22

ORIGINAL SCIENTIFIC PAPER

Chemical analysis and nutritional assessment of fluted pumpkin (*Telfairiaoccidentalis* Hook F.) seed residuefed to African catfish (*Clariasgariepinus*) at graded inclusion levels

[1]Ajayi, I.A., [2]Olaifa, F. E., [1]Olawole, A. A. and [1]Adeyemo, A. J.

[1]*Industrial unit,Department of Chemistry, University of Ibadan, Ibadan, Nigeria*

[2]*Department of Wildlife and Fisheries Management, University of Ibadan, Ibadan, Nigeria*

Summary

The chemical analysis and nutritional assessment of fluted pumpkin seed residue fed to African catfish (Clariasgariepinus) at graded inclusion levelswas carried out in order to evaluate its effect on the growth performance and nutrient utilization of the catfish. Five diets containing 0, 15, 30, 45 and 60% inclusion levels of fluted pumpkin seed residue (FPSR) as partial replacement for groundnut cake were prepared and fed to the fishes for eight weeks. Each treatment had three replicates with 15 fish per replicate (mean initial weight 140.87 ± 8.77g) in 30-litre plastic tanks and fish fed at 3% of body weight twice daily. Fish on control diet showed the best growth and nutrient utilization while diets with defatted fluted pumpkin seeds cake produced weight reduction in the fish with the least reduction on diet 2 (15% inclusion) and greatest on diet 4 (45% inclusion). The specific growth rate, feed conversion ratios and protein intake of the control fish were significantly (p<0.05) higher than those on FPSR-containing diets.Histopathological reports showed some damage to the liver of fish in higher FPSR-containing rations, torn gill tissues and changes of intestinal structure. Haematological parameters like haemoglobin, erythrocyte, sedimentation rate and biochemical parameters were within the ranges for healthy fish though reduced from pre-treatment values.

Key words: Growth, fluted pumpkin, seed residue, *Clariasgareipinus*

Introduction

Fluted pumpkin, *Telfariaoccidentalis* belongs to the family *Cucurbitaceae*. It is a creeping vegetative that spreads low across the ground with large lobed leaves, and long twisting tendrils (Horsfall and Spiff, 2005). It is usually supported with trellis during growth to protect the pod. It is of commercial importance in the lowland humid topics of West Africa (Nkang*et al.*, 2003) and grown mainly for its leaves which are used as vegetable (Gupta and Prakash, 2009). The leaves are rich in protein, oil, vitamins and minerals, folic acid, calcium, zinc, potassium, cobalt, copper, iron, vitamins A, C and K but low in crude fibre (Ladeji*et al.*, 1995). They are also rich in iron and have been reported to be useful in the treatment of anaemia (Alada, 2000). Chemically *T. occidentalis* leaf extract contains 21.31% crude protein, 6.41% crude fibre, 5.50 ether extract, 10.92% ash, and 3121ME (kcal/kg) (Nworgu, 2007). Aqueous extracts of *T.occidentalis* leaves have been tested in broiler starter feeds and the anti-nutrients present in the plants include phytic acid, tannin and saponin (Onu, 2012).

The seed of *Telfairiaoccidentalis Hook, F.*, is widely eaten in South Eastern Nigeria as a soup condiment and fermented seeds are used for the production of "Ogiriugu"; a locally made custard. The seeds have also been tried for the production of cookies and marmalade (Giami and Barber, 2004). The seeds possess nutritive and calorific values which make them useful as foods and good sources of edible oils and fats (Eddy *et al.*,2011; Odoemelam, 2005). Many workers have reported the nutritional quality, chemical composition and functional properties of fluted pumpkin seeds (Agatemor, 2006, 2007; Eddy *et al.*, 2011; Fagbemi*et al.*, 2005; Fagbemi, 2007; Fasuyi, 2006; Ganiyu, 2005). It is potentially valuable as a high protein oilseed for man andanimals (Nkang*et al.*, 2003). The dietary effects on growth, plasma lipid and tissues of rats fed with nonconventional oil from the seedshave been reported (Ajayi *et al.*, 2004). Dietary incorporation of the seeds of *T. occidentalis* resulted in good growth and did not have any detectable toxicity after 21 days (Ejike*et al.*, 2010). *Toccidentalis* seed oil has also been tested for use in prophylactic medicine for the alleviation of infertility (Akang*et al.*, 2011).

