MERIT RESEARCH JOURNALS
www.meritresearchjournals.org

Merit Research Journal of Microbiology and Biological Sciences (ISSN: 2408-7076) Vol. 10(2) pp. 010-018, May, 2022
Available online http://www.meritresearchjournals.org/mbs/index.htm

DOI: 10.5281/zenodo.6579486

Original Research Article

Haematological Effects of Extract of *Parkia biglobosa* Plants In West African Dwarf (WAD) Goats Infected with *Haemonchus contortus*

Josiah J. G[1*], Jiya Z[2], Obi O. A[3]

[1]Department of Biotechnology, Faculty of Sciences, Mewar International University (MIU), Nigeria, Masaka, Nasarawa State, Nigeria

[2]Department of Science Laboratory Technology, Federal Polytechnic, Nasarawa, Nasarawa State, Nigeria.

[3]Department of Zoology, University of Agriculture, Markudi, Benue State, Nigeria

***Corresponding Author's Email: ganajames@yahoo.com.**
Mobile Number: +2348036951530

Abstract

The effects of stem bark extracts of *Parkia biglobosa* on haematological parameters of West African Dwraf (WAD) goats averagely weigh 10kg was investigated. The plant was sourced from Tsaragi community in Edu LGA, Kwara State, Nigeria and extracted with methanol to yield crude methanol stem bark extract (CMSBE). This CMSBE was partitioned with n- Hexane, ethyl acetate and water to yield additional ethyl acetate (EA) fraction and aqueous (AQ) fraction. The haematological parameters evaluation were carried out in 18 WAD goats infected with *Haemonchus contortus* in six groups of completely block design at three animals per group. Group A and B were dosed with 5mL/kg of distilled water and 6.25mg/kg of Albendazole (ABZ) for negative and positive control respectively. Groups C and D with 1000mg/kg and 2000mg/kg of CMSBE respectively and groups E and F with 1000mg/kg of EA fraction and AQ fraction each respectively. The haematological parameters evaluated were Parked cell volume (PCV), haemoglobin concentration (Hb), total red blood cell (TRBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) and differential white blood cell count such as neutrophils, lymphocytes and monocytes, eosinophils, neutrophils and basophils. The results showed that CMSBE, EA fraction and AQ fraction have no significant (P>0.05) effect on haematological paremeters of WAD goats based on the doses used. However, the increase in Hb, RBC and PCV observed in this study suggested that *P. biglobosa* extracts may be pursued for their clinical relevance in the management of anaemia and in treatment of infectious disease caused by helminth parasites like *H. contortus*. It is therefore, recommended to establish a baseline indices for haematological parameters on the basis of factors such as sex, age, breed, and nutrition of animals and carry out further studies to determine the effects of these factors on these indices.

Keywords: Haematology; *Parkia biglobosa*; WAD goats; *Haemonchus contortus*

INTRODUCTION

The research on medicinal plants to control helminths either as phytotherapeutic or nutraceutical options is one of the leading areas of research globally (Soetan and Aiyelaagbe, 2009; Sandoval-Castro *et al*., 2012). These medicinal plants have been used by man for the management of various diseases in many developing countries of the world for a long time (Gill 1990; sofowora 1993).

One of these medicinal plants is *Parkia biglobosa* commonly called the African locust bean. It is a perennial deciduous as well as leguminous tree which belongs to the Sub family Mimosdoideae and Family Fabaceae

(formerly Leguminosae) (Burkhill, 1995). It is a multipurpose tree of West Africa and is used for medicinal and nutritional purposes (Sabiti and Cobbina, 1992; Mertz *et al.,* 2001). It has been used in treating different types of diseases such as pneumonia, diarrhoea, ulcers, malaria and as anti-snake venom (Asuzu and Harvey, 2003; Agunu *et al*., 2005).

However, when animals are exposed to the metabolites of these medicinal plants, there is always a reflector in the haematological parameters of these animals. Haematological parameters, which consist of red blood cells, white blood cells or leucocytes, mean corpuscular haemoglobin, mean corpuscular volume, and mean corpuscular haemoglobin concentration are valuable in monitoring feed toxicity especially with feed constituents that affect the blood as well as the health status of farm animals (Oyawoye and Ogunkunle, 2004).

