Rodenticidal and Toxicological Studies of Piptadeniastrum Africanum and Eurphorbia Kamerunica Pax against Albino Rats

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Abstract

Background: A significant and common category of mammals, rodents can be either native or brought to other parts of the world. Their damage to crops, the poisons used to control them, the social issues brought on by their close proximity to human habitation, and the health issues resulting from their role as zoonotic disease carriers all contribute to economic problems. This research investigated the rodenticidal and toxicological studies of Piptadeniastrum africanum and Euphorbia kamerunica against albino rat.

Results: This study showed that, in comparison to the control group, the mean weight of the Albino rats treated with ethanolic extracts of *P. africanum* and *E. kamerunica* Pax significantly decreased. Acute toxicity revealed that after 72 hours, ethanolic extracts of *P. africanum* and *E. kamerunica* Pax at 15ml had 67% and 50% mortality respectively. Furthermore, at 96hours both extracts had 83.3% and 100% mortality respectively. There was decrease in the Hb, RBC and PCV from the control. A potential explanation for the experimental rats' illogical behaviour, restlessness, and eventual death is suggested by this discovery.

Conclusion: As indicated by an increase in WBC and lymphocytes, the study's findings imply that the ethanolic extracts of *P. africanum* and *E. kamerunica* Pax may have compromised oxygen transport and adversely affected the exposed rats' defence mechanisms. Increases in the concentrations of the feed composed with *P. africanum* and *E. kamerunica* Pax resulted in increased activity of ALP, AST, and ALT, which are markers of liver damage.

Keywords: Piptadeniastrum africanum; Eurphorbia Kamerunica; Albino rat, Rodenticide; Toxicology.

Background: Rodents are considered one of the most significant mammalian pests globally due to their persistent presence near human habitations, leading to social, economic, environmental, and health issues. They damage agricultural systems, spread zoonotic diseases like Lassa fever and Salmonellosis, and result in the excessive use of chemical pesticides, which are hazardous to people and the environment. The focus has shifted towards integrated pest management (IPM) and botanical pesticides, which are cost-effective and environmentally friendly alternatives to

DOI: https://doi.org/10.5281/zenodo.15239346

conventional pesticides (Herbreteau *et al*., 2012, Abou-Hashem, 2012, Singla *et al*., 2014). Plant extracts have been utilized as pesticides since ancient Roman times and continue to be used today, especially in developing countries where they are more affordable than synthetic pesticides. Many plants, trees, shrubs, and annuals, both wild and cultivated, have been investigated for their pesticidal properties and have proven effective. Compared to traditional broad-spectrum pesticides, botanicals offer several advantages: they are effective in small doses, degrade quickly, specifically target pests and related species, and provide residue-free food and a safer environment (Abou-Hashem, 2012).

Piptadeniastrum africanum is a towering tree, reaching about 50 meters, with large buttresses and bipinnately compound leaves. Belonging to the Leguminosae family, which comprises approximately 40 genera and 2000 species of tropical and subtropical trees and shrubs, it sprouts from stumps and has sapwood that is pale reddish-yellow or pinkish-white when young. The tree is locally known as "Kiryar Kurmi" in Hausa, "Ofie" in Igbo, and "Agboni" or "Agboyin" in Yoruba. Traditionally valued for its medicinal properties, its bark and leaves contain active components like flavonoids, tannins, steroids, and glycosides, which are believed to have anti-helminth, anti-inflammatory, and antibacterial effects (Bekeh et al., 2017; Kigigha et al., 2018; Ahmad et al., 2024).

Euphorbia kamerunica Pax (Family: Euphorbiaceae) is a burgeoning plant predominantly found in the tropical and subtropical regions of Africa, America, and temperate zones worldwide. Originating mainly from Africa, the Americas, and Madagascar, this succulent species is distributed across the Sahel of Africa, including Nigeria, Cameroon, Chad, and Ethiopia. Many spurge species are grown as garden plants, and traditional Chinese medicine uses its succulent variants. The latex (milky sap) of *E. kamerunica* Pax is typically white, occasionally yellow, and coagulates within minutes upon exposure to air. This latex, often insoluble in water once congealed, contains skin irritants and carcinogenic compounds hazardous to humans and grazing livestock. The primary toxic components consist of lectins and diterpene alcohol esters, including phorbol derivatives, as well as tigliane, daphnane, and ingenane diterpene ester toxins. These chemicals are responsible for skin inflammation, redness, and edematous swelling. Ingesting the toxic latex can cause severe eye irritation, potentially leading to blindness. When consumed internally, poisoning has been linked to severe gastroenteritis, vomiting, and colicky diarrhea (Agbegbi *et al*., 2012). Thus, the goal of this research is to use Albino rats as a model to produce non-synthetic plant-based rodenticides for the management of the domestic rodent threat.

