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# Blood profile of West African dwarf bucks fed *Vigna unguiculata* L. (cowpea) husk and *Gmelina arborea* Roxb as basal diet

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***Target audience:** Animal Scientists, Feed millers, farmers and Processors*

## Abstract

*The health implication of Vigna unguiculata L. husk on 20 West African dwarf (WAD) bucks of weights averaging 9.64 kg was investigated in a completely randomized design. Haemato-biochemical profile of the bucks was evaluated in an 84-day study. Four dietary treatments were formulated and compounded to contain 0%, 25%, 50%, and 75% of cowpea husk and these were designated T1, T2, T3 and T4 respectively. Results showed that the packed cell volume (PCV) which was between 29.80 - 34.80% showed significant differences (P<0.05) among the treatment means. T4 (34.80%) was higher (P<0.05) than T2 (29.80%), but similar to the rest treatments. The red blood cells (RBCs) also showed significant difference (P<0.05) among the treatments with a value range of 9.96 - 12.02 x10$^6$/µl. The RBCs and haemoglobin values of the bucks in T2 (9.96 x106/µl) and (9.94g/dl) respectively were lower (P<0.05) than the rest treatments. White blood cells (WBC) also showed treatment effect (P<0.05), T1 (11.64 g/dl) was significantly higher (P<0.05) than all the other treatments. All the serum biochemical parameters evaluated were similar (P>0.05) among the treatments. The study demonstrates that inclusion of 75% of cowpea husk in the diets of the buck did not compromise the health of the animals.*

***Keywords**: Cowpea husk, West African dwarf bucks, haematology, serum biochemistry*

## Description of Problem

Goats are multi-functional animals that form a very important part of the livelihood of the local livestock farmers in Nigeria (1). Eighty five percent of the rural dwellers engage in goats farming, with a demography that cuts across subsistent farmers and proprietary business men of all age groups and gender (2). Goats are highly tolerant to harsh climates, with some breeds such as, the West African dwarf goats being trypanosome-resistant (3). The West African dwarf goats are suitable to the traditional system on account of their small size and short generation interval (4), and are able to thrive well on available low quality diets due to scarce grazing marginal lands (5). They provide the cheapest source of domestic meat in the tropics because of their fecundity, low feed requirement compared to cattle, and the potentials of ameliorating the challenge of low animal protein intake in developing nations like Nigeria (6, 7). In spite of these numerous potentials of goats, the unavailability of quality feed resources in sufficient quantity to sustain ruminant livestock growth all the year round remains one of the most widespread and important constraint militating against commercial ruminant animal production in most developing nations of the world (8). Supplementation with concentrate feed which seems to be an effective way to ameliorate this problem is being hampered by the steady increase in prices of conventional feed ingredients due to competition from man, other livestock and confectionary industries. Therefore the search for inexpensive, viable and readily available unconventional feed stuffs that is partly or wholly able to replace the scarce and expensive conventional feedstuffs is now a necessity.

Cowpea husk if properly harnessed can

be a useful feed ingredient in goat diets. Cowpea husk is obtained from cowpea crop after the pods are crushed and separated from the seeds. *Vigna unguiculata* L. (cowpea) is widely grown in the humid tropical and subtropical regions for human consumption (1). It is the most popular annual herbaceous legume cultivated in Africa for its edible seeds or for fodder. It may be a climber, erect or prostrate and creeping, depending on the cultivar (9). Cowpea husk is reported to have 88.00% dry matter (DM), 12.97% crude protein (CP), 0.65-7.00% ether extract (EE), 7.14-10.70% ash and 35.93-45.84% nitrogen free extract [NFE] (10, 11). Cowpea husk also contain phyto-nutrients such as, oxalate, phytate, tannin, saponin, alkaloid, flavonoid and phenolics in quantities that may not be deleterious to the health of animals (12, 13).

Feed materials have been shown to influence animal health and investigating the effects feeds consumed by animals have on the blood profile help to evaluate the toxicity or suitability such test feed material on the animals (14, 15). This study was therefore designed to evaluate the effect of diets containing graded levels of cowpea husk on the haemato-biochemical profile of West African Dwarf (WAD) goats.

## Materials and methods

### Experimental site

The study was conducted at the Teaching and Research Farm, Federal University of Agriculture, Makurdi, Benue State, Nigeria. Makurdi is located between latitude 7$^{o}$43'N and longitude 8$^{o}$31'E. (16).

### Collection of test ingredient

The cowpea husk was collected into synthetic bags from farms in Nassarawa Eggon local government area of Nasarawa State, where the cowpeas had already been harvested, threshed and the seeds separate from the husk. The collected husk was stored at room temperature until used.

