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Selected liver and kidney function indices of Wistar rats fed with *Ficus exasperata* Vahl leaf-based diet

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ABSTRACT: In a previous study, treatment of diabetes mellitus with *Ficus exasperata* leaf-based diet (FELD) significantly reduced the level of blood glucose and improved glucose utilization in diabetic rats. It is therefore important to ascertain safety of consumption of FELD in healthy rats. Twenty-four rats were randomly selected into 4 groups of 6 animals each namely: C [control rats fed diet without *Ficus exasperata* leaf (FEL)], F1, F2, and F3 [experimental groups fed diets containing 10 %, 30 % and 50 % FEL respectively]. Rats were allowed access to the compounded feed *ad libitum* for 7, 14 and 21 days. They were sacrificed at the end of the experiment and serum collected for biochemical assays. Total protein, albumin, globulin, bilirubin (total and conjugated), urea, creatinine, electrolytes, alkaline phosphatase (ALP), alanine amino transferase (ALT), aspartate amino transferase (AST), liver and kidney histopathology were evaluated. Results showed no significant difference ($p<0.05$) in albumin, globulin, bilirubin, electrolytes, ALP, AST and ALT of rats fed with test diets compared to control. Also, there were no changes in the liver and kidney histoarchitecture of rats fed with different proportions of FELD compared to control. The increased urea and creatinine concentrations of rats fed with 30 and 50 % FELD at the end of days 7 and 14 reversed to normal at the end of day 21 of the study. Therefore, results of this study suggest that consumption of 10, 30 and 50 % *Ficus exasperata* leaf-based diet for 21 days did not impair the selected liver and kidney functions indices of the treated rats.

Keywords*: Ficus exasperata*, Liver function, kidney function, leaf-based diet, albumin

Introduction

Ficus exasperata Vahl belongs to the mulberry family and is popularly known as fig plant (Oladosul *et al*., 2009). It is widespread in tropical Africa. In Nigeria, there are more than 45 different species of *Ficus* (Adewole *et al*., 2011; Mbakwem-Aniebo *et al.,* 2012). *Ficus exasperata* leaf is commonly called *ewe ipin* in Yoruba language, *kawusa* in Nupe, *ameme* in Edo and *anwerenwa* in Igbo languages in Nigeria (Ijeh and Ukweni, 2007). Traditionally, the decoction and infusion of the leaves are used to treat diabetes mellitus, ulcers, dysentery and hypertension amongst others (Joseph and Raj, 2010). Fresh leaves of the plant are regularly included during the milling or pounding stage of palm oil production by natives of Nigeria to improve the quality and stability of palm oil (Umerie *et al.*, 2004).

In previous studies, proximate compositions, mineral contents and fatty acids profile of *Ficus exasperata* leaf were studied with a view to investigating its nutraceutical potentials. Report showed that it is rich in fiber, protein and carbohydrate, low moisture and fat contents (Falade *et al.*, 2004; Bello *et al.* 2014). It is also a rich source of potassium, calcium, linoleic acid and oleic acid. Phytochemical analysis of the leaves and stem extracts also showed that it contains flavonoids, tannis, saponins, alkaloids and cyanogenic glycosides (Ijeh and Ukweni, 2007; Soji-Omoniwa, and Oloyede, 2018).

In recent years, the use of non-culinary herbs in food products had risen (Jenkins *et al*., 2008; Peng *et al*., 2010; Ansari and Kumar, 2012; Soji-Omoniwa, 2018). Herbs consist of leaves, flowers, stems and roots from a variety of herbaceous plants used either in fresh or dried form (Oxford dictionary of English, 2010: Allaby, 2012). Some herbs are used for culinary purposes, e.g. basil, bay leaves, marjoram and thyme. Others are generally used for non-culinary purposes only, e.g. *Echinacea*, evening primrose, St John's wort, *Ginkgo biloba* and *Ficus exasperata*. Some herbs may be used for both culinary and non-culinary purposes, for example ginger and garlic (Allaby, 2012). This technology of incorporating medicinal or non-culinary herbs into diet offers great promise for disease management.

For instance, Peng *et al.* (2010) fortified bread with grape seed extract (GSE), which contains catechins and proanthocyanidins. These metabolites possess strong antioxidant and free radical scavenging activity. The GSE- fortified bread elicited a significant antioxidant activity than blank bread. Also, Jenkins *et al*. (2008) extracted glucomannan, a glucose-mannose polysaccharide from the tuber roots of *Amorphophallus konjac* and incorporated it into dough of biscuits. Consumption of these biscuits reduced glycemic index significantly by 74% in healthy human volunteers and by 63% in participants with diabetes mellitus. Similarly, *Ficus exasperata* leaves were incorporated into locally-sourced food ingredients to produce *Ficus exasperata* leaf-based diet (FELD). Treatment of diabetes mellitus with FELD significantly reduced the level of blood glucose and improved glucose utilization in diabetic rats compared to control (Soji-Omoniwa and Oloyede, 2018).

Despite the extensive use of *Ficus exasperata* leaf, it is important to assess the safety of *Ficus exasperata* leaf-based diet for consumption by evaluating it effect on some selected indices of liver and kidney function of wistar rats.

Materials and Methods

Plants collection and authentication

Fresh leaves of *Ficus exasperata* were collected in February, 2018 from Odo Eri in Kogi State, Nigeria. The specimen sample was prepared and deposited for identification and authentication at the Herberium unit of the Department of Plant Biology, University of Ilorin, Ilorin, Nigeria. A voucher number UILH/001/883 was thereafter issued.

Experimental animals

Wistar rats of norvegicus strain, weighing between 100 g to 150 g were obtained from the animal holding unit of the Department of Biochemistry, University of Ilorin, Ilorin, Nigeria. The rats were housed in well ventilated cages and allowed to acclimatize to animal house conditions for 7 days. They were fed with normal rat pellet and tap water prior to the commencement of the experiment.