Methods:

Test Substances Collection:

The P. africanum and E. kamerunica Pax were obtained from Ondo West and East Local Government Area, in Ondo, Ondo State, Nigeria. The vegetation type found in this study area is typical rainforest dominated by trees, grasses and shrubs. The predominant activities in this area include farming and trading of farm produce.

Identification of Test Substances:

Plant taxonomists identified the botanicals at the Federal University of Technology, Akure, Ondo State, Nigeria's Department of Wildlife and Forestry, Faculty of Agriculture and Agricultural Technology.

DOI: https://doi.org/10.5281/zenodo.15239346

Experimental Animals:
Ekiti State University's Department of Zoology in Ado-Ekiti, Ekiti State, Nigeria, is where the albino rats were acquired. The animals were housed in well-ventilated wooden cages at the Federal University of Technology, Akure, Ondo State, Nigeria's Department of Biology's animal house. The animals were given two weeks to acclimatise before the trial. The rats were given drinking water and basic feed twice a day during the trial.

Experimental Design:
Forty-two Albino rats were divided into different groups: Group one (control) were fed with basal diet and water (food and water *ad libitum*), while Group two to seven were administered with varying dosage (5ml, 10ml and 15ml) of ethanolic extract of *Piptadeniastrum africanum* and *Euphorbia kamerunica* Pax respectively and feed for 24hours, 48 hours, 72 hours and 96 hours respectively. After ninety-six hours, the albino rats were sacrificed to check for the acute toxicity.

Plant Material Preparation (Plant powder):
The plant stem bark and root bark were harvested from the forest in Ondo town. The stem bark and root bark were air dried at room temperature (28±2^{o}C) and the Relative humidity (75±5%), after air drying the stem bark and root barks were pulverized into powder.

Preparation of Plant Ethanolic extract:
The bark from the stems and roots of the plants was collected from the Ondo town forest. The plant extracts were made, with some adjustments, according to Adedire and Akinneye's (2003) instructions. Piptadeniastrum africanum and Euphorbia kamerunica Pax were harvested. After properly cleaning the passenger stem barks twice with distilled water to get rid of any debris, they were left to drip on a wire mesh.
The stem bark and root bark were air dried at room temperature (28±2^{o}C) and the Relative humidity (75±5%), after air drying the stem bark were pulverized into powder. The powder was percolated with ethanol 96%. The obtained product was concentrated using muslin clothe to obtain a viscous ethanol extract of the plant root bark and stem bark.

Phytochemical Analysis
According to standard procedures by Lambert and Muir (1973), Stewarte *et al.*, (1974), Sofowora (1993), Edeoga *et al.*, (2005), Okwu (2005), Doherty *et al.*, (2010), and Kanife *et al.*, (2012), phytochemical analysis included both the qualitative screening of plant samples for the presence of phytochemicals and the quantitative analysis of the specific amounts of the various phytochemicals present in the plant samples.

Calculating Biochemical Parameters

Using biomarkers for the liver and kidney, the possible mechanism for the toxicity caused by the botanicals was examined. Each mouse involved in the experiment had its heart punctured, and 1.5 ml of blood was collected into Eppendorf tubes. Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activity, creatinine, and urea were measured after the blood was centrifuged for five minutes at 3000 revolutions per minute. A coloured complex is created when creatinine and picric acid combine in an alkaline solution. The concentration of creatinine directly correlates with the amount of the complex that forms. Using the Bartels and Bohmer (1972) approach, the concentration of urea was measured. The Reitman and Frankel (1957) approach was used to perform ALT and AST.

DOI: https://doi.org/10.5281/zenodo.15239346

Statistical analysis

Data analysis was conducted using version 22.0 of the Statistical Package for Social Science (SPSS®). They displayed the results as mean ± standard error. For test of significance at various concentrations, one-way analysis of variance (ANOVA) and Duncan's New Multiple Range Test (DMRT) were employed. At $p \leq 0.05$, the significant difference between the treatment group and control was identified.