Clariasgariepinus is a hardy fish and has favourable culture characteristics such as disease resistance, fast growth rate, ability to do well on artificial diets and tolerate a wide range of environmental factors. In view of the high cost of good quality groundnut cake of relatively constant chemical composition, alternative and less expensive sources of good quality protein have been used in fish diet formulations in recent years. This study was carried out to investigate the nutrient quality, nutrient utilization and growth responses *of Clariasgariepinus* juveniles on graded inclusion levels (0%, 15%, 30%, 45%, 60%) of fluted pumpkin seed residue (FPSR).

MATERIALS AND METHODS

Materials

Mature fruits of *T. occidentalis* were brought from a local market in Ibadan, Oyo State, Nigeria. The fruits were cracked open to remove the seeds, which in turn were cracked open to remove the kernels. The kernels were ground in a hammer mill and stored until needed for analysis.

Corresponding author: frajayi@yahoo.com

Methods

Preparation of seed residue

Seed oils were extracted in the Department of Chemistry, University of Ibadan using the continuous soxhlet extraction technique with petroleum ether (40-60°C) for 8h (Ajayi *et al.*, 2006). The residue obtained was air-dried for about a week before being used for this study.

This study was carried out in fifteen plastic tanks for eight weeks and consisted of five dietary treatments with FPSR included at 0 (control), 15, 30, 45, 60% as a partial replacement for groundnut cake. These inclusion levels of FPSR represented treatment diets 1-5 respectively and each treatment replicated thrice. Water in each bowl was changed daily and level maintained at 0.03m throughout the experiment for relatively uniform physico-chemical parameters and prevention of fouling from feed residues. Water was sourced from the University of Ibadan water supply and each experimental tank aerated using air stone and aerator pump (Lawson, 1995). The water quality parameters were monitored biweekly. The dissolved oxygen and pH were measured with Jenway 3015pH meter, 0.01 accuracy (Genway, Staffordshire,UK). Temperature readings were taken using mercury- in- glass thermometer calibrated in Degree Celsius (Paragon Scientific Ltd, Birkenhead, Wirral, UK) which was immersed in water for 2 minutes, withdrawn and readings taken. The FPSR residue was obtained as the remnant after oil extraction from the fluted pumpkin seeds. It was sun-dried for a week to reduce moisture and allow hexane used for extraction to evaporate, before grinding to fine powder to ensure proper mixing with other feed ingredients. The FPDS was included in varying levels in the test diets as control (0%), diet 2 (15%), diet 3 (30%), diet 4 (45%), diet 5 (60%). They were mixed with other feed ingredients to produce a 40% crude protein diet (Table 3). Pellets were produced from each diet mixture separately using starch as binder with a pelleting machine (Hobart GmbH, Rben-Bosch, Offenbug, Germany). The pellets were sun-dried for a week and kept in air-tight containers.

Experimental fish

Five-week old *Clariasgariepinus* juveniles were purchased and stocked at the rate of 15 fish per bowl (30-litre capacity). They were allowed to acclimatize for a week before the experiment. Feeding was stopped 24h before the experiment to empty the guts, maintain a uniform stomach condition and induce appetite in readiness for introduction of the test diets. The fish were fed twice daily (morning and evening) at 3% of their body weight during the experiment. Fish were weighed per treatment before the experiment and weekly thereafter. Each plastic bowl was filled with 30 litres of water and a synthetic net used to cover each bowl to prevent the fish from jumping out and also to avoid the invasion of insects.

Proximate composition of the FPSR, test diets and fish were determined on a dry matter basis at the beginning and end of the experiment using the methods described by the Association of Official Chemists (AOAC, 1990). The haematology of the fish was carried out using the methods of Blaxall and Daisley (1973) and Jain (1986). Blood samples for biochemical analysis were centrifuged for 5 minutes at 3000rpm with Hawsley minor bench centrifuge. The derived samples were stored at -20° C before analysis. Histology of some organs was carried out according to the method of Disbrey and Rack (1974).

Growth Performance Parameters

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Total dry weight of feed fed (g)}}{\text{Total weight gain (g)}}$$

$$\text{Gross feed conversion efficiency (\%)} = \frac{1}{\text{FCR}}$$ (Stickney, 1979).

