wjpmr, 2025, 11(2), 288-302

SJIF Impact Factor: 6.842

WORLD JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.wjpmr.com

Research Article

ISSN 2455-3301

WJPMR

EVALUATION OF THE ACUTE AND SUBACUTE ORAL TOXICITY OF A TOTAL AQUEOUS EXTRACT OF TRUNK BARK OF *PARKIA BIGLOBOSA* (MIMOSACEAE) IN MAMMALS

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Article Received on 19/12/2024 **Article Revised on 09/01/2025** **Article Accepted on 29/01/2025**

ABSTRACT

Parkia biglobosa (Mimosaceae) is a plant commonly used in traditional African medicine to treat several diseases including arterial hypertension, heart disease, and diabetes. This work aims to evaluate the acute and subacute oral toxicity of a total aqueous extract of trunk bark of *Parkia biglobosa* (EAqPB) respectively on mice and rats. The acute and subacute toxicity tests carried out on mice and rats orally with EAqPB were done respectively according to the guidelines of the Organization for Economic Cooperation and Development 423 and 407. The doses of 2000 and 5000 mg/Kg B.W of EAqPB were used for the acute toxicity test. For the subacute toxicity test, respective doses of 500, 1000, and 2000 mg/Kg BW of EAqPB were administered to the batches of animals at a rate of one dose per batch for 28 days. The substances were administered by gavage. The administration of EAqPB, at a dose of 2000 mg/Kg B.W then at a dose of 5000 mg/Kg B.W, did not cause any mortality in these animals during 14 days of observation. Concerning subacute toxicity, daily administration of EAqPB for 28 days to rats showed no signs of toxicity in both males and female rats. They had normal growth in body weight, a sign of an absence of toxicity. However, rats treated with EAqPB at a dose of 2000 mg/Kg B.W had a lower weight gain than animals treated with doses of 500 and 1000 mg/Kg B.W of EAqPB. The study of acute toxicity in female mice by oral route showed that EAqPB is non-toxic because the LD_{50} is greater than 5000 mg/Kg B.W. Repeated administration for 28 days of different doses of EAqPB, did not cause any signs of toxicity in rats. These results are therefore favorable to the use of this plant in traditional medicine for the treatment of diseases.

KEYWORDS: *Parkia biglobosa*, acute toxicity, subacute toxicity, mice, and rats.

INTRODUCTION

Man has always hired nature's services to relieve his ailments; she gave them back to him through traditional medicine. According to the World Health Organization (WHO, 2013), traditional medicine is defined as "the sum of all knowledge, skills, and practices based on theories, beliefs, and experiences specific to different cultures used in the preservation of health."

For several years, medicinal plants or plant-based preparations have had increasing success. Approximately 80 % of the world's population and more than 90 % of the population of developing countries use medicinal plants for their primary health care (Jiofack et al., 2010). Indeed, according to Tyler (1993), more than 13,000 species of medicinal plants are used as traditional remedies by various cultures around the world. The use of phytotherapy is explained by many reasons such as the high cost of pharmaceutical products, the socio-cultural habits of populations, the need to have therapeutic options for resistant pathogens, and the existence of diseases for which there is no effective modern treatment (Duke, 1993; Cox and Balik, 1994).

Thus, notwithstanding their undeniable therapeutic effects, toxicological studies are necessary to improve the use of these plants from the African pharmacopeia in population health care.

Several studies and works have been carried out on these medicinal plants, which are recognized for their therapeutic effects. With this in mind, we undertook to study the toxicological effect of a total aqueous extract of trunk bark of *Parkia biglobosa*, a plant known as antidiabetic in the African pharmacopeia (Yaketcha, 1988; Tra-Bi et al., 2008; Coly and Boegli, 2014).

Parkia biglobosa (Mimosaceae), commonly called *néré* in the Malinké language of Côte d'Ivoire, is a plant used to treat various diseases. It is recommended in the

treatment of amoebiasis, hookworm, ascariasis, asthma, sterility, peptic ulcers and dental pain (Yaketcha, 1988; Kouadio et al., 2000). It is also used to treat heart, kidney, and hypertension disorders (Kassi et al., 2008; Yapo et al., 2014).

The general objective of our work is to evaluate the acute and subacute oral toxicity of a total aqueous extract of trunk bark of *Parkia biglobosa* (Mimosaceae) respectively on mice and rats to contribute to the valorization of the use of plants used in traditional medicine to improve the health of populations.

I. MATERIAL AND METHODS

I.1. Plant material

The plant material consists of trunk bark of *Parkia biglobosa* (Jacq.) Benth. (Mimosaceae) collected on August 25, 2017, in Zuénoula, 373 km from Abidjan, Ivory Coast. The identification was made by Professor ZIRIHI Guédé Noël of the Botanical Laboratory using the herbarium of the National Floristic Center (CNF). The samples of *Parkia biglobosa* (Mimosaceae) are preserved respectively, under herbarium numbers 10933 of 12-22-1969, 13329 of 02-8-1976, and 13336 of 02-9-1976 in this center.

I.2. Animal material

The experiments were carried out on mice (female) and rats (male and female).

Female mice of the species *Mus musculus* (Muridae), of homogeneous Swiss parental strains, weighing between 23 and 27 g, were used for acute toxicity tests.

Rattus norvegicus rats of the *Wistar* strain, weighing between 130 and 180 g, were used for subacute toxicity. These animals come from the vivarium of the superior normal School in Abidjan (Côte d'Ivoire). They have access to food and water ad libitum. Animals were acclimated to laboratory conditions before the start of the experiment.

I.3. Preparation of the aqueous extract

The bark is cut into pieces, dried at 25 °C, and then ground in a mechanical ball mill.

Fifty grams (50 g) of ground material are mixed with slow magnetic stirring for 24 hours in 1 liter of distilled water. The macerate is filtered through hydrophilic cotton and "Wattman n02" filter paper. The filtrate obtained was dried in an oven at 60 °C. A fine brown powder is obtained, which is the total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB). A stock solution is then prepared with a given quantity of this powder, from which the experimental solutions at different concentrations will be made.

II. METHODS

II.1. Toxicological study

II.1.1. Acute oral toxicity

The study of acute oral toxicity is carried out on 9 mice grouped into 3 groups of 3 mice, weighing between 23 and 27 g. These animals are fasted for 18 hours. This study is carried out according to the guidelines of the Organization for Economic Co-operation and Development (OECD-423) (OECD, 2001). For the initial dose, we choose a level from the following four: 5, 50, 300, and 2000 mg/Kg B.W.

The level selected is that at which mortality can be expected among some of the treated animals. The dose of 2000 mg/Kg B.W is the one chosen from these predefined doses. Exceptionally, an additional maximum predetermined dose of 5000 mg/Kg B.W will be used because the results will be important elements for the protection of human and animal health if the dose of 2000 mg/Kg B.W would not have caused any death.

Each mouse receives 1 ml of a single dose, evaluated in mg/Kg body weight (mg/Kg B.W) of the substance. The mice in the control group also received 1 ml of distilled water. After administration of the extract, the animals are deprived of food again for three to four hours to carefully observe their behavior during this time. The animals are observed individually at least once during the first 30 minutes and every 24 hours after treatment.

Particular attention is required during the first four (4) hours and daily for 14 days after administration of the extracts. All observations are recorded systematically on an individual sheet, established for each animal. Observations include changes in hair, eyes, and behavior. Attention will be paid in particular to various manifestations such as tremors, convulsions, salivation, diarrhea, lethargy, sleep, and coma. The weight of each animal is determined shortly before administration of the water and extract, and then once every week for two weeks.

