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Dosage Limits of Three Multifunctional Savannah Plants and Their Effects on Haematological Parameters of Albino Rats

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Abstract: This study evaluated dosage limits of *Eucalyptus camaldulensis*, *Hibiscus sabdariffa* and *Morinda lucida* leaf, stem and root aqueous extracts on haematological parameters of 140 albino rats grouped into ten of five replications in a completely randomized design. Aqueous extract of 75 g, 100 g, and 125 g of three parts of the three plants were prepared separately by boiling with 1 L of water for 1 h. 1 mg/kg of the extracts was administered on the rats once daily for 30 days. Distilled water served as control. Weights of the rats were estimated while heamatological parameters were determined using ELISA kits. Pack cell volume (45.33%), mean cell haemoglobin concentration (34.11 g/dL) and mean cell haemoglobin (19.00 Pg) were higher in rats dosed 125 g/L *H. sabdariffa* leaf extract. Similar significant increase was observed in haemoglobin (16.12 g/dL) and red blood cell (8.97×10^{12}/L) of the rats dosed 125 g/L *H. sabdariffa* stem extract, as well as white blood cell (30.23×10^{9}/L) in rats dosed with *M. lucida* stem aqueous extract.100 g/L of *H. sabdariffa* extracts improved weights and haeamatology of the rats, hence, the dosage is recommended.

Keywords: *Eucalyptus camaldulensis*; *Hibiscus sabdariffa*; herbal preparations; health management; *Morinda lucida;* toxicity; immunological potential; diagnostic tools

1. Introduction

In recent years, demand for natural products for nutritional enhancement, health management and sustainability of life is increasing. This is due to high awareness of the relevance of natural products or high knowledge of people on acute or chronic deleterious effects of modern drugs [1–3]. Several studies have also informed the populace about the nutritional and therapeutic functions of herbs in the improvement of the immune system and energizing blood cells which are the primary functions of modern drugs [4–6]. Other studies reported that herbs can enhance the effectiveness and healthy status of blood cells, regulate their production and flow and improve the health or nutritional challenges of consumers [7,8].

Based on the contributions of herbs, extracts of many plants including *Eucalyptus camaldulensis*, *Hibiscus sabdariffa* and *Morinda lucida* are consumed without proper understanding of the dosage limits of the plant preparations and deleterious effects of such limits not only on targeted organs but also on body fluids such as blood. Blood is a major means of food and drug transportation to the targeted sites in the human and animals systems [9,10]. Although preparations of some of these plants may not have the ability to supply blood, however, they have some metabolites that can act as blood cleansers, purifiers and detoxifiers [11,12]. These agents make cells of body fluids such as blood healthy; and improve their production and their

However, abuse of herbal preparations in terms of dosage is a common practice among the poor and local people. Despite the relevance of herbal preparations on the improvement of blood and other body liquids, just a few studies to the best of our knowledge have ascertained the dosage limits of preparations of a few plants [13]. Also, in traditional medical practice, uncertainty in the dosage of herbal products remains a critical challenge facing ascertaining the standardization of herbal preparations. This is because herbs are grown naturally or cultivated under heterogeneous environments, making it difficult to quantify certain quantities and types of

phytochemical contents in the same plants found in different environments. Perhaps, environmental conditions influence both the nutritional and medicinal contents of the plants [14–16]. Based on literature review, the present study was conducted to ascertain the dosage limits of *E. camaldulensis*, *H. sabdariffa* and *M. lucida* leaf, stem and root aqueous extracts and their effects on haematological parameters using albino rats.

2. Materials and Methods

2.1. Source and Collection of Plant Materials

Flesh leaves, stem-barks and roots of *Eucalyptus camaldulensis*, *Hibiscus sabdariffa* and *Morinda lucida* were collected from a local farm along Apakila road, Abeokuta, Ogun State. The farm lies in latitude 7° 10' 27" N and longitude 3° 26' 48" E. The plants were identified at the Forestry Research Institute of Nigeria (FRIN), Ibadan, Nigeria. The plant voucher specimens and numbers (FHI-52382) (FHI-11293) and (FHI-47193) for *E. camaldulensis*, *H. sabdariffa* and *M. lucida* respectively were deposited in the herbarium.

