

Evaluation of Energy Utilization and Haematological Indices of West African Dwarf Goats Fed Varying Levels of Yam Peels and Cowpea Husk.

*Okoruwa, M.I. and Edokpayi, I.M.

Department of Animal Science, Ambrose Alli University, P.M.B. 14, Ekpoma, Nigeria.

*Corresponding Author

Name: M.I. Okoruwa

Email: odionokos@yahoo.com, okosmich@gmail.com

Abstract: Twenty four West African dwarf goats balanced for weight (7.00 ± 0.25 kg) were fed varying levels of yam peels and cowpea husk to evaluate their energy utilization and haematological indices. Goats were allotted to three dietary treatments in a completely randomized design with eight goats per treatment. The dietary treatments were as follows: Diet A (65.00% yam peels + 10.00% cowpea husk + 25.00% concentrate supplement), Diet B (60.00% yam peels + 15.00% cowpea husk + 25.00% concentrate supplement) and Diet C (55.00% yam peels + 20.00% cowpea + 25.00% concentrate supplement). The results showed that Diet A was significantly ($P < 0.05$) highest in gross energy intake (13.04MJ/kg), faecal energy intake (4.80MJ/kg), white blood cell ($16.58 \times 10^6/\mu\text{l}$) and neutrophil (35.67%) than the other dietary treatments. The digestible energy (11.01MJ/kg), metabolizable energy (10.57MJ/kg), metabolizable energy as percentage of gross energy (1.16 MJ/Kg), packed cell volume (29.32%), haemoglobin (11.05g/L), red blood cell ($10.92 \times 10^6/\mu\text{l}$) mean corpuscular haemoglobin (8.62pg), mean corpuscular haemoglobin concentration (32.86g/dl), mean corpuscular volume (27.99fl), lymphocytes (60.92%) and monocytes (2.99%) were highest ($P < 0.05$) in diet C compared to diets A and B. It is concluded that diet C (55.00% yam peels + 20.00% cowpea husk + 25.00% concentrate supplement) has the potential to enhance energy utilization and haematological indices of West African dwarf goats.

Keywords: Yam peels, cowpea husk, energy utilization, haematological indices, goats

INTRODUCTION

Goats are one of the most important domesticated small ruminants with a population of 29.2 million in Nigeria [1]. Goats production in Nigeria comprises largely of traditional rearing system characterised by poor healthcare and inadequate feeding [2]. Nutrition is one of the most important factors that determine the development and expansion of livestock sector in the tropics. The inability of ruminant livestock farmers to feed their animals with high quality forages all year round remain the most widespread technical constraints facing ruminant animal productivity in the developing nation [3]. This shortage of good quality feeds needed to sustain ruminant livestock growth, especially during the dry season has been a major challenge to the small ruminant sub-sector in the Nigeria agricultural economy [4]. Thus contemporary ruminant feeding development in developing countries like Nigeria is partly geared towards searching for inexpensive readily available feed resources which can partially or wholly substitute the scarce expensive feedstuffs and inadequate forages [5].

Yam (*Dioscorea* spp) and cowpea (*Vigna unguiculata*) are widely grown crops in the humid tropical and subtropical regions which are consumed in

various regions of the world. However, yam peels and cowpea husk are obtained from these crops after their main products of interest have been removed. The use of yam peels and cowpea husk as livestock feeds have been reported by several researchers [6,4] as a way of increasing livestock productivity and reducing the stiff competition existing between man and livestock for conventional feeds. Though literatures are available on the potential and utilization of yam peels and cowpea husk by ruminant animals [4, 7], information is still not sufficient on the combination of yam peels and cowpea husk in goat nutrition.

Thus, the present study was therefore designed to investigate the energy utilization and haematological indices of West African dwarf goats fed mixture of yam peels and cowpea husk.

MATERIALS AND METHODS

Study Site:

The study was conducted at the Teaching and Research Farm (Sheep and Goat Unit) of the Ambrose Alli University, Ekpoma, Nigeria. The average ambient temperature of the area is 30°C while the mean annual rainfall is 1556mm. The vegetation represents an

interface between the tropical rainforest and the derived savannah.

Experimental Diets:

Guinea grass that was obtained from the fallow land within the Teaching and Research Farm was allowed to wilt before being chopped manually to about 6 to 7cm. Yam peels and cowpea husk were collected from their processing centre within Ekpoma, sundried, crushed and kept separately in airtight bags till the periods of usage.

