Agricultura 14: No 1-2: 37-44 (2017)
DOI: 10.1515/agricultura-2017-0016

Growth performance, haematology and serum biochemistry of West African dwarf sheep fed cassava peel - oil palm leaf meal based diets in a hot humid tropics

Peter-Damian Chukwunomso JIWUBA[1], Lydia Chidimma JIWUBA[2] and Moses Udoha ONYEKWERE[3]

[1]*Department of Animal Health and Production Technology, Federal College of Agriculture, P.M.B.7008, Ishiagu, Ebonyi State, Nigeria*
[2]*Department of Biotechnology, National Root Crops Research Institute, P.M.B, 7006, Umudike, Abia State.*
[3]*Department of Animal Production Technology, Federal College of Agriculture, P.M.B.7008, Ishiagu, Ebonyi State, Nigeria*

ABSTRACT

The growth performance, haematological and serum biochemical characteristics of thirty-six West African Dwarf (WAD) sheep of about 10 – 12 months of age and averaged 8.53kg in weight were sourced from the College flock. Four dietary treatments designated as T1, T2, T3 and T4 were formulated to contain 0%, 10%, 20% and 30% oil palm leaf meal (OPLM) respectively were randomly assigned to the animals. The experimental animals were divided into four groups of nine animals each, with each group replicated thrice with three animals per replicate. Each group was allotted to one of the diets in a completely randomized design. The animals were weighed at the beginning of the trial and weekly subsequently and data for growth performance were generated. Blood samples were obtained from one animal in each replicate, and data generated were analyzed statistically. Average daily feed intake, total dry matter intake and average daily weight gain were significantly ($P<0.05$) influenced by the dietary treatment, with animals on T4 group having higher and better values. Feed conversion ratio (FCR) also differed significantly ($P<0.05$) with sheep on T3 and T4 (11.82 and 11.49 respectively) having the best FCR. The haematology showed that the packed cell volume (PCV), red blood cell (RBC), and mean cell haemoglobin concentration (MCV) were significantly ($P < 0.05$) improved at 10%, 20% and 30% inclusion levels of OPLM, respectively. Sheep in treatment groups had improved ($P < 0.05$) white blood cell (WBC) count than those on the control group. Serum biochemistry results showed that total protein, albumin and globulin were significantly influenced ($P < 0.05$) and tended to increase with increasing levels of test ingredient. Sheep in treatment groups had higher ($P < 0.05$) urea values than those on control. Creatinine values at 20% and 30% inclusion differed significantly ($P < 0.05$) with the control value. Cholesterol was significantly influenced ($P < 0.05$) and followed an irregular trend across the treatment groups. The results showed that inclusion of OPLM had a beneficial effect on the general performance of the WAD sheep. Therefore, 30% OPLM supplementation was recommended for optimum performance in WAD sheep.

Keywords: Sheep, supplemental diets, proximate composition, oil palm leaf meal, cassava peel, blood parameters

**Correspondence to:*
E-mail: jiwubapc@gmail.com

INTRODUCTION

Sheep is an important source of animal protein and contributes immensely to the diversification of livestock production, thus making it an integral part of the tropical agricultural system. In Nigeria, sheep are found in all agro-ecological zones of the country. They are used for meat, milk, hair (wool), skin and as a financial reverse for the rural and peri-urban population as well as playing sociocultural roles in customs and traditions of many Nigerian societies especially in a region dominated by Muslims. Nigeria is known to have the largest sheep population in Africa (33.9 million), which constitutes about 3.1% of the 1078.2 million sheep in the world (FAOSTAT 2008), and this population may be higher today thus making sheep a major contributor to animal protein. There are four main indigenous breeds of sheep in Nigeria; West African Dwarf (WAD), Balami, Ouda (Uda as the case may be) and Yankasa sheep.

The WAD sheep is a trypanotolerant small ruminant meat breed distributed widely within the rain forest and derived Savanna zones of the humid Tropics (Jiwuba *et al.* 2016a). The ewes are characteristically good mothers with proven records on multiple births, good milking ability and ability to be suckled soon after lambing. They are however less fancied than their caprine counterparts for reasons bothering more on religion and meat quality; but nevertheless, contribute substantially to the annual domestic meat consumption (Jiwuba *et al.* 2016a). The production system for this breed is mostly extensive in the south eastern Nigeria and has been left in the hands of peasant/subsistent farmers and rural families who mostly rear 1-18 of these animals per household. During the dry season, the natural feeds (roughages) available for the animal become highly fibrous and deficient in most essential nutrients required for increased rumen microbial fermentation and improved performance of the animal (Jiwuba *et al.* 2016b); thus the need for a dry season supplementation. The use of cassava peel and oil palm leaf meal could be considered in this respect as a cheap, local and available dry season supplement.

