

Trypanocidal function of *Terminalia catappa* leaf extract in Albino rat

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On *Trypanosoma brucei brucei* infected albino rats, the trypanocidal activity of the ethanolic extract of *Terminalia catappa* leaf (EETL) was evaluated. Thirty-six rats were allocated into six groups: Group 1 (control); Group 2: infected; Group 3: infected and treated with 10 mg kg⁻¹ body weight diminazene aceturate; Group 4: infected and treated with 500 mg kg⁻¹ body weight EETL; Group 5: infected and treated with 1,000 mg kg⁻¹ body weight EETL; Group 6: infected and treated with 1,500 mg kg⁻¹ body weight EETL. The highest parasitaemia level ($P < 0.05$) was recorded in group 2, compared to the rest groups. The total/complete chemo-suppression recorded in the group 3 was ($P < 0.05$) higher than the rest groups. The percentage chemo-suppression improves ($P < 0.05$) with an increased EETL dosage from 500 mg kg⁻¹ 1,500 mg kg⁻¹. The haematological and serum biochemical parameters were determined using Abacus 380 and a Reflectron® Plus BC79 analyzer, respectively. Post-infection, the rats' packed cell volume and haemoglobin concentration in group 2 and group 4 were ($P < 0.05$) lower than group 1 and other groups. On day five post-infection, the rats' red blood cell counts in groups 2 and 4 were lower ($P < 0.05$) than in other groups. On day 15 post-infection, the white blood cell counts of rats in groups 2 and 4 were lower ($P < 0.05$) than in group 1, 3 and 6. Alanine transaminase and aspartate transaminase levels in groups 2 and 4 were ($P < 0.05$) higher than the control and other treatment groups. This study demonstrated 1,500 mg kg⁻¹ EETL bodyweight efficacy in reducing the parasitemia level in *T. brucei brucei* infected rats.

Keywords: Phytoconstituents, *Terminalia catappa*, Trypanosomosis, Zoonotic diseases

1 Introduction

Trypanosomiasis is an infection caused by a parasite in both man and animals. The disorder is brought about by the *Trypanosoma* parasite, a protozoan parasite belonging to the *Trypanosoma* genus. The trypanosomes, the aetiology of animal trypanosomiasis and human African trypanosomiasis (HAT) are spread by the *Glossina* spp. (tsetse fly) (Cayla et al., 2019). Trypanosomiasis is common in areas of Sub-Saharan Africa where the climate and atmosphere are ideal for the tsetse fly, which covers an area of up to 8.7 million square kilometers (Baker et al., 2013). The presence of trypanosome in the encephalon can bring about neuronal disintegration, resulting in a coma or death if adequate care is not provided (WHO, 2013). The *T. b. gambiense* or *T. b. rhodesiense* is responsible for HAT, while *T. brucei* spp, *T. vivax*, and *T. congolense* is the foremost popular pathogenic trypanosome causing the animal trypanosomiasis (Giordani et al., 2016).

Cases of trypanosomiasis in goats, sheep and cattle are caused by and *Trypanosoma brucei brucei*, *Trypanosoma congolense*, *Trypanosoma vivax*; while *Trypanosoma evansi* and *Trypanosoma simiae* infects camels and pigs (Giordani et al., 2016).

Presently, drugs used for the management and the cure of trypanosomiasis are assorted within two groups, based on their capability to transverse the barrier between the blood and the brain (Nifortimox, melarsoprol, eflornithine) or not (suramin, pentamidine) (Bouteille and Boguet (2012). However, some of these medications had noticeable side effects, including renal dysfunction, neurological effects, and liver toxicity. In addition, these drugs are little by little losing their efficacy and relevance due to parasite resistance development (Nwodo et al., 2015a). In West Africa, pentamidine is used to treat primeval stage HAT cases. However, because of

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the common late diagnosis and subsequent cases of advanced trypanosome infection in the central nervous system, eflornithine in combination with nifurtimox is considered a better treatment option. Furthermore, melarsoprol is also preferred due to the high cost, inefficiency against *T. b. rhodesiense*, and difficulty of eflornithine administration for use against *T. b. gambiense*, despite the fact that fatal reactive encephalopathy has been reported in about 10% of patients treated with melarsoprol (Baker et al., 2013).