Ethical clearance

Ethical clearance for the study was obtained from the University of Ilorin Ethical Committee with protocol identification code UERC/LSC 067.

Plant preparation

Fresh leaves of *F. exasperata* were washed and air dried to a constant weight. They were thereafter pulverized into fine powder using an electronic blender, oven treated using laboratory oven at 110^{o}C for 6 mins and then stored in an air tight container in a refrigerator prior to analyses.

Feed ingredients

Yellow corn, maize husk, soy bean oil, soy bean grain and sucrose (sugar) were purchased from local markets in Ilorin, Kwara State, Nigeria. The corn and soy bean were stored in air tight containers prior to the commencement of the experiment. The soy bean oil was a product of Kewalram Nigeria Limited, Nigeria. Vitamin and mineral mix, D-methionine and L- lysine were purchased from local vendors in Ilorin, Nigeria.

Feed preparation and administration to experimental rats

Corn starch was prepared by rinsing and soaking 10 kg of yellow corn in 20 L of distilled water for 72 hours. It was then ground and sieved using muslin cloth. The filtrate was stored in a sac and drained under heavy weight for 6 hours, after which it was sun dried to constant weight.

Maize husk was used as the cellulose source and it was prepared by sun drying 10 kg husks for 3 days and then ground using commercial grinder.

The soy bean grain (7 kg) flour was prepared by first removing the bean coat using a commercial grinder. Thereafter, it was ground to smooth texture. The Corn starch, maize husk, sucrose, soybean flour, vitamin/mineral mix, DL-methionine and L- lysine were thoroughly mixed together in the various proportions indicated in Table 1. Soybean oil (40 ml) and distilled water (1000 ml) were added slowly to the mixed ingredients until the mixture became a paste. The paste was then pelletized using a wire mesh and then oven dried at 40^{o}C to a constant weight to form the control feed. The test feeds were prepared in a similar manner to the control feed. However, 100, 300 and 500 grams of the pulverized *F. exasperata* leaves were added to the mixed ingredients as shown in Table 1. The prepared feeds were then administered to rats *ad libitum* for a period of 7, 14 and 21days.

Animal grouping

Twenty-four (24) albino rats were randomly selected into 4 groups of 6 animals each as indicated below for each study period (days 7, 14 and 21):

C - Control rats fed diet without *Ficus exasperata* leaves (FEL)
F1 - Rats fed diet containing 10 % w/w *Ficus exasperata* leaves
F2 - Rats fed diet containing 30 % w/w *Ficus exasperata* leaves
F3 - Rats fed diet containing 50 % w/w *Ficus exasperata* leaves

Table 1: Feed Formulation of *Ficus exasperata* leaf-based diet

Ingredients (g/kg)	Control	10%	30%	50%
Corn starch	512	412	212	12
Cellulose	40	40	40	40
Sucrose	100	100	100	100
Soybean	250	250	250	250
Soybean Oil	40	40	40	40
Vitamin/mineral mix	50	50	50	50
D- Methionine	4	4	4	4
L-lysine	4	4	4	4
F. exasperata leaves	-	100	300	500

Animal sacrifice and tissue collection

Rats were sacrificed 24 hr after days 7, 14 and 21 of consuming FELD. They were anaesthetized with diethyl ether and sacrificed by incising the jugular vein using a scalpel. Blood samples were collected into plain sample bottles for biochemical analysis. After sacrifice, the rats were dissected the livers and kidneys were then isolated.

The isolated tissues were cleansed with cotton wool to remove blood stains, weighed and immediately stored in ice cold phosphate buffer. They were then homogenized in an ice-cold phosphate buffer (0.1 M, pH 7.4) (1:5$^{w}/_{v}$). The homogenates were stored in the freezer (-4^{o}C) until required for further analysis. Serum was collected by allowing blood sample to stand at room temperature for 30 mins to form clot. The supernatant which is the serum was collected using Pasteur pipette.

Biochemical parameters

Liver function indices

Total and conjugated bilirubin, albumin and globulin concentrations were determined by using the method described by Teitz (1995). Total protein concentration was determined using biuret method. Alkaline phosphatase (ALP) activities in the liver and serum were assayed using the method described by Wright *et al.* (1979). The method described by Reitman and Frankel (1957) was used for assaying the activities of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in the liver and serum.

Kidney function indices

Serum urea concentration was determined by using the method of Fawcett and Scott (1960).

Serum creatinine and electrolytes (phosphate and calcium ion) concentrations were determined using the method described by Tietz (1995). Sodium ion, potassium ion, chloride and bicarbonate concentrations were determined using Trinder (1951), Henry (2001), Sink and Neal (2009) and Bergmeyer (1987).

Histopathology study

Histopathological examination of the liver and kidney was carried out using the method described by Krause (2001).

Statistical analysis

Data were expressed as mean of 6 determinations ± SEM. The data were subjected to statistical analysis using the IBM® statistical package for social sciences (SPSS) software version 20. All significant differences were determined by one way analysis of variance (ANOVA). Post hoc multiple comparisons were done using Duncan's multiple range test. The level of significance was set at $p < 0.05$ (confidence level = 95 %).

Results

Liver function indices

The serum total protein of rats fed with 50 % FELD was significantly reduced ($p<0.05$) compared to the control group at the end of days 7, 14 and 21 of the study. The rats fed with 10 and 30 % FELD were however not significantly different ($p>0.05$) compared to the control. There was no significant difference ($p>0.05$) in results of serum albumin and globulin for all the experimental rats compared to control (Table 2). Similarly, total and conjugated bilirubin concentrations, alkaline phosphatase, alanine amino transferase and aspartate amino transferase activities for all the experimental rats were not significantly different ($p>0.05$) to the control (Table 3, Figures 1, 2, 3).