The agricultural wastes of importance in this study are cassava peels and oil palm leaves which are in abundance and hold inestimable values in ruminant feeding. Cassava is the major staple food in Nigeria, thereby enhancing the availability of the peels which are grossly underutilized and are hitherto discarded as agricultural waste (Jiwuba and Ezenwaka 2016). Oil palm leaves are obtained from pruning old midrib or harvesting palm fruit, while some people intentionally harvest fresh frond for direct feeding for their small ruminants. Cassava peel has been implicated with low protein content; hence the need to fortify it with higher protein resource. Oil palm leaf meal has a relatively high crude protein content of 16.24% (Ukanwoko *et al.* 2013) needed to maintain the ruminal environment. The leaves have also been reported to have antioxidant and so many other health benefits (Yin *et al.* 2013; Mohamed 2014). Recent efforts to optimize feed utilization of agricultural waste have been focused on different processing methods. Therefore, the processing of the cassava leaves and the oil palm leaves into meal in this study is centered toward enhancing their utilization. The study was therefore designed, to determine the growth performance, haematology and serum biochemistry of West African Dwarf sheep fed cassava peel-oil palm leaf meal supplement.

MATERIALS AND METHODS

Location of the experiment: The experiment was carried out at the sheep and goat unit, Federal College of Agriculture, Ishiagu, Ivo L.G.A., Ebonyi state, Nigeria. The College is located at about three kilometers (3km) away from Ishiagu main town. The College is situated at latitude 5.56^{0}N and longitude 7.31^{0}E, with an average rainfall of 1653 mm and a prevailing temperature condition of 28.50^{0}C and relative humidity of about 80%.

Sources and processing of experimental material: The cassava peels used in this study were sourced from the garri (a popular creamy-white West African food with a slightly fermented flavour and a slightly sour taste made from fermented, gelatinized fresh cassava tubers) processing unit, Federal College of Agriculture, Ishiagu, Ebonyi State. The peels were subsequently sundried dried (to ensure proper removal of HCN which abound in cassava and its by-products) to about 10% moisture before milling and used in the formulation of the experimental diets. Fresh green oil palm (*Elaeis guineensis*) leaves were also harvested within the College from the oil palm plantation unit. The oil palm leaves were shade-dried in batches, milled and also used at different levels in the formulation of the experimental diets.

Experimental diets: Experimental diets designated as T1, T2, T3 and T4 were formulated from cassava peel, brewers dried grain, wheat offal, oil palm leaf meal, bone meal, molasses and common salt. Diet T1 served as a positive control and contained 0% of oil palm leaf meal. Diets T2, T3 and T4 contain 10%, 20% and 30% levels of oil palm leaf meal (OPLM) respectively as illustrated in Table 1.

Management of experimental animals: Thirty-six WAD sheep of about 10 – 12 months of age and averaged 8.53kg in weight were sourced from the College flock. The experimental animals were divided into four groups of nine animals each, with each group replicated thrice with three animals per replicate. Each group was allotted to one of the diets in a completely randomized design. Care was taken to balance the weight of these animals among the groups. Each animal received the designated treatment diet in the morning for 87 days. Each animal was housed in a compartment measuring 10 × 15 m in an open-sided sheep house, and feed offered was based on 3.5% body weight per day; the animals in addition, were fed 2kg wilted *Panicum maximum* later in the day. Regular access to fresh drinking water was made available. Feed offered and refused were recorded on a daily basis. Initial weights of the animals were taken at the beginning of the trial and weekly subsequently. The experimental animals were acclimatized for 21 days before the commencement of the study in accordance with the permission and stipulated guidelines of the Federal College of Agriculture, Ishiagu (FCAI) Animal Ethics Committee. During the acclimatization period, the animals were dewormed and sprayed against external parasites. They were dewormed using kepromec (Ivermectin) subcutaneously and given

Table 1: composition of the experimental diets

Ingredients (%)	T1	T2	T3	T4
Cassava peel meal	55.00	55.00	55.00	55.00
Wheat offal	10.00	10.00	10.00	10.00
Brewers dried grain	30.00	20.00	10.00	0.00
Oil palm leaf meal	0.00	10.00	20.00	30.00
Molasses	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00
Common salt	1.00	1.00	1.00	1.00
Total	**100.00**	**100.00**	**100.00**	**100.00**

acaricide bath using Roys' Amitraz 20 at the rate of 1ml in 2 litre water prior to the experiment.