### Experimental diets

Four experimental diets were formulated and compounded to contain 0%, 25%, 50% and 75% cowpea husk. Other ingredients used were maize offal, fermented sweet orange peel meal, soybean meal, bone ash and common salt. Gmelina (*Gmelina arborea* Roxb) was fed as the basal diet.

### Experimental animals, housing and management

Twenty (20) grower WAD goats, aged between 8 - 10 months with an average weight of 9.64 kg were procured from the University of Agriculture Makurdi, Benue State and its environs, and used for the study. Two weeks to domestication of the animals on the research farm, the pens were disinfected and thoroughly washed with Izal® and allowed to dry. The floor of each compartment was covered with wood shavings to serve as bedding and litter materials. Each compartment was equipped with a feeding trough and a drinker. The animals were vaccinated against peste des petits ruminants (PPR) on arrival and given ivermectin as prophylaxis for parasites. Thereafter, the bucks were weighed and randomly distributed into four (4) treatments groups of five (5) animals each. Every animal was daily served 250 g of the concentrate supplement at 8:00 hour, and at 10.00 hour and 14.00 hour the Gmelina (*Gmelina arborea*) forage was also served. The forage was tied in small bundles and suspended from the top of each compartment within the reach of the animals. This was done to reduce feed wastage and encourage intake by the animals. The forage was given *ad libitum*. Mineral supplement in form of mineral block was provided and the animals allowed access to fresh cold water *ad libitum.*

**Table 1: Composition of experimental diets fed to WAD goats (%)**

| | Experimental diets | | | |
|---|---|---|---|---|
| Feed ingredient | T1 | T2 | T3 | T4 |
| FSPM | 25.00 | 25.00 | 25.00 | 25.00 |
| Maize offal | 48.84 | 36.63 | 24.42 | 12.21 |
| Cowpea husk | 0.00 | 12.21 | 24.42 | 36.63 |
| Soybeans meal | 23.16 | 23.16 | 23.16 | 23.16 |
| Bone ash | 2.00 | 2.00 | 2.00 | 2.00 |
| Salt | 1.00 | 1.00 | 1.00 | 1.00 |
| Total | 100 | 100 | 100 | 100 |

T1 = 0% Cowpea husk, T2 = 25% Cowpea husk, T3 = 50% Cowpea husk, T4 = 75 Cowpea husk, FSOPM = Fermented sweet orange peel meal

**Data collection and analysis**

On the last day of the study before morning feeding, 5ml of blood samples were collected from each buck via the jugular vein into two sets of sample bottles. One set of the sample bottles contained ethylene diamine tetra acetic acid (EDTA) for haematological analysis and plain sample bottles for determination serum biochemical indices. Haematological parameters measured were packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC), white blood cell (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), neutrophils, lymphocytes, monocytes, eosinophils and basophils. Serum biochemical indices measured were total protein, albumin, serum glutamic oxaloacetic transaminase (SGOT), Serum glutamic pyruvic transaminase (SGPT), cholesterol, urea and creatinine,

**Experimental design**

The completely randomized design (CRD) was used for the experiment. The study lasted for 12 weeks.

**Statistical Analysis**

Data obtained from the study was subjected to analysis of variance (ANOVA) using the (16) Statistical software. Means that were significantly different were separated using Fishers least significant difference (LSD) using the same statistical package.

**Results and discussion**

Haematological indices of the experimental goats are presented in Table 2. Replacement of maize offal with cowpea husk caused significant effect ($P<0.05$) on some haematological indices such as the RBCs, PCV, Hb and WBC. The PCV values which were between 29.80 - 34.80% showed significant differences ($P< 0.05$) among the treatments. T2 (29.80%) was lower ($P< 0.05$) than T1, and T4, but similar to T3. PCV values seemed to increase with increasing level of cowpea husk in all the diets containing the cowpea husk. Although PCV values showed treatment effect, values were within normal range of 24 - 48% reported by (18) for healthy goats, and 21 - 35 % reported by (17) for WAD goats. Observed PCV values were slightly lower than 33.75 - 37.50% reported by (19) for red Sokoto goats fed diets containing varying levels of yam peel meal with *Ficus polita* leaves as basal diet and 33.00 – 38.67% reported by (20) for WAD goats fed diets containing fermented and unfermented sweet orange peel meal. However, (21) reported comparable values of 27.25 - 32.75% for red Sokoto goats fed baobab (*Adansonia digitata* L.) fruit meal supplement.

