JCKM can be used to replace Soya beans at low quantity in the diet of freshwater fish when Sand-roasted.*

KEYWORDS: Growth, Feed utilization, *Clarias gariepinus, Jatropha curcas*

INTRODUCTION

Prices of food, especially proteinous food items of animal origin are prohibitive. This may be attributed to the combine effects of climate change, various cattle and small ruminant diseases as well as myriad of problems encountered in the poultry industry (Eshiett, 1988). The shortfall in the protein intake in Nigeria could be met by intensive fish production. This is possible through diverse high-technology abundantly available in aquaculture industry today. Feeds constitute the greatest and the most costly input in any livestock farm, especially aquaculture. Therefore, any significant reduction in the cost of feeds will consequently reduce the overall cost of production and increase the profit margin of the farm (Bot *et al.*, 2012). The limited source of feed ingredients such as fish meal, fish oil, groundnut cake and soybeans meal are also the main reason for increase of aqua-feed price. Moreover, an increasing of human demand for nutrients derived from those ingredients could reduce the contribution of those feed ingredients towards satisfying the demand for sustainable aqua-feed production (Workagegn *et al.,* 2013). The ultimate goal of livestock production is the attainment of sustainable production with minimum cost of production and maximum returns. The urgent need to arrest the skyrocketing cost of feed ingredients has prompted nutritionists, farmers and other players in the industry to shift research focus to alternative feedstuffs, which are locally available, cheap and within the reach of farmers.The need to identify alternative source of protein to develop low-cost feed ingredients on the basis of sustainable and renewable feed resources for small and medium scale fish farmers are therefore, crucial (FAO,2012). A cheaper and alternative source of feed ingredient for fish with corresponding good performance and no conflict with human food security interest is *J. curcas* kernel meal (JCKM) when detoxified. *J. curcas* kernel meal (JCKM), a by-product of bio-fuel production, has the potential of being used as livestock feed (Ojediran *et al.,* 2012).

The *J. curcas* kernel meal obtained after oil extraction is an excellent source of nutrients for animal feed if the anti-nutritional factors are reduced (Azzaza *et al.*, 2011). After oil extraction, about 50% of the weight of the seed remains as press cake, and contains 58-62% crude protein with an excellent amino acid profile and good proportion of carbohydrates (Backer & Maker 2008).It is also a good source of both saturated &unsaturated fatty acids particularly, poly unsaturated fatty acids (PUFA) such as linoleic acid (18:2n-6) and alpha linoleic acid (18:3n-3) fatty acids (Becker & Makker, 2008).Therefore, it is expected to be an excellent feed ingredient in the future to replace fish meal and soybean meal (Workagegn *et al*, 2013). The protein sources such as soybean, cotton, rape, sunflower and peanut seed cakes are either not readily available or costly for subsistence farmers; Hence, *J.curcas* is a good substitute as a protein source for livestock feeds. This is because besides being easy to grow; the crop seeds are oily and highly proteinous thereby making it a cheap protein source (Ameen O.M& Usman *et al*, 2014). Nevertheless, *J.curcas* seeds are toxic, and thus have to be detoxified prior to supplementing as a protein source in animal feeds (Ahmed &Adam, 1979). Although the seed cake meal is rich in protein, it is toxic to rats, mice, ruminants and humans due to the presence of anti- nutritional factors such as phorbol esters, curcin, trypsin inhibitors, lectin (Oladele & Oshodi 2008). Recent findings indicate that after proper detoxification process the seed meal can serve as a protein substitute in feed meals of animal feed (Abou-Arab and Abu- Salem, 2010). Hence,the objective of this study is to evaluate the effect of dietary inclusion of pre-heated *J. curcas* kernel meal on the growth performance and feed utilization efficiency of juvenile catfish *C. gariepinus*.

MATERIALS AND METHODS

Juvenile catfish *Clarias gariepinus* used for this experiment was purchased from Federal University of Technology Akure (FUTA) fish farm. The *Jatropha curcas* seed was obtained from ripe fruits harvested from different location in Ado-Ekiti, Ekiti State, Nigeria. The fish were acclimatized for seven days in plastic tanks in the laboratory. During the acclimatization period, the fish were fed with locally available feed.

