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Research Article

The Effect of Aqueous Extract of African Pear Pulp (*Dacryodes edulis*) on the Kidney of Adult Wistar Rats

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Abstract

The *Dacryodes edulis* fruit is one amongst the many indigenous tropical fruits greatly cherished and appreciated for its pulp, Nutritionists said that its pulpy pericarp has the qualities of butter and indeed rich in oil and vitamins. The aim is to study the effect of aqueous extract of African pear pulp (*dacryodes edulis*) on the kidney of adult wistar rats, Twenty adult wistar rats were randomly divided into four groups with five rats in each group (A, B, C, D and E). Group A-(Control) received only water and feed , Group B received only 500mg/kg (1ml), Group C received only 1000mg/kg (3ml), Group D received only 2000mg/kg (5ml) after 21days of administration of African Pear in graded doses. The kidney were then harvested and put in a normal saline to maintain normal physiological conditions after which they were weighed and fixed in 10% formal saline for Histological processing, Blood for serum preparation was collected through ocular puncture for biochemical studies. The results obtained in this study following the administration of african pear pulp showed significant increase in the body and organ weight compared to the control as well as the creatinine and urea level, in conclusion this study suggest that moderate intake of african pear pulp and maybe detrimental to kidney health at high dose.

Keywords: *Dacryodes edulis*; Wistar Rats; Kidney

Introduction

Dacryodes edulis is also known as African plum or African pear. It is an indigenous fruit tree in the humid low lands and plateau regions of West, Central Africa and Gulf of Guinea countries. In the south-east Nigeria, the trees are grown around homesteads and flowering takes place from January to April. The major fruiting season is between May and October [1,2]. The *Dacryodes edulis* fruit is one amongst the many indigenous tropical fruits greatly cherished and appreciated for its pulp. The plant belongs to the Burseraceae family and possesses many medicinal and nutritional properties. In Nigeria when in season, the fruit which is contained in a pod is traditionally consumed raw or after tenderization in hot water or roasted [3]. Sometimes it may be enjoyed with roasted or boiled corn. *Dacryodes edulis* tree is typically planted for its shade and its fruit. Also, the bark of the tree is aromatic [4].

Nutritionists said that its pulpy pericarp has the qualities of butter and indeed rich in oil and vitamins! Cooked flesh of the fruit has a texture similar to butter. It is this portion of the delicious African pear that is eaten, either raw or cooked, especially with corn – cooked or roasted. Pear and corn share similar season and mix well in the bowels. Studies however revealed that African pear is rich in carbohydrates, sugars, fiber, vitamins, especially thiamine, riboflavin, niacin, panthotenatefolate, vitamin C and vitamin B6. Pears have antioxidant properties, because they are rich in Vitamin C and therefore can protect body cells from oxygen-related damage caused by free radicals. The presence of fiber in pears helps prevent constipation and also ensures regularity of bowel movement. "Studies have revealed that eating pears help protect women against postmenopausal breast cancer. Pear is described as a hypoallergenic fruit, that is, less likely to produce an adverse response than other fruits.

Regular consumption of pears might lower the risk of age-related macular degeneration, the main cause of vision loss in older adults. It has been reported that pears help lower blood pressure and also reduce the chances of a stroke and high content of pectin in pears makes them useful in lowering of cholesterol "Pears have been found to be good for colon health. Pear juice, being rich in fructose and glucose, serves as a very quick source of energy. Drinking a glass of pear juice is believed to be helpful in bringing down fever. The antioxidant properties of African pear makes it good for strengthening of the immune system, while the consumption of pear juice helps relieve pain in various inflammatory conditions. "The presence of boron in it helps the body retain calcium and thus, reduces the risk of osteoporosis. The folic acid in pear prevents neural tube defects in infants.