In due course, exploring alternatives to synthetic drugs, specifically phytochemical or phytogenics, for treating trypanosomiasis is shooting up (Mashi et al., 2019). Adopting herbal remedies for managing trypanosomiasis and some other diseases was proven effective in some instances (Dada and Oloruntola, 2016, Vehekeni et al., 2020). Some plants' trypanocidal activities have been disclosed and documented (Nwodo et al., 2015b; Vehekeni et al., 2020), but information on the anti-trypanosoma properties of *Terminalia catappa* is infrequent. *Terminalia catappa* leaf extracts exhibit anti-fungal, antioxidant, anti-inflammatory, antimicrobial, antiviral, antidiarrheal, and anti-cancer as hepatoprotective properties (Tercas et al., 2017). The anti-trypanosomal activities of *Terminalia catappa* leaf extracts were also reported (Ojeleye et al., 2020). Oloruntola et al. (2021) found that a 25 mg ml⁻¹ ethanolic extract of *Terminalia catappa* leaf had trypanocidal activity *in vitro* that was comparable to that of commercially available trypanocidal drug. Besides, there are clinical pieces of evidence on animal trypanosomiasis, suggesting sequestration of red blood cells, haemolysis, and bone marrow dysfunction as part of the main pathogenetic mechanism of anaemia (Boada-Sucre et al., 2016). Consequently, studying the effects of interactions of blood indices, trypanosomes, and ethanolic extracts of *Terminalia catappa* becomes an exciting venture. Therefore, this work aimed to explore the trypanocidal activities of ethanolic extract of *Terminalia catappa* leaf in *Trypanosoma brucei brucei* infected albino rats.

2 Material and methods

2.1 *Terminalia catappa* leaf collection and extraction

Leaves of *Terminalia catappa* were plucked from their mother tree, identified and authenticated by a Plant Scientist of the Crop Soil and Pest Management's Department, The Federal University of Technology, Akure, Nigeria. The leaves of *T. catappa* were cleaned in running water, drained, chopped into smaller pieces with a stainless knife, spread lightly on a clean concrete floor under a shade and allowed to dry under the shade at an environmental temperature for twenty-eight days until

they become crispy. The leaves were then ground up into *Terminalia catappa* leaf powder (TLP) and kept in a glass jar until used. Five hundred grams of the TLP was soaked in 4.5 litres of 75% ethanol, sieved using Millipore filter paper (pore size 0.7 µm). The decoction or extracts were then thickened using a SCILOGEX SCI100-S 5L Rotary Evaporator at 35–40 °C. The dried ethanolic extract of *T. catappa* leaf (EETL) was kept at -20 °C pending use.

2.2 Phytochemical examination of the extract and trypanosome stock

The phytochemical exploration of EETL was conducted to quantitate the alkaloids, saponins and tannin (Oloruntola et al., 2021). The 2,2-diphenyl-1-picryl-hydrazyl-hydrate was determined (Oloruntola et al., 2021).

Trypanosoma brucei brucei was obtained from the Nigerian Institute for Trypanosomiasis Research in Vom, Plateau State, Nigeria, and was kept alive in the Microbiology Department of the Federal University of Technology, Akure, Nigeria, by infecting albino rats with trypanosome-infected blood.

2.3 Experimental animals

Thirty-six albino rats of seven weeks old weighing 95.72 ± 0.99 g were accommodated under a conventional laboratory environment, with ambient temperature of 26–30 °C, housed in a plastic cages and nourished with a grower's diet and potable water ad libitum. As bedding, wood shavings were scattered on the plastic cages' floors. The albino rats were randomly assigned (6 experimental rats/group) to the six study groups: 1 (the control), 2 (infected with trypanosome), 3 (infected and medicated with 10 mg kg⁻¹ body weight diminazene aceturate), 4 (infected and medicated with 500 mg kg⁻¹ body weight EETL), 5 (infected and medicated with 1,000 mg kg⁻¹ body weight EETL), and 6 (infected and medicated with 1,500 mg kg⁻¹ body weight EETL), after 14 days acclimatization period.

2.4 Trypanosome infection and medicament

Blood from confirmed parasitized rat was acquired by caudal perforation and passed out into ethylenediaminetetraacetic acid (EDTA) sample bottle, and diluted with normal saline to serve as inoculum. The rats in groups 2, 3, 4, and 5 were infected via the peritoneum with 0.1 ml of the inoculum contacting approximately 10³ trypanosomes per ml of inoculum. In all groups, the rats were administered their respective treatments orally using a gavage needle when parasitaemia was detected on day five post infestation. The treatment lasted for eight days.