Depending on the mortality observed following the administration of the extract, the 50% lethal dose (LD_{50}) is determined using the OECD-423 guidelines (OECD, 2001).

II.1.2. Subacute oral toxicity

The subacute toxicity study was conducted according to the OECD-407 guidelines (OECD, 2008). This study consisted of administering doses of EAqPB, daily, orally, to batches of animals at a rate of one dose per batch for 28 days.

Forty (40) Albino rats of the Wistar strain were divided into four (4) groups of ten (10) rats. Each group includes five female and five male rats, whose weights vary between 130 and 180 g. The animals are put in metal cages according to sex. Each animal receives 2 ml of a single dose, evaluated in mg/Kg body weight (mg/Kg B.W) of the substance. The rats in group 1, serving as controls, received distilled water. The rats in groups 2, 3, and 4, received, respectively, EAqPB at doses of 500, 1000, and 2000 mg/Kg B.W. These different doses of EAqPB are administered orally daily at the same time.

Furthermore, the rats received water and food daily, during the experiment.

The animals are observed daily to detect physiological, and behavioral changes. Blood is taken (approximately 5 ml) from fasting rats before the start of the experiment (D0) then successively on days D14 and D28. After the 28th day, the rats are fasted, anesthetized with diethyl ether, and then sacrificed. The organs (livers, kidneys, and hearts) are removed and weighed.

II.2. Statistical analysis methods and processing of results

The statistical analysis of the values and the graphical representation of the data were carried out using the software Graph PadPrism 7 (San Diego, California, USA). The statistical difference between the results was carried out using analysis of variance (ANOVA), followed by the Tukey-Kramer multiple comparison test, with a significance threshold of $P < 0.05$. All values are presented as mean ± SEM (Standard Error of the Mean).

III. RESULTS

III.1. Acute toxicity

III.1.1. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB) on the behavior of mice

Administration by gavage of a dose of 2000 mg/Kg B.W of the total aqueous extract of *Parkia biglobosa* (EAqPB) to mice did not change their behavior. However, the maximum dose of 5000 mg/Kg B.W, administered to the mice, caused a reduction in motor skills, breathing difficulties, and grouping in a corner of the cage, for 30 minutes after which their behavior turned back to normal. During the 14 days of observation, no mouse mortality was observed for doses of 2000 mg/Kg B.W and 5000 mg/Kg B.W. The 50% lethal dose (LD_{50}) of EAqPB is greater than 5000 mg/Kg B.W.

III.1.2. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB) on the body weight of mice

Figure 1 shows the effects of EAqPB on the body weight of mice during two (02) weeks of experimentation. The body weight of the animals treated with EAqPB at doses 2000 and 5000 mg/Kg B.W did not provoke any significant variation ($p > 0.05$) compared to that of the animals in the control group. Indeed, the body weight of the mice in the control group increased from 24.29 ± 1.46 g to 26.72 ± 1.40 g, either a body weight gain of 2.43 ± 0.24 g. In animals treated with EAqPB at doses 2000 and 5000 mg/Kg B.W, body weights increased from 24.21 ± 1.12 g to 26.01 ± 1.58 g and 26.10 ± 1.17 g respectively at respective body weight gains of 1.8 ± 0.21 g and 1.89 ± 0.26 g.

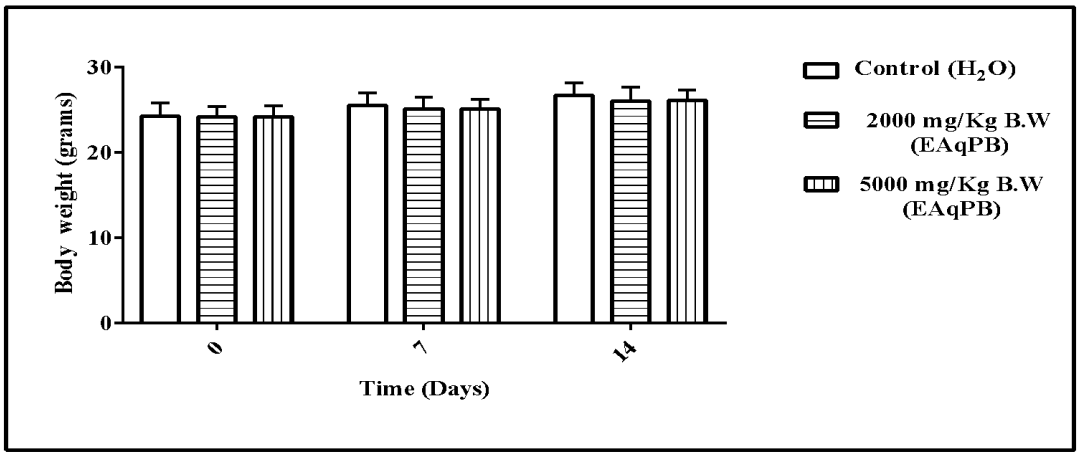

Figure 1: Variation in body weight of female mice during 14 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=3.

III.2. Subacute toxicity

III.2.1. Signs of toxicity observed in rats treated with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB)

Daily administration of the aqueous extract of *Parkia biglobosa* trunk bark to rats for 28 days showed no signs of toxicity in either males or females. All animals survived the treatments without disruption to their health and growth.

III.2.2. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB) on the body weight of rats

The body weight of rats was assessed weekly for 4 weeks (Figures 2 and 3). After four weeks of experimentation, the body weight of the animals treated with different doses of EAqPB did not vary significantly ($p > 0.05$) compared to that of the controls in both male rats and female rats except that of the treated female rats at a dose of 2000 mg/Kg B.W where we note a significant difference ($p < 0.05$).

Thus, the body weight of the female rats from the control group and the groups treated with EAqPB (500, 1000, and 2000 mg/Kg B.W) increased respectively from 137 ± 4.04 g to 150.30 ± 1.2 g, from 138. 2 ± 0.85g to 148.7 ± 0.88g, from 132.30 ± 0.4g to 146.7 ± 3g and from 132.6 ± 0.9g to 137.3 ± 3.5g; which corresponds to respective weight gains of 13.3 ± 0.8 g, 10.5 ± 0.6 g, 14.4 ± 0.8 g and 4.7 ± 0.57 g (Figure 2).

The body weight of male rats from the control group and the groups treated with EAqPB (500, 1000 and 2000 mg/Kg B.W) increased respectively from 155 ± 2.9 g to 175 ± 2.9 g, from 154.4 ± 2 .3 g to 172 ± 2.3 g; from 150 ± 1.15 g to 163.2 ± 2.88 g and from 158.4 ± 1.2 g to 176 ± 1.7 g; which corresponds to respective weight gains of 20 ± 1.7 g, 17.6 ± 2 g, 13.2 ± 0.7 g and 17.6 ± 1.4 g (Figure 3).