Table 2: Serum total protein, albumin and globulin concentrations of rats fed with *Ficus exasperata* Leaf-based Diet

Groups	Serum total protein (g/dl)			Serum albumin (g/dl)			Serum globulin (g/dl)		
	Day 7	Day 14	Day 21	Day 7	Day 14	Day 21	Day 7	Day 14	Day 21
C	8.31 ±0.26^{a}	6.65 ± 0.06^{a}	6.61 ± 0.02^{a}	5.50±0.20^{a}	5.52 ± 0.10^{a}	5.36 ± 0.05^{a}	2.81 ± 0.10^{a}	1.13 ± 0.10^{a}	1.25 ± 0.05^{a}
F1	8.30 ±0.17^{a}	6.58 ± 0.07^{ab}	6.61 ± 0.02^{a}	5.55±0.15^{a}	5.48 ± 0.15^{a}	5.28 ± 0.01^{a}	2.75 ± 0.15^{a}	1.10 ± 0.15^{a}	1.32 ± 0.02^{a}
F2	7.98±0.25^{ab}	6.68 ± 0.05^{a}	6.54 ± 0.03^{ab}	5.56±0.22^{a}	5.56 ± 0.12^{a}	5.35 ± 0.07^{a}	2.42 ± 0.30^{a}	1.12 ± 0.08^{a}	1.19 ± 0.09^{a}
F3	7.49 ±0.26^{b}	6.49 ± 0.06^{b}	6.47 ± 0.05^{b}	5.32±0.24^{a}	5.30 ± 0.14^{a}	5.32 ± 0.06^{a}	2.17 ± 0.15^{ab}	1.19 ± 0.10^{a}	1.08 ± 0.15^{a}

Values are expressed as mean of 6 determinations ± S.E.M. and those with different superscripts down the column are statistically different ($p < 0.05$)
C- Control Rats fed with feed without *Ficus exasperata* leaf; F1- Rats fed with 10 % *Ficus exasperata* leaf-based diet; F2- Rats fed with 30 % *Ficus exasperata* leaf-based diet; F3- Rats fed with 50 % *Ficus exasperata* leaf-based diet

Kidney function indices

A significant increase ($p<0.05$) in serum urea concentration of rats fed with 30 and 50 % FELD was recorded at the end of days 7 and 14 of this study compared to control (Table 4). However by day 21, there was no significant difference ($p>0.05$) in the urea concentration of the test diets compared to control. Similarly, serum creatinine concentration of groups fed with 30 and 50 % FELD increased significantly ($p<0.05$) compared to control at end of days 7 and 14, while there was no significant difference ($p>0.05$) in the results at the end of day 21 of the study. Serum electrolytes concentrations, kidney and serum ALP activities were not significantly different ($p>0.05$) to control at the end of the experimental period.

Histopathological study

Photomicrograph of both the liver and kidney of rats fed with FELD showed intact liver and kidney architecture for all the experimental groups. No degenerative changes and inflammation was observed in the livers. For the kidneys, the glomerula and tubules appeared normal, and there was no evidence of tubular necrosis.

Table 3: Serum total and conjugated bilirubin concentration of rats fed with *Ficus exasperata* leaf-based diet

	Day 7		Day14		Day21	
Group	total bilirubin (µmol/l)	conjugated bilirubin (µmol/l)	total bilirubin (µmol/l)	conjugated bilirubin (µmol/l)	total bilirubin (µmol/l)	conjugated bilirubin (µmol/l)
C	8.50 ± 0.05^a	0.02 ± 0.00^a	8.80 ± 0.26^a	0.02 ± 0.00^a	8.98 ± 0.31^a	0.02 ± 0.00^a
F1	9.00 ± 0.02^a	0.02 ± 0.00^a	8.98 ± 0.11^a	0.02 ± 0.01^a	9.47 ± 0.26^a	0.02 ± 0.01^a
F2	9.22 ± 0.21^a	0.02 ± 0.00^a	9.55 ± 0.05^a	0.02 ± 0.00^a	9.61 ± 0.04^a	0.02 ± 0.00^a
F3	9.32 ± 0.04^a	0.02 ± 0.00^a	9.56 ± 0.06^a	0.02 ± 0.00^a	9.66 ± 0.56^a	0.02 ± 0.00^a

Values are expressed as mean of 6 determinations ± S.E.M. and those with different superscripts down the column are statistically different ($p < 0.05$)

C- Control Rats fed with feed without *Ficus exasperata* leaf; F1- Rats fed with 10 % *Ficus exasperata* leaf-based diet; F2- Rats fed with 30 % *Ficus exasperata* leaf-based diet; F3- Rats fed with 50 % *Ficus exasperata* leaf-based diet

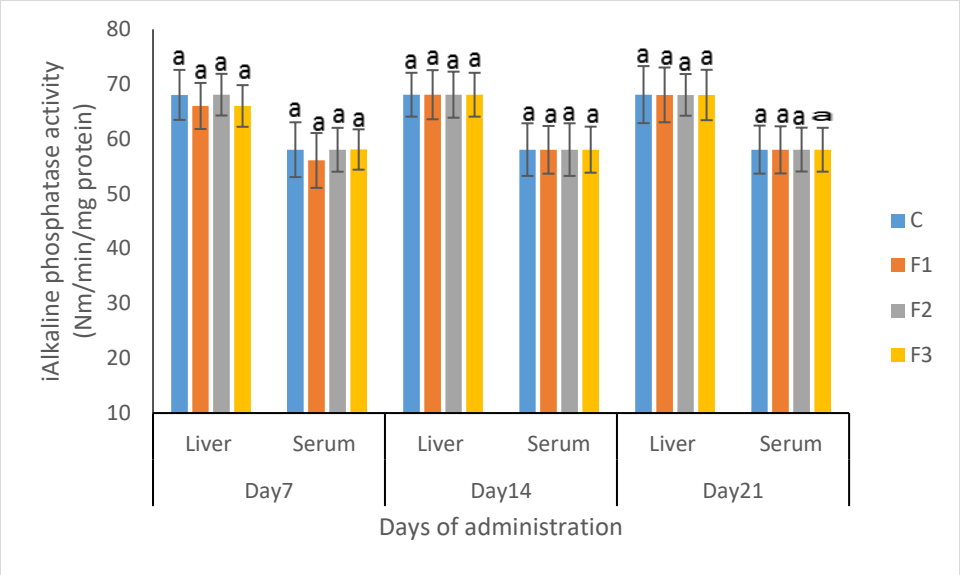


Figure 1: Liver and serum alkaline phosphatase activities of rats fed with *Ficus exasperata* leaf-based diet