2.2. Preparation of Aqueous Extract from Leaves, Stem-Barks and Roots of E. camaldulensis, H. sabdariffa and M. lucida

Aqueous extracts of the leaf, stem-bark and root aqueous extracts of the three plants were prepared according to the method [17]. Seventy-five (75 g/L), 100 g/L and 125 g/L of leaves, stems and roots of *E. camaldulensis* (EC), *H. sabdariffa* (HS), *M. lucida* (ML) were weighed, boiled in 1 L of tap water for one hour in a water bath at 100 °C separately. The extracts were filtered using a piece of sterilized white cotton cloth and allowed to cool. This procedure was reproduced daily for thirty days to avoid the expiration of the extracts.

2.4. Experimental Design

One hundred and forty Wistar albino rats (both males and females) were bred in the Small Animal House of the Department of Pure and Applied Zoology, Federal University of Agriculture, Abeokuta, Nigeria. In the 6th week, the rats were allowed a 5-day acclimatization under standard rat house conditions before the trial was initiated. Using a completely randomized design, the rats were divided into ten groups of five (5) rats per group. Rats in each group were administered 1 mL/kg/day of the extract prepared from 75 g/L, 100 g/L and 125 g/L of leaf, stem and root aqueous extracts of *E. camaldulensis*, *H. sabdariffa* and *M. lucida* daily for 30 days using oral administration method with the use of cannula. Control rats were given distilled water only. All the rats had free access to water and feed. The weights of the rats were monitored during the study.

Percentage weight was determined using the below formula.

$$\text{Percentage weight change} = \frac{W4 - W1}{W4} \times 100\%$$

2.5. Ethics Approval and Consent to Participate

Nigeria Institute of Medical Research approved the use of albino rats for this study. Also, approval for the research was granted by the Department of Veterinary Pathology, Federal University of Agriculture, Abeokuta, Nigeria review committee on 8 March 2022 after making a presentation on the research proposal, The reference number of the proposal is PG-13-0767. Similarly, the experiments were performed following the Guide of the Care and Use of Laboratory Animals of the National Institutes of Health.

2.6. Blood Collection and Dissection

At the end of the experimental period, the rats were anaesthetized with chloroform and dissected for collection of blood samples. Blood samples were collected using the cardiac puncture method [18].

2.7. Collection of Blood Haematological Parameters

Haematological parameters such as packed cell volume (PCV), red blood cell count (RBC), Haemoglobin concentration (Hb) white blood cell count (WBC), Mean cell volume (MCV), Mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) were determined according [18,19].

2.8. Statistical Analysis

Data obtained were analysed using a statistical analysis system. One way Analysis of variance (ANOVA) was conducted to determine significant differences between the parameters. Means were separated using Duncan's Multiple Range Test at $p < 0.05$.

3. Results

Figure 1 revealed the effects of graded weights of *E. camaldulensis H. sabdariffa*, *M. lucida* on the body weight of the albino rats. Rats dosed with 1 mg/kg of 100 g of EC, HS and ML leaf aqueous extracts produced the highest weight gain of 60.4, 58.0 and 62.0% respectively while weight losses of −9.28 and −19.94% were recorded in rats dosed 1 mg/kg of 125 g *M. lucida* leaves and root extracts. Table 1 revealed that 75, 100 and 125 g of leaf, stem and root extract of *E. camaldulensis* showed no significant difference on PCV, Hb, RBC and MCHC compared with control. The extracts produced a significant increase in WBC, MCV, MCH and platelets in the rats treated with the inclusion of 75 g/L to 100 g/L and 125 g/L. PCV (45.00%), H^b (15.05 g/dL), RBC (8.57×10^{12}/L), MCV (51.67 FL) and MCH (17.33 Pg) were significantly higher in rats dosed with 1 mL of 100 g *E. camaldulensis* root extract, WBC (17.50×10^9/L) and MCV (48.33 FL) in rats dosed with 100 g *E. camaldulensis* leaf extract while higher platelets (327.00×10^9/L) was recorded in rats dosed with 125 g *E. camaldulensis* stem extract. A similar significant increase was noticed in the effects of leaf, stem and root extract of *M. lucida* at 75 g/L, 100 g/L and 125 g/L on WBC and platelets of the rats. Also, PCV (49.00%), Hb (18.03 g/dL), RBC (12.910×10^{12}/L) and WBC (15.23×10^9/L) as well as MCHC (40.00 g/dL) and MCH (20.33 Pg) were significantly ($p < 0.05$) higher in albino rats dosed with 1 mL/kg of 100 *M. lucida* leaf extract, MCV (56.00 FL) in rats dosed with 100 g *M. lucida* stem extract while platelets (300.00×10^9/L) was significantly higher in the albino rats dosed with *M. lucida* root extract (Table 2).