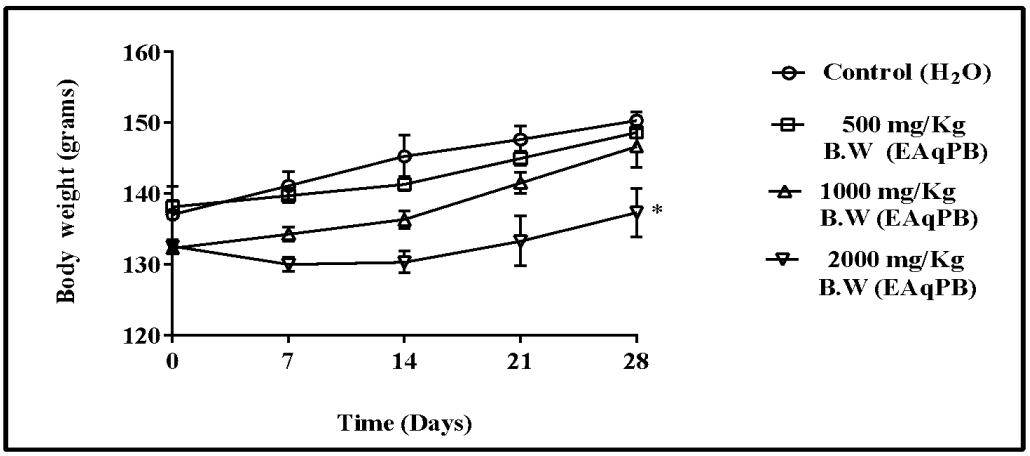

Figure 2: Variation in body weight of female rats during 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5; *p<0.05 compared to controls.

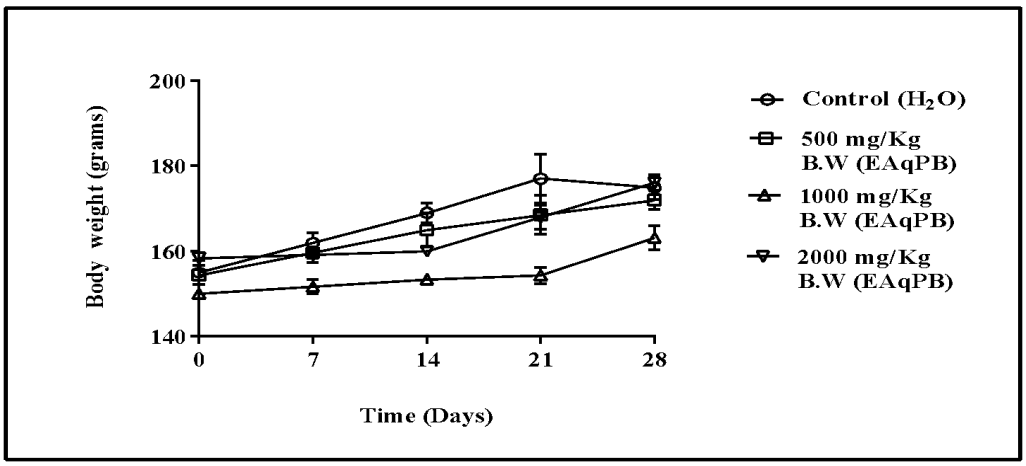

Figure 3: Variation in body weight of male rats during 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

Values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

III.2.3. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB) on the relative organ weight of rats

Table I shows the effects of EAqPB on the relative weights of the organs of male and female rats (heart, liver, and kidneys) after four weeks of administration. The increasing doses of EAqPB (500, 1000, and 2000 mg/Kg B.W) did not lead to a significant variation (p > 0.05) in the relative weight of the organs of the treated male rats and female rats compared to that of the male rats and females rats of the control batch. Indeed, the relative weight of the heart in the female rats was 0.33 ± 0.02% for the female rats in the control group, 0.31 ± 0.01%, 0.38 ± 0.05%, and 0.41 ± 0.02% respectively for rats treated with 500, 1000 and 2000 mg/Kg B.W of EAqPB.

That of the liver was 2.10 ± 0.06% for the female rats of the control group, 2.74 ± 0.20%, 2.63 ± 0.06%, and 2.87

± 0.17% respectively for female rats treated with 500, 1000 and 2000 mg/Kg B.W of EAqPB. Finally, that of the kidneys was 0.53 ± 0.06% for female rats from the control group, 0.50 ± 0.01%, 0.54 ± 0.06%, and 0.57 ± 0.06 % respectively for female rats treated with 500, 1000, and 2000 mg/Kg B.W of EAqPB.

In male rats, the relative heart weight was 0.34 ± 0.02% for control male rats, 0.35 ± 0.01%, 0.30 ± 0.01%, and 0.30 ± 0.01% respectively for male rats treated with 500, 1000, and 2000 mg/Kg B.W of EAqPB. That of the liver was 2.87 ± 0.21% for male rats from the control group, 2.40 ± 0.12%, 2.27 ± 0.02%, and 2.49 ± 0.12% respectively for male rats treated with 500, 1000, and 2000 mg/Kg B.W of EAqPB. Finally, that of the kidneys was 0.54 ± 0.02% for male rats from the control group, 0.59 ± 0.05%, 0.54 ± 0.02%, and 0.61 ± 0.02 % respectively for rats treated with 500, 1000, and 2000 mg/Kg B.W of EAqPB.

Table I: Variation in the relative weight of the organs of male and female rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

Organs	Sex	Control	Doses of EAqPB		
		H_2O (Distilled)	500 mg/Kg B.W	1000 mg/ Kg B.W	2000 mg/ Kg B.W
Heart	Male	0,34 ± 0,02	0,35 ± 0,01	0,31 ± 0,01	0,30 ± 0,01
	Female	0,33 ± 0,02	0,31 ± 0,01	0,38 ± 0,05	0,41 ± 0,02
Liver	Male	2,87 ± 0,21	2,40 ± 0,12	2,27 ± 0,02	2,49 ± 0,12
	Female	3,10 ± 0,06	2,74 ± 0,20	2,63 ± 0,06	2,87 ± 0,17
Kidney	Male	0,54 ± 0,02	0,59 ± 0,05	0,54 ± 0,02	0,61 ± 0,02
	Female	0,53 ± 0,06	0,50 ± 0,01	0,54 ± 0,06	0,57 ± 0,06

The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

III.2.4. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark on the hemogram of rats

III.2.4.1. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark on the parameters of the erythrocyte lineage of rats

Tables II and III show, respectively, the effects of EAqPB on the parameters of the erythrocyte lineage of male, and female rats after four weeks of experimentation. The different doses of EAqPB (500, 1000, and 2000 mg/Kg B.W), administered orally to rats, did not induce a significant variation ($p > 0.05$) in the number of red blood cells, hemoglobin level, hematocrit, MCV, TCMH, and CCMH in both male and female rats compared to those of rats in the control group.

III.2.4.2. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark on leukocyte lineage parameters and blood platelets of rats

Tables IV and V show, respectively, the effects of EAqPB on the parameters of the leukocyte line and the blood platelets of male and female rats after four weeks of experimentation. The administration of experimental doses of EAqPB (500, 1000, and 2000 mg/Kg B.W) induced a non-significant variation ($p > 0.05$) in the parameters of the leukocyte lineage of male and female rats. Thus, the number of white blood cells, lymphocytes, monocytes, and granulocytes did not vary significantly in male and female rats treated with increasing doses of EAqPB compared to t the control group.

The number of blood platelets of male and female rats treated with the different doses of EAqPB also did not vary significantly ($p > 0.05$) compared to that of the control group.

