

## **EFFECT OF SODOM APPLE (*Calotropis procera*) FLOWER MEAL ON GROWTH PERFORMANCE AND HEAMATOLOGICAL PARAMETERS OF RED SOKOTO GOATS DURING FIRST TRIMESTER IN SEMI ARID-REGION OF NIGERIA**

<sup>1</sup>SANI, M. H., <sup>2</sup>HASSAN, A. M., <sup>2</sup>NASIR, M., <sup>1</sup>ABDULLAHI, A.Y., <sup>2</sup>TAMBURAWA, M. S.,  
<sup>3</sup>SALISU, N., <sup>4</sup>GALADIMA, N. M., <sup>2</sup>TAHIR, A.T., <sup>2</sup>ZANGO, M. H., <sup>1</sup>ADAMU, M.,  
<sup>1</sup>MUBARAK, A.H., AND <sup>5</sup>USMAN, B.

<sup>1</sup>Department of Agricultural Education, School of Vocational Education, Sa'adatu Rimi College of Education Department of Agricultural Education Kumbotso P.M.B 2318.

<sup>2</sup>Department of Animal Science, Aliko Dangote University of Science and Technology, Wudil, P.M.B 3045, Wudil Kano.

<sup>3</sup>Department of Animal Health and Production Binyaminu Usman Polytechnic P.M.B 013, Hadejia.

<sup>4</sup>Department of Animal Production Technology, Audu Bako College of Agriculture, Dambatta P.M.B 3159 Kano State.

<sup>5</sup>Animal Care Services Konsults Nigeria Limited Plot 337, Hadejia Road behind Unity Kapital Insurance House (Now Veritas) Yankaba Road Kano.

Corresponding Author:sanimaaruf99@gmail.com

### **Abstract**

This study was to determine the effects of *C. procera* flower meal on growth performance and haematological parameters of twenty Red Sokoto goats (RSG). Five experimental diets were formulated with *Calotropis procera* (CP) flower meal at 0, 5, 10, 15, and 20% at dietary levels designated as treatments  $T_1$  (control diet),  $T_2$ ,  $T_3$ ,  $T_4$  and  $T_5$ , respectively. The experiment was laid in a Completely Randomized Design (CRD). Five treatments were allotted with four replications. Blood samples were collected from experimental animals via jugular vein during the first trimester for the determination of haematological indices. The growth parameters measured were body weight, feed intake (g/day) and feed conversion ratio (FCR). Data generated were subjected to one-way analysis of variance. The results of growth performance showed significant ( $p < 0.05$ ) differences in final weight gain. Higher values were obtained in  $T_3$  (22.27 kg) followed by  $T_2$  (22.22 kg),  $T_4$  (21.29 kg),  $T_5$  (21.82 kg) and least was occurred in  $T_1$  (20.73 kg). Significant ( $p < 0.05$ ) differences were observed in total weight gain recorded which was higher in  $T_3$  (9.34 kg) followed by  $T_2$  (9.18 kg). The results of Hematological indices showed significant ( $p < 0.05$ ) differences on Lymphocytes. This study concluded that the levels of CP flower at 5 and 10% in the diet of RSG increased body.

**Keys:** Sodom apple, growth performance, heamatology, Red Sokoto goat.

### **Introduction**

Goats are among beneficial animals in the world, providing meat, milk and fertilizer. Goats are among the earliest domesticated animals and have been associated to humans for at least 10,000 years (Monteiro *et al.*, 2018). Due to their adaptability to different environmental and climatic conditions, they are dispersed all over the world (Mahmoud, 2010). According to Food and Agriculture Organization (FAO, 2018) over 1,153 breeds of goats exist on our planet, living on every continent produce a variety of products, including milk, meat, and fibre (FAO, 2018). The current global goat population according to the FAO (2023) 1.002 billion (FAOSTAT, 2023), which has doubled in the last forty years and has increased to over 1b in 2018, the goat population has increased with the increase in human population, probably due to resource poor

smallholder farmers finding it suitable for diversifying sources of their income and nutrition (FAO, 2018).