Preparation of *Jatropha Curcas* Meal

Jatropha curcas kernels were sundried and dehulled before been subjected to different processing methods such as boiled, autoclaved, sand roasted and Raw Defatted meal. The processing methods are as follows:

i) The raw kernel after sundried was milled, poured into Muslim cloth and hydraulic pressed (defatted) until the oil was satisfactorily removed and was referred to as Raw defatted meal (RDM).

ii) The raw kernel was cooked in boiling water at 121ºC for thirty minutes, sundried, milled and defatted mechanically. This was referred to as Cooked defatted meal (CDM).
iii) The sorted seed were sand-roasted for thirty minute, in a specific quantity of sieved sand to remove the stones, the roasted seed was later milled and defatted mechanically. This was referred to as Sand roasted defatted meal (SDRM).The raw kernel was milled and placed in an autoclave at 121ºc for 30 minutes. The autoclaved samples were removed, allowed to cool to room temperature and defatted mechanically. This was then referred to as Autoclaved Defatted Meal (ADM).

Experimental Design
150 pieces of healthy juvenile catfish *C. gariepinus* of mixed-sex with an average body weight of 8.9g per fish were distributed into fifteen plastic tanks at the rate of ten(10) fish per tank. The fish were fed diet containing different heat treated *J. curcas* meal for 42 days. Each treatment has three replicates of 10 fish per replicate. The experimental fish were fed two times a day at the rate of 10% bodyweight as previously used by kassaye (Kassaye B.W, 2012).During the experimental period, the amount of feed was adjusted once in two weeks intervals based on the bodyweight of the fish for the subsequent weeks. Thus, the amount of daily feed ratio (DFR) at each sampling time was calculated using the average body weight ABW and the total no of the fish (N) and the feeding rate per day FRd-1 using DFR = ABW XN X FRd-1 (Nandial, 2004). At the end of six weeks, the experiment was terminated.

Data collection and Analysis
During the experiment, bodyweight and body length of the fish were measured at two weeks intervals. Total length was expressed as the distance from the tip of the snout to the end of the caudal fin. Feeding behaviour and mortality of the fish were also registered throughout the experiment. All data collected from the experiment were subjected to a one-way analysis of variance ANOVA

RESULTS
Table 1: Composition of Experimental diet for Juvenile Catfish *C. gariepinus*

INGREDIENTS %	CONTROL	RDM	CDM	SRDM	ADM
Groundnut cake	20.00	22.00	22.00	22.00	22.00
Fish meal	24.00	20.00	20.00	20.00	20.00.
Soya bean meal	30.00	20.00	20.00	20.00	20.00
Jatropha curcas meal	0.00	10.00	10.00	10.00	10.00
Maize	12.00	13.00	13.00	13.00	13.00
Wheat offal	13.00	14.00	14.00	14.00	14.00
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Vit. C	0.35	0.35	0.35	0.35	0.35
Enzyme	0.10	0.10	0.10	0.10	0.10
Salt	0.15	0.15	0.15	0.15	0.15
Fish premix	0.10	0.10	0.10	0.10	0.10
Dicalcium phosphate	0.10	0.10	0.10	0.10	0.10
TOTAL	100.00	100.00	100.00	100.00	100.00

TABLE 2:
Growth Performance and Feed Utilisation Efficiency of Juvenile Catfish *C. gariepinus* fed different Heat Processed and Dehulled *Jatropha curcas* Meal.

PARAMETERS	CONTROL (T1)	BOILED (T2)	AUTOCLAVED (T3)	SAND ROASTED(T4)	RAW(T5)
Initial body length (cm)	108.50±1.8[a]	103.00±4.92[a]	107.50±2[a]	106.33±3.18[a]	103.33±9.93[a]
Final body length (cm)	149.33±3.21[a]	112.92±1.7[b]	98.83±4.31[c]	122.00±10.04[a]	99.93±18.03[c]
Initial body weight (g)	89.00±1[a]	87.83±3.4[a]	86.00±2[c]	85.67±14.29[a]	82.67±10.97[a]
Final body weight (g)	259.07±11.12[a]	90.27±3.4[c]	75.80±4.04[c]	130.70±13.81[a]	86.67±12.71[c]
Body weight gain (g)	170.07±11.12[a]	2.43±6.45[c]	-10.20±5.38[c]	45.03±10.30[b]	4.00±3.3[c]
Specific growth rate	404.71±26.56[a]	5.79±15.36[c]	-24.29±12.81[c]	107.22±24.52[b]	9.52±7.87[c]
Feed conversion ratio (FCR)	0.73±0.04[c]	26.76±15.11[a]	-11.81±5.24[c]	2.47±0.66[b]	34.12±19.78[a]
Feed efficiency, FE	1.36±0.06[a]	0.05±0.03[c]	-0.1±0.05[d]	0.42±0.11[b]	0.04±0.03[c]