RESULTS

Concentration of Phytochemical Parameters in the extract of Euphorbia kamerunica Pax and Piptadeniastrum africanum

Euphorbia kamerunica Pax exhibits higher concentrations of Tannins (6.22 ± 0.02), Saponin (1.00 ± 0.02), and Flavonoid (0.74 ± 0.01) compared to Piptadeniastrum africanum, which has Tannins (4.10 ± 0.06), Saponin (0.64 ± 0.05), and Flavonoid (0.57 ± 0.01). All differences are statistically significant ($p < 0.05$). These findings suggest potential variations in the phytochemical properties of the two plants, which may have implications for their use as rodenticide.

Table 1: Concentration of Phytochemical Parameters in the extract of Euphorbia kamerunica Pax and Piptadeniastrum africanum

Phytochemical Parameter	Plant sample				df = 1
	EK	PD	Sum of Square	F value	*p* value
Tannins	6.22±0.02	4.10±0.06	4.501	950.280	0.001
Saponin	1.00±0.02	0.64±0.05	0.133	46.761	0.021
Flavonoid	0.74±0.01	0.57±0.01	0.028	104.649	0.009
Phenol	0.39±0.01	0.27±0.01	0.017	169.806	0.06
Glycoside	0.11±0.01	0.10±0.00	0.000	3.846	0.189

*EK- Euphorbia kamerunica Pax *PD- Piptadeniastrum africanum
p value: < 0.05 (significant), >0.05 (non-significant)

Effects of the Ethanolic extracts of Euphorbia kamerunica Pax and Piptadeniastrum africanum on the Haematological parameters of the Albino Rats

Table 2 showed the effects of extracts from Euphorbia kamerunica Pax and Piptadeniastrum africanum, as well as the combination of extract and diet, on the experiments' rats' RBC, WBC, haemoglobin (Hb), lymphocytes, and packed cell volume (PCV). The Hb levels decreased progressively with higher concentration of both extracts. The highest decrease was observed in the group receiving 15ml of *E.* kamerunica, reaching 9.60±3.14 g/dL compared to the control group's 15.60±2.55 g/dL. Similarly, PCV values showed a dose-

DOI: https://doi.org/10.5281/zenodo.15239346

dependent decrease. Rats treated with 15ml of *E.* kamerunica had a PCV of 35.68±4.56%, significantly lesser than the control. RBC counts demonstrated a notable decrease across treatment groups, indicating enhanced erythrocyte degradation or hemolysis. The lowest RBC count was 6.37±1.06 $\times 10^6/\mu L$ in the 15ml *E. kamerunica* group. WBC counts increased modestly with higher doses, suggesting a potential immunostimulatory effect. The most significant increase was in the Piptadeniastrum africanum high-dose group. Lymphocyte counts exhibited scientifically different elevations across treatment groups, with the highest count in rats receiving 15ml of *E. kamerunica*. The data indicated that both EPD and EEK extracts influence biochemical parameters in a concentration-dependent manner, with higher concentrations generally resulting in increased levels of the measured parameters compared to the control group.

Table 2: Effects of Ethanolic extracts of Euphorbia kamerunica Pax and Piptadeniastrum africanum on the Haematological parameters of the Albino Rats

Plant extract	Conc. (ml)	Haematological Parameter				
		RBC (million/µl)	WBC ($10^6/mm^3$)	Haemoglobin (g/dl)	Lymphocyte (%)	PCV (%)
EPD	5	8.12±0.03^{a}	8.09±0.03^{a}	15.25±0.06^{a}	60.12±0.03^{ab}	51.32±0.22^{ab}
	10	7.98±0.03^{a}	8.16±0.05^{a}	14.81±0.03^{a}	62.69±0.32^{b}	50.66±0.08^{ab}
	15	6.21±1.89^{a}	12.99±1.06^{c}	9.60±3.14^{a}	67.09±1.99^{c}	35.68±4.56^{a}
EEK	5	9.06±0.02^{a}	10.04±0.18^{ab}	13.08±0.20^{a}	62.09±0.09^{b}	52.81±0.18^{b}
	10	8.18±0.03^{a}	12.32±1.18^{bc}	12.86±0.05^{a}	72.78±0.27^{d}	50.78±0.08^{ab}
	15	6.37±1.06^{a}	12.83±0.19^{c}	8.85±2.89^{a}	79.02±0.81^{e}	45.12±5.23^{ab}
Control	0.0	9.09±1.89^{a}	8.10±1.04^{a}	15.60±2.55^{a}	58.46±0.25^{a}	58.13±9.94^{b}

EPD=Ethanolic extract of Piptadeniastrum africanum, EEK- Ethanolic extract of Euphorbia kamerunica Pax

Mean follow by the same letter in column are not significantly different (p>0.05) from one another using Duncan New Multiple Range Test (DNMRT).