Table 3 revealed significant differences in all the haematological parameters of rats dosed 1 mL/kg *H. sabdariffa* leaves, stems and roots aqueous extracts except MCHC and PLT. PCV (48.33%), Hb (16.12 g/dL), RBC (8.97×10^{12}/L), WBC (11.15×10^9/L) and platelets (252.67×10^9/L) were substantially higher in rats dosed with 125 g/L *H. sabdariffa* stem extract.

Also, MCV (57.00 FL) was significantly higher ($p < 0.05$) in rats dosed 125 g/L *H. sabdariffa* leaf aqueous extract while in all the grades (75, 100 and 125 g/L) of *H. sabdariffa* leaf and 100 g *H. sabdariffa* stem extract MCHC (34.00 g/dL) was significantly higher.

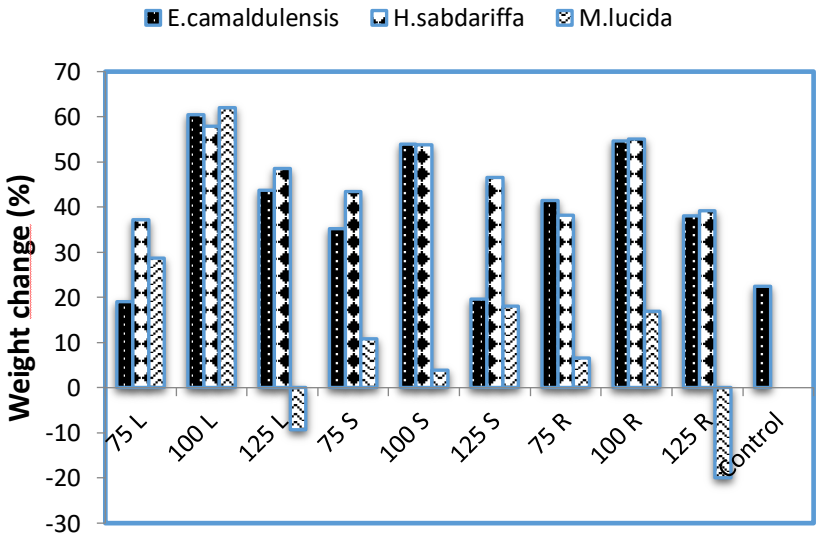

Figure 1. Effect of graded weights (1 mL/kg) of leaves, stems and roots of *E. camaldulensis*, *H. sabdariffa* and *M. lucida* on body weight of albino rats. L = Leaves, S = Stems, R = Roots.

Table 1. Effects of graded weights (1 mL/kg) of leaves, stems and roots of *E camaldulensis* on haematological parameters of albino rats.

