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Effect of Methanolic Root Extract of *Guiera senegalensis* on Some Biochemical and Hematological Parameters in Albino Rats

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Abstract The effect of the administration of methanolic extract of root of *Guiera senegalensis* on some biochemical and hematological parameters in Wister strain albino rats was investigated. After a period of about 28 days the rats given methanolic root extract of *Guiera senegalensis* showed no significant increase or decrease in the levels of the biochemical parameters compared to the rats receiving 2 ml of distilled water. That is the extract did not alter the levels of Aspartate transaminase (AST) Alanine transminase (ALT), alkaline phosphatase (ALP), Total protein and albumin. Also the levels of Urea, Creatinine, sodium, potassium, chloride and bicarbonate were not altered. There was no statistically significant change in the mean values of the hematological parameters, when compared with those of the control group.

Keywords G. Senegalensis, Wistar Strain Albino rats, alanine amino transferase, aspartate amino transferase, total protein, urea, creatinine, packed cell volume and hemoglobin.

Introduction

Medicinal plants are various plants used in herbalism and thought to have medicinal properties. Herbalism is a traditional medicinal or folk medicine practice based on the use of plants and plant extracts. Herbalism is also known as botanical medicine, medical herbalism, herbal medicine, phytotherapy etc [1]. The scope of herbal medicine is sometimes extended to include fungal and bee products, as well as minerals, shells and certain animal parts. Traditional use of medicine is recognized as a way to learn about potential future medicines. The term "herbal drug" determines the part or parts of a plant (leaves, flower, seeds, roots, barks, stem etc.) used for preparing medicines for example *Guiera senegalensis* [2]**.** Furthermore, World Health Organization defines medicinal plant as herbal preparations produced by subjecting plant materials to extraction, purification, concentration or other physical or biological processes which may be produced for immediate consumption or as a basis for herbal products. Medicinal plants produce bioactive compounds used mainly for medicinal properties. These compounds either act on different system of animals including man and or act through interfering in the metabolism of microbes infecting them[3]. The microbes may be pathogenic or symbiotic. In either way the bioactive compounds from medicinal plants play a determining role in regulating host-microbe interaction in favor of the host. The medicinal properties of plants could be based on the antioxidant, antimicrobial, antipyretic effect of the phytochemicals in them [3]. According to World Health Organization, medicinal plants would be the best source to obtain a variety of drugs. *Guiera senegalensis* belongs to the member of a family *combrataceae* and is known locally as *sabara* in Northern part of Nigeria. *Guiera senegalensis* has been found to contain some secondary metabolites which are present in fruits, seeds, leaves, stem and root of the plant [2]. Some of the chemical constituents found include: alkaloids, tannin, flavonoids, anthracenes, saponins. However these secondary metabolites found in the plant have been shown to possess some medicinal properties. [4] stated that the alkaloid present in all parts of the plant possess an antimicrobial activity and a low cytotoxicity and this might account for the prescription of decoctions of leave to treat malaria. The branches, leaves, bark and roots of *G. senegalensis* are also recommended for the treatment of stomach pain,

and diarrhoea. This can be attributed to the presence of tannins in the plant [5-7], found that the plant can also be used in treatment of viral infection. He stated that *G. senegalensis* extract can be used against several DNA and RNA viruses. Toxicology is a branch of biology, chemistry and medicine concerned with the study of the adverse effects of chemicals on living organism [8]. On the other hand toxicity is the ability of a chemical to damage an organ system such as kidney, liver, lungs, heart, spleen etc, or to disrupt a biochemical process, such as the blood distribution mechanism as well as enzymatic processes at some site in the body. Plants contain a number of chemical constituents and are employed for different medicinal purpose. However over dosage of plant products containing medicinal compound may cause toxic reactions when introduced into animal or human beings [8]. Toxicity may be classified as acute, subacute or chronic toxicity based on the rate of onset of symptoms and the rate as well as duration of exposure to the offending agent. Subacute toxicity is an adverse effect occurring as a result of repeated daily dosing of a chemical or exposure to the chemical, for part of an organisms lifespan [9]. It differs from acute toxicity only with respect to the condition under which the subject is endangered by the drug [10].

Liver is the most important and main part of the animal body. It is highly affected primarily by toxic agents and that is why some enzymes such as amino transferases have been found to be of great importance in the assessment of liver damage. The most commonly used indicators of liver damage are the amino transferases (transaminases) which include alanine amino transferase (ALT) and aspartate amino transferase (AST).