Toxicology effect of Ethanolic extract of Piptadeniastrum africanum and Eurphobia Kamerunica Pax on Albino Rats

Elevated levels of Albumin in the concentration of ethanolic extract of Piptadeniastrum africanum and Euphorbia Kamerunica Pax administered to the experimental rats compared with the Control (p<0.05). showed there was no significance in the effects of concentration between the two ethanolic extracts groups (p>0.05). The ALP result showed that the interaction with feed mixed with extracts has higher inhibition of enzyme activity compared to the control. Among the Piptadeniastrum

DOI: https://doi.org/10.5281/zenodo.15239346

africanum group EPD5 (40.38U/L) and EPD10 (45.04U/L) had insignificant difference ($p>0.05$) with the control group (44.74 U/L) while there was significant difference ($p<0.05$) between EPD 15 (52.88U/L) and the control (44.74U/L). However, in Euphorbia Kamerunica Pax group EEK5, EK10 and EEK15 (58.27, 60.29 and 65.33U/L) there was significant different ($p<0.05$) between all the concentration compared with the control group (44.74 U/L) respectively. ALT activity was used as a marker to evaluate the state of the liver, the results showed that there was an increase in the activity of ALT across both plant ethanolic extract groups, though there was no significant difference ($p>0.05$) in the ALT activity between EPD5 (17.17U/L), EPD10 (19.15U/L) and EEK5 (19.09U/L) and the control (14.14U/L). There was significant difference ($p>0.05$) in the ALT activity of both 15ml of ethanolic extract of Piptadeniastrum africanum (25.62 U/L) and 15ml of ethanolic extract of Euphorbia kamerunica Pax (24.62U/L) in comparison with the control though EPD15 (25.62 U/L) showed a distinct effect on the ALT activity.

The inhibition of the activity of Aspartate aminotransferase in the male albino rats by extract of

Piptadeniastrum africanum and Euphorbia kamerunica Pax showed that all the concentration had significantly different inhibiting activities from the control group. There was no significant difference ($p>0.05$) between EPD5 (103.19 U/L), EEK10 (109.27 U/L) and the control group (92.08 U/L). There was significant difference ($p>0.05$) between the inhibition of 15ml of the ethanolic extract of Piptadeniastrum africanum (123.62 U/L) and 15ml of Euphorbia Kamerunica Pax (135.68 U/L), also EEK15 showed the highest inhibition of AST activity.

The result on Blood Urea showed that there was no significant difference ($p>0.05$) in the effects on the concentrations among all the group of both plants i.e. EPD5 (51.22mg/dl), EPD10 (50.86 mg/dl), EPD15 (53.93 mg/dl), EEK5 (53.05 mg/dl), EEK10 (55.12 mg/dl) and EEK15 (57.62 mg/dl) extracts compared to the control group (50.55 mg/dl). The Creatinine result also showed an increase in the concentration compared with the control. There was no significant difference ($p>0.05$) between the concentration EPD5 (7.12mg/l), EEK5 (7.51mg/l) and the control (5.68mg/l), though there was significance ($p>0.05$) between EEK10 (8.72 mg/l), EEK15 (9.21 mg/l), EPD10 (7.64mg/l) and EPD15 (8.31mg/l) and the control (5.68mg/l).

Figure 1 showed that after 72 hours, ethanolic extracts of P. africanum and E. kamerunica Pax at 15ml had 67% and 50% mortality respectively. Furthermore, at 96hours both extracts had 83.3% and 100% mortality respectively. The data indicated that both Piptadeniastrum africanum (EPD) and Euphorbia kameranica Pax (EEK) extracts have a significant impact on the mortality of albino rats, with EEK showing a more pronounced effect at higher concentrations. The results suggest a concentration-dependent relationship, where higher concentrations of the extracts lead to increased mortality over time. This information is crucial for understanding the potential toxicological effects of these plant extracts.