Table II: Variation in the parameters of the erythrocyte lineage of male rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

	Parameters	Control	Doses of EAqPB		
		H_2O (Distilled)	500 mg/Kg B.W	1000 mg/ Kg B.W	2000 mg/ Kg B.W
	0 week				
Erythrocyte lineage	Red Blood Cells (10^6/µL)	6,743 ± 0,370	6,743 ± 0,370	6,743 ± 0,370	6,743 ± 0,370
	Hemoglobin (g/dL)	14,27 ± 0,29	14,27 ± 0,29	14,27 ± 0,29	14,27 ± 0,29
	Hematocrit (%)	42 ± 2,04	42 ± 2,04	42 ± 2,04	42 ± 2,04
	Mean corpuscular volume (fL)	54,33 ± 4,11	54,33 ± 4,11	54,33 ± 4,11	54,33 ± 4,11
	Mean corpuscular hemoglobin content (pg)	22,63 ± 1,45	22,63 ± 1,45	22,63 ± 1,45	22,63 ± 1,45
	Mean corpuscular hemoglobin concentration (g/dL)	36,83 ± 4,92	36,83 ± 4,92	36,83 ± 4,92	36,83 ± 4,92
	2 weeks				
	Red Blood Cells (10^6/µL)	6,957 ± 0,479	7,893 ± 0,447	7,627 ± 0,313	6,917 ± 0,067
	Hemoglobin (g/dL)	14,40 ± 0,30	15,30 ± 0,58	15 ± 0,58	14,73 ± 0,15
	Hematocrit (%)	44,10 ± 2,22	43,7 ± 1,70	42,80 ± 0,60	42,03 ± 0,37
	Mean corpuscular volume (fL)	59,07 ± 0,93	53,33 ± 0,83	53,80 ± 0,60	59,53 ± 0,77
	Mean corpuscular hemoglobin content (pg)	22,93 ± 0,03	20,37 ± 0,86	20,77 ± 1,14	21,24 ± 0,29
	Mean corpuscular hemoglobin concentration (g/dL)	38,33 ± 0,83	37,67 ± 1,17	37,47 ± 1,27	36,57 ± 1,72
	4 weeks				
	Red Blood Cells (10^6/µL)	6,920 ± 0,495	7,287 ± 0,643	6,507 ± 0,213	6,753 ± 0,123
	Hemoglobin (g/dL)	14,80 ± 0,42	15,20 ± 0,76	13,67 ± 0,68	14,50 ± 0,29
	Hematocrit (%)	39,10 ± 2,60	44,3 ± 2,30	36,87 ± 1,57	39,30 ± 3,46
	Mean corpuscular volume (fL)	59,43 ± 2,80	55,80 ± 2,89	56,23 ± 1,87	59,70 ± 0,40
	Mean corpuscular hemoglobin content (pg)	23,97 ± 1,98	21,43 ± 0,43	20,90 ± 0,49	21,93 ± 0,03
	Mean corpuscular hemoglobin concentration (g/dL)	37,87 ± 1,27	37,67 ± 0,17	37,07 ± 0,43	37,80 ± 0,90

Table III: Variation in the parameters of the erythrocyte lineage of female rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

	Parameters	Control	Doses of EAqPB		
		H_2O (Distilled)	500 mg/Kg B.W	1000 mg/ Kg B.W	2000 mg/ Kg B.W
	0 week				
Erythrocyte lineage	Red Blood Cells (10^6/µL)	7,310 ± 0,654	7,310 ± 0,654	7,310 ± 0,654	7,310 ± 0,654
	Hemoglobin (g/dL)	14,33 ± 0,35	14,33 ± 0,35	14,33 ± 0,35	14,33 ± 0,35
	Hematocrit (%)	39,86 ± 2,45	39,86 ± 2,45	39,86 ± 2,45	39,86 ± 2,45
	Mean corpuscular volume (fL)	53,97 ± 3,81	53,97 ± 3,81	53,97 ± 3,81	53,97 ± 3,81
	Mean corpuscular hemoglobin content (pg)	24,30 ± 2,97	24,30 ± 2,97	24,30 ± 2,97	24,30 ± 2,97
	Mean corpuscular hemoglobin concentration (g/dL)	37,70 ± 1,42	37,70 ± 1,42	37,70 ± 1,42	37,70 ± 1,42
	2 weeks				
	Red Blood Cells (10^6/µL)	6,800 ± 0,416	6,563 ± 0,657	6,477 ± 0,295	5,937 ± 0,787
	Hemoglobin (g/dL)	14,37 ± 0,41	14,63 ± 0,32	15 ± 1,16	14,30 ± 0,35

	Hematocrit (%)	41 ± 2,08	40,27 ± 1,87	38,30 ± 1,30	37,07 ± 3,30
	Mean corpuscular volume (fL)	56,83 ± 0,36	55,47 ± 1,13	56,87 ± 1,67	56,97 ± 0,83
	Mean corpuscular hemoglobin content (pg)	23,33 ± 1,66	24,67 ± 2,03	24,67 ± 2,40	28 ± 1
	Mean corpuscular hemoglobin concentration (g/dL)	45,53 ± 0,23	44,33 ± 2,87	41,10 ± 2,72	50 ± 5,20
	4 weeks				
	Red Blood Cells (10^6/µL)	6,610 ± 0,805	6,377 ± 0,133	5,940 ± 0,120	6,550 ± 0,180
	Hemoglobin (g/dL)	14,67 ± 0,66	14,37 ± 0,41	13,80 ± 0,79	14,07 ± 0,48
	Hematocrit (%)	40,17 ± 3,26	39,80 ± 0,90	36,43 ± 1,79	39,77 ± 0,83
	Mean corpuscular volume (fL)	61,30 ± 4,69	60,23 ± 2,17	59,73 ± 1,37	62,60 ± 3
	Mean corpuscular hemoglobin content (pg)	23,97 ± 1,12	22,37 ± 0,03	22,73 ± 0,57	21,53 ± 0,77
	Mean corpuscular hemoglobin concentration (g/dL)	41,10 ± 2,72	35,83 ± 0,07	39,03 ± 1,87	35,03 ± 0,58

Table IV: Variation in parameters of leukocyte lineage and blood platelets of male rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

	Parameters	**Control**	**Doses of EAqPB**		
		H_2O (Distilled)	**500 mg/Kg B.W**	**1000 mg/ Kg B.W**	**2000 mg/ Kg B.W**
	0 week				
Leukocyte lineage and blood platelets	White blood cells (10^3/µL)	10,90 ± 0,35	10,90 ± 0,35	10,90 ± 0,35	10,90 ± 0,35
	Lymphocytes (%)	81 ± 2	81 ± 2	81 ± 2	81 ± 2
	Monocytes (%)	15,37 ± 1,42	15,37 ± 1,42	15,37 ± 1,42	15,37 ± 1,42
	Granulocytes (%)	6,33 ± 0,49	6,33 ± 0,49	6,33 ± 0,49	6,33 ± 0,49
	Platelets (10^3/µL)	524,7 ± 29,2	524,7 ± 29,2	524,7 ± 29,2	524,7 ± 29,2
	2 weeks				
	White blood cells (10^3/µL)	12,47 ± 1,85	8,06 ± 2,46	8,13 ± 2,43	11,70 ± 0,65
	Lymphocytes (%)	82,15 ± 3,57	88,3 ± 1,2	87,40 ± 0,30	75,9 ± 4,6
	Monocytes (%)	15,03 ± 1,18	11,67 ± 3,17	11,93 ± 3,03	16,70 ± 0,20
	Granulocytes (%)	6,80 ± 0,81	5,13 ± 1,88	5,63 ± 1,63	9,23 ± 2,62
	Platelets (10^3/µL)	477 ± 77,8	544,7 ± 27,7	545,3 ± 27,3	552,3 ± 25,7
	4 weeks				
	White blood cells (10^3/µL)	14,27 ± 0,53	13,87 ± 0,56	10,67 ± 2,33	12,97 ± 1,18
	Lymphocytes (%)	86,63 ± 2,98	92,1 ± 1,2	83,43 ± 1,97	86,9 ± 3,5
	Monocytes (%)	12,70 ± 2,43	10,33 ± 2,73	11,80 ± 1,20	11,90 ± 2,40
	Granulocytes (%)	6,46 ± 0,91	5,23 ± 1,85	6,73 ± 0,76	6,56 ± 1,16
	Platelets (10^3/µL)	662,3 ± 74,8	466,7 ± 16,7	551 ± 53	676 ± 12