Assessment of these haematological parameters can be used to determine the extent of deleterious effect of foreign compounds including plant extracts on the blood. Reference ranges of haematological parameters can be useful for the evaluation of the state of health in specimens of the species as well as diagnostics and prevention of diseases (Tomenendalova *et al.,* 2014). According to Olafedehan *et al.* (2010), examining blood for their constituents can provide important information for the diagnosis and prognosis of diseases in animals. Little or nothing has been known regarding the effect of *Parkia biglobosa* on haematological parameters of West African dwarf (WAD) goats. It is therefore important to establish a baseline indice for haematological parameters of WAD goats dosed with *P. biglobosa* extract and on this basis carry out further studies to determine the effects of these changes if there are, for possible administration or withdrawal, in the management of anaemia in WAD goats.

MATERIALS AND METHODS

Study Area

The study was conducted in Biological garden of Centre for Preliminary and Extra-Mural Studies (CPES), Federal University of Technology, Minna, Niger State, Nigeria. Minna is located at the global positioning system (gps) coordinates of 9° 35' 0.7980'' N and 6° 32' 46.7376'' E. The climate of Minna is characterised by a tropical climate with two main seasons; a dry season (November to March) and a rainy season (April to October). The temperature is uniformly high throughout the year reaching the peaks of 40^0C (February-March) and 30^0C (November - December). These climatic characteristics favour the rearing of poultry, sheep and goats in the area. Most of the breeds of goats in Niger State are West African dwarf and Red Sokoto.

Sample Collection, preparation and extraction

The fresh stem bark of *P. biglobosa* were collected during the dry season in 2016 at Tsaragi community in Edu Local Government Area of Kwara State, Nigeria. This plant sample was taken to the Department of Botany, Ahmadu Bello University Zaria, Kaduna State, Nigeria, where identification was made and a Voucher number ABU/7064 was given and deposited in the herbarium in the same Department for reference purposes.

The preparation of plant samples were done by washing with water and air dried in the shade, at room temperature for one month and thereafter crushed into powder form. These were stored in air tight container for later use as described by Soetan *et al.* (2011) and Meraiyebu *et al*. (2013).

Methanol extraction was done using the method of Builder *et al. (*2012) and method of Emmanuel *et al.,* 2013 was used for solvent partitioning of crude methanol stem bark extract (CMSBE) of *P. biglobosa*. The solution (CMSBE of *P. biglobosa)* was partitioned with n- Hexane in equal volume in a separating funnel to yield n- Hexane and Aqueous (AQ) portions. Lastly, the aqueous portion was further partitioned with Ethyl acetate (EA) in equal volume also, to obtain a final Ethyl acetate (EA) and Aqueous (AQ) fractions (Figure 1 and 2). In each partitioning step, the mixtures were vigorously shaken to re-suspend the particles. Impurities were pooled together in a separate beaker and discarded. The different portions collected in separate conical flasks were again concentrated to residue over the water bath at 65 ºC and weighed to determine percentage yield in terms of the mass of the Crude Methanol extract (CME). The different fractions of stem bark extracts of *P. biglobosa* were packed in clean air-tight glass bottles and stored in the refrigerator at 4^0C until used. Figure 1,2

Experimental Animals

A total number of eighteen (18) apparently healthy ~~of~~ WAD goats were purchased from small scale farmers in Niger state, Nigeria. These goats have an average weight of 10 kg of both sexes (males and females) with homogeneous characteristics. The infections of these goats were confirmed using the methods of Soulsby, 1986 and Hansen and Perry, 1994 in the Biology Laboratory II in the Department of Animal Biology, Federal University of Technology, Minna in collaboration with Niger State Veterinary Hospital Minna, Nigeria. After confirmation, any animal with gastrointestinal infection and ectoparasites were dewormed and then immunized with *pestes des petit* (PPR) vaccine purchased from the Nigerian Veterinary Research Institute Vom, Plateau State, Nigeria.

