



Article Info

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Evaluation of Effect of *Pterocarpus santalinus* Leaf Extract on Feed Consumption, Hematological and Kidney Indices of Wistar Rats

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The primary and original source of medication development has been the plant. Long before the prehistoric period, plants were employed for medical purposes. *Pterocarpus santalinus* is a plant native to Asia and Africa that has long been used to treat a variety of diseases. The aim of this study is to evaluate the effect of *Pterocarpus santalinus* on rat's feed consumption, blood and kidney. Animals of either sex were chosen. Group 1 was given distilled water (10 ml/kg), while groups 2, 3, and 4 were given *Pterocarpus santalinus* at concentrations of 100, 200, and 400 mg/kg, respectively. Animals were kept in conventional cages and provided oral access to the extract, water, and food for 28 days before being weighed and slaughtered. Blood was drawn via heart puncture and immediately sent for hematological and chemopathological investigation. The plant's histological toxic potential on the kidney was investigated using the haematoxylin and eosin (H&E) staining technique. There was a marginally significant ($P < 0.05$) drop in RBC, HGB, and MCV, but no change in neutrophils, basophils, eosinophils, or platelets. When compared to the control, *Pterocarpus santalinus* modestly ($P < 0.05$) raised Na level at 300 mg/kg, while other parameters (K, CL, and Urea levels) were generally unaltered. Histological characteristics match haematological parameters. The result of the study showed that the *Pterocarpus santalinus* has little to no toxicity potential on the kidney of rats, indicating that it may be safe for human consumption.

Keywords: Hematological, Histological, kidney, *Pterocarpus santalinus*, feed consumption.

1. Introduction

Most people have two kidneys [12]. They are bean shaped bodies located below the abdomen, on either side of the spine. Each is approximately the size of an adult's fist [12]. Their main role is to keep the body's blood balanced for health. Excess water and toxins in the blood are removed by the kidneys. According to the National Institutes of Health (NIH), the kidneys filter approximately 120 to 152 quarts (113 to 144 liters) of blood each day, producing 1 to 2 quarts (0.94 to 1.8 liters) of urine. But they are more than a giant filter sponge. Each kidney consists of millions of tiny filters called nephrons. Local healers around the world have been using indigenous plants and herbs to treat a variety of diseases throughout the ages, and these medicines demonstrate important medicinal uses [12]. Herbs have traditionally been used to make tinctures, ointments, powders and teas, then as preparations, and finally as pure medicine [12].

Pterocarpus santalinus is a small to medium-sized tree in the Fabaceae family [12]. It has spread to

many parts of the world, including India, Sri Lanka, Saudi Arabia, Taiwan, and China [12]. The leaves are triple and alternate, approximately 3 to 9 cm long. Flowers are separate.

In traditional phytotherapy, *Pterocarpus santalinus* is used as an antipyretic, anti-inflammatory, anthelmintic, tonic, antihemorrhagic, antistatic, aphrodisiac, hypoglycemic and diaphoretic agent [12]. *Pterocarpus santalinus* is a medicinal plant rich in flavonoids and phenolics and has many medicinal uses [12]. It is a laxative, aphrodisiac, antihyperglycemic agent and diaphoretic [12]. In spite of its wide spread acceptance in traditional medicine there are few scientific information available on the toxicological significance of sustained consumption of the extract. Therefore, the aim of this study is to evaluate the effects of *Pterocarpus santalinus* on nutritional, hematological and kidney in rats in 28 days.

2. Materials and Methods

2.1 Plant collection

Fresh leaves of *Pterocarpus santalinus* were collected from its natural habitat close to Karu village, Nasarawa State, Nigeria. The plant was validated by the Department of Botany at Bingham University in Nasarawa State, Nigeria and a voucher number (BU1145) was assigned to it.

2.2 Plant preparation and extraction

Pterocarpus santalinus leaves were shade for two weeks. The dried plant material was then crushed into small pieces. The plant was extracted using 70% ethanol by diafiltration at room temperature at a rate of 200 g of extract per liter of ethanol. The liquid filtrate was concentrated and evaporated to dryness under vacuum at 40 °C using a field evaporator. Ethanol extracts were stored at -4 °C until use.