Plant Grades (g)	Concentration Levels of Hematological Parameters							
	PCV (%)	Hb (g/dL)	RBC ($\times10^{12}$/L)	WBC ($\times10^{9}$/L)	MCV (FL)	MCHC (g/dL)	MCH (Pg)	PLT ($\times10^{3}$)
75 *E. camaldulensis* leaf	39.00 ± 0.58 ^{a}	13.38 ± 0.31 ^{a}	8.01 ± 0.02 ^{a}	9.53 ± 1.44 ^{cd}	48.33 ± 0.33 ^{bc}	34.00 ± 0.00 ^{a}	16.33 ± 0.33k ^{b}	242.33 ± 30.31 ^{ab}
100 *E. camaldulensis* leaf	42.00 ± 1.15 ^{a}	14.38 ± 0.31 ^{a}	8.45 ± 0.29 ^{a}	17.50 ± 3.75 ^{a}	51.67 ± 3.33 ^{a}	33.67 ± 0.33 ^{a}	17.33 ± 0.33 ^{a}	253.00 ± 51.38 ^{ab}
125 *E. camaldulensis* leaf	43.00 ± 0.58 ^{a}	14.48 ± 0.29 ^{a}	8.52 ± 0.29 ^{a}	11.03 ± 1.73 ^{bcd}	50.00 ± 0.58 ^{abc}	34.00 ± 0.00 ^{a}	17.00 ± 0.00 ^{ab}	327.00 ± 27.13 ^{a}
75 *E. camaldulensis* stem	39.67 ± 2.60 ^{a}	13.43 ± 0.87 ^{a}	7.95 ± 0.58 ^{a}	6.08 ± 1.16 ^{d}	51.33 ± 1.76 ^{ab}	33.67 ± 0.33 ^{a}	17.00 ± 0.58 ^{ab}	208.50 ± 37.81 ^{b}
100 *E. camaldulensis* stem	40.67 ± 1.45 ^{a}	13.53 ± 0.29 ^{a}	8.46 ± 0.29 ^{a}	8.02 ± 1.15 ^{cd}	48.67 ± 0.33 ^{abc}	33.33 ± 0.33 ^{a}	16.10 ± 0.00 ^{b}	300.67 ± 0.33 ^{ab}
125 *E. camaldulensis* stem	37.67 ± 1.45 ^{a}	12.88 ± 0.59 ^{a}	7.58 ± 0.30 ^{a}	9.45 ± 1.44 ^{cd}	48.00 ± 1.15 ^{c}	33.67 ± 0.33 ^{a}	16.33 ± 0.33^{b}	302.33 ± 1.68 ^{ab}
75 *E. camaldulensis* root	39.33 ± 1.45 ^{a}	13.08 ± 0.58 ^{a}	8.51 ± 0.29 ^{a}	12.08 ± 1.73 ^{abc}	51.00 ± 0.58 ^{abc}	34.00 ± 0.00 ^{a}	17.00 ± 0.00 ^{ab}	245.00 ± 2.21 ^{ab}
100 *E. camaldulensis* root	45.00 ± 1.73 ^{a}	15.05 ± 0.58 ^{a}	8.57 ± 0.30 ^{a}	12.48 ± 2.02 ^{abc}	50.00 ± 0.58 ^{abc}	34.20 ± 0.00 ^{a}	17.00 ± 0.00 ^{ab}	254.33 ± 0.88 ^{ab}
125 *E. camaldulensis* root	41.00 ± 2.89 ^{a}	13.02 ± 0.87 ^{a}	7.57 ± 0.30 ^{a}	15.92 ± 0.58 ^{ab}	48.1.3 ± 0.58 ^{c}	33.67 ± 0.33 ^{a}	16.00 ± 0.00 ^{b}	307.33 ± 53.40 ^{ab}
Control (Tap water)	38.67 ± 4.91 ^{a}	13.00 ± 1.73 ^{a}	8.00 ± 0.58 ^{a}	5.67 ± 0.88 ^{d}	48.20 ± 1.50 ^{c}	33.67 ± 0.33 ^{a}	16.20 ± 0.58 ^{b}	237.00 ± 1.59 ^{ab}

Means (±standard error) followed by different superscripts within columns are significantly different at 5% using Duncan's Multiple Range Test (DMRT). Packed cell volume (PCV), Haemoglobin Concentration (Hb), Mean Cell Haemoglobin concentration (MCHC), Mean cell haemoglobin (MCH), Mean Cell Volume (MCV).

Table 2. Effects of graded weights (1 mL/kg) of leaves, stems and roots of *M. lucida* on haematological parameters of albino rats.