The liver is the largest organ in the body, weighing about 1.5kg or about 2% of an adults body weight. with a large right lobe and smaller left lobe, it is the largest gland and is situated in the abdominal cavity beneath the diaphragm [5]. The liver is responsible for some 500 bodily functions. It plays a role in digestion, sugar and fat metabolism, and the body's immune defense. It processes almost everything a person eats, breathes, or absorbs through the skin. About 90% of the body's nutrients pass through the liver from the intestines. The liver convert's food into energy, stores nutrients, and produces blood proteins. The liver also acts as a filter to remove harmful substances from the blood. In the developing fetus, blood cells are produced in the liver. The liver plays an important role in the digestion and processing of food. Liver cells produce bile, a greenish-yellow fluid that aids the digestion of fats and the absorption of fat-soluble nutrients.

The kidney is a paired organ located in the posterior abdominal wall, whose functions include the removal waste products from the blood and regulation of the amount of fluid and electrolytes balance in the body. As in humans, the majority of drugs and food administered are eliminated by a combination of hepatic metabolism and renal excretion [6]. It would therefore worthwhile to examine the effect of the *Dacryodes edulis* (African pear) on the kidney of an adult wistar rats.

Materials and Methods

Location and duration of the study

This study was carried out in the Department of Human Anatomy, Nnamdi Azikiwe University, Nnewi Campus, Anambra State, Nigeria. The experimental animals were allowed to acclimatize for a period of 14days after which the test substances was administered for 21days; the entire experiment lasted for five weeks.

Ethical approval

Ethical approval was obtained from the ethical committee, Faculty of Basic Medical Science, Nnamdi Azikiwe University, Nnewi Campus.

Procurement and preparation of extract

The African pear was randomly purchased from Nkwo Market in Nnewi, Anambra State of Nigeria, The African pear was washed in running tap water to remove dirt, cut into pieces and were air dried under ambient temperature. The dried fruits were milled into coarse powder using Local grinder. 500g of the dried fruits was macerated in 1.5litres of Luke-warm for 24hours. It was then filtered using a clean handkerchief and further filtration using Whatman No 1 filter paper. The filtrate was concentrated using a rotatory evaporator and was further dried using a laboratory oven at 45oc into a gel-like form. The extract was preserved in a refrigerator at 40c for further usage.

Experimental animals

The research was done with twenty adult albino wistar rats weighing between 100-180g. The rats were bought from a local farm at Nnewi and moved to the site of the experiment. They were divided into four groups (A to D) and were housed in four standard cages. The weight of each rat was measured using an analytical weighing balance. They were fed with feed and water for a period of two weeks to enable them acclimatize with their new environment before the experiment began. During the acclimatization period, the rats were fed with normal grower's mesh of known weight of about 100g daily and given Water. The group A served as the Control group while group B, C, and D served as the Test groups.

Experimental design

The rats were weighed before the administration of the test substances commenced and thereafter weighed once weekly on Fridays of the week before feeding.

The administration of the African pear was done as follows

- Group A-(Control) received only water and feed daily for three weeks
- Group B received only 500mg/kg (1ml) body weight daily for three weeks

- Group C received only 1000mg/kg (3ml) body weight daily for three weeks
- Group D received only 2000mg/kg (5ml) body weight daily for three weeks

All administration was done with canula and syringes, orally.

Organ collection

The rats were sacrificed after 21 days of administration of African Pear in graded doses. The kidney were then harvested and put in a normal saline to maintain normal physiological conditions after which they were weighed and fixed in 10% formal saline for Histological processing.

Tissue processing

After weighing the organs, a small part of the Amygdala tissues were cut out and immediately fixed in 10% formal saline in order to preserve the various constituents of the cells in their normal micro anatomical position and to prevent autolysis and putrefaction. After fixation the tissues were dehydrated to remove water and other substances. This was carried out in different percentages of alcohol 50%, 70% and 95% absolute. In each grade of alcohol, tissues were changed twice for two (2) hours, one (1) hour for each change. After dehydration, tissues were cleared in xylene for two (2) hours after which infiltration was done in molten paraffin wax at a temperature of 60oc for two (2) hours, each in two changes. When the paraffin wax cools, it sets as a hard block which allows for easy sectioning of the tissues. The tissue sections were produced by normal histochemical methods of dehydration, clearing, impregnation, embedding, sectioning and staining (with H&E). The micrographs of the relevant stained sections were subsequently taken with the aid of a light microscope.