Aspartate aminotrasferase is also called serum glutamic oxaloacetic transaminase (SGOT), normally found in red blood cells, liver, heart, muscle tissue, kidneys and pancrease. Low levels of AST are normally found in the blood. When body tissue or an organ such as the heart or liver is diseased or damaged, additional AST is realeased into the blood stream. The amount of AST in the blood is directly related to the extent of the tissue damage [11]. Aspartate transaminase catalyzes the interconversion of aspartate and α-ketoglutarate to oxaloacetate and glutamate [12].

Alanine transaminase (ALT) also called serum glutamic pyruvic transaminase (SGPT) is found in serum and in various bodily tissues, but is most commonly associated with the liver. It catalyzes the transfer of an amino group from alanine to α-ketoglutarate, the products of this reversible transamination reaction being pyruvate and glutamate.

Significantly elevated levels of ALT (SGPT) often suggest the existence of liver damage, viral hepatitis, diabetes, congestive heart failure and so on. For this reason, ALT is commonly used as a way of screening for liver problem [11].

However, the ALT is felt to be more specific indicator of liver inflammation as AST is also found in other organs, such as the heart and skeletal muscle. In acute injury to the liver, as in viral hepatitis gall bladder causes the secretion of the enzyme into the blood stream. Thus the serum alkaline phosphatase is a measure of the integrity of the hepatobiliary system and the flow of bile into the small intestine.

Other parameters use to asses liver function include total plasma/ serum protein, albumin, bilirubin, blood GSH, liver GSH etc. the level of the ALT and AST may be used as generally measure of the degree of liver damage. In chronic liver disease, this is not the case, for these enzymes may be at their normal range. Increased level of ALT and AST [11] can have a large number of implications; increase levels might involve hepatocelluar disease, active cirrhosis, metastatic liver tumor,s toxic or infection hepatitis, pancreatitis and so on.

Alkaline Phosphatase: Alkaline phospatases are group of enzymes found primarily in the liver (isoenzyme ALP-1) and bone (isoenzyme ALP-2). The enzyme can also be produce in small amount in the kidney and placenta. Alkaline phosphatase is a hydrolase enzyme responsible for removing phosphate groups from many types of molecule; the process of removing the phosphate group is called dephosphorylation and ALP act in an alkaline environment [13]. Alkaline phosphatase (ALP) test measures the total amount of alkaline phosphatase realease from the liver, or any other tissue containing ALP.

The level of this enzyme determines the possibility of bone and liver diseases. Mucosal cells lining the bile system of the liver are the source of ALP and hence the free flow of bile through the liver and down into the biliary tract and gall bladder maintains the normal level of this enzyme in the blood. Therefore damage of liver and bile duct can alter the normal level of the enzyme.

With loss of kidney function, there is accumulation of waste and toxic substance in the body, that are normally excreted by the kidney. Examples of such substances include urea, creatinine, electrolytes (such as sodium, potassium, chloride, bicarbonate) and so on [14].

Blood urea nitrogen (BUN) test measures the amount of nitrogen that comes from waste product. Urea is produced when protein is broken down in the body. Urea is made in the liver and pass out of the body in the urine. Increase in urea level increases BUN level and hence it indicates the abnormal function of the kidney. Also a BUN test may be done with a blood creatinine. The level of creatinine in the body tells how well kidneys are working [15]. The BUN to creatinine ratio can be use to determine acute renal failure, gastrointestinal bleeding etc.

Electrolytes regulate nerve and muscle function, body's hydration, blood pH, blood pressure and up building of damage tissue. Various mechanisms exist in our body that keeps the concentration of different electrolytes under strict control. Electrolyte levels are kept constant by the kidneys and various hormones, even when the body triggers changes. However an electrolyte imbalance can lead to several symptoms depending on which electrolyte is out of balance, and whether that level is too high or low [16]. Electrolyte imbalance can occur due to kidney disease, vomiting for prolonged periods, sever dehydration, acid/abase imbalance, congestive heart failure etc.

Increased sodium in the blood occurs whenever there is excess sodium in relation to water. Hypernatremia may result due to kidney disease, too little water intake, and loss of water due to diarrhea and or vomiting. Hyponatremia can result from relative increase in the amount of body water relative to sodium.