Statistical design

The statistical design used for the experiment was completely randomized design with the model

$$Y_{ij} = u + D_1 + E_{ij},$$

Where Y_{ij}+ response associated with i[th] treatment under J[th] replicate

The data obtained from haematological analysis during the study were subjected to analysis of variance (ANOVA) while standard error was used to estimate the probability of deviation from the mean at 0.05 levels. The significant mean difference was separated using the L.S.D. method as described by Steel and Torrie (1960).

RESULTS AND DISCUSSION

Water quality of experimental tank

The temperature,dissolved oxygen and pH of the water used for the fishes ranged between 25.18±0.68 to 25.66±0.41°C, 6.51±0.02 to 6.62±0.15mg/l and 6.90±0.08 to 7.04±0.14 respectively during the study. These water quality parameters (Table 1) were within recommended limits for warm water fishes (Boyd, 1982). The crude protein of the defatted fluted pumpkin seeds recorded during this study was 34.58±0.00; it is a lot higher than 3.47% and 8.40±0.25% recorded for whole seeds (Burton and Forster, 1988) and *M. tenuifolia* (Ajayi and Aghanu, 2011) respectively.

Table 1. Mean bi-weekly water quality parameters of the experimental tanks

Treatment	Parameter	Wk 2	Wk 4	Wk 6	Wk 8
1	Temp (°C)	25.03±0.45	25.20±0.16	25.70±0.00	26.02±0.05
	DO (mg/l)	6.48±0.01	6.60±0.03	6.58±0.01	6.60±0.02
	Ph	6.88±0..01	6.90±0.06	6.93±0.07	7.20±0.05
2	Temp (°C)	24.27±0.38	25.17±0.00	25.80±0.03	26.00±0.00
	DO (mg/l)	6.48±0.03	6.50±0.08	6.48±0.02	6.51±0.02
	pH	6.80±0.02	6.90±0.02	6.95±0.08	6.95±0.01
3	Temp (°C)	24.03±0.05	24.53±0.75	25.20±0.01	25.70±0.01
	DO (mg/l)	6.55±0.02	6.39±0.04	6.70±0.01	6.46±0.02
	pH	6.84±0.01	6.78±0.01	6.90±0.03	6.90±0.08
4	Temp (°C)	25.10±0.08	25.27±0.12	25.10±0.04	25.80±0.01
	DO (mg/l)	6.55±0.02	6.39±0.04	6.70±0.01	6.50±0.02
	pH	6.84±0.03	6.90±0.01	6.95±0.05	6.95±0.00
5	Temp (°C)	24.90±0.08	25.10±0.08	24.90±0.00	25.70±0.01
	DO (mg/l)	6.82±0.01	6.59±0.02	6.82±0.0.4	6.48±0.02
	pH	6.87±0.03	6.89±0.01	6.95±0.05	7.00±0.08

Table 2. Proximate and mineral composition of fluted pumpkin seed residue

Proximate composition		Mineral composition	
Parameter	**% Dry weight**	**Mineral**	**mg/g**
Crude Protein	34.58±0.00	Calcium	0.564
Crude Fibre	15.87±0.0.1	Mg	3.923
Fat	2.20±0.01	Mn	2.300
Ash	4.74±0.01	Zn	11.610
Moisture content	7.43±0.01	Fe	9.400
NFE	35.17±0.02		
Total	100		

Table 3. Gross composition of experimental diets containing fluted pumpkin seed residue (FPSR)

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
	0% (control)	15% inclusion	30% inclusion	45% inclusion	60% inclusion
Fish meal	10.13	10.13	10.13	10.13	10.13
Soybean	20.26	20.26	20.26	20.26	20.26
Groundnut cake	40.52	34.44	28.36	22.29	16.21
Pumpkin seed	-	6.08	12.16	18.23	24.31
Millet	7.03	7.03	7.03	7.03	7.03
Wheat offal	7.03	7.03	7.03	7.03	7.03
Maize	7.03	7.03	7.03	7.03	7.03
Vitamin/mineral premix	2	2	2	2	2
Di-calcium phosphate	2	2	2	2	2
Salt	1	1	1	1	1
Vegetable oil	2	2	2	2	2
Starch	1	1	1	1	1
Total	100	100	100	100	100

Table 4. Proximate composition of experimental diets containing fluted pumpkin seed residue (FPSR)