2.3 Animals

Male Wistar rats were obtained from Animal House at Bingham University. Animals were fed with standard animal pellets purchased from Grand Cereals Limited and given free access to water. The approval for this animal studies was given by Animal Ethics Committee of Bingham University College of Health Sciences (BU/2021/1175). The rats ($n = 6$) were randomized to different treatment groups at random. The study was carried out under the same conditions. The care and handling of the animals followed established instituted health guidelines [12].

2.4 Animal study

Organization for Economic Development (OECD) Recommendation No. 1 425 were used for drug analysis in this study [12]. Twenty-four (24) male rats (body weight ranging from 190 to 289 g) were randomly selected. While the rats in groups 2, 3 and 4 were given 100, 200 and 400 mg/kg of extract, respectively, group 1 was the control group and was given physiological saline (10 ml/kg). The body weight of the mice was recorded at the beginning of the experiment and once a week thereafter. The day of sacrifice was designated as D₂₉, and the day of initiation of dosing was designated as D₀.

2.5 Haematological analysis

On the 29th day of the experiment, mice were killed using diethyl ether according to the protocol. Blood test was slow due to heart attack. Blood was collected into a sample vial containing EDTA for hematological analysis including heme concentration, white blood cell count (WBC), differentiation (neutrophils, eosinophils, basophils, lymphocytes, and mononuclear cells), red blood

cells count (RBC), platelets, and thrombocytes, hemoglobin (hemoglobin) concentration. This was done with the help of an automatic hematology machine (Cell-Dyn, Abbott, USA).

2.6 Food and water consumption

The difference between daily food and water intake and the balance after 24 hours is used to calculate daily food and water consumption. Mice were sacrificed on the 29th day of the experiment and their organs were removed for further examination.

2.7 Kidney Function Test

Diagnostic equipment was used to measure electrolytes (Na⁺, K⁺, Cl⁻ and HCO₃⁻), creatinine and blood urea levels as indicators of kidney function. The above specifications were determined by the Department of Chemical Pathology, University of Jos Teaching Hospital. Kidneys were removed and stored in 10% saline and then processed according to standard procedures, sectioned, and stained with hematoxylin and eosin (H&E).

2.9 Histological study

The brain, lung, and spleen were carefully removed and preserved in 10% formal saline solution, then processed, sectioned, and stained with hematoxylin and eosin (H&E) according to routine procedures. They were measured and preserved in 10% formaldehyde for histology.

2.10 Statistical analysis

Data were expressed as the Mean ± Standard Error of the Mean (SEM). Data were analyzed statistically using one-way Analysis of Variance (ANOVA) followed by Dunnett's post hoc test for multiple comparisons between the control and treated groups. Values of $P \leq 0.05$ were considered significant.

3. Results and Discussion

3.1 Results

3.1.1 Effects of *Pterocarpus santalinus* extract on feed consumption in rats.

When compared to the control, *Pterocarpus santalinus* significantly ($P \leq 0.05$) reduced feed consumption at 100, 200, and 400 mg/kg treatment levels in the first week. When compared to the control, the increase in the second, third, and fourth was not significant. (Table 1 and figure 2).

3.1.2 Effect of 28 days oral administration of *Pterocarpus santalinus* on haematological parameters in rats.

Pterocarpus santalinus induced a minor ($P<0.05$) decrease in the levels of red blood cells, hemoglobin, platelets, and so on, as well as a substantial ($P<0.05$) rise in mean corpuscular hemoglobin concentration in rats at the dose level of 100 mg/kg compared to the control. However, mean corpuscular hemoglobin concentration had no effect on basophiles, neutrophils, eosinophils, or lymphocytes ($P<0.05$).

3.1.3 Effect of 28 days oral administration of *Pterocarpus santalinus* on renal indices and electrolytes in Wistar rats.

Pterocarpus santalinus significantly ($P<0.05$) increased Na 100 mg/kg when compared to the control. Other parameters such as creatinine, K, CL, and Urea levels) were not significantly affected.

3.1.4 Histopathological Investigations of the effect of 28 days oral administration of *Pterocarpus santalinus* on renal indices and electrolytes in Wistar rats.

At 100 mg/kg, the kidney revealed very minor tubular deformation and glomerular necrosis. At 100 mg/kg, there was also some tubular necrosis accompanying lymphocyte hyperplasia. The control group had normal renal histological characteristics.

Table 1: Effects of *Pterocarpus santalinus* extract on feed consumption in rats.