Table V: Variation in parameters of the leukocyte line and blood platelets of female rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

	Parameters	Control	Doses of EAqPB		
		H_2O (Distilled)	500 mg/Kg B.W	1000 mg/ Kg B.W	2000 mg/ Kg B.W
	0 week				
Leukocyte lineage and blood platelets	White blood cells (10^3/µL)	11,47 ± 0,81	11,47 ± 0,81	11,47 ± 0,81	11,47 ± 0,81
	Lymphocytes (%)	83,67 ± 0,66	83,67 ± 0,66	83,67 ± 0,66	83,67 ± 0,66
	Monocytes (%)	15 ± 1,09	15 ± 1,09	15 ± 1,09	15 ± 1,09
	Granulocytes (%)	6,80 ± 0,81	6,80 ± 0,81	6,80 ± 0,81	6,80 ± 0,81
	Platelets (10^3/µL)	560,30 ± 31,55	560,30 ± 31,55	560,30 ± 31,55	560,30 ± 31,55
	2 weeks				
	White blood cells (10^3/µL)	12,47 ± 1,83	9,50 ± 1,75	8,93 ± 1,03	9,03 ± 1,98
	Lymphocytes (%)	85,2 ± 2,24	80,90 ± 0,40	81,67 ± 1,41	83,63 ± 1,57
	Monocytes (%)	15,03 ± 1,70	13,83 ± 0,33	12,83 ± 0,83	11,83 ± 0,73
	Granulocytes (%)	7 ± 0,30	6,66 ± 0,73	6,76 ± 0,36	6,43 ± 1,06
	Platelets (10^3/µL)	492 ± 32,47	503,3 ± 30,7	504,7 ± 45,7	515 ± 50
	4 weeks				
	White blood cells (10^3/µL)	14,93 ± 0,74	12,17 ± 1,54	9,90 ± 2,55	11,33 ± 1,92
	Lymphocytes (%)	87,63 ± 1,98	86,80 ± 1,20	86,53 ± 3,17	86,83 ± 6,67
	Monocytes (%)	9,36 ± 1,01	10,63 ± 2,23	11,27 ± 2,55	12,97 ± 1,89
	Granulocytes (%)	5,90 ± 0,80	5,70 ± 0,70	6,23 ± 1,16	8,63 ± 3,16
	Platelets (10^3/µL)	662,30 ± 74,75	603 ± 23	639,3 ± 5,66	704,7 ± 0,33

III.2.5. Effects of a total aqueous extract of Parkia biglobosa trunk bark on certain biochemical parameters of rats

III.2.5.1. Effects of a total aqueous extract of Parkia biglobosa trunk bark on the lipid profile of rats

Tables VI and VII show, respectively, the effects of EAqPB on the lipid profile of male and female rats after four weeks of experimentation. The different doses of EAqPB (500, 1000, and 2000 mg/Kg B.W), administered to rats, did not significantly affect ($p > 0.05$) the level of total cholesterol, HDL-cholesterol, LDL-cholesterol, and triglycerides of the rats treated rats compared to that of rats in the control group.

III.2.5.2. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark on serum markers of rat liver

Tables VIII and IX respectively show the effects of EAqPB on the serum markers of the liver of male and female rats after four weeks of experimentation. The different doses of EAqPB (500, 1000, and 2000 mg/Kg B.W), administered to rats, did not significantly affect ($p > 0.05$) the level of total proteins, total bilirubin, conjugated bilirubin, alkaline phosphatase (PAL), gamma glutamyltransferase, aspartate aminotransferase (ASAT) and alanine aminotransferase (ALT) of treated male and female rats compared to that of rats in the control group.

III.2.5.3. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark on serum kidney markers of rats

Tables X and XI show, respectively, the effects of EAqPB on the serum markers of the kidneys of male, and female rats after four weeks of experimentation. The different doses of EAqPB (500, 1000, and 2000 mg/Kg B.W), administered to rats, did not significantly affect ($p > 0.05$) the serum level of urea, creatinine, and acid uric acid of treated male and female rats compared to that of control rats.

III.2.5.4. Effects of a total aqueous extract of *Parkia biglobosa* trunk bark on the electrolytes of rats

Tables XII and XIII respectively show the effects of EAqPB on the electrolytes of male and female rats after four weeks of experimentation. The different doses of EAqPB (500, 1000, and 2000 mg/Kg B.W), administered to the rats, did not significantly affect ($p > 0.05$) the ionogram of the treated male and female rats compared to that of the rats in the control group after 28 days of treatment.

Table VI: Variation in the lipid profile of male rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

Parameters	Control	Doses of EAqPB		
	H_2O (Distilled)	500 mg/Kg B.W	1000 mg/ Kg B.W	2000 mg/Kg B.W
0 week				
Total Cholesterol (g/L)	0,78 ± 0,07	0,78 ± 0,07	0,78 ± 0,07	0,78 ± 0,07
HDL-Cholesterol (g/L)	0,22 ± 0,04	0,22 ± 0,04	0,22 ± 0,04	0,22 ± 0,04
LDL-Cholestérol (g/L)	0,43 ± 0,06	0,43 ± 0,06	0,43 ± 0,06	0,43 ± 0,06
Triglycerides (g/L)	0,43 ± 0,02	0,43 ± 0,02	0,43 ± 0,02	0,43 ± 0,02
2 weeks				
Total Cholesterol (g/L)	0,78 ± 0,03	0,78 ± 0,01	0,82 ± 0,01	0,82 ± 0,01
HDL-Cholesterol (g/L)	0,23 ± 0,01	0,20 ± 0,01	0,22 ± 0,02	0,20 ± 0,01
LDL-Cholestérol (g/L)	0,37 ± 0,05	0,42 ± 0,01	0,38 ± 0,01	0,45 ± 0,01
Triglycerides (g/L)	1,20 ± 0,12	0,89 ± 0,01	0,86 ± 0,01	0,89 ± 0,03
4 weeks				
Total Cholesterol (g/L)	0,77 ± 0,06	0,77 ± 0,01	0,83 ± 0,02	0,82 ± 0,01
HDL-Cholesterol (g/L)	0,26 ± 0,02	0,21 ± 0,03	0,23 ± 0,02	0,21 ± 0,03
LDL-Cholestérol (g/L)	0,33 ± 0,03	0,45 ± 0,03	0,37 ± 0,01	0,44 ± 0,03
Triglycerides (g/L)	0,94 ± 0,21	0,69 ± 0,03	0,55 ± 0,10	0,65 ± 0,01

The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

Table VII: Variation in the lipid profile of female rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

Parameters	Control	Doses of EAqPB		
	H_2O (Distilled)	500 mg/Kg B.W	1000 mg/ Kg B.W	2000 mg/Kg B.W
0 week				
Total Cholesterol (g/L)	0,82 ± 0,04	0,82 ± 0,04	0,82 ± 0,04	0,82 ± 0,04
HDL-Cholesterol (g/L)	0,24 ± 0,04	0,24 ± 0,04	0,24 ± 0,04	0,24 ± 0,04
LDL-Cholestérol (g/L)	0,35 ± 0,05	0,35 ± 0,05	0,35 ± 0,05	0,35 ± 0,05
Triglycerides (g/L)	0,47 ± 0,02	0,47 ± 0,02	0,47 ± 0,02	0,47 ± 0,02
2 weeks				
Total Cholesterol (g/L)	0,73 ± 0,02	0,73 ± 0,05	0,75 ± 0,01	0,85 ± 0,01
HDL-Cholesterol (g/L)	0,25 ± 0,03	0,20 ± 0,02	0,20 ± 0,02	0,27 ± 0,03