Values are expressed as mean of 6 determinations ± S.E.M. and those with different superscripts down the column are statistically different ($p < 0.05$)

C- Control Rats fed with feed without *Ficus exasperata* leaf; F1- Rats fed with 10 % *Ficus exasperata* leaf-based diet; F2- Rats fed with 30 % *Ficus exasperata* leaf-based diet; F3- Rats fed with 50 % *Ficus exasperata* leaf-based diet.

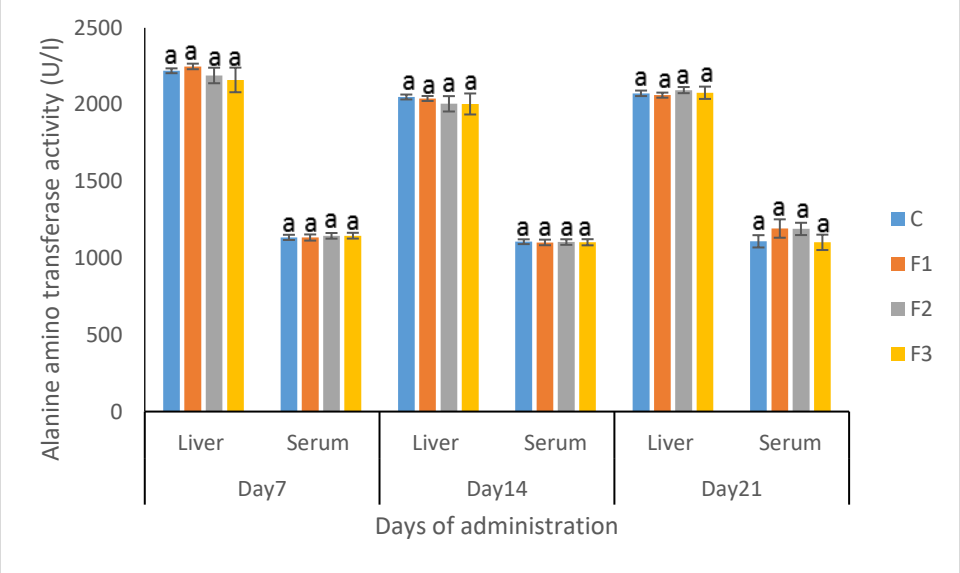


Figure 2: Liver and serum alanine amino transferase activity of rats fed with *Ficus exasperata* leaf-based diet

Values are expressed as mean of 6 determinations ± S.E.M. and those with different superscripts down the column are statistically different ($p < 0.05$)

C- Control Rats fed with feed without *Ficus exasperata* leaf; F1- Rats fed with 10 % *Ficus exasperata* leaf-based diet; F2- Rats fed with 30 % *Ficus exasperata* leaf-based diet; F3- Rats fed with 50 % *Ficus exasperata* leaf-based diet

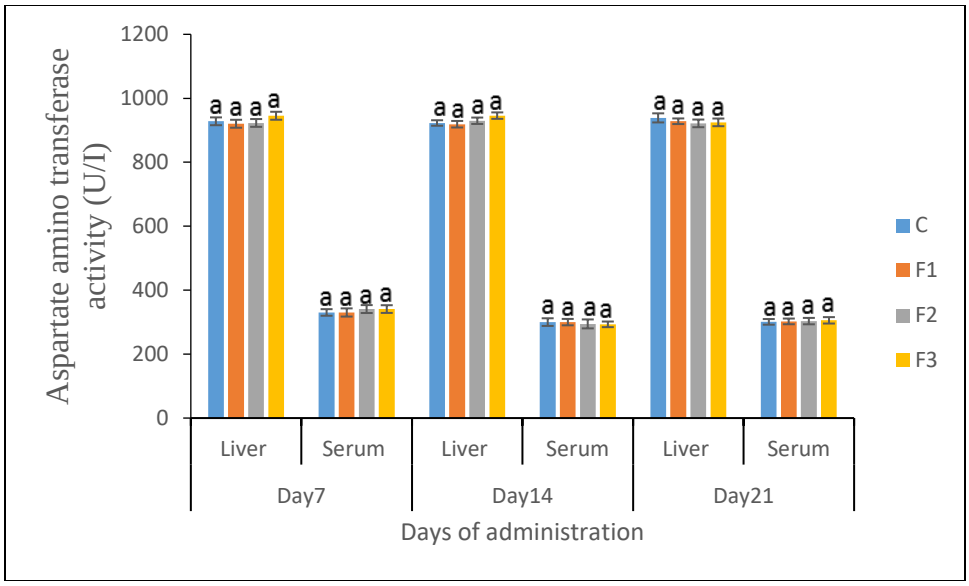


Figure 3: Liver and serum aspartate amino transferase activity of rats fed with *Ficus exasperata* leaf-based diet

Values are expressed as mean of 6 determinations ± S.E.M. and those with different superscripts down the column are statistically different ($p < 0.05$)

C- Control Rats fed with feed without *Ficus exasperata* leaf; F1- Rats fed with 10 % *Ficus exasperata* leaf-based diet; F2- Rats fed with 30 % *Ficus exasperata* leaf-based diet; F3- Rats fed with 50 % *Ficus exasperata* leaf-based diet

Kidney function indices

Table 4: Serum urea and creatinine concentrations of rats fed with *Ficus exasperata* leaf-based diet