Blood profile studies: Blood samples (10 ml) were drawn from the animals on the last day (87) of the study. The sheep were bled through the jugular vein. The samples were separated into two lots and used for biochemical and haematological determinations as described by Dacie and Lewis (1991). An initial 5ml was collected from each sample in a labelled sterile universal bottle containing 1.0 mg/ml ethylene diamine tetraacetic acid (EDTA) and used for haematological analysis. Another 5ml was collected over the anti-coagulant free bottle. The blood was allowed to clot at room temperature and serum separated by centrifuging within three hours of collection. Serum biochemistry and haematological parameters were measured using Beckman Coulter Ac-T10 Laboratory Haematology Blood Analyzer and Bayer DCA 2000+ HbA1c analyzer, respectively. Mean cells haemoglobin (MCH), MCV and mean cell haemoglobin concentrations (MCHC) were calculated.

Chemical Analysis: Proximate analysis of different experimental diets and that of the test ingredients were carried out at the College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Animal Nutrition Laboratory, according to the methods of AOAC (2000).

Statistical Analysis: The data obtained were analyzed using the Statistical Package for Social Sciences Window 17.0. One - way analysis of variance (ANOVA) was employed to determine the means and standard error. Differences between treatment means were separated by Duncan New Multiple Range Test as outlined by Obi (1990).

RESULTS

The proximate composition of the experimental diets, cassava peel meal (CPM) and OPLM are presented in Table 2. The performance of WAD sheep fed the cassava peel-oil palm leaf meal based diets is shown in Table 3. Total weight gain, average daily weight gain, (ADWG), total feed intake, average daily feed intake (ADFI), total dry matter intake (TDMI) and feed conversion were significantly different ($P<0.05$) while final body weight gain was similar ($P>0.05$) across the treatment groups. The haematological characteristics of WAD sheep fed cassava peel-oil palm leaf meal based diets are presented in Table 4. Packed cell volume (PCV), red blood cell (RBC), mean cell haemoglobin concentration (MCHC) and white blood cell (WBC) were significant ($P<0.05$) while haemoglobin (Hb), mean cell haemoglobin (MCH) and mean cell volume (MCV) were similar ($P>0.05$) across the treatments. The serum biochemical characteristics of WAD sheep fed cassava peel-oil palm leaf meal based diets are presented in Table 5. All the serum biochemical indices evaluated are significantly ($p<0.05$) influenced by the dietary treatment.

DISCUSSION

The dry matter (DM), crude protein (CP), crude fibre (CF), ash, ether extract (EE) and nitrogen free extract (NFE) for the experimental diets did not follow a particular trend, but all comparable with the control diet. This may be attributed to the similarities of Brewers dried grain (BDG) and oil palm leaf meal in terms of CF, and CP. The dry matter values of the experimental diets are in agreement with the reported values by Ekeocha and Fakolade (2012). The CPM values however are comparable with the values reported by Ifut (1988) and Ukanwoko (2007) for same agricultural by product. The proximate constituents of the OPLM are in agreement with the values obtained by Wong and Zahari (1992) and Esonu *et al.* (2008). However, the differences in the proximate composition values could be attributed to the stage of development when the leaves were harvested, location, season, soil type and soil fertility, the level of dryness of the leaves and processing method used; a view collaborated by Jiwuba *et al.* (2016c).

There is an improvement in the body weight gain across the treatment groups, with T2 having the lowest body weight gain and T4 having the highest body weight gain. The lower body weight gain of T2 animals compared to other treatments maybe attributed to the lower initial body weight of the T2 animals. The highest body weight observed in T4 animals may-be attributed to the higher feed and dry matter intake observed in this treatment group. Hence dry matter intake is an important factor in the utilization of feed by ruminants (Jiwuba *et al.* 2016b). In earlier reports (Rout *et al.* 2009; Chong *et al.* 2012) palm oil leaves have been reported to be high in many biologically active compounds like flavonoids, which can be of great significance to increase palatability which further can increase intake. This in agreement with the earlier report by Schlolant (1983) who opined that the quantity of feed consumed is largely dependent on the palatability of the diet. The higher and better total feed intake and ADFI observed in T4 may be attributed to

Table 2: Proximate composition of the experimental diets, cassava peel meal and oil palm leaf meal.