Treatment (mg/kg)	Week 1	Week 2	Week 3	Week 4
DW (10ml/kg)	398.91±1.32	303.91±40.05	204.45±8.46	119.30±12.21
BV (50)	286.43±4.54*	293.70±58.67	363.55±8.44	224.50±55.51
BV (100)	260.72±14.60*	262.52±63.59	237.20±37.55	229.51±4.57
BV (200)	281.74±4.52*	355.63±18.87	370.40±59.31	260.15±11.65

*Significantly different from the distilled water (DW) Control at $p<0.05$.

Table 2: Effect of 28 days oral administration of *Pterocarpus santalinus* on hematological parameters in Wistar rats.

Hematological parameters	Treatment (mg/kg)			
	DW(10ml/kg)	100	200	400
WBC ($\times 10^9/L$)	8.21±0.772	6.74±1.32	7.71±0.71*	7.23±1.85
RBC ($\times 10^{12}/L$)	8.30±0.34	6.65±0.66*	8.11±0.57	7.78±0.56
HGB (g/dL)	15.95±0.56	11.29±0.66*	14.33±0.96	14.62±0.11
HCT (g/dL)	60.26±2.03	56.60±3.74	34.67±3.18	53.40±1.81
MCV	66.62±0.93	60.40±1.44	57.17±0.31	69.60±1.72
MCH	19.17±0.17	17.80±1.02	18.83±0.37	18.80±0.20
MCHC (g/dL)	35.71±0.23	27.40±1.12	32.65±0.32	34.43±0.71
PLT ($\times 10^9/L$)	683.83±40.35	471.00±23.12*	652.31±12.20	677.34±52.32
LYM (%)	92.11±4.56	89.20±4.11	89.83±6.19	86.11±1.25
NEUT ($\times 10^9/L$)	12.14±3.67	11.99±3.54	13.14±5.66	11.56±5.32
EOSI ($\times 10^9/L$)	2.67±0.35	2.41±0.66	1.96±0.14	1.90±0.27
BASO ($\times 10^9/L$)	1.88±0.28	2.00±0.59	2.13±1.70	2.31±2.11

Data presented as Mean ± SEM: n = 6, (WBC = white blood cells, RBC = red blood cells, HGB = hemoglobin, HCT = hematocrit, MCV = mean corpuscular volume, MCH = mean corpuscular hemoglobin, MCHC = mean corpuscular hemoglobin concentration, PLT = platelet, LYM = lymphocyte, NEUT = neutrophils, EOSI = eosinophils, BASO = basophils).

Table 3: Effect of 28 days oral administration of *Pterocarpus santalinus* on renal indices and electrolytes in wistar rats.

Renal indices and electrolytes	Treatment (mg/kg)			
	DW(10ml/kg)	100	200	400
Potassium (mmol/L)	6.26±0.24	6.69±0.21	5.92±0.36	5.68±0.26
Sodium (mmol/L)	147.00±2.90	122.20±2.82*	147.00±1.95	144.25±1.88
Chloride (mmol/L)	110.15±5.83	101.87±6.34	107.32±2.36	101.50±2.67
Urea (mmol/L)	9.35±0.29	8.95±0.86	9.46±0.27	8.65±0.42
Creatinine ($\mu\text{mol/L}$)	69.47±9.65	72.23±15.11	64.33±15.21	64.54±6.10

Data presented as Mean ± SEM: n = 6, *significantly different from the distilled water (DW) control at $p<0.05$. SHBP = Safi® herbal blood purifier, DW = distilled water.

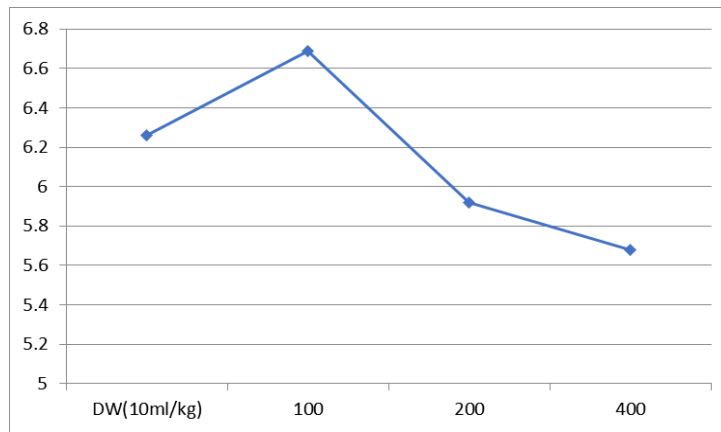


Fig 1: graph showing effect of the ethanol leaf extract of *Pterocarpus santalinus* on serum potassium level in rats