These animals were provided with standard diet (fed with cured, cut and carry forage supplemented with

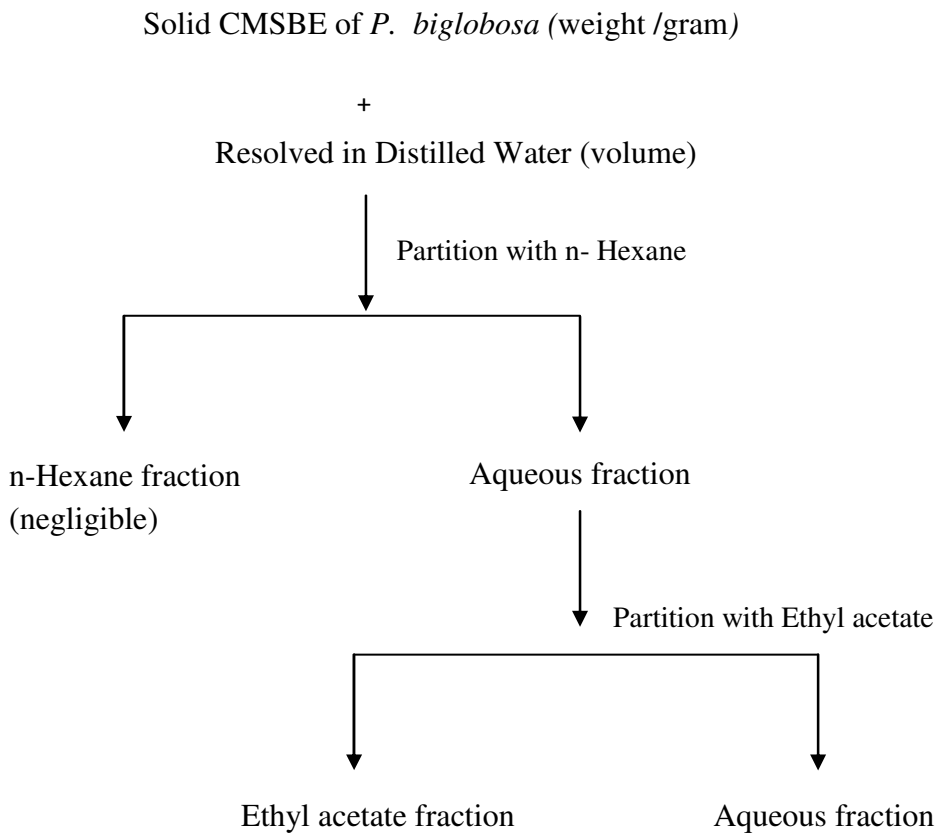

Figure 1. Flow Chart of Solvent Partitioning of CMSBE of *P. biglobosa*

Figure 2. Solvent Partitioning: Ethyl Acetate and Aqueous Layers Separated

Figure 3. Photograph of Experimental West African Dwarf (WAD) Goats Housed in Pens Constructed in Biological Garden FUT, Minna

maize offal, groundnut hay, yam peeled, beans husk, salt lick) and water *ad libitum* after maintaining them in cleaned and fumigated concrete-floored pens constructed in Biological garden of Centre for Preliminary and Extral-mural Studies, (CPES) FUT, Minna (Figure 3). These animals were observed daily throughout the experimental work which lasted for 8 weeks. The study conducted was in accordance with the ethical rules on animal experimentation as approved by the Ethical Committee of the Department of Animal Biology FUT, Minna. These animals were acclimatized for two weeks before the commencement of the study (Anaeto *et al*., 2009; Builders *et al.,* 2012). Figure 3

Recovery of infective Larvae (L_3) of *H. contortus* for WAD goats infection

Infective larvae of *H. contortus* were obtained from abomasums purchased from goats slaughtered in Minna Abattoir and transported to the Biology Laboratory II in the Department of Animal Biology, Federal University of Technology, Minna, Nigeria, in a cooler with ice block and then washed immediately. Female worms were separated from male worms by their large size and presence of vulva flap. The crushing to rupture the uteri of female worms to release their eggs and culturing to recover the larvae (L_3) was done using the method of Van Wyk *et al.* (2004) and Makun *et al*. (2008). The harvested larvae were stored in water at 4 °C. Thereafter, WAD goats were dosed accordingly.