Compositions	T1	T2	T3	T4	CPM	OPLM
Dry matter	90.25	90.45	90.21	91.73	93.20	89.11
Crude protein	10.48	11.55	13.03	13.79	5.10	17.23
Crude fibre	26.09	24.83	23.08	24.12	16.11	18.37
Ash	9.35	8.70	15.05	10.32	22.56	9.01
Ether extract	0.45	0.86	0.64	1.22	3.94	3.91
Nitrogen free extract	43.88	44.51	38.41	42.28	45.49	40.59

OPLM=Oil palm leaf meal; CPM= Cassava peel meal

Table 3: Growth performance of WAD sheep fed cassava peel-oil palm leaf meal based diets.

Parameters	T1	T2	T3	T4	SEM
Initial body weight (kg)	8.53	7.50	9.67	8.41	0.62
Final body weight (kg)	12.77	11.00	14.33	13.63	0.64
Total weight gain (kg)	4.24^{ab}	3.50^{b}	4.66^{ab}	5.22^{a}	0.19
Average daily weight gain (g/d)	48.74^{c}	40.23^{d}	53.56^{b}	60.00^{a}	3.23
Total feed intake (kg)	53.70^{b}	50.00^{c}	55.07^{b}	58.74^{a}	3.62
Average daily feed intake (g/d)	617.24^{ab}	574.71^{b}	632.99^{ab}	675.17^{a}	11.28
Total dry matter intake	48.46^{b}	44.23^{c}	49.70^{b}	53.87^{a}	3.11
Feed conversion ratio	12.66^{ab}	14.29^{a}	11.82^{b}	11.49^{b}	0.81

$^{a-c}$ Means within the same row with different superscripts are significantly different (P < 0.05)

Table 4: Haematological indices of WAD sheep fed cassava peel-oil palm leaf meal based diets.

Parameters	T1	T2	T3	T4	SEM
Packed cell volume (%)	29.71^{b}	32.25^{a}	33.30^{a}	31.29^{a}	0.19
Haemoglobin (g/dl)	9.35	10.40	10.60	10.21	0.15
Red blood cell (x10^{12}/L)	12.08^{b}	12.53^{a}	12.60^{a}	12.99^{a}	0.06
Mean cell haemoglobin conc. (%)	36.50^{a}	34.25^{b}	33.68^{b}	36.27^{a}	0.23
Mean cell haemoglobin (pg)	10.35	9.50	10.26	10.44	0.21
Mean cell volume (fl)	34.80	32.70	32.85	33.81	0.20
White blood cell (x 10^{9}/L)	15.0^{c}	16.82^{b}	16.55^{a}	16.76^{a}	0.16

$^{a-b}$ Means within the same row with different superscripts are significantly different (P < 0.05)

Table 5: Serum chemistry indices of WAD sheep fed cassava peel-oil palm leaf meal based diets.

Parameters	T1	T2	T3	T4	SEM
Total protein (g/dl)	6.79^{b}	6.58^{b}	7.56^{a}	7.83^{a}	0.17
Albumin (g/dl)	2.91^{c}	3.21^{b}	4.11^{a}	4.04^{a}	0.09
Globulin (g/dl)	3.72^{b}	4.42^{a}	4.70^{a}	4.99^{a}	0.11
Urea (mg/dl)	12.68^{c}	14.37^{b}	16.32^{a}	17.02^{a}	0.31
Creatinine (mg/dl)	1.61^{b}	1.75^{b}	1.89^{a}	1.87^{a}	0.03
Cholesterol (mg/dl)	54.97^{c}	60.87^{a}	59.13^{b}	56.37^{bc}	0.21

$^{a-c}$ Means within the same row with different superscripts are significantly different (P < 0.05)

improved palatability of the diet. Palatability which is the degree of acceptability of a diet is a function of the diet and post-ingestive feedback. However, the lowest total feed intake and ADFI observed in T2 may be attributed to lower dry matter composition of the diet. Even though there was no statistical (p>0.05) difference between the T3 and T4, the latter had the least FCR indicating a better feed conversion ratio (FCR). The superior feed efficiency of diets T3 and T4 over the other diets is a reflection of the observed higher feed utilization and indeed higher growth rates of the sheep fed the respective diets. Factors which influence FCR among other include breed and sex of animals as well as nutrition and environment.