Groups	Urea (mg/dl)			Creatinine (mg/dl)		
	Day 7	Day 14	Day 21	Day 7	Day 14	Day 21
C	59.89±0.35^{a}	54.61 ± 0.50^{a}	52.21± 0.76^{a}	0.18±0.04^{a}	0.24 ± 0.02^{a}	0.78 ± 0.02^{a}
F1	58.98 ± 0.36^{a}	56.44 ± 0.33^{a}	55.87± 5.04^{a}	0.74±0.03^{ab}	0.28 ± 0.02^{a}	0.82 ± 0.03^{a}
F2	76.77 ±0.30^{b}	58.89 ± 0.12^{b}	50.83 ± 0.30^{a}	1.49±0.04^{bc}	1.22 ± 0.04^{b}	1.00 ± 0.03^{a}
F3	123.97±0.18^{c}	60.32 ± 2.02^{b}	51.66 ± 0.22^{a}	2.08 ±0.03^{c}	1.28 ± 0.03^{b}	1.19 ± 0.04^{a}

Values are expressed as mean of 6 determinations ± S.E.M. and those with different superscripts down the column are statistically different ($p < 0.05$)

C- Control Rats fed with feed without *Ficus exasperata* leaf; F1- Rats fed with 10 % *Ficus exasperata* leaf-based diet; F2- Rats fed with 30 % *Ficus exasperata* leaf-based diet; F3- Rats fed with 50 % *Ficus exasperata* leaf-based diet

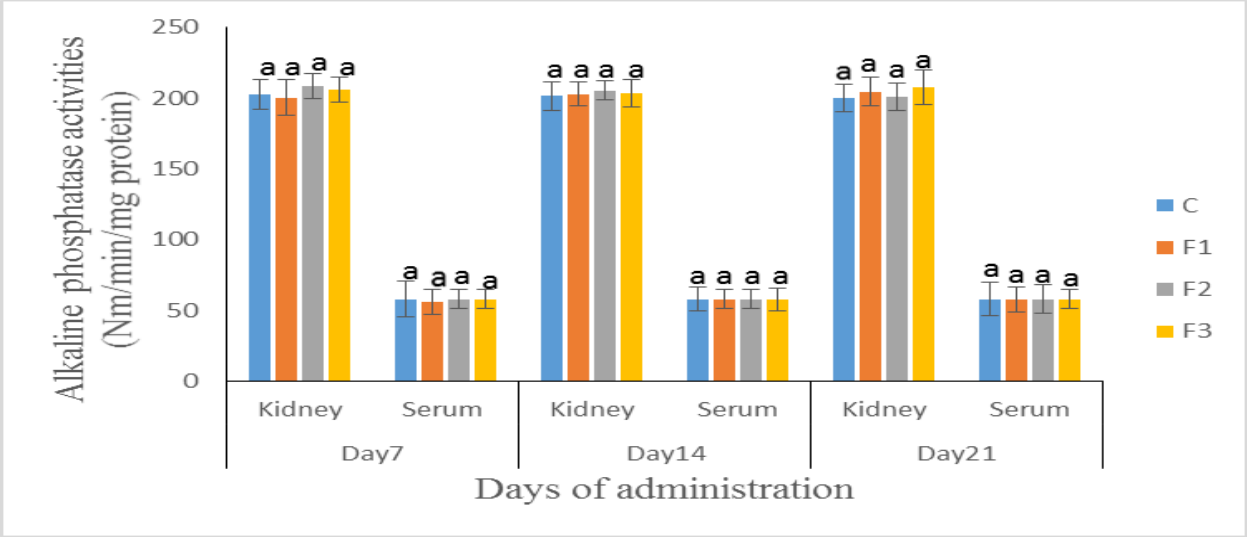


Figure 4: Kidney and serum alkaline phosphatase activity of rats fed with *Ficus exasperata* leaf-based diet

Values are expressed as mean of 6 determinations ± S.E.M. and those with different superscripts down the column are statistically different ($p < 0.05$)

C- Control Rats fed with feed without *Ficus exasperata* leaf; F1- Rats fed with 10 % *Ficus exasperata* leaf-based diet; F2- Rats fed with 30 % *Ficus exasperata* leaf-based diet; F3- Rats fed with 50 % *Ficus exasperata* leaf-based diet

Discussion

The present study evaluated the effect of *Ficus exasperata* leaf-based diet on some selected liver and kidney function indices of wistar rats. Liver and kidney are important organs that perform a central role in metabolism. The liver is responsible for the uptake, metabolism, conjugation, and excretion of various endogenous and foreign substances. It also perform immunological function, as the reticuloendothelial capacity of the liver plays a role in phagocytosis, and clearance of microorganisms and endotoxins from the portal blood. The kidney on the other hand maintains total body homeostasis through excretion of metabolic wastes and regulation of intracellular fluid volume, electrolyte composition, and acid-base balance (Ukoha *et al.*, 2015). Hence, ensuring that any therapeutic agent developed does not impair the functions of these organs is very important.

The non-significant alteration in the albumin, globulin and bilirubin concentrations as well as the ALP, ALT and AST activities observed in this study, suggests there is no impairment in both the enzymic and non-enzymic parameters of the liver function at the end of days 7, 14 and 21. However, the cause of the significant reduction in the total protein concentration of group fed with 50 % FELD for days 7, 14 and 21 observed was not clear, because there was no concomitant alteration in albumin or globulin concentrations of the rats. The level of total protein in the blood is normally a relatively stable value, reflecting a balance in loss of old protein molecules and production of new protein molecules. However, total protein may decrease in conditions where production of albumin or globulin proteins is impaired, such as severe liver disease (Busher, 1990).