Experimental infection and grouping of WAD goats to assess the effects of plant extract on haematological parameters

To evaluate the effect of *P. biglobosa* extract on WAD goat haematological parameters, each Animal was dosed with a 5 ml aliquot of the L_3 of *H. contortus* parasites solution estimating a dose of 2500 larvae per animal using syringe. The methods of Makun *et al*. (2008); Chiejina *et al.* (2010) and Lucas and Amaechi (2015) were used. Twenty one days after experimental infection, faecal samples were taken to determine the faecal egg count to ensure that these animals were infected with *H. contortus*. Animals were then assigned to experimental groups for treatment as described by Epplin *et al.* (2015). The Experimental animals were divided into six treatment groups (A, B, C, D, E and F) of three animals each on day zero. The grouping was done using complete randomized design (CRD), taking into consideration their live weight (Anaeto *et al*., 2009; Builders *et al.,* 2012). The six groups were assigned to different doses of

Table 1. Dosage of Albendazole (ABZ) and Extracts Administration to WAD Goats

Group	Extract	Dosage
A	Distilled water	5 ml/kg
B	Albendazole	6.25 mg/kg
C	CMSBE of *P. biglobosa*	1000 mg/kg
D	"	2000 mg/kg
E	EA fraction	1000 mg/ kg
F	AQ fraction	1000 mg/ kg

Key: CMSBE- crude methanol stem bark extract; EA- Ethyl acetate fraction; AQ- Aqueous fraction

Table 2. Changes in Erythrocyte Parameters of Infected WAD Goats dosed with CMSBE, EA Portion and AQ Portion of *P. biglobosa* and Standard Drug (Albendazole)

Erythrocyte Parameters	Group	Baseline	5th	10th	15th
PCV (%)	A	25.67±0.33	26.33±0.33	27.33±0.67	28.00±0.00
	B	31.67±2.85	30.33±1.67	30.67±1.33	32.00±0.58
	C	32.33±3.84	30.67±2.19	30.00±1.53	30.33±1.20
	D	26.00±2.08	29.00±0.58	30.33±0.33	32.00±0.58
	E	30.33±2.73	32.33±2.19	31.67±1.86	31.00±2.08
	F	27.67±1.86	29.67±1.86	30.67±1.33	30.67±0.33
Hb (g/dl)	A	**6.53±1.07**	8.73±0.13^{a}	9.30±0.00^{b}	**9.25±0.05^{b}**
	B	10.50±0.95	10.06±0.53	9.97±0.33	10.73±0.43
	C	10.73±1.27	10.16±0.72	9.97±0.52	10.26±0.66
	D	8.63±0.71	9.43±0.30	10.10±0.10	10.63±0.20
	E	10.06±0.90	10.73±0.72	10.53±0.62	10.47±0.64
	F	9.20±0.61	9.83±0.62	10.06±0.39	10.17±0.09
TRBC (10^{9}/l)	A	**3.33±0.33^{a}**	3.00±0.00^{a}	4.00±0.00^{b}	**4.00±0.00^{b}**
	B	3.33±0.67	3.33±0.33	3.67±0.33	4.67±0.33
	C	5.33±0.67	3.67±0.67	4.33±0.88	4.67±0.33
	D	**3.00±0.58^{a}**	4.33±0.67	5.00±0.58	**5.67±0.33^{b}**
	E	4.67±0.33	3.33±0.33	4.67±0.67	4.33±0.33
	F	4.67±0.33	4.00±0.58	5.00±0.58	5.00±0.00
MCV (%)	A	38.67±1.76	39.00±1.73^{a}	38.67±1.76	41.50±0.50
	B	42.00±0.58	45.00±0.58	43.00±1.00	43.33±1.33
	C	42.33±0.88	42.33±0.33	41.67±0.33	41.67±0.33
	D	40.67±0.67	42.00±0.58	42.33±0.33	43.33±1.33
	E	41.00±0.58	41.67±0.88	41.67±0.33	42.00±0.00
	F	41.67±0.33	42.00±0.58	42.00±0.00	41.67±0.33
MCH (%)	A	**9.00±0.57^{a}**	11.67±0.33^{b}	11.67±0.33^{b}	**11.50±0.50^{b}**
	B	10.67±0.67	11.33±0.33	12.00±0.00	11.67±0.33
	C	11.67±0.33	11.33±0.33	11.33±0.33	11.33±0.33
	D	11.33±0.33	10.67±0.33	12.00±0.00	11.67±0.33
	E	11.33±0.33	11.00±0.00	11.33±0.33	11.33±0.33
	F	12.00±0.00	11.67±0.33	11.33±0.33	11.33±0.33
MCHC (%)	A	29.33±1.76	34.33±1.67	31.33±0.67	30.50±0.50
	B	31.33±0.33	33.00±1.53	36.33±2.60	36.67±2.91
	C	32.67±0.67	33.00±1.53	33.33±1.33	33.00±1.53
	D	31.33±0.33	37.67±2.73	34.33±1.67	34.67±1.33
	E	31.00±0.00	33.67±1.20	33.67±1.67	33.33±1.33
	F	32.00±0.00	33.67±2.73	33.00±1.53	33.33±1.33