DOI: https://doi.org/10.5281/zenodo.15239346

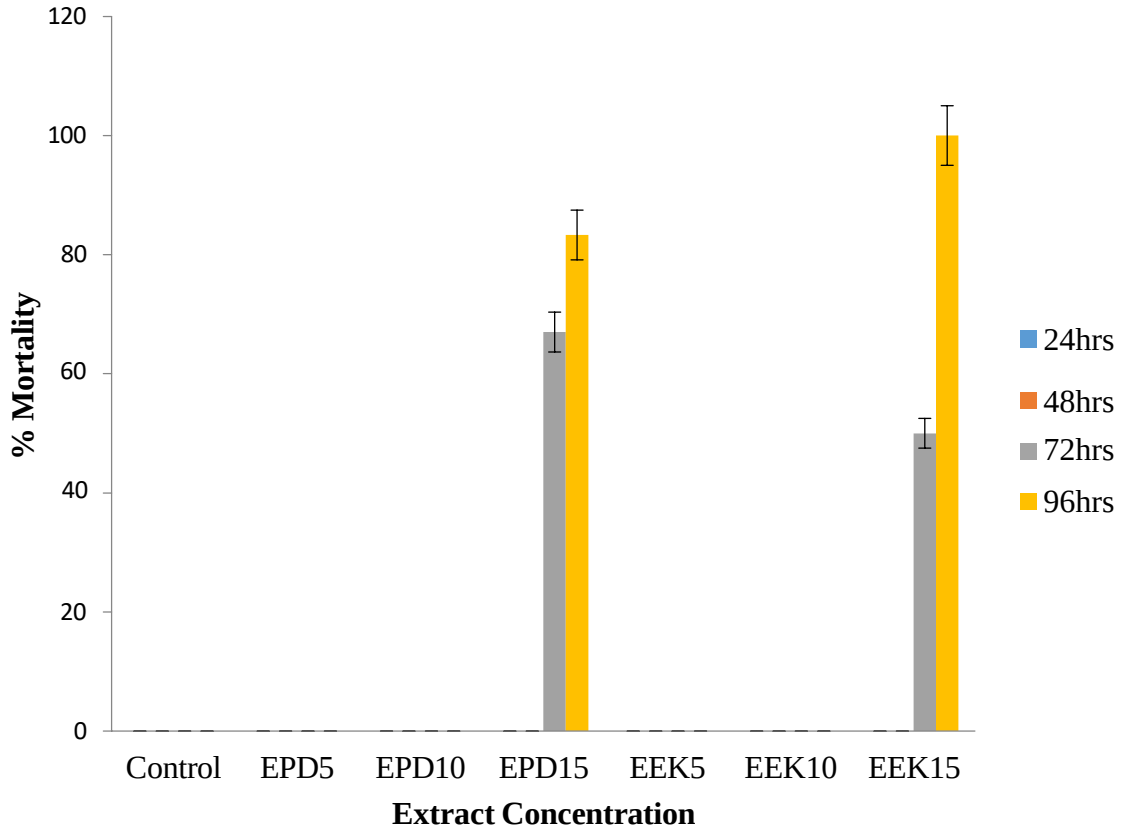

Figure 1: % Mortality of Albino rat fed with Piptadeniastrum africanum and Euphorbia kamerunica Pax

Table 3: Effects of Ethanolic extracts of Euphorbia Kamerunica Pax and Piptadeniastrum africanum on the Biochemica;lParameter of Albino Rats.