Parameters	Diet 1 (0%)	Diet 2 (15%)	Diet 3 (30%)	Diet 4 (45%)	Diet 5 (60%)
Crude Protein (%)	41.25±0.00	40.62±0.01	41.35±0.01	40.85±0.01	39.85±0.00
Crude fibre (%)	4.28±0.01	4.53±0.01	5.64±0.00	4.49±0.00	5.59±0.02
Ether extract (%)	3.76±0.01	3.58±0.00	4.12±0.02	3.89±0.01	4.03±0.00
Ash content (%)	8.86±0.01	7.89±0.00	7.76±0.01	8.06±0.00	7.38±0.01
Moisture content (%)	10.26±0.00	10.12±0.01	10.35±0.02	10.27±0.00	10.14±0.00
Nitrogen Free Extractives %	31.59±0.00	33.26±0.00	30.78±0.01	32.44±0.00	32.91±0.02

Table 5. Proximate composition of the fishes before and after the experiment

Sample	Initial	Diet1 (0%)	Diet2 (15%)	Diet 3 (30%)	Diet 4 (45%)	Diet 5 (60%)
Crude protein (%)	23.40±0.04	14.20±0.18	11.80±0.39	10.99±0.18	13.51±0.19	10.59±0.37
Moisture content (%)	7.33±0.05	8.20±0.03	9.31±0.10	9.71±0.03	9.27±0.02	9.84±0.02
Ether extract (%)	5.91±0.03	3.26±0.07	2.30±0.03	2.27±0.04	2.36±0.04	2.13±0.02
Ash content (%)	11.43±0.05	8.66±0.04	4.66±0.02	3.53±0.07	4.94±0.02	3.21±0.07
Nitrogen Free Extractives	50.75±0.05	64.65.57±0.13	71.09±0.44	72.82±0.21	69.00±0.17	73.70±0.38
Crude Fibre	1.18±0.04	1.03±0.02	0.84±0.03	0.66±0.03	0.93±0.03	0.54±0.08

Table 6. Growth performance and nutrient utilization of Clariasgariepinus fed varying inclusion levels of FPSR

Parameter	Diet 1 (0%)	Diet2 (30%)	Diet3 (45%)	Diet 4 (45%)	Diet 5 (60%)
Initial body weight (g)	123.83±4.40	145±0.82	145.83±0.24	145.17±0.24	144.5±0.87
Final body weight (g)	194.33±16.21	103.33±6.64	101.5±3.89	89.33±8.11	92.67±9.57
Body wt. gain/loss (g)	70.5±15.50	-41.67±7.42	-44.33±3.88	-55.83±8.34	-51.83±8.87
Body wt gain/loss (%)	57.00±7.52	28.71±4.97	30.40±2.66	38.45±5.68	35.88±6.27
Specific Growth Rate (%/ day)	0.80±0.15	-0.61±0.12	-0.65±0.07	-0.74±0.03	-0.80±0.17
Feed Conversion Ratio	4.53±1.10	-5.78±1.29	-5.28±0.53	-4.25±0.81	-4.45±0.99
No of fish stocked	15	15	15	15	15
Experimental period (wk)	8	8	8	8	8
Survival Rate (%)	86.67	75.53	86.57	66.67	75.47
Cost per kg of feed (N)	125.3	122.3	119.2	116.2	113.2

Table 7. Haematological parameters of the African catfish (Clariasgariepinus) juveniles fed with varying levels of FPSR

Parameters	Before Treatment	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Packed Cell Volume (%)	24.00±0.00	20.67±2.52a	20.67±1.15a	26.67±3.06b	25.00±2.65ab	22.67±2.52ab
Haemoglobin (g/dl)	7.90±0.01	6.77±0.81a	6.73±0.40a	8.70±1.01b	8.17±0.91ab	7.40±0.85ab
Red blood cells x 10^{12}/L	3.28±0.04	3.65±0.95a	13.97±5.94b	17.81±3.34b	8.85±4.88ab	11.47±8.16ab
White blood cells x 10^9/L	10.60±0.05	7.47±2.57a	26.07±12.02c	8.13±0.05a	23.6±12.34bc	10.6±4.20ab
Platelets x 10^9/L	10.00±0.00	13.33±8.08a	8.67±2.31a	15.67±6.03a	11.67±2.89a	15.33±6.43a
Erythrocyte Sedimentation Rate (mm/hr)	6.00±0.02	2.00±1.00a	4.33±3.21a	3.00±1.00a	6.00±1.00a	5.67±4.04a
MCV (Fl)	72.00±0.03	35.00±24.28a	16.33±8.08a	14.67±1.15a	32.33±12.58a	27.33±17.04a
MCH (Pg)	24.00±0.02	19.00±5.20b	6.67±3.21a	4.67±0.58a	10.33±4.04a	8.33±5.51a
MCHC (Pg)	32.00±0.00	32.33±0.58a	32.00±0.00a	32.00±0.00a	32.00±0.00a	32.00±0.00a
Lympliocytes (%)	60.00±0.01	71.67±10.41a	61.33±7.57a	70.67±10.07a	67.33±6.81a	60.33±8.39a
Neutrophilis (%)	40.00±0.01	28.33±10.41a	38.67±7.57a	29.33±10.07a	32.67±6.81a	39.67±8.39a