The Hb values also showed treatment

effect (P<0.05), and ranged between 9.94-11.20 g/dl. Hb has the physiological function of transporting oxygen to the tissues of animals for oxidation of ingested feed for the release of energy to enable other body functions (22). Although Hb values showed significant differences (P<0.05) among the treatment means, observed values were within the normal range of 7 - 15g/dl reported by (17) for healthy WAD goats, 8 – 12 g/dl reported by (23) for goats. Hb values in this study were similar with 9.30 - 11.90 g/dl reported by (24) for WAD sheep fed fertilized maize leaf concentrate diets, while lower values of 8.38 - 9.42 g/dl were reported by (19) for Kano brown goats fed diets containing water soaked sweet orange peels. The RBC values ranged between 9.96 - 12.02 $x10^6$/µl and there was treatment effect (P<0.05). T2 (9.96 $x10^6$/µl) was lower (P<0.05) than the rest treatment, but between T1, T2, T3 and T4 there was no difference. There seemed to be a gradual increase in the RBC from T2 - T4 as the level of cowpea husk increased in the diets. Although differences (P<0.05) in mean values existed, observed values were normal and within the reference range of 9.2 - 13.5 x $10^6$/µl reported by (17) for WAD goats. The RBCs serves as a carrier of the haemoglobin and PCV is a function of RBCs. These haematological indices are directly or indirectly involved transport of oxygen, carbon dioxide and nutrients. Thus, low RBCs signify anaemia and reduction in tissue oxygen supply and amount of carbon dioxide returned to the lungs (22). Abnormal production of RBCs results in primary and secondary polycythemia (25). RBCs, Hb and PCV of experimental animals were not abnormally high, which means that the use of cowpea husk in the diets of the experimental goats did not negatively increase or lower the production of RBCs or cause poor of oxygen transport which would result to impaired oxidation of ingested feed and consequently the release of energy for other important body functions in animals.

The WBC values significantly differed (P<0.05) among the treatment means. The values were 11.64, 6.56, 8.36 and 8.16 $x10^3$/µl for T1, T2, T3 and T4 respectively. T1 (11.64 $x10^3$/µl) was higher (P<0.05) than the rest treatments, while T2 - T4 were similar. The WBC and its differentials, functions as body defense against infections and foreign bodies. Observed values of WBC were within the normal reference range of 6.50 - 20.10 ($x10^3$ u/l) reported by (17) for healthy WAD goats, 7.50 - 12.84 $x10^3$/µl reported by (26) for WAD does fed selected crop by-products and 4 - 13 x $10^3$/µl reported by (27) for healthy goats. This means that cowpea husk in the diets did not cause immune-suppression in the animals or compromise their ability to combat microbial infections or respond to the presence of foreign bodies.

The values of the serum biochemical indices of the experimental bucks are presented on Table 3. None of the parameters measured showed treatment effect (P<0.05) among the treatment means.

The total protein (TP) values ranged from 5.58 - 7.78 g/dl and were similar across the treatments, implying that the TP level of the diets were adequate. Observe values of CP were similar to the 5.93 - 8.05g/dl reported by (28) for WAD goats fed diets combining yam peels with cowpea husk, and 5.80 - 7.80g/dl reported by (24) for WAD goats fertilized maize leaf concentrate diets, while (19) reported 5.78 - 6.52 for Kano brown goats fed water soaked orange peel with *Gmelina arborea* leaves as the basal diet. Albumin values ranged from 2.04 - 2.26 g/dl and did not show treatment effect (P>0.05) among the treatments. Albumin is a strong health indicator, and since the treatments containing the test ingredient were similar to the control, it implies that cowpea husk did not exert any adverse effect on the albumin nor its normal function as to cause a deviation in good health.

**Table 2: Haematological indices of WAD bucks fed diets containing cowpea husk**

| | Experimental diet | | | | |
|---|---|---|---|---|---|
| Parameters | T1 | T2 | T3 | T4 | SEM |
| Packed Cell Volume (%) | 33.60$^{a}$ | 29.80$^{b}$ | 32.30$^{ab}$ | 34.80$^{a}$ | 1.05$^{*}$ |
| Haemoglobin (g/dl) | 11.20$^{a}$ | 9.94$^{b}$ | 10.80$^{ab}$ | 11.60$^{a}$ | 0.35$^{*}$ |
| Red Blood Cells (x10$^{12}$/L) | 11.48$^{a}$ | 9.96$^{b}$ | 11.34$^{a}$ | 12.02$^{a}$ | 0.37$^{*}$ |
| Mean Corpuscular Volume (fl) | 29.28 | 30.00 | 28.62 | 28.94 | 0.66$^{ns}$ |
| Mean Corpuscular Haemoglobin (pg) | 9.76 | 10.04 | 9.52 | 9.64 | 0.22$^{ns}$ |
| MCHC (g/dL) | 33.30 | 33.34 | 33.30 | 33.30 | 0.19$^{ns}$ |
| White Blood Cells (x10$^{9}$L) | 11.64$^{a}$ | 6.56$^{b}$ | 8.36$^{b}$ | 8.16$^{b}$ | 1.07$^{*}$ |
| Lymphocytes (%) | 63.60 | 64.40 | 61.80 | 63.20 | 2.35$^{ns}$ |
| Neutrophils (%) | 33.20 | 31.20 | 34.00 | 31.00 | 2.51$^{ns}$ |
| Basophils (%) | 0.00 | 0.20 | 0.00 | 0.00 | 0.10$^{ns}$ |
| Eosinophils (%) | 2.60 | 2.40 | 2.60 | 3.40 | 0.87$^{ns}$ |