Table 5: Serum cation concentrations in rats fed with *Ficus exasperata* leaf-based diet

Groups	Na^+ (mmol/l)			K^+ (mmol/l)			Ca^{2+} (mmol/l)		
	Day 7	Day 14	Day 21	Day 7	Day 14	Day 21	Day 7	Day 14	Day 21
C	109.28± 2.74[a]	108.00±1.20[a]	109.22±1.40[a]	3.61±0.27[a]	3.68±0.20[a]	3.60±0.30[a]	2.51±0.02[a]	2.50±0.10[a]	2.52±0.01[a]
F1	109.63±2.40[a]	109.24±2.00[a]	109.20±1.00[a]	3.81±0.27[a]	3.80±0.24[a]	3.81±0.26[a]	2.51±0.10a	2.52±0.02[a]	2.51±0.02[a]
F2	108.34±2.32[a]	109.62±1.00[a]	108.22±2.02[a]	3.53±0.02[a]	3.58±0.18[a]	3.56±0.17[a]	2.49±0.02[a]	2.48±0.12[a]	2.50±0.02[a]
F3	109.28±1.74[a]	108.00±1.84[a]	108.24±2.24[a]	3.61±0.27[a]	3.61±0.28[a]	3.60±0.26[a]	2.51±0.02[a]	2.51±0.10[a]	2.51±0.01[a]

Values are expressed as mean of 6 determinations ± S.E.M. and those with different superscripts down the column are statistically different ($p < 0.05$)
C- Control Rats fed with feed without *Ficus exasperata* leaf; F1- Rats fed with 10 % *Ficus exasperata* leaf-based diet; F2- Rats fed with 30 % *Ficus exasperata* leaf-based diet; F3- Rats fed with 50 % *Ficus exasperata* leaf-based diet

Table 6: Serum anion concentrations in rats fed with *Ficus exasperata* leaf-based diet

Groups	PO_4^{3-} (mg/dl)			Cl^- (mmol/l)			HCO_3^- (mmol/l)		
	Day 7	Day 14	Day 21	Day 7	Day 14	Day 21	Day 7	Day 14	Day 21
C	7.69±0.39[a]	7.68±0.38[a]	7.68±0.39[a]	79.26±1.18[a]	78.26±1.15[a]	78.30±1.20[a]	32.16±3.43[a]	33.23±2.24[a]	32.20±2.20[a]
F1	7.66±0.40[b]	7.64±0.80[a]	7.66.0.41[a`]	80.36±1.59[a]	78.40±1.08[a]	79.00±1.89[a]	33.32±1.57[a]	33.20±2.00[a]	33.00±1.18[a]
F2	7.72±0.47[ab]	7.70±0.45[a]	7.70±0.44[a]	81.11±0.81[a]	79.05±0.80[a]	78.42±1.15[a]	35.37±4.11[a]	34.02±1.18[a]	32.00±2.00[a]
F3	7.69±0.39[a]	7.70±0.36[a]	7.70±0.42[a]	79.26±1.18[a]	79.08±1.18[a]	77.02±2.28[a]	32.16±3.43[a]	33.20±2.02[a]	33.34±1.00[a]

Values are expressed as mean of 6 determinations ± S.E.M. and those with different superscripts down the column are statistically different ($p < 0.05$)
C- Control Rats fed with feed without *Ficus exasperata* leaf; F1- Rats fed with 10 % *Ficus exasperata* leaf-based diet; F2- Rats fed with 30 % *Ficus exasperata* leaf-based diet; F3- Rats fed with 50 % *Ficus exasperata* leaf-based diet

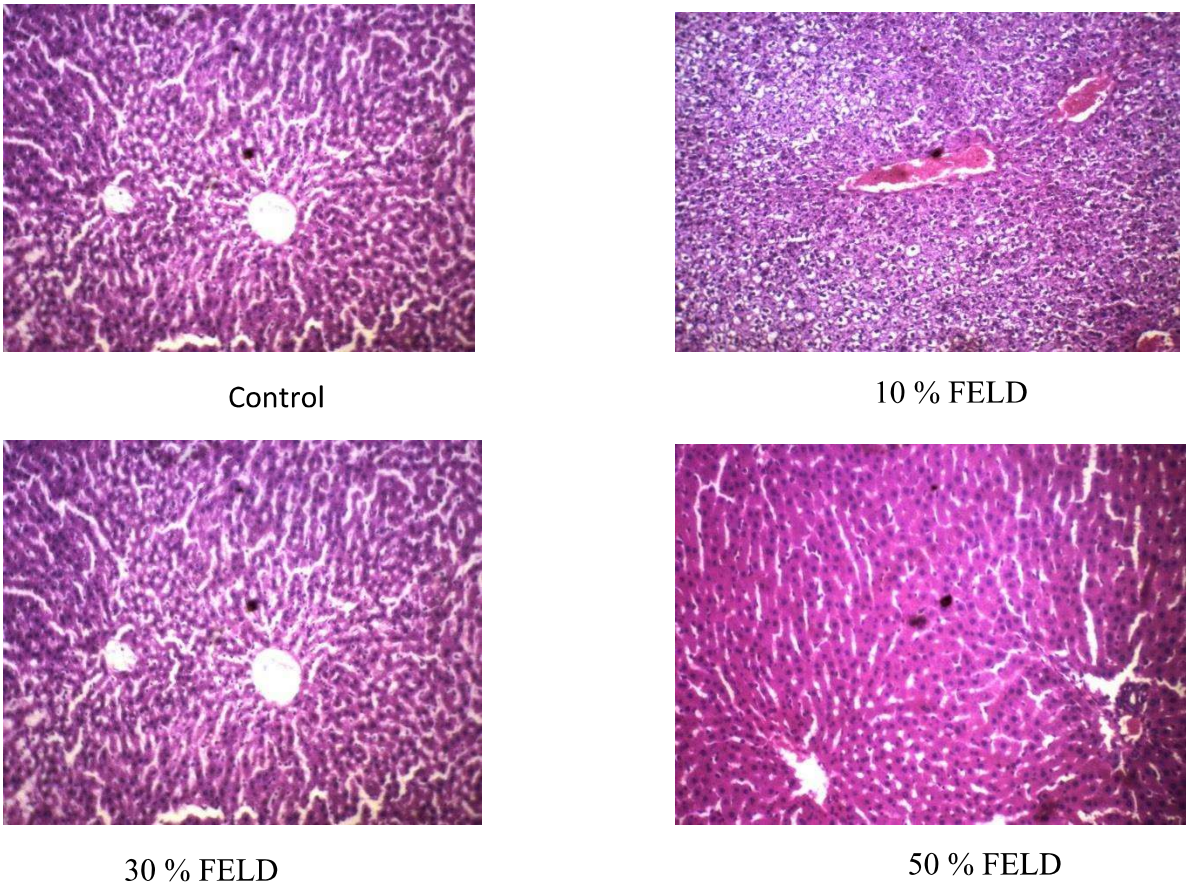
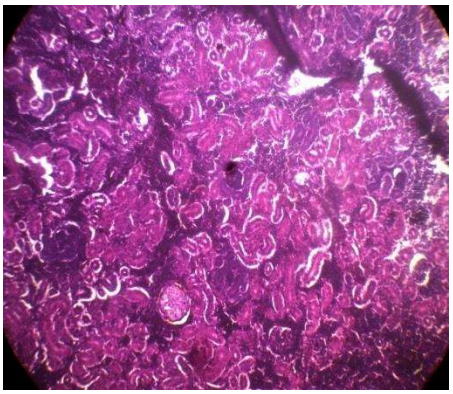
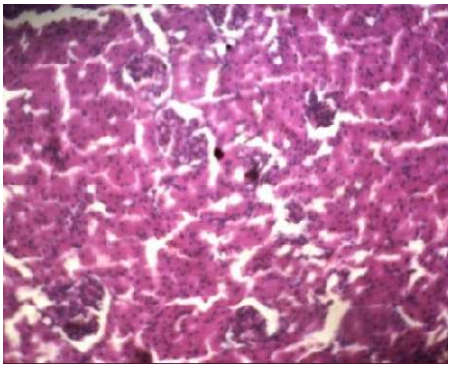