Note: MCV = Mean corpuscular volume, MCH =mean corpuscular haemoglobin, MCHC = mean corpuscular haemoglobin concentration

Table 8. Plasma proteins of African catfish fed with varying inclusion levels of FPSR.

Parameters	Before Experiment	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Total protein	3.4±0.01	3.57±0.25b	3.20±0.26ab	3.20±0.20ab	3.20±0.10ab	3.13±0.15a
Albumin	1.4±0.00	1.27±0.15b	1.00±0.00a	1.00±0.00a	1.03±0.06a	1.07±0.06a
Globulin	2.0±0.02	2.30±0.10	2.20±0.26a	2.20±0.2a	2.17±0.15a	2.07±0.12a

Proximate and mineral composition of the seed residue

The values for moisture, fat, ash, and NFE were 7.43±0.01, 2.20±0.01, 4.74±0.0 and 35.17±0.02 respectively for FPSR (Table 2). These values were similar to earlier reports by Fagbemi (2007) for the proximate composition and calcium content fluted pumpkin who also concluded that processing had a significant effect on the proximate composition of the full fat and defatted fluted pumpkin seed flours. Zinc was the dominant mineral element measured in this study followed by iron.

Gross and proximate composition of experimental diets

Removal of oil appeared to increase the crude protein, ash and crude fibre contents of the defatted seed residues while reductions were observed in fat, moisture content, nitrogen free extractives, and calcium, magnesium and iron contents of the defatted seeds. The feeds compounded were not significantly different in both gross and proximate compositions (Tables 3 and 4 respectively) except for the partial replacement of groundnut cake by fluted pumpkin defatted seed flour in the gross composition of feeds.

Proximate composition of fish before and after the experiment

On all diets, fish proximate compositions were greater ($p<0.05$) before the experiment than at the end of the experiment except for moisture content and the nitrogen free extractives (carbohydrate) which increased at the end of the experiment (Table 5). The control diet gave the best ($p<0.05$) crude protein, fat, ash and crude fibre compared to other diets. Diet 5 (60% FPSR inclusion) produced the highest NFE content in the fish. This reflected a poor response of the fish to the feed. Though the FPSR has good crude protein content, the balance of amino acid may not be good enough for *C.gariepinus* juveniles as fluted pumpkin is reported to be limiting in both tryptophan and methionine (Agbede *et al.*, 2008; Fagbemi, 2007) which are essential amino acids. Also oil extraction with hexane could have left some residues of hexane and anti nutrients intact in the FPSR.

Growth performance and nutrient utilization of fish

The initial mean body weights of fish were 123.83±4.40, 145±0.82, 145.83±0.24, 145.17±0.24 and 144.5±0.71g for diets 1 to 5 respectively. At the end of the experiment, there was increase only in weight in fish fed on control diet and a general loss in weight in fish on FPSR-containing diets (Table 6) with the greatest loss recorded in diet 4 (45% FPSR). Other performance indices followed a similar trend.The feed conversion rate was poor and mortalities were recorded on all treatments including the control. Fish tended to avoid FPSR-containing diets. Fish tended to avoid FPSR-containing feeds. This might have been due to low palatability and unattractive odour of the feed. It has also been reported that fluted pumpkin seeds contain some anti nutritional factors such as tannins, saponins, phytic acid and oxalates, glycosides, flavonoids, alkaloids and resins (Nkang*et al.*, 2003; Nworgu*et al.*, 2007; Onu, 2012) which are known to inhibit or depress growth. The survival rate was highest in the control with 86.67% and lowest in diet 4 (45% FPSR).