Plant Grades (g)	Concentration Levels of Hematological Parameters							
	PCV (%)	Hb (g/dL)	RBC ($\times10^{12}$/L)	WBC ($\times10^{9}$/L)	MCV (FL)	MCHC (g/dL)	MCH (Pg)	PLT ($\times10^{3}$)
75 *M. lucida* leaf	43.33 ± 2.03 ^{ab}	14.500 ± 0.87 ^{ab}	8.54 ± 0.29 ^{ab}	3.55 ± 0.29 ^{c}	50.00 ± 1.7 ^{ab}	33.67 ± 0.33 ^{ab}	17.00 ± 0.58 ^{ab}	227.00 ± 0.59 ^{ab}
100 *M. lucida* leaf	49.00 ± 1.73 ^{a}	18.03 ± 0.58 ^{a}	12.91 ± 0.58 ^{a}	15.23 ± 1.59 ^{a}	51.67 ± 2.3 ^{ab}	40.00 ± 0.00 ^{a}	20.33 ± 1.5 ^{a}	230.67 ± 1.83 ^{a}
125 *M. lucida* leaf	44.33 ± 0.33 ^{ab}	14.98 ± 0.02 ^{ab}	8.54 ± 0.29 ^{ab}	8.02 ± 1.73 ^{bc}	52.33 ± 4.91 ^{ab}	33.67 ± 0.33 ^{ab}	17.33 ± 0.88 ^{ab}	254.00 ± 0.38 ^{ab}
75 *M. lucida* stem	40.00 ± 0.00 ^{ab}	13.40 ± 0.31 ^{ab}	8.47 ± 0.29 ^{ab}	3.90 ± 0.10 ^{c}	47.33 ± 0.33 ^{ab}	33.67 ± 0.33 ^{ab}	16.00 ± 0.00 ^{ab}	203.00 ± 1.96 ^{bc}
100 *M. lucida* stem	41.00 ± 0.58 ^{ab}	13.80 ± 0.20 ^{ab}	8.07 ± 0.07 ^{ab}	13.93 ± 2.25 ^{bc}	56.00 ± 0.58 ^{a}	33.00 ± 0.00 ^{ab}	17.00 ± 0.58 ^{ab}	239.00 ± 3.21 ^{ab}
125 *M. lucida* stem	40.33 ± 1.45 ^{ab}	13.80 ± 0.42 ^{ab}	7.78 ± 0.40 ^{ab}	4.48 ± 0.29 ^{c}	50.00k ± 0.58 ^{ab}	34.10 ± 1.73 ^{ab}	18.00 ± 1.15 ^{ab}	291.00 ± 2.20 ^{a}
75 *M. lucida* root	38.60 ± 2.03 ^{ab}	12.83 ± 0.73 ^{ab}	8.00 ± 0.00 ^{ab}	6.17 ± 1.01 ^{bc}	48.00 ± 2.31 ^{ab}	33.33 ± 1.73 ^{ab}	15.67 ± 0.88 ^{ab}	230.67 ± 1.467 ^{b}
100 *M. lucida* root	43.00 ± 0.58 ^{ab}	14.07 ± 0.07 ^{ab}	8.07 ± 0.07 ^{ab}	16.60 ± 1.03 ^{bc}	51.67 ± 0.67 ^{ab}	33.00 ± 0.58 ^{ab}	17.00 ± 0.00 ^{ab}	283.00 ± 2.83 ^{a}
125 *M. lucida* root	43.33 ± 0.88 ^{a}	14.65 ± 0.26 ^{a}	8.44 ± 0.27 ^{ab}	16.23 ± 3.09 ^{b}	51.67 ± 0.67 ^{ab}	34.00 ± 0.00 ^{ab}	17.33 ± 0.33 ^{ab}	153.67 ± 6.06 ^{c}
Control (Tap water)	38.67 ± 4.91 ^{a}	13.00 ± 1.73 ^{a}	8.00 ± 0.58 ^{ab}	5.67 ± 0.88 ^{bc}	48.00 ± 1.53 ^{ab}	33.67 ± 0.33 ^{ab}	16.00 ± 0.58 ^{ab}	237.00 ± 1.59 ^{ab}

Means (±standard error) followed by different superscripts within columns are significantly different at 5% ($p < 0.05$) using Duncan's Multiple Range Test. Packed cell volume (PCV), Haemoglobin Concentration (Hb), Mean Cell Haemoglobin concentration (MCHC), Mean cell haemoglobin (MCH), Mean Cell Volume (MCV).

Table 3. Effects of graded weights (1 mL/kg) of leaves, stems and roots of *H. sabdariffa* on haematological parameters of albino rats.