Plant extract	Conc.	Biochemical Parameter						
		Protein (g/dl)	Albumin (g/dl)	ALP (U/L)	Urea (mg/dl)	Creatinine (mg/l)	ALT (U/L)	AST (U/L)
EPD	5	6.37±0.18^{a}	5.20±0.12^{b}	40.38±0.38^{a}	51.22±0.11^{a}	7.12±0.03^{ab}	17.17±0.05^{ab}	103.19±0.83^{b}
	10	6.86±0.02^{ab}	5.35±0.03^{b}	45.04±4.79^{ab}	50.86±0.15^{a}	7.64±0.57^{bc}	19.15±0.12^{abc}	112.46±1.61^{c}
	15	8.20±0.02^{bc}	5.56±0.16^{b}	52.88±0.31^{bc}	53.93±1.25^{a}	8.31±0.05^{bc}	25.62±4.09^{d}	123.62±3.09^{d}
EEK	5	8.33±0.07^{bc}	5.02±0.02^{b}	58.27±0.37^{cd}	53.05±0.05^{a}	7.51±0.02^{ab}	19.09±0.09^{abc}	109.27±1.27^{bc}
	10	8.59±0.14^{c}	5.13±0.02^{b}	60.29±0.14^{cd}	55.12±0.02^{a}	8.72±0.02^{bc}	22.56±0.08^{bcd}	131.10±0.32^{e}
	15	8.77±0.12^{c}	5.43±0.05^{b}	65.33±2.55^{d}	57.62±1.40^{a}	9.21±0.15^{c}	24.62±0.29^{cd}	135.68±2.52^{e}
Control	0.0	6.22±1.21^{a}	4.02±0.59^{a}	44.74±3.76^{ab}	50.55±5.26^{a}	5.68±1.26^{a}	14.14±1.62^{a}	92.08±2.14^{a}

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Discussion:

Phytochemical Screening Of Piptadeniastrum Africanum And Euphorbia Kamerunica Pax:

Phytochemical analysis of the bark from Piptadeniastrum africanum and Euphorbia kamerunica Pax reveals the presence of tannins, saponins, flavonoids, glycosides, and phenols. These compounds are frequently responsible for the medicinal properties of plants. Tannins, for instance, are not only utilized in leather tanning, fabric dyeing, and ink production but also play a significant role in various medical applications (Owoeye et al., 2018). Concentration of tannins in Euphorbia kamerunica Pax and Piptadeniastrum africanum are the most valuable. The combination of decreased intake and low real digestibility of protein resulted in a detrimental effect on growth rate. These may limit intake of forage legumes by decreasing palatability or by negatively influencing digestion. Due to its ability to attach to the bacterial enzymes and create indigestible complexes with cell wall carbohydrates, tannin may decrease the digestibility of cell walls (Egbuna and Ifeneje, 2015; Youkparigha et al., 2019). Chronic ingestion of phenol can lead to nausea, vomiting, headaches, abdominal pain, sore throat, mouth ulcers and dark urine may occur, as well as respiratory and cardiovascular effects (Egbuna and Ifeneje, 2015) these were observed in experimental animals fed with the highest concentration of both ethanolic plant extracts.

Due to their saponins hemolytic properties, which cause the rupture of erythrocytes and the release of haemoglobin; saponins decrease the efficiency of nutrient conversion and utilisation in ruminants (Egbuna and Ifeneje, 2015). Due to their bitterness and throat-irritating properties, saponins function as a growth inhibitor in monogastric animals and decrease their feed intake. According to the findings of Egbuna and Ifeneje (2015), It has been discovered that dietary saponins from a variety of plants reduce fertility, induce ruminant bloat and photosensitisation, and impact protein digestibility by blocking a number of digestive enzymes, including chymotrypsin and trypsin. This experiment showed a decrease in the mean weight gain of the experimental animal, which was in agreement with their findings. Due to their toxicity to numerous species, saponin can be used for their insecticidal, antibiotic, fungicidal, and other therapeutic activities (Owoeye et al., 2018). Among the chemicals that protect certain plants against insects or other animals that would eat them are cardiac glycosides, also referred to as cardiac olides. These medications have a severely detrimental effect on the vertebrate heart while also activating the brain's vomiting-inducing nerve region.

Higher glycoside doses cause animals to lose their rhythm, which is followed by ventricular tachycardia and fibrillation (Owoeye et al., 2018). The body and organ weight are used in toxicological research as a marker for metabolic status, typical growth and development of the organism, and side effects of various chemicals, such as organ malfunction, detoxification processes, and organ toxicity (Mossa et al., 2018). This study showed that when compared to the control group, the mean weight of the Albino rats treated with ethanolic extracts of Piptadeniastrum africanum and Euphorbia kamerunica Pax decreased significantly, according to this study. This finding agrees with the report of Obeten et al., (2013). This drop in the average weight of the rats may indicate that Piptadeniastrum africanum and Euphorbia kamerunica Pax plant has a diuretic effect, causing rodents to lose weight. Furthermore, increased concentrations of ethanolic extract of Piptadeniastrum africanum led to increased

DOI: https://doi.org/10.5281/zenodo.15239346

mortality which was similarly observed in C. gariepinus exposed to aqueous extracts of Piptadeniastrum africanum reported by Bekeh et al., (2017).