Figure 5: Photomicrographs showing representative hematoxylin-eosin-stained (400x) sections of the livers of control and experimental rats

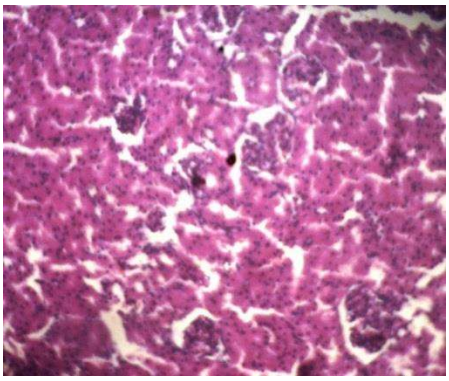
FELD – *Ficus exasperata* leaf-based diet



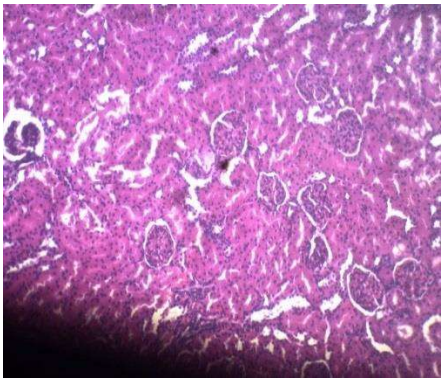
Control



10 % FELD



30 % FELD



50 % FELD

Figure 6: Photomicrographs showing representative hematoxylin-eosin-stained (400x) sections of the kidneys of control and experimental rats

FELD – *Ficus exasperata* leaf-based diet

The kidney function parameters evaluated in this study shows a significant increase in the serum urea and creatinine concentrations of rats fed with 30 and 50 % FELD for 7 and 14 days respectively. This suggests there might be an initial assault in the excretory function of the kidneys, which was later reversed at the end of day 21 of this study. Urea is synthesized in the body of many organisms as part of the urea cycle, either from the oxidation of amino acids or from ammonia (Walter, 2004). It is found soluble in the blood and is excreted by the kidney as a component of urine. Creatinine on the other hand, is a break-down product of creatine phosphate in muscle and is usually produced at fairly constant rates by the body. It is freely filtered at the glomerulus and is not reabsorbed by the tubules. The level of serum creatinine is the most commonly used indicator of renal function. A rise in blood creatinine levels is observed only with marked damaged to functioning nephrons (Kaplan and Pesce, 1996; Gross *et al*., 2005).

The results of the serum electrolytes and alkaline phosphatase activities were not altered compared to the control in this study. This further corroborated reversal of the initial assault on the kidney function of groups fed with 30 and 50 % FELD respectively. Also, this findings was further supported by the results of the histopathology assessment of the liver and kidney which showed intact tissues architecture. The non-toxic effect of FELD observed in this study is in agreement with reports of some previous researchers that have rendered the leaf of *F. exasperata* relatively safe for possible human consumption (Sowemimo *et al*., 2007; Ogbonnia *et al*., 2011).

Conclusion

The results of this study suggest that consumption of 10, 30 and 50 % *Ficus exasperata* leaf-based diet for 7, 14 and 21 days did not impair the selected liver and kidney functions indices of experimental rats. Therefore, it might be safe for consumption.

References

Adewole, S.O., Adenowo, T.K., Thajasvarie, N. and Ojewole, J.A.O. (2011). Hypoglycaemic and hypotensive effects of *Ficus exasperata* vahl. (Moraceae) leaves aqueous extract in rats. *African Journal of Traditional, Complementary and Alternative medicines*, 8: 275 - 283.

Allaby, M. (2012). A Dictionary of Plant Sciences. Oxford University Press

Ansari, M.M. and Kumar, D.S. (2012). Fortification of Food and Beverages with Phytonutrients. *Food and Public Health*, 2 (6): 241 – 253

Bello, M. O., Abdul-hammad, M., Adepoju, A. J., Esan, O. A. and Tiamiyu, A. A (2014). Nutritional Composition and Fatty Acids Profile of *Ficus exasperata* Fruit and Fruit Oil. *Journal of Natural Sciences Research*, 4 (2): 25 - 29.