Potassium is normally excreted by the kidneys, so disorders that decrease the function of the kidney can result in hyperkalemia. Certain medication may also predispose an individual to hyperkalemia. However, hypokalemia can arise due to kidney disease, vomiting or diarrhea, excessive loss due to heavy sweating etc [16].

Materials and Methods

Collection and Identification of Plant Materials

The root of *G. senegalensis* was collected from Jere Local Government Area, Borno State Nigeria. The plant was identified and authenticated by a plant taxonomist from the Department of Biological Science, University of Maiduguri. The voucher specimen with number BCHGR1 was deposited at the herbarium of the Department of Biochemistry. The root of *G. senegalensis* was shade dried, ground to fine powder using pestle and mortar and stored in cellophane bags at room temperature before use.

Preparation of Extract

Heat Treatment

The root of *G. senegalensis* was washed to remove particles and dust and then heated at 80^oC for 10 minutes and 60^oC for 30 minutes [17]. About 200 g of the weighed powdered root (sample) was partitioned using methanol/aqueous (70:30). The crude extract obtained was concentrated to dryness at 45^oC using water bath. The extract was weighed, labeled and kept for later use.

Experimental Animals

A total of 16 adult Wister strain albino rats of both sexes weighing between 150 g and 200g were used in this study. The rats were obtained from the small animal farm unit of University of Maiduguri. The animals were maintained under standard conditions of light and temperature with free access to standard diet and water *ad libitum.*

The 16 albino rats were divided into four (4) groups of four (4) rats each. The extract was administered daily and orally using feeding tube with group 2, 3 and 4 receiving 100 $mgKg^{-1}$, 150 $mgKg^{-1}$ and 200 $mgKg^{-1}$ of the extract respectively for 4 weeks (28 days) and the first (1^{st}) group receives distilled water which served as the control group. At the end of the fourth week, the rats from all groups were sacrificed and the blood samples were collected, centrifuged and serum were obtained for biochemical analysis that of hematological parameters was assayed weekly.

Analytical Methods

Liver Function Test

Liver function was monitored by level of some enzymes such as aspartate amino transferase, alanine aminotransferase, alkaline phosphatase, and other parameter such as total protein, albumin, bilirubin etc.

Determination of Serum Aspartate Amino transferase and alanine amino transferase was done using kits based on the reported method [18]. Total protein was assayed by the biuret method [18].

Renal (Kidney) Function Test

Renal function was monitored by the determination of non-protein nitrogen substances present in the serum. The tests are urea, creatinine and electrolyte.

Serum urea and creatinine were assayed by the reported method [19].

Estimation of Na^+ and K^+ by flame photometric method [20].

Methods of Determination of Hematological Parameters

Sample was collected from the tail vein of each rat by slightly cutting off the tip of the tail, and used for determination of the hematological parameters.

Determination of Packed Cell Volume

Packed Cell Volume (PCV) was determined by hematocrit method [21].

Determination of Red Blood Cells

Red Blood Cells (RBCs) were counted using the double counting chamber.

Determination of White Blood Cells

The number of White Blood Cells (WBCs) was determined using a method similar to that used for determination of RBCs. However, the diluting fluid used in the determination of WBCs is Turk's solution, and the graduation on the WBCs-micropipette is usually from 1- 11ml mark.

Determination of Direct Leucocyte Count by the method of Baker and Silverton, [22]

Determination of Hemoglobin

Hemoglobin (Hb) estimated by Sahli's Visual Comparison Method.

Statistical Analysis

The data obtained was subjected to analysis of variance (ANOVA) and differences between means were done by the Tukey-Kramer Multiple Comparisons Test. The Instat statistical software was used, and the results obtained are presented below in tabular form; values are expressed as Mean ± SD.

Results

Effect of *Guiera senegalensis* on Some Liver Function Parameters In Albino Rats

The serum level concentration of some liver parameters, alkaline phosphatase (ALP), aspartate transaminase (AST) alanine transaminase (ALT), total protein and albumin are presented in table 1 below.