2.5 Samples' collection and analysis

The experimental rats were bled at the saphenous vein on a 5-day interval to discover the degree of parasitaemia and haemogram quantity. At the concluding stage of the experiment, the cardiac puncture was used for blood samples needed for the parasitaemia level determination, haemogram and serum analyses. The samples of albino rats' blood for parasitaemia and haemogram analyses were collected into EDTA-bottle, while those for serum chemistry and enzymes analyses were collected into plain bottles. The Rapid Matching method was used to determine the parasitaemia level, while the average percentage chemo-suppression (CS) was estimated using the following formula (Dada and Oloruntola, 2016):

$$\text{chemosuppression} = \frac{PNC - PSG}{PNC} \times 100$$

where:

PNC – parasitaemia level in the negative control; *PSG* – parasitaemia level on the study groups

The red blood cells (RBC), haemoglobin concentration (HbC), packed cell volume (PCV), and white blood cells (WBC) were determined within two hours post-collection using Abacus 380 analyser (Diatron MI PLC. Hungary). The blood drawn in the ordinary bottle was centrifuged, and its serum was collected into another new ordinary bottle and frozen at -20 °C before use. The serum biochemical (alanine transaminase (ALT), asparate transaminase

(AST), urea, creatinine, and cholesterol) were determined using a Reflectron® Plus BC79 (Roche Diagnostic, GmbH Mannheim, Germany).

2.5 Statistical analysis

Data were put via one-way analysis of variance (ANOVA) with Statistical Package for Social Sciences version 20 using the following model:

$$T_{ij} = \mu + f_i + E_{ij}$$

where:

T_{ij} – the dependent observed variable's value; μ – population mean; f_i – consequence of *i*th treatment; E_{ij} – random error

Means were sorted out with Duncan multiple range test of Statistical Package for Social Sciences.

3 Results and discussion

EETL's phytochemical examination disclosed alkaloids, flavonoids, saponins, and tannins; besides, EETL also has antioxidant properties, having 83.01% 2,2-diphenyl-1-picryl-hydrazyl-hydrate (Figure 1).

Anti-protozoan, anti-inflammatory, antibacterial, anti-fungal, antiviral, antioxidant, antiplasmodial, anti-pyretic, mutagenic, larvicidal, cytotoxicity, and activities have been discovered in medicinal plant extracts and phytochemical constituents, according to ethnopharmacological research (Oloruntola et al.,

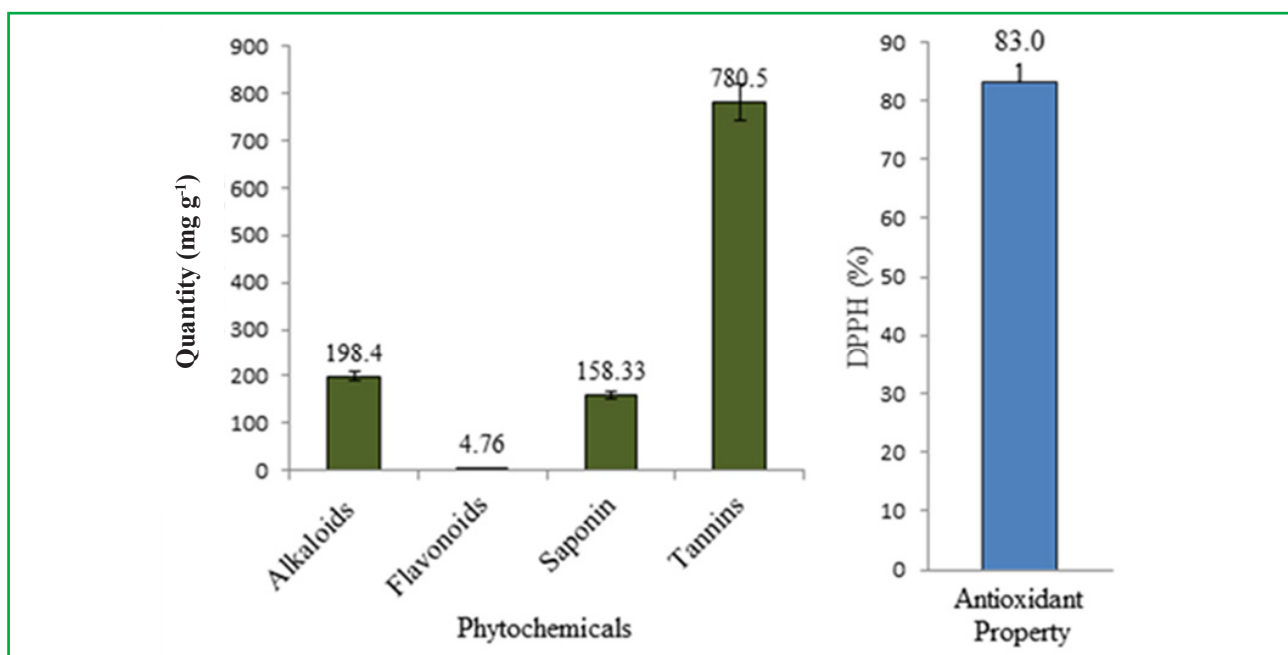


Figure 1 The phytochemical and antioxidant property of ethanolic extract of *Terminalia catappa* leaf; DPPH: 2,2-diphenyl-1-picryl-hydrazyl-hydrate