Goats are mainly concentrated in Asia (57.7%) and Africa (35.7%), making up 93.4% of the total number in the world (FAOSTAT, 2023). This is due to the importance of goats to the high number of poor and small holder farmers in Asia and Africa (Mahendra and Dilip, 2021). The same Authors reported that, production of small ruminants, especially sheep and goats, is largely rooted in specific regions, for both historical and religious reasons. This is the case in Muslim countries where pork is not a food option, and in India where beef is not eaten, in both cases due to religion (Mahendra and Dilip, 2021). Nigeria is among of the four leading livestock producers in sub-Sahara Africa with total livestock population approximately 156.31 million, cattle, 156.31 million, sheep, 43.4 million, goats 76 million, Cattle 18.4 million and Poultry 180 million (FAO, 2023). Worldwide, goat meat production is higher than meat production from cattle. Goats are herbivorous animals which belong to a group of animals called ungulate and to family called capridae (Ogunniyi, 2010). Goat is an integral part of a traditional crop livestock production. Similarly, they are different from one another by their size, shape and production types (Mahendra and Dilip, 2021).

In Nigeria, Red Sokoto goats are mainly found in Sokoto and Kano state (DAGRIS, 2008). The coat colour is usually dark red brown; males are darker than females (FDLPCS, 2000). The subtypes or ecotypes of the red Sokoto goat extend outside the main centre of its distribution, the colour varies and various ecotypes types are recognized such as dark Red, Brown, light Brown and Black (Umar, 2013). The Red Sokoto goat produces one of the world's most valuable skin, which provides leather of special quality known as Moroccan leather which is superior to the skin of any other breed of Nigerian goat. The export of skin (tanned or dried) is an important source of income in Northern Nigeria (Kwari, 2001), while the meat and milk obtained from the breed constitute major sources of animal protein for subsistence farmers (Kwari, 2001). They can reproduce one, double or triple kids per kidding.

Blood which is a vital special circulatory tissue is composed of cells suspended in a fluid intercellular substance (plasma) with the major function of maintaining homeostasis. Different biochemical and haematological analyses of blood are used to evaluate the overall physiological status of animals (El-Nasri *et al.*, 2016). Determination of the base line values can aid in evaluation of management practices, nutritional and diagnosis of health conditions of animals (El-Nasri *et al.*, 2016). Furthermore, hematological tests is used for the determination of the various levels of blood parameters are useful in predicting health problems and diseases that can reduce animal performance and lead to economic loses such as reduced milk and wool production and might result in mortalities (Bani *et al.*, 2008).

*Calotropis procera* (Aiton) Dryand is a soft-wooded, perennial shrub of the family Apocynaceae and subfamily Asclepiadaceae (the milkweed family). It is an evergreen xerophytic plant, generally found in arid and semi-arid habitats (Al-Rowaily *et al.*, 2020). The word "Calotropis" is derived from Greek, meaning "beautiful," which refers to its flowers; whereas "procera" is a Latin word referring to the cuticular wax present on its leaves and stem (Hassan *et al.*, 2015). It is known by various common names such as apple of sodom, calotrope, giant milkweed, Indian milkweed, wild cotton, rubber tree, ushar, etc., in different parts of the world. It also shares a close homology with its con-generic plant *C. gigantea* (CABI, 2021). This study was to determine the effects of *C. procera* flower meal on growth performance and haematological parameters of twenty Red Sokoto goats (RSG).

## Materials and Methods

### Study Area

The study was conducted at International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Minjibir/Wase Farm Livestock Unit Research Station. The experiment lasted for six (6) month (2<sup>nd</sup> February 2024 – 3<sup>rd</sup> August, 2024). The experimental site is located on the latitude 12.08.45''N, longitude 8.39.51''E, Alt. 429 m. The farm is located in the Sudan savannah, 40 kilometers northeast of Kano with minimum and maximum temperature of 12-23°C and 29-38°C. The annual rain fall is about 690 millimeters and has a growing raining season of around 120 days, the rain fall starts from June and stops in October. The livestock that are found in the area includes, sheep, goats and cattle breeds (Okagbenin *et al.*, 1999).

### Source and Preparation of *Calotropis Procera* Flower Meal

Fresh *Calotropis procera* flowers were harvested from the bush, around the Wudil local government area. The *Calotropis procera* flowers were air dried under the shade for 3 - 5 days until they became crispy to touch. Sub-sample of the air - dried flower were taken to the laboratory for chemical composition and phytochemical analysis using standard procedure of AOAC (2002).

### Experimental Diets

Five (5) experimental diets were formulated with *C. procera* flowers meal at 0, 5, 10, 15, and 20% at dietary levels designated as Treatments T<sub>1</sub> (control diet), T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub>, respectively as shown in Table 1. The diets were formulated to satisfy the nutrients requirements of goats as recommended by National Research Council (NRC, 2001).