Table 1: Effect of Methanolic Root Extract of *G. senegalensis* on Some Liver Function Parameters in Albino Rats

Groups	ALP IU/L	AST IU/L	ALT IU/L	TP mg/dl	ALB mg/dl
Group1(control)	226.000±2.30	120.500±3.30	48.750±3.47	67.000±0.81	28.750±1.43
Group 2 (100mg/Kg)	228.25±4.04	117.750±8.51	50.750±6.73	66.00±1.95	29.500±1.65
Group 3 (150mg/Kg)	231.50±0.28	116.250±6.78	43.250±3.30	64.500±1.65	30.000±0.40
Group 4 (200mg/Kg)	231.50±0.28	120.00±5.83	46.750±1.25	68.500±1.19	28.5±0.95

Key: ALP- Alkaline phosphatase, AST-Aspartate Transaminase, ALT- Alanine Transaminase. TP- Total Protein, ALB- Albumin. N=4 (n= number of replicates), Mean ± SD, p>0.05

Table 2: Effect of Methanolic Root Extract of *G. senegalensis* on Some Kidney Function Parameters in Albino Rats

Groups	Urea mg/dl	Creatinine mg/dl	Na^+ mmol/L	K^+ mmol/L	Cl^- mmol/L	HCO_3^- mmol/L
Group (control)	7.750±0.45	112.750±2.75	136.000±2.82	8.225±0.33	96.000±3.36	21.750±0.47
Group 2 (100m/Kg of extract)	8.300±0.19	117.50±2.65	131.500±0.28	7.600±0.30	94.750±0.47	22.500±0.28
Group 3 (150mg/Kg of extract	7.300±0.37	112.750±4.05	136.750±1.10	7.050±0.11	99.000±1.00	23.500±0.28
Group 4 200mg/Kg of extract	7.500±0.29	109.250±6.61	136.750±1.75	7.375±0.29	99.000±1.91	22.250±0.48

n=4 (n=replication number), Mean ± SD, p>0.05

Table 3: Effect of Methanolic Root Extract of *G. senegalensis* on Red Blood Cells (RBC) ($x10^6$ mm^{-3}) in Albino Rats

	0 WEEK	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK
Group 1	6.10±0.11	6.70±0.05	7.25±0.10	8.10±0.12	8.43±0.26
Group 2 (100mg/Kg)	6.60±0.00***	8.25±0.10***	10.26±0.02***	11.25±0.10***	8.25±0.97 ns
Group 3 (150mg/Kg)	6.35±0.10 *	6.50±0.12 ns	9.88±1.52**	7.75±0.10**	7.00±0.85 ns
Group 4 (200mg/Kg)	6.75±0.10***	5.60±0.00***	7.50±0.11 ns	7.05±0.10***	8.55±0.62 ns

Values are Mean ± SD; ns: Not Significant; *P<0.05; **P<0.01; ***P<0.001

Number of replicates = 4

* Means significant when compared with control group; **moderately significant; ***highly significant

Table 4: Effect of Methanolic Root Extract of *G. senegalensis* on White Blood Cells (WBC) ($x10^3mm^{-3}$) in Albino Rats

	0 WEEK	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK
Group 1	5.65±0.10	20.65±0.10	14.10±0.60	20.75±0.10	25.15±3.76
Group 2 (100mg/Kg)	6.40±0.00***	20.80 ±0.00 ns	20.05±0.10***	14.30±0.12***	26.90±4.27***
Group 3 (150mg/Kg)	6.40±0.00***	23.30±0.12***	15.65±0.10***	20.75±0.10**	23.65±0.64ns
Group 4 (200mg/Kg)	6.70±0.12***	24.20±0.00**	15.70±0.12***	12.55±0.10***	24.30±0.20***

Values are Mean ± SD; ns; not significant ***P<0.001; **P<0.01; Number of replicates = 4

** means moderately significant when compared with control; ***highly significant

Table 5: Effect of Methanolic Root Extract of *G. senegalensis* on Packed Cell Volume (PCV) (%) in Albino Rats

	0 WEEK	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK
Group 1	36.25±1.75	45.25±1.70	41.75±6.70	43.25±3.59	49.00±2.00
Group 2 (100mg/Kg)	37.00±7.39 ns	43.75±4.50	44.50±3.10	45.50±2.08	46.25±2.87 ns
Group 3 (150mg/Kg)	43.25±5.73 ns	46.00±4.24	42.75±0.95	45.00±4.24	40.50±3.78**
Group 4 (200mg/Kg)	46.25±2.63 ns	40.00±0.00	43.00±2.70	41.50±1.00	47.25±1.89 ns

Values are Mean ± SD; ns: Not Significant; **P<0.01; Number of replicates = 4

*means significant when compared with control group; **moderately significant; ***highly significant