Jiwuba *et al.* (2016d) reported that PCV is generally used as an index of toxicity and its value is been influenced by breeds, age and sex of the animal. The PCV obtained in the present study (29.71 to 33.30%) is however compared with 28.00 - 34% and 27.3 - 32.3% for West African Dwarf sheep fed graded levels of *Gmelina arborea* leaves and cassava peel concentrates and West African Dwarf sheep fed Panicum-cassava peels supplemented with or without *Leucaena*-based multinutrient blocks reported by Aye and Tawose (2016) and Aye (2013). The values obtained in this study also fell within the normal physiological range of 24 – 45% and 27-45% reported for apparently healthy sheep by RAR (2009) and Kramar (2000) respectively and 27.75 – 36.67% for WAD ram reported by Oyeyemi and Ajani (2014). This thus indicated stability in the physiological status and possible absence of toxic factors affecting blood homeostasis in the experiments animals. The significant improvement in PCV values for the animals on the test diets is also in agreement with the findings of Ukanwoko *et al.* (2013) who fed oil palm leaf meal – cassava peel based diets to WAD goats. The haemoglobin values though (P>0.05) similar across the groups are within the normal physiological of 8-16g/dl and 9-15g/dl as reported by RAR (2009) and Kramar (2000) respectively for sheep and 9.13 – 12.27g/dl for WAD ram as reported by Oyeyemi and Ajani (2014). Increase in the Hb values is generally linked with the greater ability to the resistance of disease and the low level is an indication of disease infection and poor nutrition. The animals on the treatment diets (T2, T3 and T4) recorded higher values in RBC than the sheep on the control diets. The RBC values obtained in this study are within the normal range of 10.82–16.11($X10^{12}$/L) reported by Oyeyemi and Ajani (2014) for WAD rams and 9-15 ($X10^6$µl or $X10^6mm^3$) reported by Jain (1993) and Kramar (2000) for sheep. The normal physiological range of RBC reported in this study for the WAD rams is an indication of the absence of anemia, normal oxygen circulation to the tissues and carbon dioxide to the lungs. Mean corpuscular haemoglobin concentration (MCHC) is normally a further measurement that can assist in the diagnosis of abnormalities affecting red cell counts. MCHC is very important in the diagnosis of anaemia and also serve as a useful index of the capacity of the bone marrow to produce red blood cells (Etim *et al.* 2013). The within normal physiological range of 33-38% reported by Oyeyemi and Ajani (2014) for WAD ram and 31-38g/dl reported by RAR (2009) for apparently healthy sheep gave a clear indication of the absence of anaemia among the experimental groups. The white blood cell function to fight infections, defend the body through phagocytosis against invasion by foreign organisms and to produce or transport antibodies in immune response. The decrease in WBC is an indication of fall in the production of defensive mechanism to combat infection (Ehebaet et al. 2008). The normal physiological values of WBC obtained in this study may suggest well developed immune system of the experimental animals or absence of foreign bodies or parasites in the circulatory system of experimental animals. This perhaps highlights the ethno-veterinary properties of oil palm leaves (*Elaeis guineensis*) as reported by Yin et al. (2013) and Mohamed (2014). Also, the significant variations in the WBC counts of sheep on treatment diets could be attributed in part to improved digestibility and utilization of nutrients in the diets (Jiwuba et al. 2017).