As a member of the flavonoid group, alkaloids toxin stuns fish by reducing their oxygen consumption, while saponins affect the fish's respiratory system. P. africanum's ethanolic extract may have produced the same reaction as Bekeh et al. (2017) since it contains alkaloids and saponins. This may help to explain why the Albino rats utilised in this investigation responded differently to the presence of different stimulant doses. The symptoms such as reduced body weight, dilated eyes, reduced fur, increased breathing and inactive general behavioural patterns displayed by the experimental rat in the study provide strong evidence that the exposed rat's death may have resulted from compromised respiratory function. Therefore, the presence of these phytochemicals contributes to it cytotoxic and poisonous effect on rats.

Toxicological effects of Ethanolic extract of Euphorbia kamerunica Pax and Piptadeniastrum africanum on the Haematological parameters of the Albino Rats:

The exposed animals were less active and more submissive than the control group, according to clinical findings. Mortality was noted in EPD15 and EEK15, but not in control, EPD5, EPD10, EEH5, or EEH10. A dose-dependent decrease in body weight increase was observed in the treated group. According to Ohaeri et al. (2011), haematological and biochemical indices are trustworthy metrics for evaluating the health of both humans and animals. Serum enzyme activity and changes in haematological parameters were often signs of toxicity, organ damage, and cell damage (Dwivedi, 2021).

Intoxicated rats administered ethanolic extracts of Piptadeniastrum africanum and Euphorbia kamerunica Pax showed a significant ($p<0.05$) rise in WBC and lymphocytes, but RBC, haemoglobin percentage, and PCV all dramatically decreased in all groups when compared to the control. The experiment's findings by Ayotunde et al. (2010) and Bekeh et al. (2017) are consistent with the alterations in blood parameters of adult C. gariepinus following 96 hours of exposure to ethanolic extracts of P. africanum and E. kamerunica Pax. They reported no significant changes in RBC counts, hematocrit value, and hemoglobin content, but observed significant increases in WBC counts and lymphocyte percentage, along with a decrease in blood platelets. Significant changes in Hb, RBC, and PCV of the treated experimental rats were lower than the control, possibly explaining the irrational behavior, restlessness, and subsequent mortality observed. The study suggests that the ethanolic extracts of P. africanum and E. kamerunica Pax compromised the immune system, impairing oxygen transport and negatively impacting the defense mechanism of the exposed rats. This was evidenced by an increase in WBC lymphocytes and enhanced clotting time (thrombocytosis) in the event of vascular injury. These results indicate that the extract is hematologically toxic to the rats, especially at the highest concentration administered.

Toxicological effects of Ethanolic extract of Euphorbia kamerunica Pax and Piptadeniastrum africanum on the Biochemical parameters of the Albino Rats:

According to Hannah et al. (2016) and Dwivedi (2021), biochemical parameters are biomarkers used to assess the potential harmful effects on the liver and kidneys that may result from disrupted physiological

DOI: https://doi.org/10.5281/zenodo.15239346

functions that cause a variety of disorders. The study's findings revealed a marked rise in the enzymatic activity of AST and ALT, which indicates that a hepatic lesion causes tissue to leak into plasma, deteriorating membrane permeability and producing distinctive white globules (Albasha and Azab, 2014) that directly destroy liver cells. This study revealed a significant increase ($p<0.05$) in the activity of ALT and AST in the composite feed with Piptadeniastrum africanum and Euphorbia kamerunica Pax administered rats, an insignificant increase was solely seen at EPD5 and EEK5 in the ALT activity.

An increase in the activities of ALP, AST, and ALT was observed with higher concentrations of the formulated feed containing Piptadeniastrum africanum and Euphorbia kamerunica Pax. This suggests that at elevated concentrations, the antioxidants or nutrients in these plant extracts are unable to neutralize the toxic effects on liver cells, thereby failing to prevent or mitigate the damage caused by reactive oxygen species (ROS). These results align with those of Arise et al. (2009), who found that frequent administration of different doses of aqueous extracts of Eucalyptus globulus leaves significantly increased the activities of acid and alkaline phosphatase in the albino rats' liver and serum. A detrimental effect on liver functioning is shown by the substantial rise in ALT, ALP, and AST. Dasgupta (2015) states that AST and ALT are the two enzymes most frequently linked to hepatocellular damage in the liver. Additionally, AST is found in many other tissues, such as the liver, kidney, brain, and skeletal muscles (Dasgupta, 2015). According to Mbong et al. (2022), elevated transaminase ALT and AST activity could be a sign of liver injury.