Plant Grades (g)	Concentration Levels of Hematological Parameters							
	PCV (%)	Hb (g/dL)	RBC ($\times10^{12}$/L)	WBC ($\times10^{9}$/L)	MCV (FL)	MCHC (g/dL)	MCH (Pg)	PLT ($\times10^{3}$)
75 *H. sabdariffa* leaf	44.00 ± 2.30 ^{abc}	14.80 ± 0.750 ^{abc}	8.06 ± 0.54 ^{abc}	3.10 ± 0.06 ^{d}	54.67 ± 0.88 ^{ab}	34.00 ± 0.11 ^{a}	18.33 ± 0.33 ^{ab}	191.00 ± 5.20 ^{a}
100 *H. sabdariffa* leaf	44.33 ± 0.33 ^{abc}	14.95 ± 0.08 ^{abc}	8.18 ± 0.35 ^{abc}	4.45 ± 0.83 ^{cd}	54.67 ± 2.91 ^{ab}	34.00 ± 0.05 ^{a}	18.33 ± 0.90 ^{ab}	224.00 ± 17.32 ^{a}
125 *H. sabdariffa* leaf	45.33 ± 1.45 ^{ab}	15.40 ± 0.46 ^{ab}	8.20 ± 0.04 ^{abc}	5.60 ± 0.23 ^{c}	55.33 ± 2.03 ^{ab}	34.11 ± 0.00 ^{a}	19.00 ± 0.58 ^{a}	234.00 ± 38.68 ^{a}
75 *H. sabdariffa* stem	43.00 ± 0.00 ^{abc}	14.40 ± 0.05 ^{abc}	7.49 ± 0.00 ^{c}	6.25 ± 0.49 ^{c}	52.67 ± 0.00 ^{a}	33.33 ± 0.33 ^{a}	19.00 ± 0.00 ^{a}	185.00 ± 5.19 ^{a}
100 *H. sabdariffa* stem	44.66 ± 0.88 ^{abc}	15.20 ± 0.05 ^{ab}	8.50 ± 0.10 ^{ab}	8.48 ± 0.87 ^{b}	57.00 ± 0.88 ^{ab}	34.00 ± 0.58 ^{a}	18.00 ± 0.00 ^{ab}	201.67 ± 12.41 ^{a}
125 *H. sabdariffa* stem	48.33 ± 0.33 ^{a}	16.12 ± 0.12 ^{a}	8.97 ± 0.02 ^{a}	11.15 ± 0.09 ^{a}	54.00 ± 0.58 ^{ab}	33.67 ± 0.33 ^{a}	18.33 ± 0.00 ^{ab}	252.67 ± 4.33 ^{a}
75 *H. sabdariffa* root	41.00 ± 1.73 ^{bc}	13.92 ± 0.58 ^{bc}	7.63 ± 0.31 ^{bc}	3.95 ± 0.58 ^{cd}	52.00 ± 0.00 ^{ab}	33.67 ± 0.33 ^{a}	17.33 ± 0.33 ^{ab}	206.67 ± 33.19 ^{a}
100 *H. sabdariffa* root	42.33 ± 0.33 ^{abc}	14.07 ± 0.06 ^{abc}	7.99 ± 0.00 ^{abc}	4.97 ± 0.58 ^{cd}	53.00 ± 0.58 ^{ab}	33.33 ± 0.33 ^{a}	18.00 ± 0.00 ^{ab}	218.00 ± 13.28 ^{a}
125 *H. sabdariffa* root	43.67 ± 0.33 ^{abc}	14.88 ± 0.11 ^{abc}	8.05 ± 0.04 ^{abc}	5.58 ± 1.42 ^{ab}	53.67 ± 0.33 ^{ab}	33.33 ± 0.33 ^{a}	18.00 ± 0.00 ^{ab}	248.00 ± 30.02 ^{a}
Control (Tap water)	38.67 ± 4.91 ^{c}	13.00 ± 1.73 ^{c}	8.00 ± 0.57 ^{abc}	5.67 ± 0.88 ^{c}	48.00 ± 1.53 ^{c}	33.67 ± 0.33 ^{a}	16.00 ± 0.58 ^{c}	237.00 ± 15.58 ^{a}

Means (±standard error) followed by different superscripts within columns are significantly different at 5% using Duncan's Multiple Range Test (DMRT). Packed cell volume (PCV), Haemoglobin Concentration (Hb), Mean Cell Haemoglobin concentration (MCHC), Mean cell haemoglobin (MCH), Mean Cell Volume (MCV).