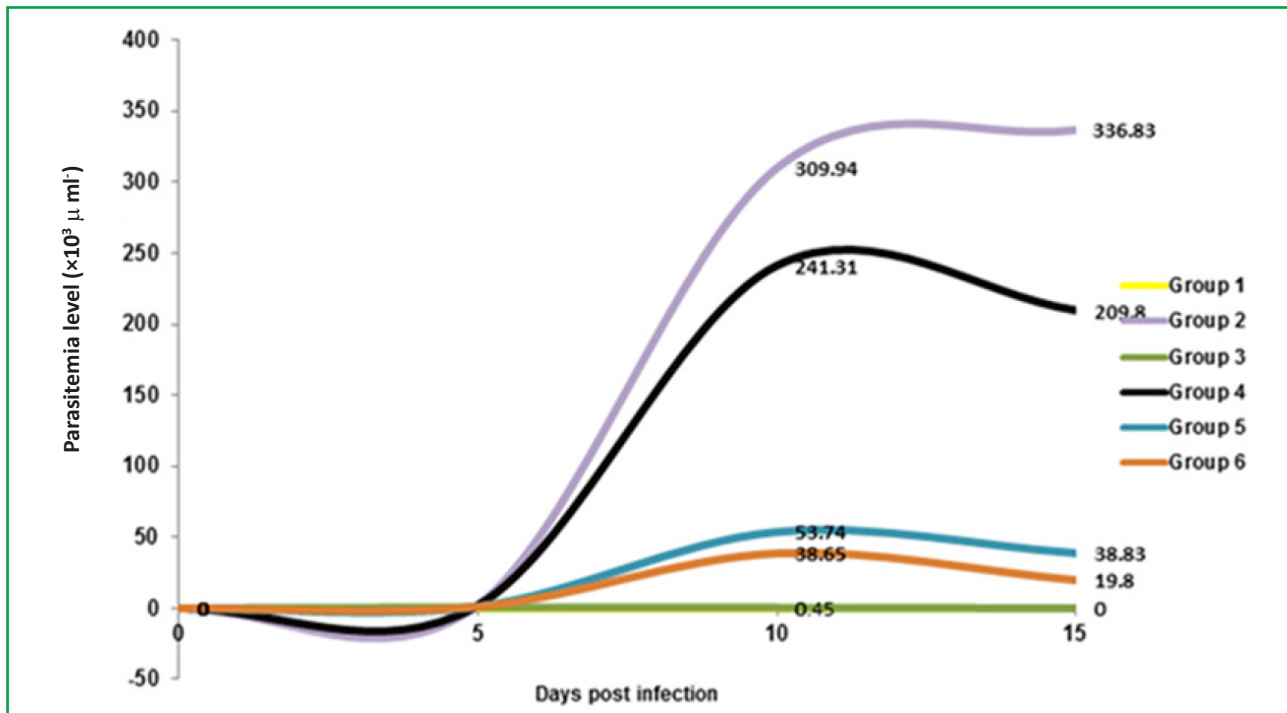


Figure 2 The effect of *Terminalia catappa* ethanolic extract on the Parasitemia level/day ($\times 10^3 \mu \text{ ml}^{-1}$) of albino rats infected with *Trypanosoma brucei brucei*
 EETL – ethanolic extract of *Terminalia catappa* leaf; Group 1: control; Group 2: infected; Group 3: infected and medicated with 10 mg kg⁻¹ body weight diminazene aceturate; Group 4: infected and medicated with 500 mg kg⁻¹ body weight EETL; Group 5: infected and medicated with 1,000 mg kg⁻¹ body weight EETL; Group 6: infected and medicated with 1,500 mg kg⁻¹ body weight EETL

2018; Maroyi and Semenya, 2019). The alkaloids, in particular, have antiparasitic, antiviral, and antimicrobial properties (Bouayad et al., 2012); flavonoids have anti-inflammatory, anti-oxidative, anti-oncogenic, and anti-mutagenic properties (Panche et al., 2016); saponins have hypocholesterolemic, inflammatory, and immune-stimulating properties (Liu et al., 2016); and tannin (Madaki et al., 2016). Bioactive compounds present in plant extracts, such as alkaloids, polyphenols, terpenes, and quinones, have been shown to inhibit the growth of *Trypanosoma* spp. (Mann et al., 2011).