MCHC= Mean corpuscular haemoglobin concentration, SEM = Sum of Error Mean, ns = Not significant, * = P<0.05, T1 = 0% Cowpea husk, T2 = 25% Cowpea husk, T3 = 50% Cowpea husk, T4 = 75 Cowpea husk

Cholesterol is vital to cell membranes, nerve fibre and bile salts and it is an important precursor of the sex hormone (29). Cholesterol values in this study were between 98.90 - 100.00mg/dl, and within normal range 64.60-136.40 mg/dl reported by (25) for healthy goats. Observed values were higher than 61.50 - 92.00mg/dl reported by (30) for WAD goats fed diets containing graded levels of sweet orange peel meal and 60.95 - 67.25 mg/dl reported by (21) for red Sokoto goats fed baobab (*Adansonia digitata*) fruit meal supplement, but within 122.60 - 135.68 mg/dl reported by (31) for red Sokoto goats fed high levels of yam peels. Cholesterol levels of ≤180mg/dl are safe in ruminants and may not result to arteriosclerosis (32). Arteriosclerosis, a clinical condition that could trigger cardiac vascular problems is associated with buildup of cholesterol and other substances on arterial walls, this shows that the experimental diets did not trigger increase in the cholesterol level of the bucks, and also that meat from the experimental bucks is safe, and its consumption would not lead to cholesterol elevation.

**Table 3: Serum biochemistry of West African dwarf bucks fed diets containing cowpea husk**

| | Experimental diet | | | | |
|---|---|---|---|---|---|
| Parameters | T1 | T2 | T3 | T4 | SEM |
| Total protein (g/dl) | 5.58 | 7.78 | 5.90 | 5.88 | 1.05$^{ns}$ |
| Albumin (g/dl) | 2.24 | 2.26 | 2.14 | 2.04 | 0.23$^{ns}$ |
| Globulin (g/dl) | 3.34 | 5.52 | 3.76 | 3.84 | 1.08$^{ns}$ |
| Cholesterol (mg/dl) | 119.0 | 99.96 | 98.90 | 100.0 | 11.12$^{ns}$ |
| Urea (mg/dl) | 21.74 | 17.74 | 19.60 | 20.88 | 5.60$^{ns}$ |
| Creatinine (mg/dl) | 1.00 | 1.06 | 1.00 | 0.90 | 0.11$^{ns}$ |
| Biluribin (mg/dl) | 0.12 | 0.11 | 0.50 | 0.09 | 0.19$^{ns}$ |
| (SGOT) (µ/l) | 104.1 | 54.1 | 66.30 | 99.40 | 17.48$^{ns}$ |
| (SGPT) (µ/l) | 33.3 | 29.60 | 25.10 | 24.38 | 11.26$^{ns}$ |

SGOT = Serum glutamic oxaloacetic transaminase, SGPT = Serum glutamic pyruvic transaminase, SEM=Sum of error mean, ns= Not significant.T1 = 0% Cowpea husk, T2 = 25% Cowpea husk, T3 = 50% Cowpea husk,
T4 = 75 Cowpea husk.

The creatinine values of the experimental animals ranged from 0.90 - 1.06 mg/dl. Although there were no differences (P>0.05) among the treatment means, creatinine values seemed to slightly decease from T2 - T4 with increasing level of cowpea husk in the diets. Observed values were within the normal range of 0.90 - 1.80mg/dl reported by (27) for healthy goats, but higher than 0.45 - 0.72mg/dl reported by (33) for WAD goats fed bambara nut meal based diets. The creatinine levels observed in this study indicates that treatment diets had no deleterious effects on the lean tissue mass of the animals as to cause emaciation. Serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) values ranged from 54.10 - 104.10IU/l and 24.38 - 33.30IU/l, SGOT and SGPT are liver enzymes. The similarity (P>0.05) among the treatments implies that, treatments containing cowpea husk were safe and did not alter the levels of these enzymes as to interfere with the normal functioning the liver.

**Conclusions and Applications**

1. The results from this study showed that replacing maize offal with cowpea husk up to 75% level did not cause any negative effect on the haematological and serum biochemistry of the WAD goats.
2. Farmers can incorporate cowpea husk in the diets of WAD goats up to 75% level, particularly during the dry period for economic goat production without any adverse effect.

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