Haematological parameters of the fish

The haematology of the fish showed significant differences ($p<0.05$) in PCV, haemoglobin and white blood cells while there were no significant differences ($p>0.05$) in platelets, erythrocyte sedimentation rates, mean corpuscular volume,mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, lymphocytes and neutrophils (Table 7). The values obtained in this study were within the recommended values (Blaxall and Daisley, 1973) for healthy fish. PCV levels were lower in FPSR-containing rations except in diets 3 and 4 (30 and 45% FPSR). Haemoglobin content followed a similar trend. However, RBC increased above the initial values in diets 2 to 5 with the highest in diet 3 (30% FPSR). Haemapoitic properties of *T.occidentalis* have been reported as shown by increases in PCV, haemoglobin concentration, red blood cells (Alada, 2000;Oyeyemi*et al.*,2008). WBC decreased from the initial measurements in the control and diet 3 (30% FPSR) but increased in diets 2 (15% FPSR) and 4 (45% FPSR) (Table 7). These changes could be due to stress that accompanies changes in dietary protein (Harms *et al.*, 1996). No significant differences were reported in mean albumin and globulin levels in all treatments (Table 8).

Some workers have reported that blood parameters are important in assessing the quality and suitability of feed ingredients for farm animals (Ayoola, 2011; Singh *et al.*,2008). Babatunde*et al.* (1992) also reported that blood parameters are the major indices of physiological, pathological, and nutritional status of an organism and changes in the constituent compounds of blood when compared to normal values could be used to interpret the metabolic stage of an animal as well as the quality of feed.The stunting and matting of the villi in the intestines reported in some treatments indicated a reduction in the surface area available for digestion and absorption of feeds.This may have been due to the presence of tannins and saponins which are known to cause indigestion (Iweala and Obidoa, 2009) and have been reported to damage intestinal mucosa in fish and affect protein digestibility by forming sparingly digestible saponin-protein complexes. They have also been reported to be very toxic to fish in water, damaging respiratory epithelium of gills through detergent action (Francis and Becker, 2002).

Iron was the dominant metal recorded in this study. Many workers have reported that though iron is an essential element for normal cell function and metabolism, excess of it becomes highly toxic by inducing reactive oxygen species production (Thyagaraju and Maralidhara, 2008). One of the organs most affected in the fish in some treatments is the liver;this could have accounted for the changes in the liver in the higher FPSR-containing diets. Tannins, even though classified as antioxidants, at a high dose, could be pro-oxidant and allow lipid peroxidation (Akang*et al.*, 2011).

Result of the histological analyses of fish

The fish on the control diet showed no lesions in the small intestine, kidney, brain, liver, pancreas and ovary but torn tissues were observed in the gills.The fish on diet 2 (15% inclusion of FPSR) exhibited torn gill tissues, moderate congestion of vessel in lamina propria and villi, severe villi stunting/matting (fusion) and goblet cell hyperplasia in the small intestine. No lesions were observed in the liver, heart, and brain. On diet 3 (30% inclusion of FPSR), fish showed no lesions in the heart, brain, liver and kidney but the small intestine exhibited severe widespread villous denudation, stunting and matting.The liver of the fish on diet 4 (45% inclusion levelof FPSR) had moderate sinusoidal congestion and moderately severe vacuolar degeneration of hepatocytes. However, the brain, ovary, gills and small intestines showed no lesions. Fish on diet 5 (60% inclusion of FPSR) had mild goblet hyperplasia in the small intestine, sinusoidal and vascular congestion, widespread vacuolar degeneration of the hepatocytes in the liver but no lesions in the heart, gills, brain, kidney, ovary.

CONCLUSION AND RECOMMENDATION

The growth performance and nutrient utilization of *Clariasgariepinus* on diets containing different levels of fluted pumpkin defatted seeds were studied. At the end of the 8-week feeding trial, it was observed that though fluted pumpkin defatted seeds contained high crude protein content, it did not translate to good growth performance in *C. gariepinus* juveniles. The low cost of preparing FPSR-containing diets notwithstanding, further studies would need to be carried out and good processing methods to be employed if FPSR is to be utilized as a fish feed ingredient. Other types of extraction like mechanical pressing or cold extraction may be tried instead of solvent extraction because of residual hexane which might have remained in the residue. The inclusion of digesters and feeding stimulants may also be attempted.