Table 1 shows EETL treatment's effects on the average parasitemia and percentage chemo-suppression in *Trypanosoma brucei brucei* infected albino rats on day 15 post-infection. The average parasitaemia in the albino rats in the control and groups treated with the diminazene aceturate and 1,500 mg kg⁻¹ body weight EETL were statistically similar ($P > 0.05$). However, they were lower ($P < 0.05$) than the rest groups. The highest average parasitaemia level was recorded in group 2 (*Trypanosoma brucei brucei* infected rats). The total and complete chemo-suppression recorded in the diminazene aceturate treated group (group 3) was significantly ($P < 0.05$) higher compared to the rest groups. In addition, percentage chemo-suppression improves

($P < 0.05$) significantly with an increased EETL dosage from 500 mg kg⁻¹ to 1,000 mg kg⁻¹ or 1,500 mg kg⁻¹.

Figure 2 shows the effects of EETL on the parasitemia level per day ($\times 10^3 \mu \text{ ml}^{-1}$) in *Trypanosoma brucei brucei* infected albino rats. The daily parasitemia levels progressed in

Table 1 The effect of the ethanolic extract of *Terminalia catappa* leaf on the Parasitemia level and percentage chemo-suppression in albino rats infected with *Trypanosoma brucei brucei*

Group	Average parasitemia ($\times 10^3 \mu \text{ ml}^{-1}$)	Chemosuppression (%)
1	0.00 \pm 0.00d	0.00 \pm 0.00d
2	336.66 \pm 100.84 ^a	0.00 \pm 0.00d
3	0.00 \pm 0.00d	100.00 \pm 0.00 ^a
4	209.80 \pm 61.54 ^b	37.83 \pm 2.43 ^c
5	38.83 \pm 2.21 ^c	85.51 \pm 5.20 ^b
6	19.80 \pm 0.38d	92.77 \pm 2.36 ^b
P value	0.01	0.00

Means in the same column with different letters are significantly different ($P < 0.05$); Group 1: control; Group 2: infected; Group 3: infected and medicated with 10 mg kg⁻¹ body weight diminazene aceturate; Group 4: infected and medicated with 500 mg kg⁻¹ body weight EETL; Group 5: infected and medicated with 1,000 mg kg⁻¹ body weight EETL; Group 6: infected and medicated with 1,500 mg kg⁻¹ body weight EETL

the albino rats in all *Trypanosoma brucei brucei* infected and treated/untreated groups (groups 2 to 6), from day five post-infection until day ten post-infection when it reduced at differing rates in groups treated with 10 mg kg⁻¹ body weight diminazene acetate (group 3) and EETL (groups 4, 5 and 6). No parasitaemia was recorded in the control group (group 1).

Several phytochemicals with anti-trypanosomal properties have been discovered (Ameenah and Mohamad, 2013; Nwodo et al., 2015b). Phytochemicals also interact with the mitochondrial electron transport systems of trypanosomes, which increases the methylation of hydroxyl groups, resulting in increased lipophilicity and molecule permeability across the parasites' membrane (Nwodo et al., 2015b). The improved chemosuppression observed in this study with an increased EETL dose from 500 mg kg⁻¹ to 1,000 mg kg⁻¹ and 1,500 mg kg⁻¹ further supports EETL's trypanocidal properties. The bioactive compounds present in the ethanolic extract of *Terminalia catappa* leaf were found to inhibit lipid peroxidation in trypanosomes (Mergia et al., 2014) and form complexes with protein, resulting in decreased parasite motility (Ojelele et al., 2020). The anti-trypanosomal activity of the diminazene acetate and EETL is shown by the different curve patterns shown by the various treatment groups and the declination of the parasitemia level curve in the diminazene acetate and EETL treated groups from day ten post-infection. It was also discovered

that the chemical composition and dosage of *T. brucei brucei* infected rats have a significant impact on the chemotherapy.