Bergmeyer, H. U. (1987). Methods of enzymatic analysis, third edition, vol. VII. Pp 572.

Busher, J. T. (1990). Serum Albumin and Globulin. In: Walker, H. K, Hall, W. D., Hurst, J. W., editors. *Clinical Methods: The History, Physical and Laboratory Examinations*. 3rd edition. Boston:Butterworths. Chapter 101. Available from: https://www.ncbi.nlm.nih.gov/books/NBK204/

Falade, O. S., Dare, A. F., Bello, M. O., Osuntogun, B. O. and Adewusi, S. R. A. (2004). Varietal changes in proximate composition and the effect of processing on the ascorbic acid content of some Nigerian vegetables. *Journal of Food Technology*, 2: 103 - 108.

Fawcett, J. K. and Scott, J. E. (1960). A rapid and precise method for the determination of urea. *Journal of Clinical Chemistry*, 13 (2): 156 - 159.

Gross, M. L., Amann, K. and Ritz, E. (2005). Nephron number and renal risk in hypertension and diabetes. *Journal of the American society of Nephrology*, 16 (1): S27 – S29.

Henry, J. B. (2001). Clinical Diagnosis & Management by Laboratory Methods, 20th Edn.

Ijeh, I. I. and Ukweni, A. I. (2007). Acute effect of administration of ethanol extracts of *Ficus exasperata* vahl on kidney function in albino wistar rats. *Journal of Medicinal Plant Research*, 1 (2): 027 – 029.

Jenkins, A. L., Jenkins, D. J. A., Wolever, T. M. S., Rogovik, A. L., Jovanovski, E., Bozikov, V., Rahelic, D. and Vuksan, V. (2008). Comparable postprandial glucose reductions with viscous fiber blend enriched biscuits in

healthy subjects and patients with diabetes mellitus: Acute randomized controlled clinical trial. *Croatian Medical Journal*, 49: 772 - 782.

Joseph, B. and Raj, S.J. (2010). Phytopharmacological and phytochemical properties of three *Ficus* species - An overview. *Int J Pharma Bio Sci*, 1:246-53.

Kaplan, L. A. and Pesce, A. J. (1996).Clinical Chemistry: Theory, Analysis, Correlation. 3rd ed. St. Louis, MO: Mosby, Pp 1064.

Krause, W. J. (2001). The art of examining and interpreting histologic preparations: A student handbook. Partheton publishing group, UK, Pp 566.

Mbakwem-Aniebo, C., Onianwa, O. and Okonko, I. O. (2012). Effects of *Ficus Exasperata Vahl* on common dermatophytes and causative agent of *Pityriasis versicolor* in Rivers State, Nigeria. *American Journal of Dermatology and Venereology*, 1 (1): 1 – 5.

Ogbonnia, S.O., Mbaka, G.O., Anyika, E.N., Emordi, J.E. and Nwakakwa, N. (2011). An evaluation of acute and subchronic toxicities of a Nigerian polyherbal tea remedy. *Pak J Nutr*, 10:1022-8.

OladosuI, A., Zubair, M.F., Ali, M.S. and Olawore, N.O. (2009). Anticandidal activity of volatile compounds from the root bark of *Ficus exasperata* Vahl-Holl (Moraceae). *JEOBP*, 12:562-8.

Oxford dictionary of English (2010). Herb. Oxford University Press (3rd ed.) p. 819.

Peng, X., Ma, J., Cheng, K. W., Jiang, Y., Chen, F. and Wang, M. (2010). The effects of grape seed extract fortification on the antioxidant activity and quality attributes of bread. *Food Chemistry*, 119: 49 - 53.

Reitman, S. and Frankel, S. (1957). A colorimetric method for determination of serum glutamate oxaloacetate and glutamic pyruvate transaminase. *American Journal of Clinical Pathology*, 28: 56 - 58.

Sink, T. D. and Neal, J. W. (2009). Stress response and posttransport survival of hybrid striped bass transported with or without clove oil. *North American Journal of Aquaculture*, 71: 267 - 275.

Soji-Omoniwa, O. and Oloyede, H. O. B (2018). Normoglycaemic Action of *Ficus exasperata vahl.* Leaf-Based Diet on Fructose and Streptozotocin-induced Diabetic Rats. *Nigerian Journal of Biochemistry and Molecular Biology*, 33(1&2):18-31.

Sowemimo, A. A., Fakoya, F. A., Awopetu, I., Omobuwajo, O. R. and Adesanya, S. A. (2007). Toxicity and mutagenic activity of some selected Nigerian plants. *Journal of Ethnopharmacol*ogy, 113: 427 - 432.

Tietz, N. W. (1995). Clinical Guide to Laboratory tests. 3rd ed. Philadelphia. WB. Saunders, Pp. 268 - 273.

Trinder, P. (1951). A rapid method for the determination of sodium in serum. *Analytical Chemistry*, 76: 596 - 599.

Ukoha, U. U., Mbagwu, S. I., Ndukwe, G. U., and Obiagboso, C. (2015). Histological and biochemical evaluation of the kidney following chronic consumption of *Hibiscus sabdariffa*. *Advances in biology*. 1-5.

Umerie, S. C., Ogbuagu, A. S. and Ogbuagu, J. O. (2004). Stabilization of palm oils by using *Ficus exasperata* leaves in local processing methods. *Bioresource Technology*, 94: 307 - 10.

Walter, F. B. (2004). Medical Physiology: A Cellular and Molecular Approach. Elsevier Saunders, Pp. 837.

Wright, R., Albert, K. G. M., Marran, S. and Millwardsandler, G. H. (1979). Liver and biliary disease. W.B. Sanders Company Limited, London.