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Effects of Processed Cassava Root Meal on the Histology of Intestine and Liver of Juvenile *Oreochromis niloticus* Reared in Cages

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Abstract

The study investigated the histology of the intestine and liver of *Oreochromis niloticus* fed graded levels of differently processed cassava root meal in cages for 49 days. Five isonitrrogenous (cp 35%) and isocaloric (G 4.44 Kcal/lg) diets were formulated such that oven-dried (60c) and gelatinized fermented cassava root meal replaced maize at 25% and 50% respectively. The control diet had only maize as energy source. In *Oreochromis niloticus* fed oven-dried cassava meals histological changes like erythrocyte infiltration, haemorrhage and pyknossis in the liver cells and inflammation and sloughing-off of epithelial cells of the intestine increased with increasing dietary levels. However, *Oreochromis niloticus* fed diets containing gelatinized cassava meal showed no signs of histological damage in both intestine and liver tissues. The result implies that gelatinization after fermentation is an effective means of detoxifying cassava root meal and making it suitable as maize substitute in diets for *Oreochromis niloticus*.

Keywords: Cassava, histology, Oreochromis niloticus, cages

Introduction

To meet the ever increasing demand for animal protein arising from human population increase the expansion and intensification of fish culture has been recommended (Delgado *et al*., 2003). Maize has been the major dietary energy source for aquaculture feed but its high cost end scarcity majorly due to insurgency in the northern part of Nigeria has led to interest in the use of maize substitute.

Nigeria is regarded as the highest producer of cassava in the world with production estimate of about 33 million metric toners per annum (FAO, 2005). The potential of cassava as an alternative energy source to maize is therefore enormous. However, the limitation is the high cyanide content of cassava. Histopathology have been used in fish to identify and evaluate the toxic effects of exposure to contaminants (Olveira –Ribeiro *et al.,* 2000; Rabitto *et al*., 2003).

This study was designed therefore to evaluate the effects of graded levels of processed cassava tuber meal on the histology of the intestines and liver of *O. niloticus* reared in cases in Otamiri River.

Materials and Methods

Fresh raw cassava tubers (bitter variety) obtained from Umuagwo, Ohaji-Egbema L.G.A. Imo State were peeled washed and grated into mash.

The mash was dewatered using a sac and split into two portions one part of which was oven-dried at 60^0C. The other portion was allowed to ferment for four days at ambient temperature in plastic vats. The fermented mash was then mixed with water at the ratio of 1 litre of water per kilogram of mash in a pot and heated while stirring until it sufficiently gelatinized. The product was then sun dried for three (3) days when they become crispy to touch. The two types of cassava meals (oven-dried and fermented gelatinized) were milled using 2mm sieve and used to formulate isonitrogenous (CP 35%) and isocaloric (GE 4.43 Kcal/mg) diets at 0%, 25% and 50% maize substitution levels for *O. niloticus*

Ten net cages (1 X 1 X 1 m) each stocked with 50 juvenile *O. niloticus* average weight 20g were moored to a platform in Otamiri River. The fish were acclimatized for 7 days using commercial feed. Thereafter, each of the five (5) diets was assigned to 2 cages in a completely randomized manner and fish fed at 5% body weight two times daily for 49 days.

The intestine and liver of fish from each treatment were collected at commencement and at the end of the experiment. These were processed for histological examination, stained and mounted on slides. Sections were viewed using Leica DM 70 binocular microscope and photo micrographed.