The main cause of elevated creatinine levels is substantial impairment of functioning nephrons (Mukinda and Eagles, 2010). Rats with higher urea and creatinine levels are therefore seen to be important markers of the plant extracts' capacity to cause or worsen nephrotoxicity. Through glomerular filtration and, to a lesser extent, proximal tubular secretion, the kidneys primarily eliminate creatinine from the blood. There is little to no tubular reabsorption of creatinine. Creatinine levels in the blood increase when renal filtration is compromised. Consequently, the creatinine clearance (CrCl), which is correlated with the glomerular filtration rate (GFR), may be computed using the creatinine levels in blood and urine (Harita et al., 2008). Since creatinine is a marker of renal function, its estimation is crucial for calculating GFR and, consequently, clinically significant.

This study revealed an insignificant increase EPD5 and EEK5 concentration administered group. A significant increase with increase in the concentration of extract was obtained ($p<0.05$) in both extracts of Piptadeniastrum africanum and Euphorbia kamerunica Pax (EPD10, EPD15, EEK10 and EEK15) compared to the control groups. The increase in creatinine as the concentration of plant extract increases was in alignment with the study of Mbong et al., (2022) on modification of testosterone levels with Piptadeniastrum africanum in Wistar rats. Any medicine that disrupts the kidneys' natural function may cause blood creatinine levels to rise. Therefore, the notable impact of extracts from Euphorbia kamerunica Pax and Piptadeniastrum africanum on these kidney function indicators is evidence of their harmful effects on the kidneys at the dosage that was given. This rise in blood creatinine levels could indicate that the kidney nephron's excretory systems are working properly to remove harmful substances from the body. This implies that the plants extract of Piptadeniastrum africanum and Euphorbia kamerunica Pax

DOI: https://doi.org/10.5281/zenodo.15239346

contributed to the increase in creatinine level is associated to renal dysfunction and nephrotoxicity.

Total protein plasma, which includes albumin, globulin, and fibrinogen, is a measure of the body's total protein content. Since albumin makes up the majority of plasma (more than 50%), a drop in albumin levels may be interpreted as a sign of malnutrition and a protein shortage in the body (Khasanah et al., 2015). Serum protein levels increased, but they did not differ substantially from the control; nonetheless, EPD15 was significantly higher than the control. In contrast to the control, the albumin level rose noticeably at all concentrations of the ethanolic extract of Euphorbia kamerunica Pax and Piptadeniastrum africanum.

Conclusion

Current and future-orientated research is examined, together with the history of advancements in rodenticide creation and control technology. To attain far more accurate, economical, and socially acceptable pest management, technological advancements are required. According to the study's findings, ethanolic extracts of P. africanum and E. kamerunica Pax can both be used to control rodents. Based on these results, it can be concluded that handling either plant extract poses no risk, unlike synthetics that need numerous safety precautions. These extracts might work well as an alternative to dangerous synthetic contact insecticides, which harm human health and contaminate the environment by bioaccumulating. As such, in further research, the active ingredients in both powders, ethanolic and aqueous extracts of the plant should be known and used synergistically against pests especially rodents and this product may be recommended to agrochemical firms, research institutes and health services because these rodents also are vectors that transmits diseases such as Lassa fever, salmonellosis, plague, leptospirosis, leishmaniasis, toxoplasmosis etc.

Abbreviations

ANOVA: Analysis of variance; FUTA: Federal University of Technology, Akure.

Acknowledgements

The authors acknowledge the technical support provided by the Plant Taxonomist of the Department of Forestry and Wood Technology, FUTA, in identifying the experimental plant.

Funding

The study was self-financed.

Availability of data and materials

Sharing of data not applicable.

Contributions of the authors

This research work was carried out in collaboration among all authors. JOA conceived, designed the study, data analysis and manuscript reviewing; POA collected the data; KDI wrote the manuscript draft, and references search. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Inapplicable

Authorisation for publishing

Inapplicable

Conflicting interests

No conflicting interests are disclosed by the authors.

DOI: https://doi.org/10.5281/zenodo.15239346

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DOI: https://doi.org/10.5281/zenodo.15239346