Statistical analysis

The data were analyzed using SPSS version 23. Values were represented as MEAN and SEM, Relative Organ weight (Brain) were analyzed using One way ANOVA, followed by Post Hoc LSD multiple comparison. Body weight was analyzed using Student dependent T-test. Values were considered significant at $P < 0.05$.

Result

The effect of African pear on body weight of Wistar Rats

Result from the table above show that there was a significant increase in the body weight in group A when comparing the initial weight (125.00 ± 2.88) to the final weight (142.00 ± 2.50). For group B, there was a significant increase in the body weight when comparing the initial weight (180.00 ± 0.00) to the final weight (183.00 ± 2.50). For group C, there was an insignificant decrease in the body weight when comparing the initial weight (140.00 ± 0.00) to the final weight (145.00 ± 9.57). For group D, there was an insignificant increase in the body weight when comparing the initial weight (130.00 ± 0.00) to the final weight (140.00 ± 13.54).

Body weight (g)		MEAN	±SEM	P-VALUE	T-Value
Group A	Initial	125.00	±2.88		
	Final	142.00	±2.50	0.006*	-7.000
Group B	Initial	180.00	±0.00		
	Final	193.00	±2.50	0.001*	-3.000
Group C	Initial	140.00	±0.00		
	Final	175.00	±9.57	0.638	-0.522
Group D	Initial	130.00	±0.00		
	Final	170.00	±13.54	0.514	-0.739

Table 1: Showing the Effect of African Pear on Body weight.

Data were analyzed using Student dependent T-test and values were considered significant at $P < 0.05$. *$P < 0.05$ means significant.

		MEAN	±SEM	P-VALUE	F-VALUE
Relative Kidney weight (g)	Group A	0.44	±0.01	-	
	Group B	0.43	±0.00	0.699	
	Group C	0.45	±0.02	0.035*	
	Group D	0.43	±0.02	0.699	

Table 2: Showing the Effect of African Pear on Relative Organ weight of Kidney.

Data were analyzed using One way ANOVA followed by Post HOC Fisher's LSD multiple comparism, and data were considered significant at $P < 0.05$. *$P < 0.05$ means significant and $P>0.05$ means not significant.

Result from the table show that there was an insignificant decrease in the relative liver weight in group B (3.56 ± 0.39), C (3.62 ± 0.20) and D (3.56 ± 0.04) when compared to group A (4.22 ± 0.08). For the relative kidney weight, there was a significant increase in group C (0.50 ± 0.02), while an insignificant decrease in group B (0.43 ± 0.00) and D (0.43 ± 0.02) when compared to group A (0.44 ± 0.01).

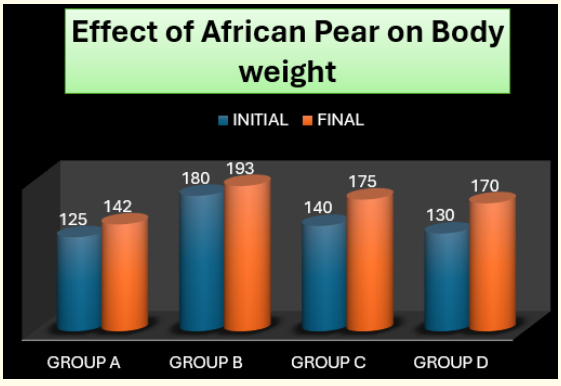

Figure 1: Bar chart showing the Effect of African Pear on Body weight.