Table 1: Gross Composition of Experimental Diets

Ingredients	Control (0%)	Raw cassava		Galatinzed cassava	
		(25%)	(50%)	(25%)	(50%)
Fish meal	27.45	27.45	27.45	27.45	27.45
Soya bean cake	54.90	54.90	54.90	54.90	54.90
Maize	5.15	3.86	2.57	3.86	2.58
Cassava meal	0.00	1.29	2.57	1.29	2.58
Wheat bran	2.00	2.00	2.00	2.00	2.00
Vitamin C	0.50	0.50	0.50	0.50	0.50
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Palm oil	0.50	0.50	0.50	0.50	0.50
Vitamin premix	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Bone meal	2.00	2.00	2.00	2.00	2.00
Binder	2.00	2.00	2.00	2.00	2.00
Cod liver oil	2.00	2.00	2.00	2.00	2.00
Crude protein	35.48	34.66	35.01	35.21	35.25
Gross Energy (calc)KJ/Kg	4.42	4.35	4.40	4.45	4.43

Results and Discussion

Results showed that *O.niloticus* fed diet with 25% oven-dried cassava meal had slight damage to the intestinal tissue (plate 1) while the liver hepatocytes has no observed negative effect. On the other hand, both intestinal epithelial cells and liver hepatocytes of *O.niloticus* fed diets with 25% gelatinized fermented cassava meal showed normal cell disposition In *O. nilolicus* fed diet where maize was substituted with 50% oven dried cassava meal the intestinal tissue suffered damage. Increased level of inflammatory and haemorrhagic cells and characteristic dilated blood vessels were observed (plate 2) with sloughed off cells in the lumen. The liver has lost its characteristic architecture with increased vacuolation in hepatocytes. Sections also were characterized by erythrocyte infiltration into blood sinusoids, increased haemorrhage and pyknotic hepatocytes (plate 3) in contrast, both the liver and intestinal cells of juvenile *O. niloticus* fed 50% gelatinized fermented cassava diets showed normal disposition (Plate 4).

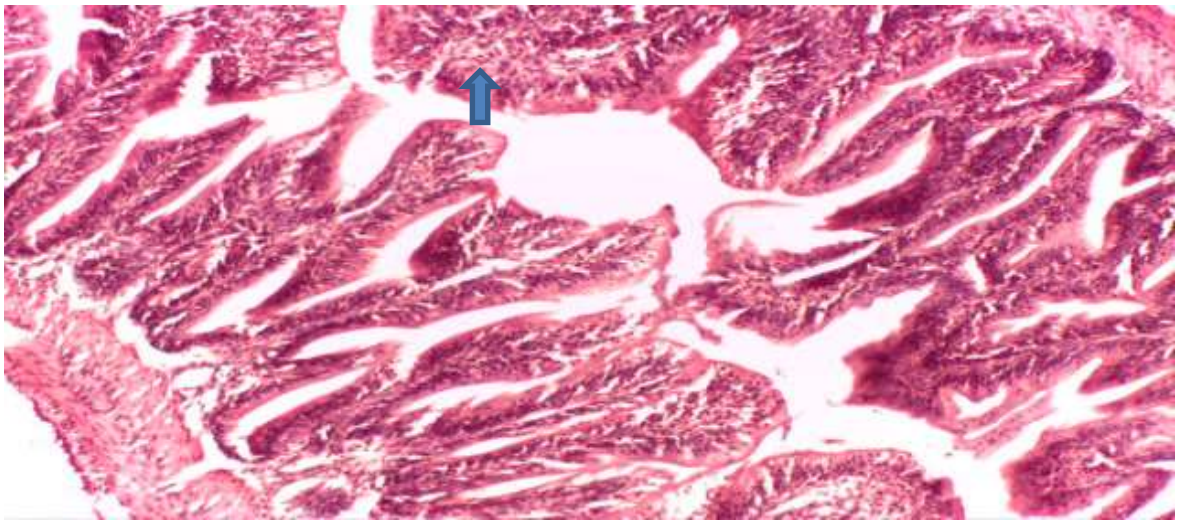

Plate 1: Histologic section of the intestine of *O. niloticus* fed diet containing 25% oven-dried cassava shows sloughed off epithelium (A) and Haemorrhage (B). Other tissue elements appear normal (400 times magnification).