**Table 1: Composition of the experimental diets containing *Calotropis procera* flower meal (CPFM)**

| Ingredients                | Treatments |            |            |            |            |
|----------------------------|------------|------------|------------|------------|------------|
|                            | T1 (0%)    | T2 (5%)    | T3 (10%)   | T4 (15%)   | T5 (20%)   |
| Maize offal                | 26.50      | 23.40      | 22.50      | 21.30      | 20.00      |
| Wheat offal                | 23.00      | 22.50      | 21.00      | 19.00      | 18.00      |
| CSC                        | 17.00      | 17.00      | 17.00      | 17.00      | 16.70      |
| CP flower                  | 0.00       | 5.00       | 10.00      | 15.00      | 20.00      |
| Rice offal                 | 27.20      | 25.80      | 23.20      | 21.40      | 19.00      |
| Molasses                   | 3.00       | 3.00       | 3.00       | 3.00       | 3.00       |
| Bone meal                  | 2.00       | 2.00       | 2.00       | 2.00       | 2.00       |
| Salt                       | 1.00       | 1.00       | 1.00       | 1.00       | 1.00       |
| Premix                     | 0.30       | 0.30       | 0.30       | 0.30       | 0.30       |
| <b>Total</b>               | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> |
| <b>Calculated analysis</b> |            |            |            |            |            |
| <b>Dry matter%</b>         | 88.58      | 88.54      | 88.18      | 87.95      | 87.75      |
| <b>CP%</b>                 | 17.97      | 18.01      | 18.04      | 18.04      | 18.01      |
| <b>CF%</b>                 | 13.84      | 14.67      | 15.34      | 16.17      | 16.77      |
| <b>EE%</b>                 | 4.71       | 4.45       | 4.00       | 4.62       | 5.21       |
| <b>Ash%</b>                | 8.29       | 7.98       | 7.52       | 7.30       | 7.80       |
| <b>NFE%</b>                | 43.80      | 43.43      | 43.28      | 41.88      | 40.06      |
| <b>ME(Kcal/kg)</b>         | 2546.18    | 2500.43    | 2459.48    | 2461.20    | 2444.65    |

CP = crude protein, CF = crude fat, EE ether extract, NFR = nitrogen free extract, ME = metabolizable energy,

## **Experimental Animals and Management**

Twenty (20) female Red Sokoto goats with age range between one to two years old (average body weight 13 kg) were used for the study. Age was determined by eruption pattern as described by Banerjee, (1998). Healthy animal and clinically free of diseases were used for the study. The animals were purchased at Wudil market (Kara). The Does were housed in semi-open pens. The pens were constructed to provide enough shade and ventilation in dry season and protection from rain during the rainy season. The shelter was provided with troughs and drinking water was provided *ad libitum*. Animals were treated against internal and external parasites using Ivotek super® (Ivermectin + Clorsulon) at dose of 200 µg/kg body weight. They were also, vaccinated against (*pnuemo-enteritis complex*, known as *peste-des-petits ruminants* (PPR) at a dosage of 0.5 ml/animal subcutaneously. Experimental animals were quarantined for four weeks before the commencement of the experiment. The experiment was lasted for six months. (GnRH) injection was used for estrus synchronization and two bucks were used for mating.

## **Experimental Design and Procedure**

The experiment was laid in a Completely Randomized Design (CRD). Five treatments were allotted with each having four replications. The five treatments were 0, 5, 10, 15, and 20 % of *C. procera* flower meal.

## **Body weight evaluation and growth performance of Red Sokoto Goat (RSG)**

All the does were weighed at the beginning of the experiment before being allocated to their respective treatments. Records of weight gain at were carried out weekly throughout the experimental period.

## **Performance Parameters**

**Feed Intake (FI):** was determined by subtracting leftover from the feed offered (kg) every morning before feeding.

**Weight Gain (WG):** The weight gain of each animal was determined by subtracting the final weight from initial weight gain (kg) of the animal.

**Average Daily Gain (ADG):** were obtained by dividing total weight gain (g/d) by the number of days of the collection period.

**Feed Conversion ratio:** was calculated by dividing average daily feed intake over average daily weight gain.

## **Blood Collection**

During the first trimester of pregnancy five (5 ml) of the blood sample were collected from all experimental animal via jugular vein, the remaining five (5ml) blood was introduced in to bottles containing anticoagulant, Ethylenediamine tetraacetic acid (EDTA) for haematological assay. The collected blood sample were placed in a Styrofoam box and transported to the laboratory for the determination of haematological parameters.