Guinea grass was fed as basal diet for all the bucks while combination of yam peels and cowpea husk at various inclusion levels with formulated concentrate were used as the experimental diets. The composition of the concentrate supplement was 12.0% wheat offal, 9.00% brewer's dry grain, 1.75% bone meal, 1.25% salt and 1.00% vitamin. However, the three experimental diets that were formulated and designated were:

Diet A = 65.00% yam peels + 10.00% cowpea husk + 25.00% concentrate supplement.

Diet B = 60.00% yam peels + 15.00% cowpea husk + 25.00% concentrate supplement

Diet C = 55.00% yam peels + 20.00% cowpea husk + 25.00% concentrate supplement.

Management of Experimental Animals:

Twenty four growing West African dwarf male goats with an average body weight of 7.00 ± 0.25 kg and aged between 7 and 8 months old were used for the experiment. The goats were sourced from weekly sheep and goats market located at Ekpoma. Prior to the commencement of the experiment, goats were treated against ecto and endo parasites using ivomec. Microbial infections were also controlled by using antibiotics. Goats were housed in demarcated individual pens with concrete floor and dwarf wall.

Completely randomized design was adopted for the experiment in which the goats were divided into three groups of eight goats each after balancing for weight and each group was randomly allotted to one of the three dietary treatments. The basal and experimental diets were fed to bucks once daily in equal ratio of 50:50 respectively, at the rate of 5% (DM basis) of their body weight. The weighed experimental diets were offered every morning (8.00am) followed by the guinea grass on exhaustion of the diets. Goats were having free access to water throughout the experimental study. Moreover, the experiment lasted for 84 days comprising 14-days period of metabolic study.

EXPERIMENTAL STUDIES

Energy Utilization Study:

At the end of the 10th week, energy study was carried out on the experimental goats. Six goats per treatment (totalling 18) were selected and randomly allocated to individual metabolic cages designed for separate collection of faeces and urine. The study was

carried out in the last 7-day feeding regime after 7-day adjustment period. Fresh feeds of known weights were then given to the goats. The left-over were collected the following day and weighed. Faecal samples were also collected daily and sundried. The process of collection lasted for 7 days at the end of which replicate samples were bulked together. The collected faecal samples were later oven dried at 80°C for 24 hours before they were stored separately in air-tight containers until required for analysis.

Gross energy of feeds and faeces were determined using an adiabatic bomb calorimeter. Dietary gross energy (GE) intake minus the gross energy of faeces gave digestible energy (DE). Metabolizable energy (ME) intake was calculated as 96% of DE [8].

Haematological Study:

Blood samples were collected from each goat by the jugular venipuncture at the last day of the feeding trial before terminating the experiment. The animals were bled in the morning prior to feeding and average of 5ml was collected from each goat. The blood samples were transferred immediately into sterile samples bottles containing ethylene diamine-tetra-acetic acid (EDTA) which was used for the haematological analysis.

However, haematological analysis of packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), the mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), total white blood cell (WBC) and the differential counts were carried out according to the methods reported [9-10].

Chemical and Statistical Analyses

The proximate composition of the experimental diets and guinea grass were determined according to the procedures of AOAC [11].

Data obtained on energy utilization and haematological parameters were analysed using the general liner model (GLM) procedure for repeated measurement analysis of variance (ANOVA) using the software program of statistical analysis system [12]. Duncan Multiple Range Test (DMRT) was used to separate the means at ($P < 0.05$) to determine the difference between means.

RESULT AND DISCUSSION

Table I shows the proximate composition of the experimental diets and guinea grass used in this study. Experimental diets dry matter ranged from 89.97 to 96.05%, suggesting the ability to retain more nutrient in the diets. Crude protein of diet A (12.98%), diet B (14.69%) and diet C (15.32%) were considerably differed in values with diet C being the highest and diet A the lowest. However, the values of crude protein obtained in this study satisfied the Gatemby [13]

recommendation of 10 to 12% crude protein requirement for growth performance of sheep and goats. Crude fibre and ether extract that ranged from 26.54 to 38.69% and 2.93 to 3.76% respectively in the diets increased with increasing levels of cowpea husk inclusion in the experimental diets. Ash and nitrogen free extract that ranged from 4.03 to 5.09% and 38.20 to

52.46% respectively, were varied in values and increased with increasing levels of yam peels inclusion in the diets.