The total protein did not follow a regular pattern but however fell within the range of 6.0–7.9 g/dl reported for apparently healthy sheep (Fielder 2016). The higher total protein observed in T3 and T4 may-be attributed to the higher dietary protein of the respective diets as evidenced in the proximate composition. This is in agreement with the findings of Jiwuba et al. (2016e) who observed a positive relationship between serum protein and dietary protein. This further demonstrates better utilization of the dietary proteins by experimental animals especially those in T3 and T4, thereby aiding total protein availability. The range of values 2.91-4.11g/dl reported in this study is above the normal physiological of 2.40-3.30g/dl reported by Kaneko (1989) for apparently healthy sheep. Albumin functions chiefly in the regulation of colloidal osmotic pressure of the blood, assist in the movement of fatty acids, hormones, bilirubin, cations and drugs in the blood. However, the high albumin level (above normal range) observed in T3 and T4 may-be attributed to the higher dietary protein of the respective treatments. The range of 3.72-4.99g/dl for serum globulin reported in this present study fell within the normal of 3.50-5.70 g/dl according to Fielder (2016). This is an indication of proper functioning of the liver and high immunity response of the experimental animals. Hence, Rastogi (2008) reported that globulins function to carry lipid fraction of proteins and in the transportation of antibodies for generating an immune response. The serum urea in this study nevertheless, fell within the normal range of 8-20g/dl reported by Fielder (2016). The normal range of values reported in this study indicated therefore that the dietary protein was well utilized since urea is used as an index of renal function. The creatinine was highest (1.89mg/dl/) in T3 and lowest (1.61mg/dl) T1 and nevertheless fell within the normal range of 1.2 - 1.9 mg/dl for apparently healthy sheep as reported by Kaneko (1989) and Fielder (2016); thus suggesting that there was no wasting or catabolism of muscle and that the animals did not survive at the expense of body reserve. Hence, Prvulovic et al. (2012) noted that creatinine level is directly correlated with muscle mass and kidney function in animals. Cholesterol is the precursor of cholesterol ester, bile acids and steroid hormones. Cholesterol is implicated in vascular disease and is of diagnostic importance in hypothyroidism. The serum cholesterol in this study nevertheless, fell within the normal range of 52-76mg/dl reported by Fielder (2016). Serum Cholesterol has been associated with the quality and quantity of fat in the diet (Esonu *et al.* 2001). High serum cholesterol has for long been implicated in the etiology of arteriosclerosis and other heart diseases (Mc Donald *et al.* 1995; Ramos *et al.* 2003).

CONCLUSION

The results of the study revealed that varying levels of oil palm leaf meal in a cassava peel meal based diet for West Africa Dwarf (WAD) sheep is safe and enhanced feed and dry matter intake, body weight gain, blood homeostasis and health status of the animals. Oil palm leaf meal can, therefore, be included up to 30% without adverse effect on the performance of West Africa Dwarf (WAD) sheep.

Acknowledgments

The authors are grateful to the Department of Animal Health and Production Technology, Federal College of Agriculture Ishiagu, Ebonyi State, Nigeria for the technical support.