Each value is mean±SEM for three goats in each group. The mean for each parameter with different superscript alphabet in the same row are statistically significant different (P<0.05)

extracts as shown in Table 1 below. Blood samples were collected every 5th day for 16 days from the jugular vein of each goat into a bottle with EDTA using a 5 ml disposable syringe to determine haematological parameters. The administration plant extract was done orally by gavage using the method of Lorke (1983). The

Table 3. Changes in White Blood Cell and its Differential Count of Infected WAD Goats Treated with CMSBE, EA Portion and AQ Portion of *P. biglobosa* and Standard Drug (Albendazole)

WBC Parameters	Group	Baseline	5th	10th	15th
TWBC 10^9/l	A	2.00±0.00	2.33±0.33	2.33±0.33	2.50±0.50
	B	**3.33±0.33^a**	2.67±0.33	2.00±0.00	**2.00±0.00^b**
	C	**3.67±0.00^a**	2.67±0.33	2.67±0.33	**2.33±0.33^b**
	D	2.67±0.33	2.67±0.33	2.67±0.33	3.00±0.00
	E	**3.33±0.33^a**	2.00±0.00	2.33±0.33	**2.00±0.00^b**
	F	**3.67±0.33^a**	2.67±0.33	2.67±0.33	**2.33±0.33^b**
Neutrophils (%)	A	2.00±0.00^a	3.00±0.00	3.00±0.00	3.00±0.00
	B	2.67±0.33	3.00±0.00	3.00±0.00	3.00±0.00
	C	4.33±0.33^b	3.00±0.00	3.00±0.00	3.00±0.00
	D	2.67±0.67	2.67±0.33	3.00±0.00	3.00±0.00
	E	3.67±0.33	3.00±0.00	3.00±0.00	2.67±0.33
	F	4.00±0.00^b	3.00±0.00	3.33±0.33	3.00±0.00
Lymphocyte (%)	A	36.67±2.91	39.67±2.03	40.00±1.16	41.00±0.00
	B	41.33±0.33	43.67±1.20	42.33±0.33	43.00±0.00
	C	42.67±0.33	42.33±0.33	42.00±0.58	43.00±1.00
	D	40.67±0.67	43.67±0.88	43.67±0.88	45.67±1.76
	E	41.33±0.67	42.67±0.33	43.00±1.00	42.67±1.20
	F	42.00±0.00	42.67±0.88	43.33±0.88	43.67±1.20
Monocytes (%)	A	0.67±0.33	1.33±0.33	2.00±0.00	1.50±0.50
	B	1.00±0.00	1.00±0.00	1.67±0.33	2.00±0.00
	C	1.00±0.00	1.33±0.33	1.67±0.33	1.67±0.33
	D	2.00±0.00	1.67±0.33	2.00±0.00	2.33±0.33
	E	2.00±0.00	2.00±0.00	2.00±0.00	1.33±0.33
	F	1.67±0.33	2.00±0.00	1.67±0.33	2.33±0.33
Eosinophils (%)	A	**0.00±0.00^a**	0.67±0.33	1.33±0.33	**1.00±0.00^b**
	B	**0.00±0.00^a**	1.00±0.00	1.00±0.00	**1.00±0.00^b**
	C	0.67±0.33	1.00±0.00	1.00±0.00	0.67±0.33
	D	1.00±0.00^b	0.67±0.33	1.00±0.00	1.33±0.33
	E	1.00±0.00	1.00±0.00	1.00±0.00	0.67±0.67
	F	1.33±0.33	0.67±0.33	1.00±0.00	1.33±0.33
Basophils (%)	A	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00^a
	B	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00^a
	C	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00^a
	D	**0.00±0.00^a**	0.00±0.00	0.00±0.00	**0.33±0.33^b**
	E	**0.00±0.00^a**	0.00±0.00	0.00±0.00	**0.67±0.33^b**
	F	**0.00±0.00^a**	0.00±0.00	0.00±0.00	**0.33±0.33^b**