### Determination of Haematological Indices

The haematological parameters were determined using the Cell-DYN 3500 Hematology Analyzer (Abbott Diagnostic Division, Santa Clara CA). Recommended settings and calibration for haematology were applied according to the manufacturer's operation manual. Blood samples with Ethylenediamine tetraacetic acid (EDTA) anticoagulant were used for the determination of the selected hematological parameters. The following parameters were determined; haemoglobin (g/dL), white blood cell ( $10^3/\mu\text{L}$ ), packed cell volume (%) mean corpuscular volume (g/dL) mean corpuscular haemoglobin (pg/cell) mean corpuscular haemoglobin concentration (g/dL) and lymphocytes (%) by using the method described by Jain, (1986).

### Growth performance of red Sokoto goats fed different level of *C. procera* flower meal

The results of growth performance of Red Sokoto goats fed different level of *C. procera* flower meal is presented in table 2. A significant ( $p < 0.05$ ) differences were observed across all the treatments values recorded in final weight gain. Higher values were obtained in T3 (22.27 kg) followed by T2 (22.22 kg), T4 (21.29 kg), T5 (21.82 kg) and least was occurred in T1 (20.73 kg). A significant ( $p < 0.05$ ) differences were observed across all the treatments values recorded in total weight gain recorded which was higher in T3 (9.34 kg) followed by T2 (9.18 kg). There were significant ( $p < 0.05$ ) differences on average daily gain (ADG). Higher in T3 (66.72 g/d), then T2 (62.98 g/d), T5 (60.00 g/d), T1 (56.98 g/d) and least was recorded in T4 (55.68 g/d). Also, a significant ( $P < 0.05$ ) differences were observed across all the treatments values recorded in total feed intake (g). Higher values in T1 (39.83 kg) followed by T2 (33.56 kg), T5 (27.10 kg), T4 (26.68 kg) and the least was obtained in T3 (20.43 kg). A significant ( $p < 0.05$ ) differences were observed on Average daily feed intake recorded (ADFI) and. Higher values were obtained in T2 (239.52 g), T1 (284.4 g) and lower values were recorded in T5 (193.60 g), T4 (190.57 g) and (T3 (146.10 g). A significant ( $p < 0.05$ ) difference was observed across all the treatments values recorded on feed conversion ratio. Higher values in T1 (5.01), followed by T2 (3.70), T4 (3.50), T5 (3.23) and the least was obtained in T3 (2.19), respectively.

**Table 1: Growth performance of Red Sokoto goats fed different level of *C. procera* flower meal**

| Parameters             | Treatments          |                     |                     |                      |                      | SEM   |
|------------------------|---------------------|---------------------|---------------------|----------------------|----------------------|-------|
|                        | T1 (0%)             | T2 (5%)             | T3 (10%)            | T4 (15%)             | T5 (20%)             |       |
| Initial weight (kg)    | 12.75               | 13.04               | 12.95               | 13.69                | 13.42                | 0.50  |
| Final weight gain (kg) | 20.73 <sup>c</sup>  | 22.22 <sup>a</sup>  | 22.27 <sup>a</sup>  | 21.29 <sup>b</sup>   | 21.82 <sup>b</sup>   | 0.44  |
| Total weight gain (kg) | 7.98 <sup>bc</sup>  | 9.18 <sup>a</sup>   | 9.32 <sup>a</sup>   | 7.62 <sup>c</sup>    | 8.38 <sup>b</sup>    | 0.24  |
| ADG (kg)               | 56.98 <sup>c</sup>  | 62.96 <sup>b</sup>  | 66.71 <sup>a</sup>  | 55.68 <sup>c</sup>   | 60.05 <sup>b</sup>   | 1.76  |
| Total feed intake (kg) | 39.83 <sup>a</sup>  | 33.56 <sup>a</sup>  | 20.46 <sup>b</sup>  | 26.68 <sup>b</sup>   | 27.10 <sup>b</sup>   | 4.07  |
| ADFI (g/d)             | 284.40 <sup>a</sup> | 239.52 <sup>a</sup> | 146.10 <sup>b</sup> | 190.57 <sup>ab</sup> | 193.60 <sup>ab</sup> | 23.28 |
| Feed conversion ratio  | 5.01 <sup>a</sup>   | 3.66 <sup>b</sup>   | 2.19 <sup>c</sup>   | 3.50 <sup>b</sup>    | 3.23 <sup>b</sup>    | 0.02  |

<sup>ab</sup> Means along the same row with different superscripts differ significantly ( $p < 0.05$ ) differences; SEM = Standard error of means; ADG = average daily gain, ADFI = average daily feed intake recorded.