The out-turn of the EETL on the erythrogram of *Trypanosoma brucei brucei* infected albino rats is shown in Table 2. On days 5, 10 and 15 post-infection, the PCV and HbC of the rats in group 2 (infected and not treated) and group 4 (infected and treated with 500 mg kg⁻¹ EETL) were significantly ($P < 0.05$) lower, compared to the control (group 1) and others (groups 3, 5 and 6). On day five post-infection, the RBC counts of the albino rats in groups 2 and 4 were significantly lower ($P < 0.05$) than groups 1, 3, 5 and 6. On day 10 after infection, RBC counts were identical to those on day 5, with the exception of group 5, where RBC was slightly ($P < 0.05$) reduced. Compared to the control, all *T. brucei brucei* infected, and treated groups (groups 2 to 6) had significantly lower RBC counts on day 15 post-infection ($P < 0.05$). Groups 3, 5, and 6 had identical RBC counts but were higher ($P < 0.05$) than groups 2 and 4.

Most clinical cases of trypanosomiasis have been linked to parasitaemia and subsequent anaemia. Additionally, packed cell volume and haemoglobin concentration are two markers for assessing the magnitude of trypanosome infection (Stijlemans et al., 2018). As a result, the relatively low PCV and HbC levels found in albino rats in groups 2 (infected and not treated) and 4 (infected and treated

Table 2 The effect of *Terminalia catappa* ethanolic extract on the erythrogram of albino rats infected with *Trypanosoma brucei brucei*

Erythrogram	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	P value
PCV							
Day 0	51.70 ± 0.72	51.70 ± 0.63	52.21 ± 1.66	51.03 ± 0.75	50.87 ± 0.68	51.53 ± 1.01	0.91
Day 5	49.76 ± 0.20 ^{ab}	46.07 ± 1.30 ^b	51.97 ± 1.44 ^{aa}	46.17 ± 1.49 ^b	51.20 ± 1.47 ^a	51.12 ± 1.96 ^a	0.04
Day 10	50.95 ± 0.66 ^{ab}	45.16 ± 2.23 ^c	51.93 ± 1.51 ^a	46.07 ± 2.07 ^{bc}	50.14 ± 0.86 ^{ab}	51.00 ± 0.77 ^{ab}	0.03
Day 15	51.98 ± 1.67 ^a	41.95 ± 1.10 ^b	52.05 ± 1.48 ^a	42.99 ± 1.69 ^b	50.18 ± 0.58 ^a	51.55 ± 1.25 ^a	0.01
RBC							
Day 0	8.43 ± 0.31	7.00 ± 0.05	8.49 ± 0.51	6.95 ± 0.08	7.77 ± 0.08	7.77 ± 0.09	0.17
Day 5	8.35 ± 0.24 ^a	6.80 ± 0.01 ^b	8.24 ± 0.22 ^a	6.84 ± 0.02 ^b	7.66 ± 0.44 ^a	7.88 ± 0.01 ^a	0.01
Day 10	8.48 ± 0.51 ^a	6.74 ± 0.09 ^c	7.85 ± 0.02 ^{ab}	6.76 ± 0.04 ^c	7.45 ± 0.08 ^{bc}	7.81 ± 0.58 ^{ab}	0.01
Day 15	8.48 ± 0.28 ^a	6.31 ± 0.23 ^c	7.88 ± 0.04 ^b	6.01 ± 0.11 ^c	7.51 ± 0.06 ^b	7.94 ± 0.02 ^b	0.01
HbC							
Day 0	17.32 ± 0.24	17.23 ± 0.21	17.40 ± 0.55	17.01 ± 0.25	16.95 ± 0.22	17.18 ± 0.33	0.91
Day 5	16.58 ± 0.06 ^{ab}	15.35 ± 0.43 ^b	17.32 ± 0.48 ^a	15.39 ± 0.49 ^b	17.06 ± 0.49 ^a	17.04 ± 0.65 ^a	0.04
Day 10	16.98 ± 0.22 ^{ab}	15.05 ± 0.74 ^c	17.31 ± 0.51 ^a	15.35 ± 0.68 ^{bc}	16.71 ± 0.28 ^{ab}	17.00 ± 0.35 ^{ab}	0.03
Day 15	17.32 ± 0.32 ^a	13.98 ± 0.36 ^b	17.35 ± 0.49 ^a	14.33 ± 0.32 ^b	16.72 ± 0.19 ^a	17.18 ± 0.41 ^a	0.01

abc – means with different superscripts along the rows are significant ($P < 0.05$); PCV – packed cell volume (%); RBC – red blood cell ($\times 10^6 \text{ mm}^{-3}$); HbC – haemoglobin concentration (g l^{-1}); EETL – ethanolic extract of *Terminalia catappa* leaf; Group 1: control; Group 2: infected; Group 3: infected and medicated with 10 mg kg⁻¹ body weight diminazene acetate; Group 4: infected and medicated with 500 mg kg⁻¹ body weight EETL; Group 5: infected and medicated with 1,000 mg kg⁻¹ body weight EETL; Group 6: infected and medicated with 1,500 mg kg⁻¹ body weight EETL