Each value is mean±SEM for three goats in each group. The mean for each parameter with different superscript alphabet in the same row are statistically significant different (P<0.05).

dosage of animals in positive control group (B) was once while in group C, D, E and F lasted for three consecutive days. Table 1

Data Analysis

The data collected were expressed as mean± standard deviation of the observation which were further subjected to t- test and one way analysis of variance (ANOVA) followed by Turkey's post hoc test where necessary. Value of P< 0.05 was considered significant. GraphPad Instat version 3.05 Windows from Graphpad Software (2000), San Diego, California USA (www.graphpad.com) was used to analyze the data.

RESULTS

The effects of CMSBE, EA and AQ portions of *P. biglobosa* administered orally for 3 consecutive days on haematological parameters of WAD goats are shown in Table 2. There was no significant difference (P>0.05) in Parked cell volume (PCV), haemoglobin concentration (Hb), total red blood cell (TRBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) in all groups administered with the extracts, except in total red blood cell in group D where significant (P<0.05) change was observed between the pre-dosage (Baseline) and 15th day post-dosage. However, the mean corpuscular haemoglobin concentration (MCHC)

increased in all the groups (group A, B, C, D, E and F).

The total white blood cell changed significantly (P<0.05) in group B, C, E and F between the pre-dosage (baseline) and 15 day post- dosage. Similarly, the differential white blood cell count such as neutrophils, lymphocytes and monocytes did not differ significantly (P> 0.05) between the baseline and after 15th day post-dosage among the groups administered with the extracts (Table 3). Conversely, eosinophils level in group A and B and basophils level in group D, E and F differ significantly (P <0.05) while eosinophils level among group C, D, E and F and group A, B and C for basophils levels did not show any significant change (P>0.05) between baseline and 15th day post- dosage (Table 3).

DISCUSSION

Haematological parameters comparison could serve as baseline information for nutrient deficiency, physiology and health status of farm animals (Daramola *et al*., 2005). Research findings by Onyenyili *et al*. (1998) showed that the anaemia is as a result of haemolytic phenomenon and or inhibition of blood cell synthesis by active constituents of the extract and decrease in haematological parameters has been associated with anaemia. In this study, the active constituents of *P. biglobosa* did not cause lysis of blood cells and or inhibition in blood cells synthesis, since there was no reduction in hematological parameters. Haematological data obtained from the present study were within the normal range reported for apparently healthy WAD goats of the same age (Opara *et al*., 2010).

The Packed cell volume (PCV) in this study ranged from 25.67±0.33 to 32.33± 3.84% in all the groups dosed with *P. biglobosa* extracts. This result agreed with that of Tambuwal *et al* (2002) who obtained the Parked cell volume (PCV) to be 25.7 ± 3.1% for Red Sokoto goats. This also falls within the range of 21-35% reported by Daramola *et al.* (2005) in apparent health WAD goats. The findings of this study support that PCV varies among breeds of goats. Increase in PCV values in this study may be attributed to increase in environmental temperature (Aye, 2012). High PCV haematocrit values indicate either an increase in the number of circulating RBC or reduction in circulating plasma volume (Kopp and Hetesa, 2000). Haematological traits especially PCV and Hb were correlated with nutritional status of the animal (Baneejee 2007). The higher PCV values observed in this study might likely be a sign of healthier goats.