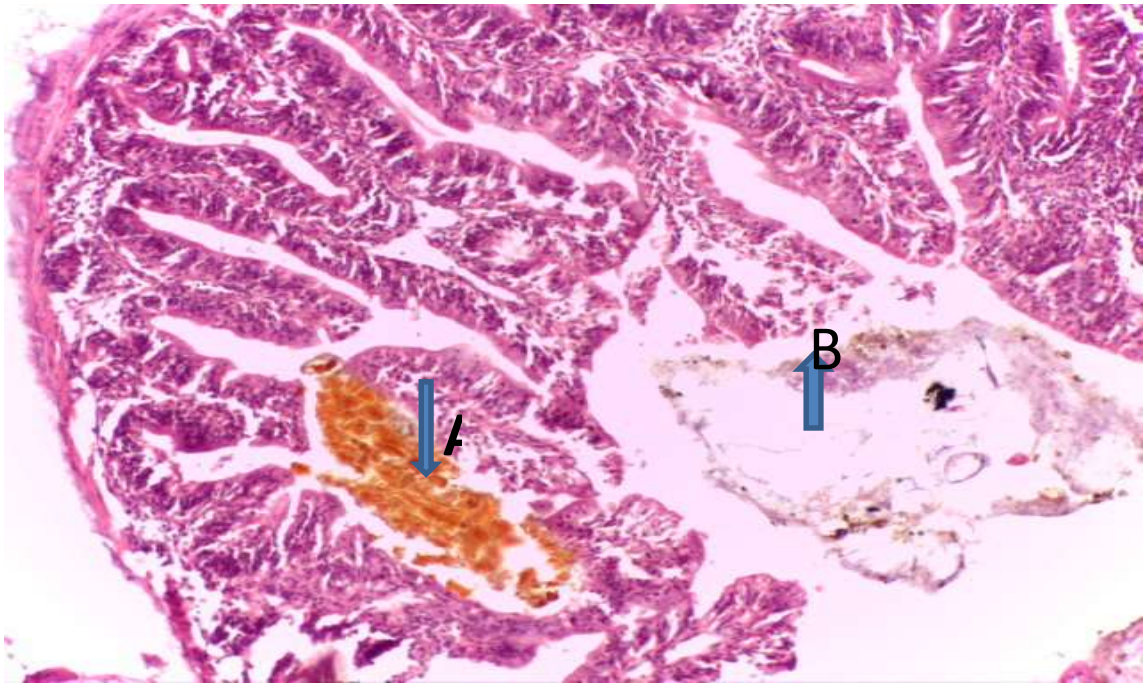

Plate 2: Histologic section of the intestine of *O. niloticus* fed 50% oven-dried cassava showing sloughed off epithelium(A) , haemorrhage (B). Other tissue elements appear normal (400 times magnification).