LDL-Cholestérol (g/L)	0,44 ± 0,03	0,41 ± 0,05	0,42 ± 0,01	0,46 ± 0,02
Triglycerides (g/L)	1,02 ± 0,06	0,84 ± 0,08	0,87 ± 0,06	0,89 ± 0,03
4 weeks				
Total Cholesterol (g/L)	0,90 ± 0,08	0,75 ± 0,01	0,80 ± 0,02	0,93 ± 0,06
HDL-Cholesterol (g/L)	0,27 ± 0,02	0,21 ± 0,01	0,26 ± 0,02	0,26 ± 0,01
LDL-Cholestérol (g/L)	0,34 ± 0,04	0,45 ± 0,01	0,45 ± 0,01	0,44 ± 0,01
Triglycerides (g/L)	1,18 ± 0,16	0,82 ± 0,01	0,79 ± 0,08	0,81 ± 0,01

The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

Table VIII: Variation in the concentration of serum markers in the liver of male rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark.

Parameters	**Control**	**Doses of EAqPB**		
	H_2O (Distilled)	**500 mg/Kg B.W**	**1000 mg/Kg B.W**	**2000 mg/Kg B.W**
0 week				
T Proteins (g/L)	75,67 ± 0,67	75,67 ± 0,67	75,67 ± 0,67	75,67 ± 0,67
T Bilirubin (mg/L)	5 ± 0,44	5 ± 0,44	5 ± 0,44	5 ± 0,44
C Bilirubine (mg/L)	1,12 ± 0,07	1,12 ± 0,07	1,12 ± 0,07	1,12 ± 0,07
PAL (UI/L)	350 ± 42,4	350 ± 42,4	350 ± 42,4	350 ± 42,4
γGT (UI/L)	27,33 ± 2,67	27,33 ± 2,67	27,33 ± 2,67	27,33 ± 2,67
ASAT(UI/L)	179 ± 9,1	179 ± 9,1	179 ± 9,1	179 ± 9,1
ALAT (UI/L)	47 ± 4,04	47 ± 4,04	47 ± 4,04	47 ± 4,04
2 weeks				
T Proteins (g/L)	75,67 ± 0,67	75,67 ± 0,67	77 ± 1	76,33 ± 0,33
T Bilirubin (mg/L)	5 ± 0,57	5 ± 1,15	6,7 ± 0,35	7,06 ± 0,57
C Bilirubine (mg/L)	1,01 ± 0,01	0,96 ± 0,03	1,03 ± 0,08	0,99 ± 0,01
PAL (UI/L)	348,7 ± 46,5	378,7 ± 63,5	386,3 ± 67	368,3 ± 21,1
γGT (UI/L)	41,33 ± 1,86	43 ± 2,08	37 ± 1	42 ± 3
ASAT(UI/L)	187,3 ± 9,7	160,7 ± 4,7	161,7 ± 22,4	160,3 ± 2,3
ALAT (UI/L)	63,33 ± 4,33	58 ± 1	60,33 ± 0,33	58,33 ± 4,33
4 weeks				
T Proteins (g/L)	75,33 ± 0,88	76,67 ± 0,33	77,33 ± 0,67	77,67 ± 1,33
T Bilirubin (mg/L)	5,33 ± 0,33	5,33 ± 1,45	5,66 ± 0,88	6,66 ± 0,33
C Bilirubine (mg/L)	1,66 ± 0,33	1,33 ± 0,33	1,66 ± 0,33	2 ± 0,57
PAL (UI/L)	440,7 ± 31,9	491,7 ± 28,4	487,7 ± 5	473,7 ± 21,6
γGT (UI/L)	41,33 ± 3,18	39 ± 2,08	36,67 ± 2,33	36,33 ± 2,40
ASAT(UI/L)	155,3 ± 14,7	143 ± 7	152,3 ± 16,3	170 ± 22
ALAT (UI/L)	71,67 ± 4,98	81,67 ± 13,33	71,67 ± 10,33	60 ± 10

T Proteins: Total Proteins; Bilirubin T: Total Bilirubin; Bilirubin C: Conjugated Bilirubin; ALP: Alkaline phosphatase; γGT: Gamma glutamyltransferase; ASAT: Aspartate aminotransferase; ALT: Alanine aminotransferase.
The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

Table IX: Variation in the concentration of serum markers in the liver of female rats after 28 days of treatment with the total aqueous extract of *Parkia biglobosa* trunk bark.

Parameters	**Control**	**Doses of EAqPB**		
	H_2O (Distilled)	**500 mg/Kg B.W**	**1000 mg/ Kg B.W**	**2000 mg/Kg B.W**
0 week				
T Proteins (g/L)	75,67 ± 0,88	75,67 ± 0,88	75,67 ± 0,88	75,67 ± 0,88
T Bilirubin (mg/L)	5 ± 0,44	5 ± 0,44	5 ± 0,44	5 ± 0,44
C Bilirubine (mg/L)	1,05 ± 0,07	1,05 ± 0,07	1,05 ± 0,07	1,05 ± 0,07
PAL (UI/L)	406,3 ± 40,9	406,3 ± 40,9	406,3 ± 40,9	406,3 ± 40,9
γGT (UI/L)	28,33 ± 1,67	28,33 ± 1,67	28,33 ± 1,67	28,33 ± 1,67
ASAT(UI/L)	182,3 ± 24,8	182,3 ± 24,8	182,3 ± 24,8	182,3 ± 24,8
ALAT (UI/L)	53 ± 1,15	53 ± 1,15	53 ± 1,15	53 ± 1,15
2 weeks				
T Proteins (g/L)	75,67 ± 0,88	75,67 ± 0,33	77,67 ± 0,33	75,67 ± 0,33
T Bilirubin (mg/L)	5,33 ± 0,66	7,33 ± 0,33	5,66 ± 0,88	6,66 ± 0,33
C Bilirubine (mg/L)	0,97 ± 0,04	0,88 ± 0,08	0,82 ± 0,04	0,85 ± 0,14
PAL (UI/L)	431,3 ± 38,1	390,7 ± 32,40	419 ± 29	397,7 ± 64,20

γGT (UI/L)	41 ± 1,53	39,67 ± 0,33	44,33 ± 1,67	47 ± 1
ASAT(UI/L)	153,3 ± 8,8	144 ± 8,5	153,7 ± 6,3	148 ± 12,2
ALAT (UI/L)	70,67 ± 0,66	63,33 ± 0,88	60,57 ± 2,89	61,67 ± 6,67
4 weeks				
T Proteins (g/L)	75,33 ± 1,20	73,67 ± 0,33	76,33 ± 0,67	75,33 ± 0,67
T Bilirubin (mg/L)	6 ± 0,57	7,33 ± 0,33	5,66 ± 0,88	6,33 ± 0,33
C Bilirubine (mg/L)	1,33 ± 0,33	1,66 ± 0,33	2,33 ± 0,66	1,66 ± 0,33
PAL (UI/L)	401 ± 11,6	434,7 ± 12,8	409 ± 5,1	421,7 ± 5,8
γGT (UI/L)	39,33 ± 1,20	42,33 ± 2,85	43,33 ± 2,91	40,67 ± 1,45
ASAT(UI/L)	175 ± 28,30	146,3 ± 17,30	154 ± 13	163,7 ± 23,70
ALAT (UI/L)	74 ± 13,50	69,67 ± 11,33	63,50 ± 2,08	66 ± 11

T Proteins: Total Proteins; Bilirubin T: Total Bilirubin; Bilirubin C: Conjugated Bilirubin; ALP: Alkaline phosphatase; γGT: Gamma glutamyltransferase; ASAT: Aspartate aminotransferase; ALT: Alanine aminotransferase.
The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

Table X: Variation in the concentration of serum markers in the kidneys of male rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark.