REFERENCES

1. AOAC. Association of Official Analytical Chemists: *Official Methods of Analysis*. 6th Edition. Washington DC, USA. 2000.
2. Aye PA, Tawose OM. Physiological responses of West African Dwarf sheep fed graded levels of *Gmelina arborea* leaves and cassava peel concentrates under different management systems. Agric. Biol. J. N. Am. 2016;7(4):185-195.
3. Aye PA. Growth performance, physiological and haematological parameters of West African Dwarf sheep fed Panicum-cassava peels supplemented with or without *Leucaena*-based multinutrient blocks. Am. J. Food. Nutr. 2013;3(3): 135-146.
4. Chong KP, Atong M, Rossall S. The roles of syringic, caffeic and 4- hydroxybenzoic acids in *Ganoderma* - oil palm interaction. Asian J. Microbiology, Biotechnol and Environmental Sci. 2012;14(2):157-166.
5. Dacie JV, Lewis M. Practical haematology. 8th edition. Longman group ltd. London. 1991;88-96.
6. Eheba ETE, Omoikhojie SO, Bangbose AM, Druna MB, Isidhahomen CE. Haematology and serum biochemistry of weaner rabbits fed cooked Bambara groundnutmeal as replacement for soybean meal. Proc. 33rd Annual Conf. Nig. Soc. Anim. Prod., Ayetoro, Ogun. 2008;192-196.
7. Ekeocha AH, Fakolade PO. Nitrogen balance of pregnant West African Dwarf (WAD) ewe fed Mexican sunflower leaf meal (MSLM) based diets. *J Anim Prod Adv.* 2012; 2(9):398-404.
8. Esonu BO, Emelalom OO, Udedibie ABI, Herbert U, Ekpor CFE, Okoli IC, Iheukwumere, FC. Performance and blood chemistry of weaner pigs fed raw mucuna bean (velvet been) meal. Trop. Anim. Prod. Investig. 2008;4:49-54.
9. Esonu BO, Udedibie ABI, Emenalom OO, Madumere, CC and Uchegbu, OA. Evaluation of oil palm (Elaeis guineensis) leaf meal as feed ingredient in broiler diets. Nig. J. Anim. Prod. 2008;35(1):32–39.
10. Etim NN, Enyenihi GE, Williams ME, Udo MD, Offiong EEA. Haematological Parameters: Indicators of the Physiological Status of Farm Animals. Brit. J. Sci. 2013;10(1):33-45.
11. FAOSTAT
12. Fielder SE. Serum Biochemical Reference Ranges. Merck & Co., Inc., Kenilworth, NJ, USA. 2016.
13. Ifut OJ. The potential of cassava peels for feeding goats in Nigeria. In: cassava as livestock feed in Africa. 1988; 72- 81.
14. Jain NC. Veterinary haematology.4th edition.Baillere, Tindall. 1993;297.
15. Jiwuba PC, Ahamefule FO, Ikwunze K, Assam EM. Prolificacy and pre-weaning mortality of West African dwarf sheep raised intensively in a hot humid environment. Archives of Current Research International. 2016a;5(1):1-7.
16. Jiwuba PC, Ahamefule FO, Ogbuewu IP, Ikwunze K. Blood chemistry and haematology of West African Dwarf goats fed *Moringa oleifera* leaf meal (MOLM) in their diets. Comparative Clinical Pathology.2017;26 (3);621-624.
17. Jiwuba PC, Ahamefule FO, Okechukwu SO, Ikwunze K. Feed intake, body weight changes and haematology of West African dwarf goats fed dietary levels of *Moringa oleifera* leaf meal. Agricultura, 2016C;13(1-2):71-77.
18. Jiwuba PC, Ezenwaka LC, Ikwunze K, Nsidinanya NO. Blood profile of West African Dwarf goats fed provitamin A cassava peel-centrosema leaf meal based diets. Analele Stiintifice ale Universitatii,, Alexandru Ioan Cuz", Sectiunea Genetica si Biologie Moleculara TOM XVII, Fascicula. 2016d;3:27-134.
19. Jiwuba PC, Ezenwaka LC. Growth performance and apparent nutrient digestibility of West African dwarf goats fed B-carotene cassava peel-centrosema leaf meal based diets. Case Studies Journal. 2016; 5(8): 204-210.
20. Jiwuba PC, Ikwunze Ume SI, Nsidinanya NO. Performance, apparent nutrient digestibility and cost benefit of West African Dwarf Goats fed dietary levels of *Moringa oleifera* leaf meal. Journal of Advances in Biology and Biotechnology. 2016b; 8(3): 1-9.
21. Jiwuba PC, Ugwu DO, Kadurumba OE, Dauda E. Haematological and Serum Biochemical Indices of weaner rabbits fed Varying Levels of Dried Gmelina Arborea Leaf Meal. International Blood Research and Reviews. 2016e;6(2):1-8.
22. Kaneko JJ. Clinical biochemistry of domestic animals, 4th ed. New York, Academic Press. 1989.
23. Kramar JW. Normal haematology of cattle, sheep and goats. In: Feldman, B. F., Zinkl, J. G., Jain, N. C. (editors). Schalm's Veterinary Haematology. 5th edition.Lippincott Williams and Wilkins. U.S.A, Philadelphia. 2000;1075-1084.
24. Mc-Donald P, Edwards RA, Greenhalgh JFD, Morgan, CA. Animal Nutrition. 5th edition. Longman publishers, Edinburgh, U.K. 1995. 607.
25. Mohamed S. Oil Palm Leaf: A new functional food ingredient for health and disease prevention. J Food Process Technol 2014;5(2);1-6.
26. Obi IU. Statistical methods of detecting differences between treatment means and ed., Snapp press, Enugu, Nigeria. 1990.
27. Oyeyemi MO, Ajani OS. Haematological parameters and serum testosterone of West African Dwarf rams treated with aqueous extract of Cnidosacontifolius (Chaya). Journ Med. Plant Research. 2014;8(14):571–575.
28. Prvulovic D, Kosarcic S, Popovic M, Dimitrigevic D, Grubor-Lajsic G. The influence of hydrated aluminosilicate on biochemical and haematological blood parameters, growth performance and carcass traits of pigs. J Anim Vet Adv. 2012; 11(1):134–140.