### Haematological parameters of RSG fed CPFM based diets during the first trimester

The results of haematological parameters of RSG fed CPFM based diet during the first trimester is presented in table 3. There were significant ( $p < 0.05$ ) differences across all the treatments values on packed cell volume (PCV). Higher in T<sub>4</sub> (16.40 %), T<sub>2</sub> (16.04 %), T<sub>1</sub> (15.89 %), T<sub>3</sub> (15.51 %) and the least was obtained in T<sub>5</sub> (12.86 %). But, non-significant ( $p > 0.05$ ) difference was observed across all the treatments values recorded on haemoglobin (GB) and red blood cell (RBC) count. A significant ( $p < 0.05$ ) differences were observed across all the treatments values for mean corpuscular hemoglobin (MCH). Higher in T<sub>4</sub> (22.57 pg), T<sub>2</sub> (21.82 pg), T<sub>1</sub> (20.72 pg) T<sub>3</sub> (19.72 pg) and the lowest was obtained in T<sub>5</sub> (19.27 pg). Also, a significant ( $p < 0.05$ ) differences were observed across all the treatments values recorded on mean corpuscular haemoglobin concentration (MCHC) which was higher in T<sub>2</sub> (63.35 g/dL) T<sub>4</sub> (66.58 g/dL), T<sub>3</sub> (65.73 g/dL) the lowest values were obtained in T<sub>1</sub> and T<sub>5</sub>. But, a non-significant ( $p > 0.05$ ) differences were observed across all the treatments values recorded on mean corpuscular volume (MCV) and white blood cell (WBC). A significant ( $p < 0.05$ ) difference was observed across all the treatments values recorded on lymphocytes (LYP %) with higher in T<sub>4</sub> (74.425 %) followed by T<sub>5</sub> (68.05 %), T<sub>3</sub> (63.95 %), T<sub>2</sub> (56.35 %) and T<sub>1</sub> (56.875 %), respectively.

**Table 3: Hematological parameters of RSG fed CPFM based diets during the first trimester**

| Parameters       | Treatments          |                     |                     |                    |                     | SEM  | Reference values * |
|------------------|---------------------|---------------------|---------------------|--------------------|---------------------|------|--------------------|
|                  | T1 (0%)             | T2 (5%)             | T3(10)              | T4 (15%)           | T5(20)              |      |                    |
| PCV (%)          | 17.52 <sup>a</sup>  | 15.95 <sup>a</sup>  | 16.35 <sup>a</sup>  | 14.85 <sup>b</sup> | 16.25 <sup>a</sup>  | 0.87 | 16.0-25.0          |
| Hb(g/dL)         | 9.95                | 9.27                | 9.10                | 8.62               | 8.92                | 0.29 | 8.0-12.0           |
| RBC( $10^6$ /uL) | 4.90                | 4.57                | 4.61                | 4.20               | 4.65                | 0.23 | 8.0-18.0           |
| MCH (pg)         | 20.72 <sup>ab</sup> | 21.82 <sup>a</sup>  | 19.72 <sup>b</sup>  | 22.57 <sup>a</sup> | 19.27 <sup>b</sup>  | 0.91 | 52-80              |
| MCHC(g/dL)       | 58.35 <sup>b</sup>  | 63.35 <sup>a</sup>  | 65.73 <sup>a</sup>  | 66.58 <sup>a</sup> | 58.35 <sup>b</sup>  | 3.52 | 30-36              |
| MCV (fL)         | 35.60               | 34.70               | 35.40               | 34.52              | 35.00               | 0.24 | 22.0-38.0          |
| WBC( $10^3$ /uL) | 15.89 <sup>b</sup>  | 16.04 <sup>ab</sup> | 15.51 <sup>b</sup>  | 16.40 <sup>a</sup> | 12.68 <sup>c</sup>  | 0.93 | 4.0-13.0           |
| LYP (%)          | 56.87 <sup>b</sup>  | 56.35 <sup>b</sup>  | 63.95 <sup>ab</sup> | 74.42 <sup>a</sup> | 68.05 <sup>ab</sup> | 1.93 | 50-70              |

<sup>abc</sup> Means along the same row with different superscripts differ significantly ( $p < 0.05$ ) differences; SEM-standard error of mean; WBC-number of leukocytes, RBC-erythrocytes, HGB-haemoglobin, PCV- pack cell volume, MCV-mean corpuscular volume, MCH-mean corpuscular haemoglobin, MCHC-mean corpuscular haemoglobin concentration, LYP- lymphocytes

\* Njidda *et al.*, (2013).