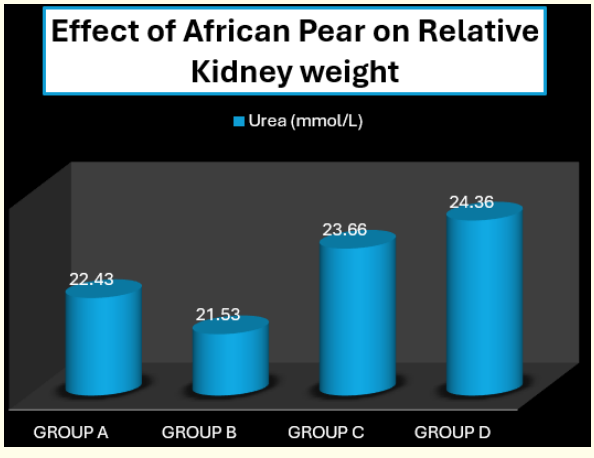

Figure 2: Bar chart showing the Effect of African Pear on Relative Kidney weight.

The effect of African pear on creatinine and urea level

		MEAN	±SEM	P-VALUE	F-VALUE
Creatinine (mg/dL)	Group A	0.73	±0.03		
	Group B	1.26	±0. 03	0.000*	
	Group C	1.16	±0. 03	0.000*	
	Group D	1.63	±0. 08	0.000*	
Urea (mmol/L)	Group A	22.43	±0.80		
	Group B	21.53	±1.75	0.701	
	Group C	23.66	±2.02	0.049*	
	Group D	24.36	±1.53	0.417	

Table 3: Showing the Effect of African Pear on Creatinine and Urea level.

Data were analyzed using One way ANOVA followed by Post HOC Fisher's LSD multiple comparism, and data were considered significant at P < 0.05. *P < 0.05 means significant and P>0.05 means not significant.

Result from the table show that there was a significant increase in creatinine level in group B (1.26 ± 0. 03), C (2.46 ± 0. 03) and D (1.63 ± 0. 08) when compared to group A (0.73 ± 0.03). For Urea level, there was a significant increase in group C (27.66 ± 2.02), and insignificant increase in group D (24.36 ± 1.53), while an insignificant decrease in group B (21.53 ± 1.75) when compared to group A (22.43 ± 0.80).

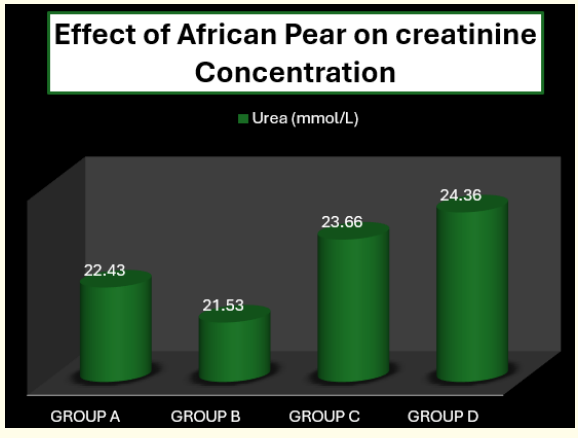

Figure 3: Bar chart showing the Effect of African Pear on Creatinine Concentration.

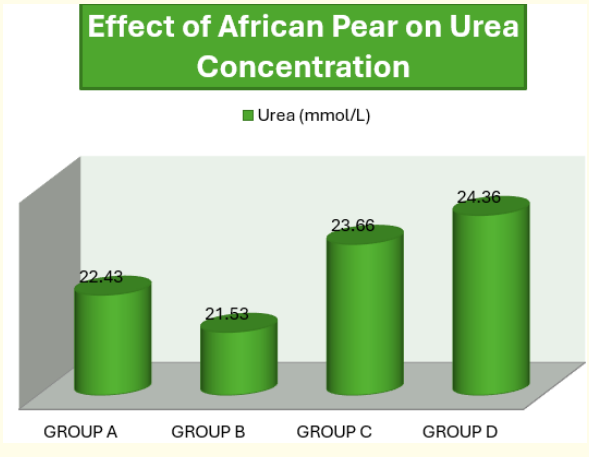

Figure 4: Bar chart showing the Effect of African Pear on Urea Concentration.