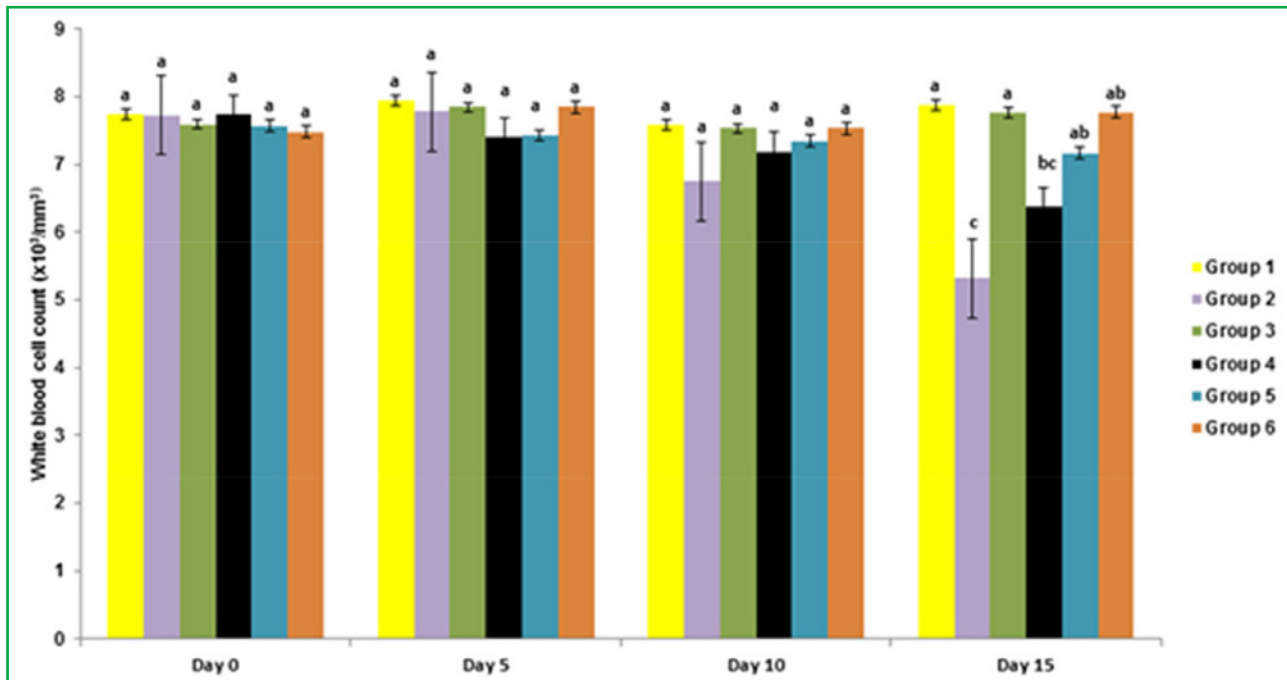


Figure 3 The effect of *Terminalia catappa* ethanolic extract on the white blood cell count of albino rats infected with *Trypanosoma brucei brucei*
 EETL – ethanolic extract of *Terminalia catappa* leaf; Group 1: control; Group 2: infected; Group 3: infected and medicated with 10 mg kg⁻¹ body weight diminazene aceturate; Group 4: infected and medicated with 500 mg kg⁻¹ body weight EETL; Group 5: infected and medicated with 1,000 mg kg⁻¹ body weight EETL; Group 6: infected and medicated with 1,500 mg kg⁻¹ body weight EETL

with 500 mg kg⁻¹ EETL) indicate that *T. brucei brucei* infection can cause severe anaemia in rats, particularly when not treated or controlled correctly. Furthermore, this finding demonstrates that the administration of 1,000 or 1,500 mg kg⁻¹ EETL will effectively prevent anaemia in *T. brucei brucei* infected animals.

The glueing of the trypanosome flagellums to the red blood cells causes anaemia in trypanosomiasis patients (Boada-Sucre et al., 2016). As a result of the trypanosome's proximity to red blood cells through sialic acid receptors, the red blood cell's membrane is traumatized at the contact point (Mbaya et al., 2012). Often, because of the trypanosome's motility in the bloodstream, there is an increase in erythrophagocytosis due to a change in the red blood cells' oligosaccharide make-up' surface (Boada-Sucre et al., 2016).