4. Discussion

Effects of *E. camaldulensis*, *H. sabdariffa* and *M. lucida* leaf aqueous extracts on weight albino rats varied with the inclusion of weight grades of the plants. Higher percentage weight gain sustained by albino rats dosed with 100 g/L *E. camaldulensis*, *H. sabdariffa* and *M. lucida* leaf aqueous extracts could indicate a higher concentration of nutritional contents in the leaves of the plants as a major nutritional index compared with other parts of the plants [8,20]. Weight loss recorded in albino rats dosed with 125 g/L of *M. lucida* leaf and root extracts suggest a certain level of toxicity and that the plants could be used to monitor weight change, especially in diabetic and obese patients [8,21].

Rats dosed with *E. camadulensis* and *H. sabdariffa* leaf aqueous extracts and control rats were very healthy and active while rats dosed with *M. lucida* stem and roots aqueous extracts at 125 g/L were weak and sustained weight loss. The weight loss recorded may be ascribed to the inability of the rats to feed *ad libitum* due to the bitter taste of the preparations of the plants. This observation is in agreement with the findings of [22] who reported a significant decrease in weight of rats dosed with 400 mg/kg of Methanol extract of *Moringa Oleifera* as well as [23] who observed low appetite and body weakness in rats treated with 500, 1000 and 1500 mg/kg aqueous extract of *M. klucida*. The significant increase observed in the pack cell volume, haemoglobin, red blood cell and white blood cell count of the rats could be attributed to the ability of the biochemical constituents of the plants toward the enhancement of haematological parameters of consumers [21] and as an immunological potential of the plants to microbial infections [24].

In the same trend, an increase in the packed cell volume observed in the rats may indicate antianaemic potential of the plant, probably due to the presence of phytochemicals. This observation is in agreement with the submission of [25,26] who posited that substances with antianaemic effect are known to stimulate increased production of erythrocytes and improved packed cell volume as well as haemoglobin. These results, therefore, imply that consumption of the three parts at normal dosage will improve haematological parameters and physiological status of the patients or indicate the presence of the principal parameters in the plants which function as phagocytes which the body system defends against invading microorganisms by ingesting and destroying them [9,21,24].

The significant increase observed in the white blood cell count as influenced by the consumption of the plant extracts reflects leucopoiesis and possible immunomodulatory effects of the extracts which augmented the production of more white blood cell count [27]. This might have increased the rats' capability to produce antibodies and a high degree of resistance to diseases [27,28]. The packed cell volume, haemoglobin and red blood cell count increase recorded may be as a result of the level of the ash content of the plants which indicated the amount of minerals iron and copper which are important in haemoglobin synthesis [29]. The values of mean cell volume and the amount of heamoglobin in red blood cells, mean cell heamoglobin and mean cell haemoglobin concentration are diagnostic tools commonly used to characterize the types of anaemic condition [30,31]. Increased mean cell volume and mean cell heamoglobin values observed in rats dosed *H. sabdariffa* leaf, stem and root aqueous extracts are categorized as macrocytic/normochromic anaemia [30]. There has been a report that prolonged administration of aqueous leaf extract of *M. lucida* at different grades increased haematological parameters of patients [25].

5. Conclusions

The present study showed that 1 mL/kg of leaf, stem and root of *H. sabdariffa* aqueous extracts improved the weight of rats compared with *E. camaldulensis* and *M. lucida* extracts. Also, aqueous extracts of the three parts of the plants at the dosage enhanced haematological parameters of the rats therefore consumption of the plants either as food or for therapeutic purposes is recommended.

Author Contributions: Anthony Wale Ojewumi, Gabriel A. Dedeke, and Abdullahi Adeyemi Adegoke: conceptualization, methodology, software; Anthony Wale Ojewumi, Abdullahi Adeyemi Adegoke: data curation, writing—original draft preparation; Abdullahi Adeyemi Adegoke: visualization, investigation; Gabriel A. Dedeke: supervision; Abdullahi Adeyemi Adegoke, Anthony Wale Ojewumi: software, validation; Anthony Wale Ojewumi: writing—reviewing and editing.

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Institutional Review Board Statement: This research project has received ethical approval from the Ethical Committee of the Department of Veterinary Pathology, Federal University of Agriculture, Abeokuta, Nigeria according to their ethical guideline with Ref no: PG-13-0767. The experiments were performed following the Guide of the Care and Use of Laboratory Animals of the National Institutes of Health

Informed Consent Statement: Written informed consent has been obtained from the patient(s) to publish this paper.

Data Availability Statement: Not applicable.

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Conflicts of Interest: No conflict of interest was declared.

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