Table 6: Effect of Methanolic Root Extract of *G. senegalensis* on Hemoglobin Concentration (Hb) (g/dl) in Albino Rats

	0 WEEK	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK
Group 1	12.90± 0.73	45.25±1.70	12.30±0.93	12.18±0.26	14.2±0.55
Group 2 (100mg/Kg)	13.05±2.24ns	43.75±4.50	12.93±1.09	12.25±0.50	13.55±0.50 ns
Group 3 (150mg/Kg)	15.10±1.47ns	46.00±4.24	12.3±1.10	12.15±0.91	11.60±1.17**
Group 4 (200mg/Kg)	15.70±0.73ns	40.00±0.00	12.05±0.17	11.25±0.10	13.30±0.58 ns

Values are Mean ± SD; ns: Not Significant; **P<0.01

Number of replicates = 4

** means moderately significant when compared with control group

Table 7: Effect of Methanolic Root Extract of *G. senegalensis* on Neutrophils (%) in Albino Rats

	0 WEEK	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK
Group 1	21.00± 0.82	28.00±0.82	21.75±0.50	20.50±0.578	26.50±2.38
Group 2 (100mg/Kg)	21.50±0.58	29.00±0.82ns	23.50±0.58ns	29.00±0.82***	29.50±3.70
Group 3 (150mg/Kg)	21.75±1.26	21.25±0.96***	22.75±2.06ns	29.00±0.82***	25.00±1.41
Group 4 (200mg/Kg)	20.75±0.96	28.25±0.50ns	24.50±0.58*	24.00±0.82***	25.30±0.50

Values are Mean ± SD, ns: Not Significant; *P<0.05; ***P<0.001

Number of replicates = 4

*means significant when compared to control group; ***means highly significant.

Table 8: Effect of Methanolic Root Extract of *G. senegalensis* on Lymphocytes (%) in Albino Rats

	0 WEEK	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK
Group 1	65.00± 0.82	52.75±0.50	54.50±0.57	60.50±1.00	54.75±0.50
Group 2 (100mg/Kg)	65.00±0.82	50.75±4.27ns	55.25±0.50	53.25±0.50***	55.75±2.36
Group 3 (150mg/Kg)	64.00±1.63	55.50±0.58ns	53.75±3.78	51.00±0.82***	57.75±3.20
Group 4 (200mg/Kg)	65.00±0.82	51.50±0.57ns	57.50±0.58	52.5±1.29***	54.25±0.50

Values are Mean ± SD ; ns: Not Significant; ***P<0.001

Number of replicates = 4

*** means highly significant when compared to control group

Table 9: Effect of Methanolic Root Extract of *G. senegalensis* on Monocytes (%) in Albino Rats

	0 WEEK	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK
Group 1	6.50±0.58	9.50±0.58	10.25±0.50	9.00±0.00	8.75±1.26
Group 2 (100mg/Kg)	6.25±0.50	11.00±1.16	10.25±0.50ns	7.50±0.58**	6.50±1.00 ns
Group 3 (150mg/Kg)	6.75±0.50	10.75±0.50	11.25±1.50ns	9.75±0.50ns	7.75±1.50 ns
Group 4 (200mg/Kg)	6.75±0.50	10.25±0.50	8.50±0.58 ns	10.50±0.58**	8.50±0.58 ns

Values are Mean ± SD ; ns: Not Significant; ***P<0.001

Number of replicates = 4

** means moderately significant when compared to control group

Table 10: Effect of Methanolic Root Extract of *G. senegalensis* on Eosinophils (%) in Albino Rats

	0 WEEK	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK
Group 1	7.50±0.58	7.50±0.58	14.25±0.50	7.50±0.58	9.75±1.26
Group 2 (100mg/Kg)	7.25±0.50	7.25±0.50ns	11.25±0.00ns	7.25±0.50ns	7.50±0.96*
Group 3 (150mg/Kg)	7.50±0.58	7.50±0.58***	13.00±4.08ns	7.50±0.58ns	9.25±0.50 ns
Group 4 (200mg/Kg)	7.50±0.58	7.50±0.58ns	9.50±0.58*	7.50±0.58*	11.25±0.50 ns

Values are Mean ± SD; ns: Not Significant; *P<0.05; ***P<0.001
Number of replicates = 4
* means significant when compared to control group; ***highly significant

Discussion

Plants that are of medicinal value are often used as herbal remedy for the restoration and maintenance of good health. Some herbs have been considered as drugs and therefore generally safe and effective [23]. Most herbs have been associated with broad action on a number of physiological systems in concert unlike the pharmaceutical drugs which are usually designed to elicit a specific effect.