The haemoglobin concentration (Hb) did not differ significantly (P>0.05) among the *P. biglobosa* extracts administered group when compared to control. They were within the reference range of 8- 14 g/dl for goats (Sirois, 1995). The Hb concentration in this study fell within the range of high values obtained for Red Sokoto goats (Tambuwal *et al*., 2002). Though, higher than the result of Shaikat *et al*. (2013) who reported the range of 3.6 - 6.6 g/dl of haemoglobin in goats. Similar values of Hb concentrations were reported by Bhatt *et al.* (2007), in kids and lambs fed with Prosopis leaves. West African Dwarf goats seem to possess relatively high Hb values, and this is an advantage in terms of the oxygen carrying capacity of the blood (Opara *et al*., 2010)

The value of TRBC is within the normal range and the values obtained agreed with the results of Njidda *et al.* (2013) on Kano Brown and Red sokoto breed of goats fed on natural grazing range land of Northern, Nigeria. The erythrocytic indices (MCV, MCH and MCHC) which are important in characterization of anaemia, did not significantly (P>0.05) differ in infected WAD goats dosed with extracts of *P. biglobosa* and were within the normal ranges (Merck and Dohme, 2015). The erythrocytic indices were quite similar with that of Njidda *et al*. (2013) on haematological parameters of goats of Semi Arid environment fed on natural grazing rangeland of Northern Nigeria.

The WBC parameters in this study were within the normal range of apparently healthy goats. There was no change in total WBC counts, neutrophils, lymphocytes, monocytes and eosinophils among the groups administered with extracts of *P. biglobosa* in comparison to control. The lower WBC counts recorded in the administered groups of extracts of *P biglobosa* in this study contradicted the report of Njidda *et al.* (2013) who reported high WBC counts in Kano brown and Red Sokoto breed of goats fed on natural grazing rangeland of Northern, Nigeria. The WBC differentials (lymphocytes and neutrophils) in comparable showed that the lymphocytes constituted the majority of the WBC counts and is higher than the neutrophils. In goats like other ruminants, there are more lymphocytes than neutrophils in circulation (Olusanya *et al.,* 1976). Lymphocytes are the key elements in the production of immunity. Low levels can be seen in some bacterial infections, aplastic anaemia and in some forms of leukemia while high values can be observed in viral infection, and in some forms of leukemia. On the other hand, neutrophils were observed to be a very effective killing machine (Ganong, 2005). The neutrophils in this study were lower than the report of Njidda *et al.* (2013). The lymphocytes in this study was higher than that of Shaikat *et al*. (2013) who reported the range of 1.6 - 38% lymphocytes in goats but agreed with the report of Njidda *et al.* (2013) in Sokoto red breed of goats.

The values of eosinophils and monocytes were generally lower while basophils were not recorded except in groups D, E and F where 0.3 -0.6 % range of basophils were recorded during 15th day post treatment of the CMSBE, EA and AQ portions of *P. biglobosa.* The results of eosinophils, monocytes and basophils were quite similar to the results of Njidda *et al.* (2013).

CONCLUSION

The CMESB seemed to be blood friendly as none of these parameters (Parked cell volume haemoglobin concentration, total red blood cell, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and total WBC counts as well as WBC differential counts) were altered during haematological, analyses.

These haematological parameters can be used to assess the health as well as the physiological status of farm animals under consideration. The increase in Hb, RBC and PCV observed in this study suggested that *P. biglobosa* extracts may be pursued for their clinical relevance in the management of anaemia and in treatment of infectious disease caused by helminth parasites like *H. contortus*. Moreover, it is recommended to establish a baseline indice for haematological parameters on the basis of factors such as sex, age, breed, and nutrition of animals and carry out further studies to determine the effects of these factors on these indices.

ACKNOWLEDGEMENT

The authors would like to appreciate the students of Etsu Aliyu Senior Secondary School Tsaragi for assistance in sourcing and pounding of stem bark of *Parkia biglobosa* plant. We are also thankful to laboratory technical staff of veterinary hospital Minna, Niger State, STEB –B centre for Biotechnology Laboratory, Federal University of Technology (FUT) Minna, and Biological Garden of Centre for Preliminary and Extral-Mural Studies, FUT, Minna for their technical supports.

Conflict of Interest: Authors declare no conflict of interest

AUTHORS' CONTRIBUTIONS

Conceptualisation: Josiah JG., Jiya Z.; collecting data: Josiah JG., data analysis: Josiah JG; Obi OA; obtaining funding: Josiah JG, Obi OA, Jiya Z and writing manuscript: Josiah JG; Obi OA

Financial Disclosure: This research received no grant from any funding agency/sector.

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