LITERATURE

Agbede J., Adegbenro M., Onibi G., Oboh C., Aletor V. (2008) Nutritive evaluation of *Telfairiaoccidentalis*leaf protein concentrate in infant foods. *African Journal of Biotechnology,* 7 (15) 2721-2727.

Agatemor C. (2006) Studies of selected physicochemical properties of fluted pumpkin (*Telfairiaoccidentalis* Hook F.) seed oil and tropical almond (*Terminaliacatappia* L.) *Pakistan Journal of Nutrition*,5 (4) 306-307.

Agatemor J. (2007) Fluted pumpkin (*Telfariaoccidentalis*hook f.) seed: A nutritional assessments. *Electronic Journal of Environmental, Agricultural and Food Chemistry*, 6 (2) 1787-1793.

Ajayi I., Oderinde R., Taiwo V., Agbedana E. (2004) Dietary effects on growth, plasma lipid and tissues of rat fed with non-conventional oil of *Telfairiaoccidentalis*. *Journal of Science Food and Agriculture*, 84, 1715–1721.

Ajayi I., Oderinde R., Kajogbola D., Uponi J. (2006) Oil content and fatty acid composition of some underutilized legumes from Nigeria. *Food Chemistry*,99, 115-120.

Ajayi I., Aghanu V., (2011) Chemical characterization of *Monodoratenuifolia* seeds from Nigeria. *Seed Science and Biotechnology*, 5, 59-62.

Akang E., Oremosu A., Dosumu O., Ejiwunmi A. (2011) *Telfairiaoccidentalis*,; a prophylactic medicine for alcohol's damaging effect on the testis. *Macedonian Journal of Medical Sciences*, 4 (4) 380-387.

Alada A. (2000) Thehaematological effect of *Telfairiaoccidentalis*diet preparation. *African Journal of Biomedical Research*, 3, 185-186.

AOAC, (1991) Official Methods of Analysis of Association of Analytical Chemist, Washington D.C.

Ayoola S. (2011) Haematological characteristics of *Clariasgariepinus* (Buchell, 1822) juveniles fed with poultry hatchery waste. *Iranica Journal of Energy and Environment*, 2 (1) 18-23.

Babatunde G., Fajimi A., Oyejide A. (1992) "Rubber seed oil versus palm oil in broiler chicken diets. Effects on performance, nutrient digestibility, haematology and carcass characteristics. *Animal Feed Science and Technology,* 35, 133–146.

Blaxhall P., Daisley K. (1973) Routine haematological methods for use with fish blood. *Journal of Fish Biology*, 5, 771.

Boyd C. (1982) Water quality management for pond fish culture. Elsevier Amsterdam. 317.

Burton B., Forster W. (1988) Human Nutrition, 4th edition. McGraw –Hill, New York.

Disbrey B., Rack J. (1974) Histological Laboratory Methods. Livingstone, Edinburgh, pp: 56-128.

Eddy N., Ukpong J., Ebenso E. (2011) Lipid characterization and industrial potentials of pumpkin seeds (*Telfairiaoccidentalis*) and cashew nuts (*Anacardiumoccidentale*). *E-Journal of Chemistry*, 8 (4) 1986-1992.

Ejike C., Ugboaja P., Ezeanyika L. (2010) **Incorporation of Boiled Fluted Pumpkin (*Telfairiaoccidentalis* Hook F.) Seeds 1: Growth and Toxicity in Rats. Research Journal of Biological Sciences 5 (2) 140-145.**

Fagbemi T. (2007) Effects of processing on the nutritional composition of fluted pumpkin (*Telfairiaoccidentalis)* seed flour. *Nigerian Food Journal,* 25 (1) 1-22.

Fagbemi T., Eleyimi A., Atum H., Akpambang O. (2005) Nutritional composition of fermented fluted pumpkin (*Telfairiaoccidentalis*) seed for production of "Ogiri Ugu" fermented foods and beverages: General 2005 IFT Annual Meeting, New Orleans, Louisiana.

Fasuyi A. (2006) Nutritional potentials of some tropical vegetable leaf meals: chemical characterization and functional properties. *African Journal of Biotechnology*, 5, 49-53.

Francis G., Becker K. (2002) Feed ingredients: Anti nutrients in plant-derived fish feed ingredients. The Advocate, pp 37-38.