Parameters	**Control**	**Doses of EAqPB**		
	H_2O (Distilled)	**500 mg/Kg B.W**	**1000 mg/ Kg B.W**	**2000 mg/Kg B.W**
0 week				
Créatinine (mg/L)	4,66 ± 0,33	4,66 ± 0,33	4,66 ± 0,33	4,66 ± 0,33
Urea (g/L)	0,44 ± 0,02	0,44 ± 0,02	0,44 ± 0,02	0,44 ± 0,02
Uric acid (g/L)	20,67 ± 1,86	20,67 ± 1,86	20,67 ± 1,86	20,67 ± 1,86
2 weeks				
Créatinine (mg/L)	4,33 ± 0,33	4,67 ± 0,33	4,66 ± 0,33	4 ± 0,57
Urea (g/L)	0,38 ± 0,04	0,34 ± 0,02	0,27 ± 0,06	0,31 ± 0,03
Uric acid (g/L)	21,33 ± 1,86	23,67 ± 1,86	20,67 ± 0,33	24,33 ± 2,33
4 weeks				
Créatinine (mg/L)	4,33 ± 0,33	4,66 ± 0,33	4 ± 0,57	4 ± 0,57
Urea (g/L)	0,36 ± 0,03	0,27 ± 0,08	0,25 ± 0,07	0,27 ± 0,07
Uric acid (g/L)	21,33 ± 1,86	19,33 ± 0,33	19 ± 1	19 ± 0,58

The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

Table XI: Variation in serum kidney marker concentration of female rats after 28 days of treatment with the total aqueous extract of trunk bark *Parkia biglobosa*.

Parameters	**Control**	**Doses of EAqPB**		
	H_2O (Distilled)	**500 mg/Kg B.W**	**1000 mg/ Kg B.W**	**2000 mg/Kg B.W**
0 week				
Créatinine (mg/L)	4,33 ± 0,88	4,33 ± 0,88	4,33 ± 0,88	4,33 ± 0,88
Urea (g/L)	0,44 ± 0,04	0,44 ± 0,04	0,44 ± 0,04	0,44 ± 0,04
Uric acid (g/L)	19,67 ± 1,45	19,67 ± 1,45	19,67 ± 1,45	19,67 ± 1,45
2 weeks				
Créatinine (mg/L)	5,66 ± 0,88	7,33 ± 0,33	7,33 ± 0,33	6,66 ± 0,33
Urea (g/L)	0,37 ± 0,02	0,34 ± 0,02	0,33 ± 0,04	0,31 ± 0,05
Uric acid (g/L)	19,67 ± 1,45	19 ± 1	21,33 ± 0,88	21,33 ± 1,86
4 weeks				
Créatinine (mg/L)	5,33 ± 0,33	4,33 ± 0,88	5 ± 0,57	4,33 ± 0,88
Urea (g/L)	0,35 ± 0,02	0,26 ± 0,06	0,31 ± 0,04	0,35 ± 0,02
Uric acid (g/L)	19,67 ± 1,45	19,67 ± 0,88	19,67 ± 0,33	19 ± 1

The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

Table XII: Variation in the serum ionogram of male rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

Electrolytes	Control	Doses of EAqPB		
	H_2O (Distilled)	500 mg/Kg B.W	1000 mg/ Kg B.W	2000 mg/Kg B.W
0 week				
Na^+ (mEq/L)	144,7 ± 0,7	144,7 ± 0,7	144,7 ± 0,7	144,7 ± 0,7
Cl^- (mEq/L)	99 ± 1	99 ± 1	99 ± 1	99 ± 1
K^+ (mEq/L)	6,16 ± 0,13	6,16 ± 0,13	6,16 ± 0,13	6,16 ± 0,13
Ca^{2+} (mg/L)	93,67 ± 1,33	93,67 ± 1,33	93,67 ± 1,33	93,67 ± 1,33
Mg^{2+} (mg/L)	20 ± 0,58	20 ± 0,58	20 ± 0,58	20 ± 0,58
P^{5+} (mg/L)	60,33 ± 0,33	60,33 ± 0,33	60,33 ± 0,33	60,33 ± 0,33
2 weeks				
Na^+ (mEq/L)	146,3 ± 0,3	142 ± 1	144 ± 2	143,7 ± 0,3
Cl^- (mEq/L)	97,67 ± 0,33	110 ± 6	100 ± 1	97,67 ±0,33
K^+ (mEq/L)	6,13 ± 0,13	6,73 ± 0,36	4,83 ± 0,12	5,4 ± 0,37
Ca^{2+} (mg/L)	105,70 ± 4,33	107,30 ± 3,67	103,70 ± 1,33	117,70 ± 3,33
Mg^{2+} (mg/L)	22,33 ± 0,33	23 ± 2	21 ± 0,58	22,67 ± 0,33
P^{5+} (mg/L)	63,33 ± 2,67	68 ± 2	60,67± 0,33	67,33 ±0,67
4 weeks				
Na^+ (mEq/L)	143,3 ± 0,3	141,3 ± 1,3	141,7 ± 0,3	144,3 ± 0,7
Cl^- (mEq/L)	106,7 ± 3,33	101 ± 2	101,7 ± 1,3	105,7 ± 2,33
K^+ (mEq/L)	5,93 ± 0,06	4,86 ± 0,13	5,76 ± 0,16	5,63 ± 0,16
Ca^{2+} (mg/L)	101 ± 2	100,30 ± 1,33	107,70 ± 3,33	117,30 ± 1,33
Mg^{2+} (mg/L)	22,67 ± 0,33	22 ± 1	24,33 ± 0,33	21,67 ± 0,33
P^{5+} (mg/L)	73 ± 1,53	76,67 ± 3,33	77 ± 1	76,33 ± 0,67

The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

Table XIII: Variation in the serum ionogram of female rats after 28 days of treatment with total aqueous extract of *Parkia biglobosa* trunk bark (EAqPB).