Figure 3 illustrates the sequel of EETL treatments on the WBC count of albino rats infected with *Trypanosoma brucei brucei*. The WBC counts of rats in groups 2 and 4 were statistically ($P < 0.05$) lower than the control group and others on day 15 after infection (groups 3 and 6). Leukopenia expression has been identified in animals after *Trypanosome* infection (Abdullahi et al., 2019; Ndung'u et al., 2020). As a result, the low white blood cell count observed in *Trypanosoma brucei brucei* infected groups (groups 2 and 4) may be attributed to

trypanosome infection's immunosuppressive effects (Abdullahi et al., 2019; Ndung'u et al., 2020). This finding also highlights the virulence of the parasitic infection in the aforementioned groups and the possible importance of white blood cells in trypanosomiasis immunopathogenesis. The leukopenia observed in this study after infection with *Trypanosoma brucei brucei* may be attributed to leucophagocytosis induced by leucocyte antigen covering and decreased leucocyte output.

The levels of urea, creatinine and cholesterol in the treatment groups were comparable ($P > 0.05$) (Table 3). Groups 2 and 4 had substantially higher ALT and AST levels than the control and other care groups ($P < 0.05$). Serum biochemistry studies reveal information about the physiological condition of an organism's organs. On the other hand, these enzymes are extremely useful in detecting muscular, hepatic, pancreatic, and skeletal disorders (Oloruntola et al., 2018). The amounts of serum aspartate transaminase and serum alanine transaminase can diagnose liver and biliary system problems. On the other hand, the serum aspartate transaminase shows additional pathological cases, including myocardial damage or necrosis, as well as non-specific tissue injury (Oloruntola et al., 2016).

As a result, the increased aspartate transaminase serum concentration found in *Trypanosoma brucei brucei*

Table 3 The effect of *Terminalia catappa* ethanolic extract on the serum biochemical indices of albino rats infected with *Trypanosoma brucei brucei*

Serum biochemical indices	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	P value
Alanine transaminase (I.U l ⁻¹)	20.73±0.81 ^c	24.99±1.13 ^a	21.50±0.82 ^{abc}	24.71±1.83 ^a	20.73±0.66 ^c	21.17±0.92 ^{bc}	0.04
Aspartate transaminase (I.U l ⁻¹)	41.61 ^b ±2.62	53.93±3.47 ^a	43.32±3.03 ^b	52.85±2.83 ^a	41.79±1.87 ^b	41.95±3.17 ^b	0.02
Urea (mg dl ⁻¹)	15.28±1.63	17.23±3.25	15.38±0.72	17.81±2.78	15.61±2.35	15.35±0.98	0.92
Creatinine (mg dl ⁻¹)	0.37±0.06	0.57±0.05	0.45±0.61	0.48±0.63	0.46±0.08	0.43±0.09	0.51
Cholesterol (mg dl ⁻¹)	21.48±2.09	22.91±2.35	19.05±1.97	22.00±2.00	23.25±1.93	21.59±2.17	0.76

Means with different superscripts along the rows are significant ($P < 0.05$); EETL: Ethanolic extract of *Terminalia catappa* leaf; Group 1: Control; Group 2: infected; Group 3: infected and medicated with 10 mg kg⁻¹ body weight diminazene aceturate; Group 4: infected and medicated with 500 mg kg⁻¹ body weight EETL; Group 5: infected and medicated with 1,000 mg kg⁻¹ body weight EETL; Group 6: infected and medicated with 1,500 mg kg⁻¹ body weight EETL

infected rats in groups 2 and 4 reveals the possibility of hepatic damage and myocardial infarction in *T. brucei brucei* cases that have been poorly treated. In trypanosusceptible animals, general inflammation linked to the tenacity of myeloid cells/macrophages cells has been identified as a significant cause of liver injury (Akinseye et al., 2020).

4 Conclusions

In this study, the parasitemia level in *T. brucei brucei* infected albino rats was reduced by 1,500 mg kg⁻¹ EETL bodyweight. In *T. brucei brucei* infected albino rats, the chemo-suppression percentage increases as the EETL dose is increased from 500 mg kg⁻¹ to 1,000 mg kg⁻¹ 1,500 mg kg⁻¹. Untreated or mismanaged *T. brucei brucei* infected albino rats could develop anaemia due to low PCV and RBC and leukopenia, as well as hepatic and myocardial damage. The timely administration of 1,000 mg kg⁻¹ EETL and 1,500 mg kg⁻¹ EETL, on the other hand, could prevent the aforementioned pathological cases. Furthermore, *T. brucei brucei* infection in rats can result in elevated serum aspartate transaminase and serum alanine transaminase, which can be prevented by giving 1,000–1,500 mg kg⁻¹ EETL.

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