Histopathological findings

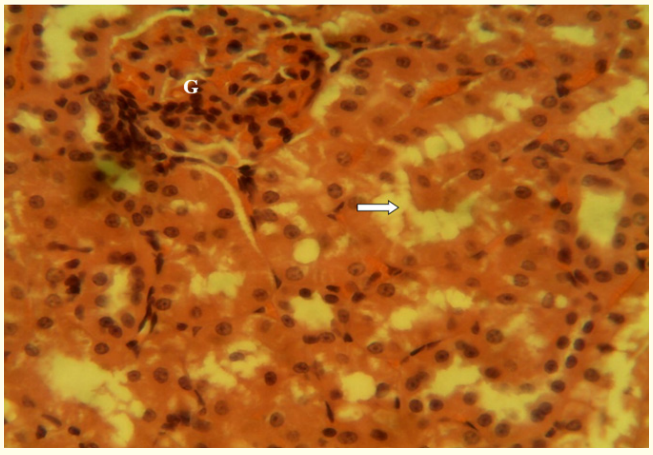

Figure 5: (GROUP A: CONTROL). Photomicrograph section of the kidney showing the glomerulus (G) and renal tubules (white arrow), the kidney architecture are well preserved. Stained by H & E Technique (X 400).

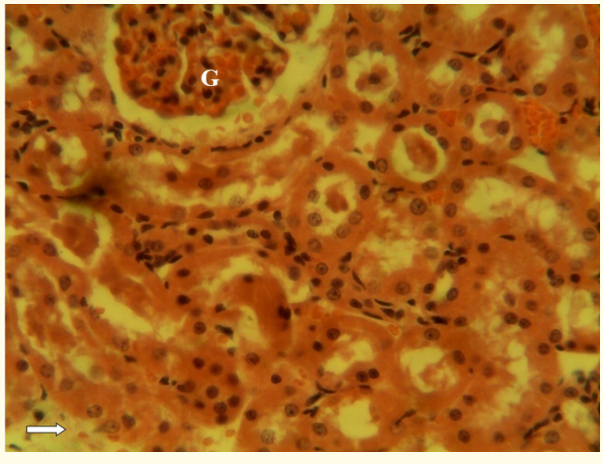

Figure 6: (GROUP B: Administered 500mg/kg of African pear). Photomicrograph section of the kidney showing the glomerulus (G) intact and mild distortion of renal tubules (white arrow). Stained by H & E Technique (X 400).

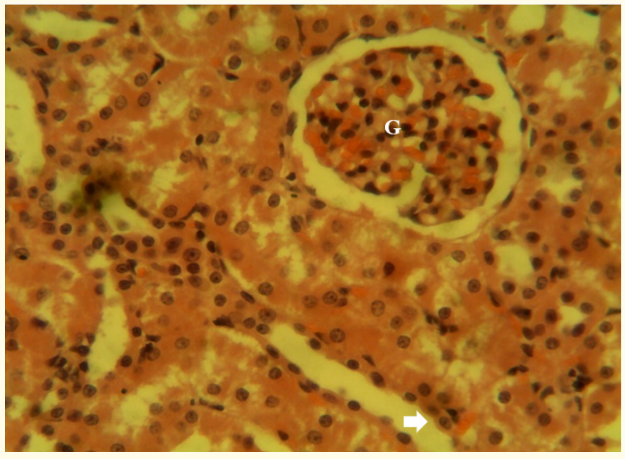

Figure 7: (GROUP C: Administered 1000mg/kg of African pear). Photomicrograph section of the kidney showing the glomerulus (G) intact and increased diameter of renal tubules (white arrow). Stained by H & E Technique (X 400).