Values in each row with different letter are significantly different (P<0.05)

DISCUSSION

The average values of all the recorded initial body weight and body length of the fish recorded at the beginning of the experiment were not significantly different (P>0.05). Therefore, the performance variation of the fish among treatments was due to the effect of dietary inclusion of different heat processed and dehulled *J. curcas* kernel meal (JCKM).

The present study confirmed that dietary inclusion of different heat treated JCKM to the diet of catfish *C. gariepinus* showed remarkable variation on palatability of the diets, feeding behavior, growth performance and feed utilization efficiency of fish (Table 2). Fish fed with control diets and sand roasted *J. curcas* meal had significant (P<0.05) higher growth performance with better feed utilization efficiency than the feed fed the rest of the diets. The control diet had better palatability and more active feeding behavior than the rest of the experimental diets. The reason might be due to low amount of anti-nutritional factors that affects the taste of the diets and also limits the availability of nutrient in those diets (Makkar *et al:*1997). The appreciable growth increase in terms of body weight gain (45.03) recorded in sand roasted JCKM corroborated the result that roasting of seeds inactivates trypsin inhibitor and reduces lectin activity by 50% on average (Makkar *et al:*1998).

Lower growth performance of fish fed boiled, autoclaved and raw JCKM might be due to higher level of anti-nutritional factors such as phytic acid and saponins. Since these substances are reluctant to reduce with simple heat treatment, they can be found in higher concentration in these diets (Rug *et al.*, 2000). This confirm the report that higher proportion of phytic acid in fish diets reduces the digestibility of protein and bioavailability of minerals (especially Ca^{2+} and Fe^{2+}) and thus, depresses the growth performance of fish fed the diets (Azzaza *et al.*, 2011).

Similarly, the best feed utilization efficiency FE (1.36) and Feed conversion ratio FCR (0.73) was observed on fish fed controlled diet followed by the fish fed sand roasted JCKM (2.47 FCR and 0.42 FE). The result of nutrient utilization values of the two diets (T1 and T4) in this study implies a very good utilization of the diets. However, feed utilization efficiency of the fish fed the rest of the diets were significantly low, similar observation was reported earlier in Nile tilapia

(Workagegn *et al.,* 2013). This is in line with the report of Aregheore *et al*., (2003) that it is not possible to destroy phorbol-esters by heat treatment because they are heat stable and can withstand temperature as high as 160^{0}C for 30mins. Goel *et al*., (2007) also stated that the level of phorbol-ester, the toxic substance in JCKM, can be reduced by simple heat treatment followed by chemical treatments. The present results also confirmed the earlier work of Azzaza *et al.,* (2011) who reported that anti-nutritional factors such as trypsin inhibitors and phenols can be further reduced when the diet is treated by both 4%NaOH plus moist heat treatment.In this research work the lowest feed utilization efficiency was observed for fish fed boiled, autoclaved and raw dehulled JCKM which in turn leads to decrease in growth performance. The reduction could be as a result of higher concentration of the anti-nutritional factors and toxic substances which reduce the metabolic activities of the fish and digestibility of protein in the fish fed the diets.

CONCLUSION

The overall growth performance and feed utilization efficiency of fish fed controlled diet and sand-roasted JCKM are similar. This suggests that JCKM is one of the promising feed ingredients in the future to replace the most important and limited protein sources such as fish meal and soybean meal if well detoxified as certain anti-nutritional factors might have impaired the absorption of some essential amino acid component of the other heat processed *J. curcas* kernel meal thus causing growth depression in juvenile catfish *C. gariepinus*. Therefore, further processing methods other than heat treatment solely could possibly enhance the nutritional quality of *J. curcas* kernel meal in fish diets.

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