### Discussion

#### Growth performance of Red Sokoto goats fed different level of *C. procera* flower meal

The Growth performance (Table 2) of red Sokoto goats fed different levels of *C. procera* flower meal base diet shows that, the final body weight gain values recorded in this study were an indication of effective utilization of nutrients available in *C. procera* flower diets that lead to improved weight gain in pregnant Red Sokoto goats. The results revealed that T<sub>2</sub> (22.22 kg) and T<sub>3</sub>(22.27 kg) had the highest final weight gain which were superior to other treatments. This results was lower the finding of Adebal, *et al.*, (2010) were the obtained (27.98 kg as final weight in goats) fed 30% dry leaves. This variation could probably be associated with environmental factors. The results of average daily weight gain (ADWG kg) across all the

treatment values were lower than the finding of Kanazo, *et al.*, (2016) which ranging from (70-81.42g) using *C. procera*. This variation probably could be attributed to the level of inclusion in the experimental diets. The results of average daily feed intake (ADFI) revealed that higher values were recorded across all the treatment values. This results was not in line with the findings of Adebal, *et al.*, (2010) were the obtained 180.53 at 33% and 96.78 at 66% levels of inclusion in the diets. This variation it could be due to level of inclusion and method of drying of the leaves. Maroyi *et al.*, (2012) reported that drying of the flower reduce the toxicity of plant. The feed efficiency reveals lower values recorded across all the treatments. This results was not similar with the findings of Adebal, *et al.*, (2010), were the obtained (20.93g) fed silk hay at 100% level of inclusion to goats.

### **Haematological parameters of RSG fed CPFM based diets during pregnancy**

The hematological parameters of RSG fed CPFM based diets during pregnancy show that, the results of WBC obtained in this study were higher in T<sub>2</sub> and T<sub>3</sub> were similar with the finding ( $7.40 \pm 0.6 \times 10^3/\mu\text{L}$ ) reported by El-Badwi and Bakiet (2001) who fed non- pregnant with latex of *C. procera* at 0.3ml/d. It has been reported by Daramola, *et al.* 2005) that increase in WBC above normal range (4.0-13.0) is the indication of presence of exogenous foreign bodies in the blood. Results of RBC revealed that all the values across treatments were lower than the normal range. This result is lower than the finding of El-Badwi and Bakiet (2001) for non - pregnant goats with ( $6.58 \pm 0.43 \times 10^6 \text{ mm}^3$ ). This lower in the RBC it could be probably related to slight action of antioxidants which are present in the flower of *C. procera* flower. Reduction of RBC Hb and PVC in the indication of anaemia. Heamoglobin concentration across treatment values were within the normal range (8-12g/l) which were similar with the finding of Ashiru (2014) within the range of 8-15 g/dl for red Sokoto goats fed *Piliostiga thormingii*. This indicated that all the experimental animals are in normal health. The results of PCV across all the treatments were within the normal range (16 -25%) except T<sub>4</sub> which fell below the normal range. This results was lower than the values ( $42.05 \pm 1.18\%$ ) reported by El-Badwi and Bakiet (2001) fed pregnant goats with latex of *C. procera* at (0.3ml/d). This could probably be associated with high content of phytochemical in latex of *C. procera* than in dry flower of *C. procera*. The results of MCV and MCH across the treatment were in the normal ranges which were similar with the value ( $22.3 \pm 1.13\%$ ) of Njidda *et al.*, (2013) for goats fed on natural grazing land of Northern Nigeria. The results of MCHC values across all the treatments are higher than values ( $16.82 \pm 0.33 \text{ ml/d}$ ) reported by El-Badwi and Bakiet (2001) fed non-pregnant goats with latex of *C. procera* at (0.3 ml/d). This variation could probably be due to physiological stages in the different of the animals. The results of lymphocytes recorded were within the normal range (50 - 70). This results in line with finding (71. 1 of  $\pm 1.90 \%$ ) report by Njidda *et al.*, (2013). This indicated that the immune system was protected and all the animals were in good health without compromised defense system.

### **Conclusion**

In this study, inclusion levels of *C. procera* flower meal at 5 and 10% in the diets of RSG increase body weights gain and lymphocytes in the first trimester.

## Recommendation

The study recommended that; levels of *C. procera* flower at 5 and 10% in the diets of RSG for increase body weight gain and optimum immune status of pregnant Red Sokoto goat.

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