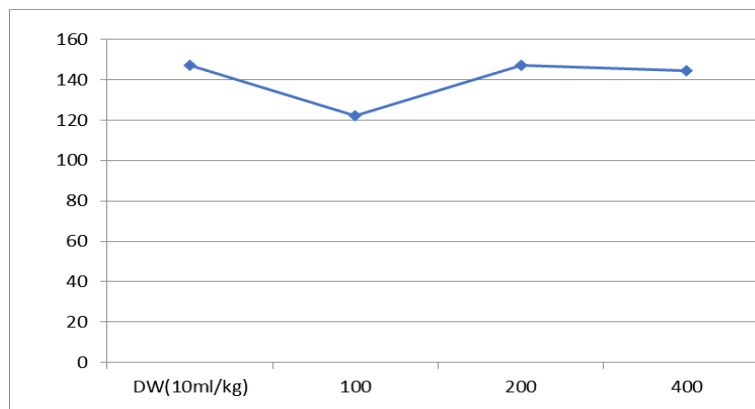


Fig 2: graph showing effect of the ethanol leaf extract of *Pterocarpus santalinus* on serum sodium level in rats

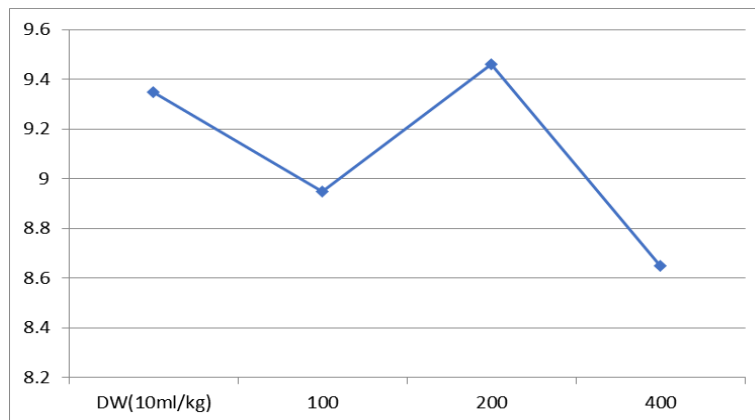


Fig 3: graph showing effect of the ethanol leaf extract of *Pterocarpus santalinus* on serum urea level in rats

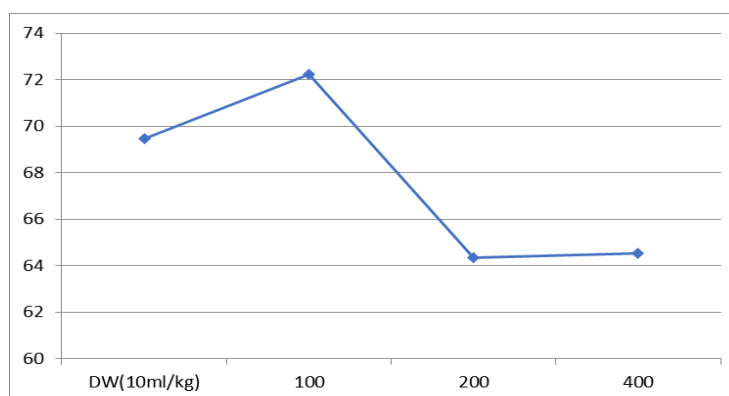


Fig 4: graph showing effect of the ethanol leaf extract of *Pterocarpus santalinus* on serum creatinine level in rats