Ganiyu O. (2005) Hepatoprotective property of ethanolicand aqueous extracts of fluted pumpkin (*Telfairiaoccidentalis*) leaves against Garlic-induced oxidative stress. *Journal of Medicinal Food*, 8 (4) 560-563.

Giami S., Barber L. (2004) Utilization of protein concentrates from ungerminated and germinated fluted pumpkin (*Telfairiaoccidentalis Hook F.*) seeds in cookie formulations. *Journal of Science and Food Agriculture*,84 (14) 1901 – 1907.

Gupta S., Prakash J. (2009) Studies on Indiangreen leafy vegetables for their antioxidant activity.*Plant Food Human Nutrition*, 64, 39-45.

Harms C., Sullivan C., Hodson R., Stoskopf M. (1996) Chemical pathology and histopathology characteristics of net-stressed striped bass with 'red tail'*Journal of Aquatic Animal Health*, 8, 82-86.

Horsfall M. Jr., Spiff I. (2005) Equilibrium sorption study of Al^{3+}, Co^{2+} and Ag^{+} in aqueous solutions by fluted pumpkin (*Telfairiaoccidentalis*hook f). Waste Biomass. *Acta Chimica Slovenica*, 52, 174-181.

Iweala E., Obidoa O. (2009) Some biochemical, haematological and histological responses to a long term consumption of *Telfairiaoccidentalis*-supplemented diet in rats. *Pakistan Journal of Nutrition,* 8 (8) 1199-1203.

Jain N. (1986) Schalm's Veterinary Haematology, 4th ed. Lea and Febiger, Philadelphia. pp. 1221.

Ladeji O., Okoye Z., Ojobe T. (1995) Chemical evaluation of thrnutirive value of leave of fluted pumpkin (*Telfairiaoccidentalis*) *Food Chemistry*, 53 (4) 353-355.

Lawson T. (1995) Fundamentals of Aquaculture Engineering.Chapman and Hall. pp. 28-39.

Nkang A., Omokaro D., Egbe A. Amanke G. (2003) Variations in fatty acid proportions during desiccation of *Telfairiaoccidentalis* seeds harvested at physiological and agronomic maturity. *African Journal of Biotechnology*, 2 (2) 33-39.

Nworgu F. (2007) Economic importance and growth rate of broiler chickens served fluted pumpkin (*Telfairiaoccidentalis*) leaves extract. *African Journal of Biotechnology*, 6 (2) 167–174.

Nworgu F., Ekemezie A., Ladele A., Akinrolabu B. (2007) Performance of broiler chickens served heat-treated fluted pumpkin (*Telfariaoccidentalis*) leaves extract supplement. *African Journal of Biotechnology*,6, 818-825.

Odoemelam S. (2005) Proximate composition and selected physicochemical properties of the seeds of African oil bean (*Pentaclethramarcrophylla*) *Pakistan Journal of Nutrition*, 4, 382-383.

Onu P. (2012) Effect of aqueous extract of *Telfairiaoccidentalis* leaf on the performance and haematological indices of starter broilers. ISRN Veterinary Science, 2012 Article ID 726515, 4 pages doi:10.5402/2012/726515

Oyeyemi M., Leigh O., Ajala O., Badejo A., Emikpe B. (2008) The effects of the aqueous extract of "Ugu" (*Telfairiaoccidentalis*) leaves on the testis and spermatozoa characteristics in the male albino rat (Wistar strain). *Folia Veterinaria*, 52 (2) 102-105.

Singh D., Nath K., Trivedi S., Sharma Y. (2008) Impact of copper on haematological profile of freshwater fish, (*Channapunctatus*). *Journal of Environmental Biology*, 29 (2) 253-257.

Steel R., Torrie J. (1960) Principles of procedures of statistics. Mc. Graw-Hill Book Co., Inc. New York.

Stickney R. (1979) Principles of warm water aquaculture. ISBN 04103388X. Wiley New York pp 375

Thyagaraju B., Maralidhara (2008) Vulnerability of prepubertal mice testis to iron induced oxidative dysfunction in vivo and functional implications. *International Journal of Fertility and Sterility*, 1 (4) 145-154.

Taitzoglou A., Tsantarliotou M., Zervos I., Kouretas D, Kokolis N. (2001) Inhibition of human and ovine acrosomal enzymes by tannic acid in vitro. *Reproduction*, 121, 131-137.