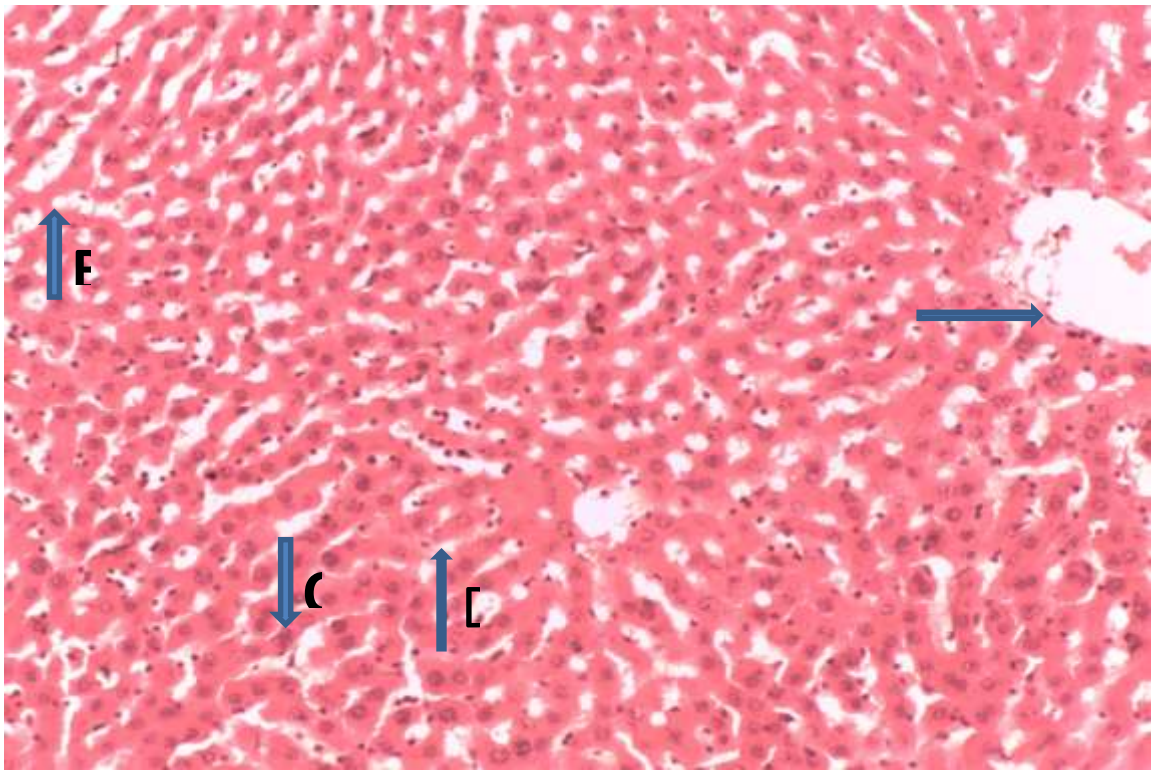

Plate 3: Histologic section of the liver of *O. niloticus* fed 50% oven-dried cassava diet showing slightly enlarged central vein (A), dilated sinusoids (B), and normal lamina (C) of hepatocytes. The heaptoytes (D) appear pyknotic in some areas (400 times magnification).