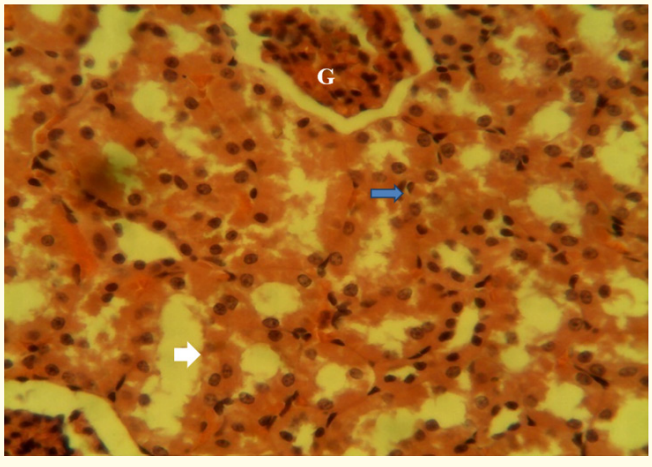

Figure 8: (GROUP D: Administered 2000mg/kg of African pear). Photomicrograph section of the kidney showing the glomerulus (G) intact, with infiltration of mesangial cells (blue arrow) and hypercellularity of renal tubules (white arrow). Stained by H & E Technique (X 400).

Discussion

The kidney whose function is to remove the waste products released by the liver through the urine. That said, the functional relationship between the liver and the kidney is the type that is obvious and cannot be overlooked. The African pear is indigenous to Nigeria and its nutritional and medicinal properties are far reaching.

The results from this research showed that there was significant increase in the weight of the control and group B but not in group C and group D the increase in body weight was expected considering the high lipid content of African pear [7]. In fact, [8] both noted a rise in the total cholesterol level, HDL cholesterol, LDL cholesterol, VLDL cholesterol and triacylglycerol levels in animals fed with pulp extract of African pear. The implication of the high levels of these cholesterol derivatives in development of cardiovascular diseases can never be over emphasized [9].

The control had a higher relative organ weight compared with the other groups. This is in contradiction to the findings of [8] who recorded higher relative liver and kidney weights in the test groups. The reasons for the variation may be because of difference in the length of experimental periods. The work of [8] spanned a period of six weeks while the present work took three weeks. Three weeks may have been enough time for general body weight increase but not enough for concurrent increase in organ weight, hence the lower relative organ weights.

Significantly higher creatinine levels were observed in the test groups when compared with the control group. This goes to contradict the findings of [8]. Also, Group C and D had higher urea concentration levels compared with the control group which tarry with the work of [10]. The increased level of urea observed is an indication of azotaemia. High blood urea is associated with increased tissue protein catabolism, excess breakdown of blood protein and diminished excretion of urea due to kidney damage [11].

The mechanism behind this kidney damage is poorly understood but one thing is sure, this much creatinine is not coming from the liver as damaged liver cannot produce much creatinine. Other sources of creatinine include muscles, with the heart being a prime suspect.

Histopathological findings showed In kidney, group B showed mild distortion of renal tubules, Group C showed increased diameter of renal tubules, Group D showed infiltration of messengian cells and hypercellularity of renal tubules.

The mechanism by which higher doses of African pear causes pathological changes on the kidney cannot be far-fetched from its phytochemistry. As rightly put by `Suzuki [12], in as much as pear has been publicized as a safe and nutritious, care must be taken as to the amount of intake. Two major culprits are the high fat content of pear and the presence of antioxidants like vitamin C. In the case of liver, high fat content would mimic or tend to cause fatty liver thereby imposing much oxidative burden on the liver. One would expect antioxidants like vitamin C to help the liver, but recent study by [13] has shown that antioxidants like vitamin C in higher concentration can switch to the role of pro oxidant. This combined effect of high calorie and pro oxidants is enough to affect the liver, kidney and other organs of the body in adverse manner.

Oxidative stress once induced can lead to cell death usually by damaging the nuclear material thereby inducing the cell to initiating apoptosis [14].

Conclusion

Based on the data presented in this work, the researcher concluded that:

- African pear at moderate intake is safe for kidney.
- African pear at high doses may be detrimental to kidney health.

Recommendations

Based on the data presented in this work, the researcher recommended that:

- Consumers should consume only moderate amount of pear per day to avoid any harm to their vital organs.

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