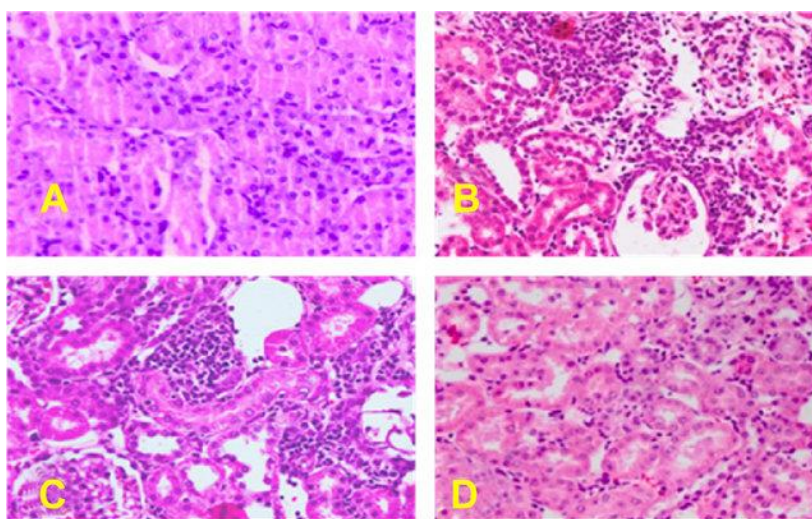


Plate 1: Histological sections of Kidneys of a) rats treated with Normal saline 10 ml/kg, (b) *Pterocarpus santalinus* 100 mg/kg (c), *Pterocarpus santalinus* 200 mg/kg bw (d) and *Pterocarpus santalinus* 400 mg/kg stained with H&E Technique.

3.2 Discussion

Healthy kidneys filter approximately half a glass of blood every minute, remove waste products and excess water, and produce urine [12]. Urine is carried from the kidneys to the bladder through two tubes called ureters, one on each side of the bladder. Traditionally, herbs are often smoked for medicinal or preventive purposes, especially in our world. This can affect kidney function and integrity. This shows the importance of this study [12]. This study used Wistar rats to evaluate the effects of different doses of *Pterocarpus santalinus* extract on hematological and biochemical blood and kidney histopathology tests over a 28-day period. MCHC is an important measure of the average heme concentration of red blood cells [12]. Usually low red blood cell, hemoglobin and hematocrit levels indicate diabetes. Compared to the control group, pterostilbene had no effect on any of the measured parameters at doses of 200 and 400 mg/kg. The reduction of RBC, HGB, PLT and MCV at 100 mg/kg indicates that *Pterocarpus santalinus* interferes with normal hemoglobin production and content in red blood cells and thus may be

effective for diabetes [12]. In addition, 100 mg/kg body weight may be the best concentration of this product, where the heme and hematocrit ratio decreases ($P < 0.05$) and may have an effect on the red blood index. Some phytochemicals have been shown to have an effect on hematocrit. It has been shown that saponins are cytolytic and can cause hemolysis [12]. Therefore, the appearance of low red blood cells (such as hematocrit and hemoglobin) may be due to the presence of saponins in some ingredients in the product. As nephrotoxicity occurs; Therefore, changes in its levels indicate renal failure [12]. After taking pterostilbene, the sodium ion concentration in the blood increased significantly, indicating the possibility of the pump maintaining the stability of its content even if the potassium ion concentration in the blood was not affected [12]. Although single-column nephron destruction does not occur in chronic kidney disease, salt homeostasis is maintained until the majority of the primary nephron population is destroyed [12]. Increases in serum creatinine, urea, uric acid, K^+ , Cl^- and HCO_3^- levels after administration of extracts or drugs may indicate renal failure [12]. *Pterocarpus santalinus* may interact with biochemical parameters such as c

reatinine metabolism, resulting in increased synthesis, or the tissue may become fully or partially at its functional capacity for tubular excretion [12]. There were no changes in blood sugar urea, uric acid, K⁺, Cl⁻ and HCO₃⁻ levels in the rats, especially when more food was eaten. The histological characteristics of rat kidneys were also collected and analyzed unchanged. This study, based on hematological methods, shows that the plant has no effect on kidney function or the integrity of the structure. Phenolics and triterpenoids. [12]. The antioxidant properties of plant molecules such as saponins, tannins, phenols, and triterpenoids may play a role in reducing tissue damage in organs. Matrix deposition and epithelialization. Open wound healing through cell matrix contracture causes tissue to migrate to the wound site. Matrix deposition is the process of binding collagen, proteoglycans, and proteins to form a new extracellular matrix [12]. The process in which epithelial cells in the wound or remaining skin appendages (such as hair follicles and sebaceous glands) lose contact inhibition and migrate into the wound is called epithelialization. As migration progresses, the number of stem cells increases and more epithelial cells are provided [12].

4. Conclusion

The result obtained from this study suggest that the ethanol plant extract of *Pterocarpus santalinus* had relatively no toxic effect on hematological and histological parameters which indicate that it may be safe for consumption even when used for a sustained period of time. Further study into pharmacological, molecular and genetic significance of the plant's phytochemical composition against traditional claims.

Conflict of Interest

The authors declare no conflict of interest.

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