Electrolytes	Control	Doses of EAqPB		
	H_2O (Distilled)	500 mg/Kg B.W	1000 mg/ Kg B.W	2000 mg/Kg B.W
0 week				
Na^+ (mEq/L)	145,3 ± 0,66	145,3 ± 0,66	145,3 ± 0,66	145,3 ± 0,66
Cl^- (mEq/L)	100 ±1	100 ±1	100 ±1	100 ±1
K^+ (mEq/L)	6,03 ± 0,13	6,03 ± 0,13	6,03 ± 0,13	6,03 ± 0,13
Ca^{2+} (mg/L)	93,67 ± 1,33	93,67 ± 1,33	93,67 ± 1,33	93,67 ± 1,33
Mg^{2+} (mg/L)	19,78 ± 0,39	19,78 ± 0,39	19,78 ± 0,39	19,78 ± 0,39
P^{5+} (mg/L)	58,67 ± 1,85	58,67 ± 1,85	58,67 ± 1,85	58,67 ± 1,85
2 weeks				
Na^+ (mEq/L)	146,7 ± 0,33	140,7 ± 0,3	142,7 ± 1,3	144 ± 1
Cl^- (mEq/L)	97,33 ± 0,33	100,7 ± 0,3	98,67 ± 0,33	101 ± 2
K^+ (mEq/L)	6,26 ± 0,13	5,63 ± 0,20	5,33 ± 0,40	5,30 ± 0,35
Ca^{2+} (mg/L)	105,70 ± 4,33	102,30 ± 0,67	107 ± 4	102,30 ± 0,67
Mg^{2+} (mg/L)	23 ± 1	24,67 ± 0,67	22,67 ± 0,33	24 ± 2,31
P^{5+} (mg/L)	58 ± 4,61	55,33 ±1,67	57,67 ±0,33	56,67 ±0,33
4 weeks				
Na^+ (mEq/L)	143,7 ± 0,33	144,7 ± 0,3	144 ± 1	145,7 ± 0,3
Cl^- (mEq/L)	103,3 ± 3,33	106,3 ± 0,7	111,3 ± 0,33	105 ± 1
K^+ (mEq/L)	5,86 ± 0,06	5,13 ± 0,16	5,14 ± 0,17	5,56 ± 0,26
Ca^{2+} (mg/L)	101 ± 3	103 ± 1	113,30 ± 2,67	102,70 ± 0,33
Mg^{2+} (mg/L)	23 ± 0,57	24,33 ± 1,33	20,33 ± 0,67	23 ± 1
P^{5+} (mg/L)	73 ± 1,52	72,33 ± 0,67	69,33 ± 0,67	74,67 ± 0,33

The values expressed represent the mean followed by the standard error of the mean (m ± SEM), with n=5.

DISCUSSION

The study of the acute oral toxicity of the total aqueous extract of Parkia biglobosa bark trunk (EAqPB) in female mice made it possible to provide an estimate, according to the guidelines and recommendations of OECD-423, lethal dose 50% (LD_{50}). The results show that the administration of EAqPB, at a dose of 2000 mg/Kg B.W, and then at a dose of 5000 mg/Kg of B.W,

does not cause any mortality in these mice during 14 days of observation. The LD_{50} is therefore greater than 5000 mg/Kg B.W according to the directives and recommendations of OECD-423.

The animals did not experience any significant change in body weight. Given these results, EAqPB is non-toxic. This absence of toxicity by gavage observed with the total aqueous extract of trunk bark of *Parkia biglobosa* is also observed with other plants of the traditional African pharmacopoeia such as the leaves of *Moringa oleifera* (Moringaceae), the leaves of *Lophira lanceolata* (Ochnaceae) and the whole plant of *Crotalaria retusa* (Fabaceae) respectively by Samedidu-Gyekye et al. (2014), Oussou et al. (2016) and Goh bi et al. (2021). Indeed, these researchers have shown that the aqueous extracts of *Moringa Oleifera* leaves, *Lophira lanceolata*, and the whole plant of *Crotalaria retusa* have LD_{50} greater than 5000 mg/Kg B.W.

Concerning subacute toxicity, daily administration of the total aqueous extract of *Parkia biglobosa* trunk bark for 28 days showed no toxicity in both male and female rats. All animals survived the treatments. They had normal growth in body weight, a sign of an absence of toxicity. However, rats treated with EAqPB at a dose of 2000 mg/Kg B.W had a lower weight gain than animals treated with 500 and 1000 mg/Kg B.W of EAqPB.

This low weight gain observed at a dose of 2000 mg/Kg B.W with EAqPB in female rats would be due to the high concentration of phenolic compounds in our crude plant extract. Tannins are known to retard growth by reducing the digestion and/or absorption of amino acids and minerals (Laurena et al., 1984). The total aqueous extract of *Parkia biglobosa* trunk bark is a good source of phenolic compounds and polyphenol oxidases. Polyphenols are oxidized to quinones by polyphenol oxidases. These quinones will complex the proteins, thereby reducing the amino acids available to be ingested by the animals (Da Damio and Thompson, 1992).

In terms of organ weight, a variation in the relative weight of the organs is an index of toxicity that generally results in a disruption of normal functioning or a specific lesion of these organs. Physical signs of toxicity could be changes in histology, organ weight, and organ-specific enzyme production (P'ng et al., 2012). In this study, the results revealed that the relative weight of vital organs such as the heart, liver, and kidneys of animals treated with EAqPB did not differ significantly from that of the control. This suggests that our extract does not disrupt the normal functioning of these organs.

These results are similar to those obtained with several medicinal plants from the African pharmacopoeia. Indeed, Ukwubile et al. (2020) and Yamssi et al. (2020), respectively studying the toxicity of methanolic extracts of leaves of *Camellia sinensis* (Liliaceae) in mice, of bark of *Pentaclethra macrophylla* (Fabaceae) and leaves of *Psidium guajava* (Myrtaceae) in rats, showed that these extracts did not significantly modify the weight of the animals and the relative weight of the organs.

The evaluation of hematological parameters is an important indicator for assessing the toxicity of any substance. The hematopoietic system is sensitive to chemicals and plant extracts. According to Olayode et al. (2019), the extracts of certain plants considerably modify hematological parameters.

The results of this study indicate a non-significant variation in the parameters of the erythrocyte line (red blood cells, hemoglobin, hematocrit, MCV, TCMH and CCMH), the leukocyte line (white blood cells, lymphocytes, monocytes, and granulocytes) and blood platelets of treated rats compared to those of the rats in the control group. These results are similar to those obtained by Ouolouho et al. (2018) on the aqueous and ethanolic extracts of the seeds of this same plant.

Biochemical parameters can be used as markers to assess the proper functioning of vital organs. Under normal conditions, enzymes are found in cells. But when these organs undergo alterations, the enzymes are found in the blood circulation, thus leading to an increase in their activity in the serum (Chavez et al., 2015; Ogunmoyole et al., 2019).

Some enzymes are organ specific, while others are not. This is the case for ALT which is remarkably specific to the liver while AST is present, most often, in the myocardium, skeletal muscle, brain, and kidneys (Elfaki et al., 2020). Serum proteins such as albumin are synthesized by the liver, whose relative weight could provide information on the synthesis capacity of the liver. A drop in serum albumin level generally indicates a disruption in the liver's ability to synthesize proteins (Rasekh et al., 2008). Urea, uric acid, creatinine, and electrolytes are indicators of kidney functioning (Flamant et al., 2015; Musila et al., 2017). An increase in their levels indicates abnormalities in glomerular filtration or renal function (Zakaria et al., 2016).

The results of the subacute toxicity study indicated a non-significant variation in the parameters of liver function, renal function, and electrolytes of the animals treated with the different doses of EAqPB (500, 1000 and 2000 mg/Kg B.W). Daily administration of doses of 500, 1000, and 2000 mg/Kg B.W of EAqPB, for 28 days, did not cause dysfunction or damage to the heart, liver, and kidneys.

As for the lipid profile parameters of rats treated with increasing doses of EAqPB (500, 1000, and 2000 mg/Kg B.W), no significant variation was observed.

Similar results were obtained with methanolic extracts of the leaves of Dacryodes edulis (Burseraceae) on rats by Ononamadu et al. (2020).

CONCLUSION

The study of acute toxicity by the oral route showed that the aqueous extract is non-toxic because the LD_{50} is greater than 5000 mg/Kg B.W. Repeated administration for 28 days of different doses of EAqPB did not cause any signs of toxicity in rats. These results are therefore favorable to using this plant in traditional medicine to treat diseases.

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