The toxic risks of some plants are due to the substance found in the plant which can induce liver and kidney toxicity [24]. This can be characterized by biochemical and hematological alterations, reduction in body weight of the animal, behavior and feeding pattern [25].

The biochemical indices of liver and kidney monitored in the serum in this study are useful markers for assessing the functional capacities of the organs [26]. Biochemical indices (parameters) of organ function if altered will impair the normal functioning of the organ [27]. Therefore the absence of significant effect on the liver and kidney function indices by the extract of *G. senegalensis* root is an indication that the normal functioning of these organs were not affected. It also indicates that the normal functioning of the nephrone at the tubular and globular levels was not altered.

It was stated that there are many enzyme found in the serum that did not originally originate from the serum. During tissue damage however, some of these enzymes find their way into the serum probably by leakage. Serum enzyme measurements are therefore a valuable tool in clinical diagnosis providing information on the effect and nature of pathological damage to any tissue [28].

AST and ALT are considered to be sensitive indicators of hepatocellular damage and within limit can provide a quantitative evaluation of the degree of damage to the liver [29].

After 28 days of treatment however, there were no alteration in the level of ALT, AST, ALP, total protein and albumin. Comparison between the various treatment groups (test) and their respective control groups shows no significant increase or decrease in the level of the parameters.

Also the level of urea, creatinine and electrolytes (Na^+, K^+, Cl^- and HCO_3^-) were not altered after 28 days of extract administration. The result showed that the level of urea, creatinine, Na^+, K^+, Cl^- and HCO_3^- were not significantly different when compared the test groups with the control group. These results showed that subacute oral intake of *G. senegalensis* root extract was not hepatotoxic and nephrotoxic to rats given 100mg/Kg, 150mg/Kg and 200mg/Kg treated groups. The extract may contain compounds which are not toxic to the liver and kidney and hence may possess hepatoprotective and nephroprotective potency. The results also showed that the use of methanolic root extract of *G. senegalensis* in treatment of many disease may not interfere with the functional integrity of the kidney and liver tissues. From the results there was no significant change in the PCV, Hb and RBC values after about 4 weeks of administration of methanolic root extract of *G. senegalensis* to the rats this could imply that the methanolic root extract of this plant did not inhibit (to a large extent) erythropoietin production by the kidney [30].

However, this experimental study did not last for long; it lasted only about 4 weeks. Therefore the long term effect of the methanolic root extract of this plant cannot be deduced from this study.

The slight increase observed in WBC production was due to the fact that the extract must have stimulated immune response [31]. Differential leucocyte count (DLC) gives the percentage of the individual cells that make up the WBC, and from the results there was increase and decrease in the values of neutrophils and lymphocytes respectively. Increase in the values of neutrophil usually leads to corresponding decrease in the value of lymphocytes, that was why there was an increase in neutrophil value, while the lymphocyte value decreased [32] and this change in the values of neutrophil and lymphocytes can be traced to the administered plant extract (a foreign substance) [33].

There was no significant change in the values of monocytes and eosinophils. The reason why eosinophils did not change in their values may be due to the fact that the plant extract did not stimulate allergic response in the rats, as eosinophil values normally increase during allergic conditions and parasitic infections [32].

Conclusions

The research showed that there was no significant increase or decrease in the level of liver and kidney function parameters. This shows that the normal function of kidney and liver tissues were not altered at different doses of extract administration (100mg/Kg, 150mg/Kg and 200mg/Kg).

Therefore methanolic root extract of *G. senegalensis* may not possess hepatotoxic and nephrotoxic activity and hence can be safe for oral consumption at low doses.

From the results of this study, it is obvious that to some extent, the methanolic root extract of *Guiera senegalensis* did not suppress the erythropoietic activities of the rats at the doses tested. Again it seemed that the extract increased the immune activity of the rats. Therefore the plant is relatively safe for use in folk medicine.

Recommendation

The research recommends for further toxicity study using higher doses since oral intake of methanolic extract of root *G. senegalensis* was safe for medicinal purposes up to 200 mg/kg.

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