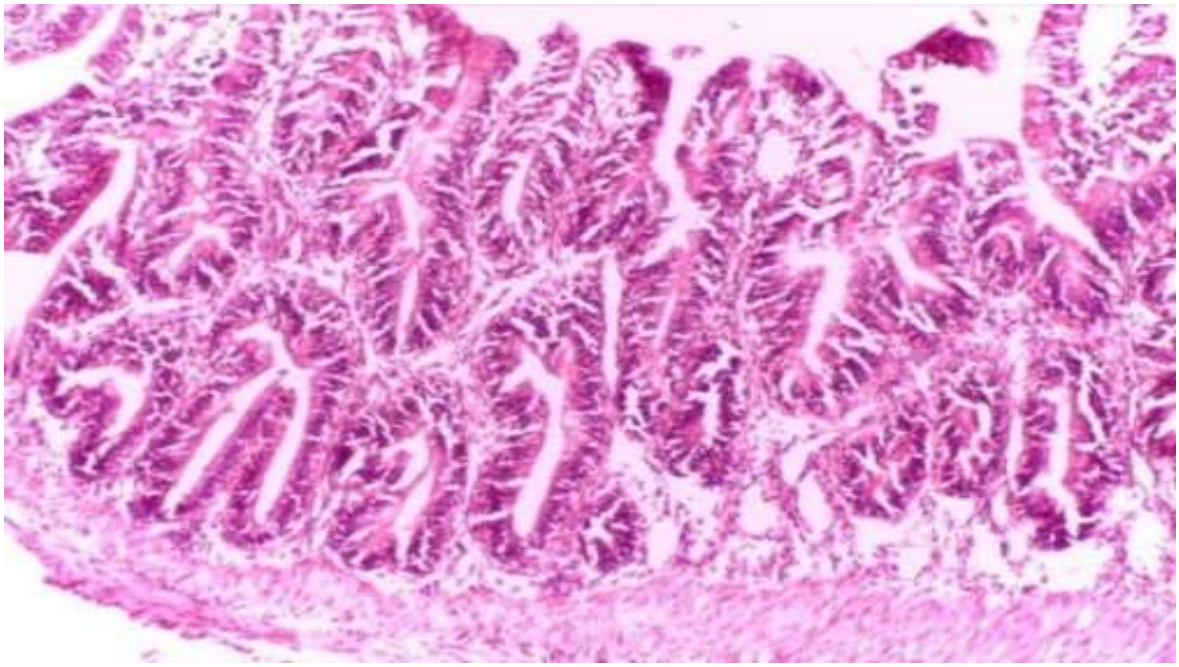

Plate 4: The histologic section of the small intestine of *O. niloticus* fed diet with gelatinized fermented cassava (50%) showing normal tissue disposition (400 times magnification)

The processed cassava meal contains potentially toxic levels of cyanogenic glycoside, linamarin which on hydrolysis produce hydrogen cyanide (HCN) which is highly toxic (Udedibia and Asoluka, 2008). In the present study the effects of different concentrations of HCN contained in the different test diets on the intestine and liver of *O. niloticus* were investigated. Slight damage detected in the intestine of *O. niloticus* fed 25% substituted oven dried cassava meal in this work agrees with the findings reported by Mohamed (2009) of irritation and destruction of mucosa membrane of intestine of *Tilapa zilli* and *Solea vularis* exposed to some pollutants. The intestine of *O. niloticus* fed diet with 50% substitured oven-dried cassava meal showed increased level of inflammatory and haemorrhagic cells and characteristic in dilated blood vessel with sloughed off cells in the lumen. Similarly, Kaound *et al.* (2011) reported degenerative and necrotic changes in the intestinal mucosa and submucosa with necrotized cells aggregated in the intestinal lumen of *O. niloticus* treated with cadmium. Osuigwe *et al.* (2006) reported progressive damage to the epithelial mucosa of *Heterobranchus longifilis* intestines with increasing dietary level of raw jack bean seed meal.

The results observed on the liver included histological characteristics such as increased vacuolation associated with lipid accumulation and erythrocyte infiltration into blood sinusoid. These change are generally associated with the response of hapatocytes to toxicants (Van Dyk *et al.,* 2007*).* The loss of the characteristics architecture of the liver cells of *O. niloticus* fed diet with 50% substituted oven-dried cassava, meal is a very early and non-specific 3signal of disturbance of hepatocellular homeostasis (Braunbeck, 1998), while increased vaculolation with nuclear pyknosis indicated a severe adverse effect on the hepatocytes. This reaction is in agreement with the results reported by Kaoud *et al.* (2011) on the liver of *O. niloticus* treated with cadmium.

In this study, severity of changes in the liver tissue increased with increasing concentration of oven-dried cassava meal in the diet. While at 25% substitution of maize by oven-dried cassava meal apparently no changes in the liver tissue were observed, at 50% substitution, marked histological changes in the tissue task place. The damages observed in the intestine and liver cells of *O. niloticus* fed diets containing oven-dried cassava meal in this study may be attributed to the presence of hydrocyanide which was not eliminated by the ineffective oven drying of cassava meal. The damage caused the organs exacerbated with increasing dietary level of the oven-dried cassava. However, it was noted that subjecting cassava meal to fermentation and gelatinization eliminated substantially the HCN. Consequently, the intestine and liver cells of *O. niloticus* fed diets with gelatinized fermented cassava meal in this study showed normal disposition. This is in agreement with Cardose *et al.* (2005) who reported that boiling and drying reduced the cyanide content of cassava meal such that growth of catfish was enhanced.

Conclusion

In conclusion dietary levels of oven-dried cassava meal had adverse effects on the histology of intestine and liver cells of *O. niloticus* while gelatinized fermented cassava meal at levels used in this study had no adverse effect.

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