29. Ramos KS, Melchert RB, Chacon E, Ascata-Jr D. Toxic responses in: Klassen, C.D. and Watkins, J.B. (editors), Cassaret and Doull's Essentials of Toxicology, McGraw Hill Medical publishing Division, New York. 2003;266–287.
30. Research Animal Resource (RAR). Reference values for laboratory animals. Normal haematological values RAR websites.RAR.University of Minnesota. 2009.
31. Rout SP, Choudary KA, Kar DM, Das L, Jain A. Plants in traditional medicinal system - future source of new drugs. Int. J. Pharm. Pharmaceutical Sci. 2009;1:1-23.
32. Scholant W. A compendium of rabbit production appropriate for conditions in developing countries. Schriftenreihe der GTZ. 1985;169:85.
33. Ukanwoko AI, Ironkwe MO, Nmecha C. Growth performance and hematological characteristics of West African dwarf goats fed oil palm leaf meal – cassava peel based diets. J Anim Pro Sd Adv. 2013;3:1-5.
34. Ukanwoko AI. Evaluation of cassava peel – cassava leaf meal based diets for meat and milk production by West African Dwarf goats in South Eastern Nigeria. Ph.D Thesis. Michael Okpara University of Agriculture, Umudike. Nigeria. 2007.
35. Wong HK, Zahari MW. Characterization of oil palm by – products as feed for ruminants. In proc. 15th MSAP conference on Vision 2020 towards more efficient and effective animal production strategies. Malaysian Society of Animal Production, Malaysia. 1992;58–61.
36. Yin NS, Abdullah S, Phin CK. Phytochemical constituents from leaves of *Elaeis guineensis* and theirantioxidant and antimicrobial activities. Int J Pharm Pharm Sci. 2013; *5(*4):137-140.

Vpliv krmljenja pritlikave zahodnoafriške pasme ovac vzrejenih v vlažnih tropskih razmerah z zmesjo ostankov lupljenja gomoljev kasave in listov oljne palme na rastnost in krvno sliko

IZVLEČEK

Rastnost, hematološke in biokemijske serumske lastnosti so bile proučevane pri 36. ovcah pritlikave zahodno afriške pasme, pri starosti 10 do 12 mesecev in poprečni telesni masi 8,53 kg. Živali so izvirale iz črede v lasti visoke šole. Štirje različni obroki so bili pokladani živalim T1, T2, T3 in T4, ki so vsebovali 0%, 10%, 20% in 30% zmesjo ostankov lupljenja gomoljev kasave in listov oljne palme (OPLM) v obroku ovac.

Proučevane živali so bile ločene v štiri skupine, vsaka je imela po devet živali, in znotraj te so bile deljene v tri ponovitve, v vsaki so bile po tri živali. Vsaka skupina živali je dobila specifičen obrok po naključnem oblikovanju poskusa. Živali so bile individualno tehtane tedensko. Vzorci krvi so bili odvzeti eni živali iz proučevane skupine. Poprečna konzumacija krme, celokupna konzumacija suhe snovi in velikost dnevnega prirasta so bili pod značilnim vplivom obroka. Ovce skupine T4 so se značilno boljše v proučevanih lastnostih in so se značilno ($P < 0,05$) razlikovale od ostalih skupin. Statistično značilno najboljšo konverzijo krme so imele ovce skupine T3 in T4 ($P < 0,05$). Vsebnost rdečih krvnih celic ločenih od plazme (PCV), rdeče krvne celice in koncentracija hemoglobina (MCV) je bila značilno ($P < 0,05$) izboljšana v obrokih z 10%, 20% in 30% OPLM. Prav tako so imele proučevane skupine v krvi značilno večjo vsebnost levkocitov ($P < 0,05$) kot kontrola. Vsebnost skupnih proteinov, albumina in globulina je bila značilno ($P < 0,05$) pod vplivom naraščajočih vrednosti dodatka OPLM v krmi ovac. Ovse krmljene z dodatkom OPLM so imeli značilno ($P < 0,05$) večjo vsebnost uree v primerjavi s kontrolno skupino. Prav tako je pri vključitvi 20% in 30% OPLM v obroku ovac imelo značilen ($P < 0,05$) vliv na vsebnost kreatina v primerjavi s kontrolo. Vsebnosti holesterola so bile pod značilnim ($P < 0,05$) vplivom OPLM, vendar se ni pokazal določen vzorec na osnovi katerega bi lahko naredili zaključke. Rezultati poskusa so pokazali, da ima OPLM dobrodejen na večino rastnih lastnosti pritlikave pasme zahodnoafriških ovac. Priporočljiva je uporaba 30% dodatka OPLM v obroku ovac za doseganje optimalnih rastnih lastnosti.

Ključne besede: ovca, krmni dodatki, kasavini olupki, palmini listi, krvni parametri