Moreover, the proximate composition of guinea grass obtained in this study was similar to the reference values reported by Okoruwa *et al.*[14].

Table 1. Proximate composition (%DM basis) of the experimental diets and guinea grass.

Parameters	Diets			Guinea grass
	A	B	C	
Dry matter	89.97	94.25	96.05	68.52
Crude protein	12.98	14.69	15.32	7.04
Crude fibre	26.54	32.89	38.69	30.89
Ether extract	2.93	3.38	3.76	3.88
Ash	5.09	4.77	4.03	8.56
Nitrogen free extract	52.46	44.27	38.20	49.63

Table 2: Energy utilization (MJ/kg) of West African dwarf goats fed experimental diets.

Parameters	Treatment			SEM±
	A	B	C	
Gross energy (GE) intake	13.0 ^a	12.17 ^b	12.06 ^b	0.63
Faecal energy (FE) output	4.80 ^a	2.16 ^b	1.05 ^c	0.08
Digestible energy (DE) intake	8.24 ^c	10.01 ^b	11.01 ^a	0.17
Metabolizable energy (ME) intake	7.91 ^c	9.61 ^b	10.57 ^a	0.25
ME as % of GE	0.65 ^b	0.96 ^b	1.16 ^a	0.03

^{a, b, c} means within the same row with different superscripts differ significantly (P<0.05). SEM = Standard error of mean.

Table 2 shows the energy utilization (MJ/Kg) of West African dwarf goats fed experimental diets. Energy utilization by small ruminants has been reported by Johnson *et al.* (2003) to play a vital role in determining the nutrient retained and performance of animals. Significant difference (P<0.05) was observed in gross energy intake with goats on diet A (13.4MJ/kg) being the highest follow by those on diet B (12.17MJ/kg) with those on diet C (12.06MJ/kg) being the lowest. The gradual decrease in trend of gross energy intake by goats as the inclusion levels of yam peels decreased with increase in cowpea husk in the diets could be associated with the level of energy content in yam peels. Okoruwa *et al.* [14] reported that energy content of a feed is the function of gross energy intake of the feed by animal. Faecal energy (FE) output values of 4.08, 2.16 and 1.05MJ/kg were obtained for diets A, B and C respectively. Faecal energy output of animals on diet A was significantly highest, followed by diet B before diet C. The progressive significant (P<0.05) decrease in trend of faecal energy output across diets in response to increase in inclusion level of yam peels could probably be due to imbalanced levels of nutrient utilization caused by inhibitory effects of

residual toxic substances of yam peels. This is in agreement with the earlier report of Ahamefule *et al.* [15] that although tuber peels have very low anti-nutritional factors when processed, its presence could influence high faecal output in animals. The estimated digestible energy (DE) and metabolizable energy (ME) intake values were significantly (P<0.05) highest in diet C (11.01 and 10.57MJ/kg) and lowest in diet A (8.24 and 7.91MJ/kg). The highest DE and ME intake values observed in diet C compared to other diets could be explained by low energy loss through faecal output that attributed to proper and balance energy utilization by the goats. This finding is in agreement with the report of Bawala and Akinsoyinu [3] that low faecal energy output of animals has a direct effect on digestible and metabolizable energy intakes of goats.

ME as percentage of GE among treatment effects was not significant (P>0.05) between diets A (0.65MJ/kg) and B (0.96MJ/kg) but diet C (1.16MJ/kg) was significantly (P<0.05) higher than diet A and B. Johnson *et al.* [16] reported that digestible and metabolizable energy intakes of animal is a function of a percentage of GE of that same animals.

Table 3: Haematological parameters of West African dwarf goats fed varying levels of yam peels and cowpea husk.

Parameters	Diets			SEM \pm
	I	II	III	
PCV (%)	23.96 ^c	25.62 ^b	29.32 ^a	1.01
Hb (g/l)	7.56 ^c	9.20 ^b	11.05 ^a	0.67
RBC ($\times 10^6/\mu\text{l}$)	8.24 ^c	10.01 ^a	10.92 ^a	0.29
MCH (Pg)	6.98 ^b	7.98 ^b	8.62 ^a	0.70
MCHC (g/dl)	29.99 ^b	30.01 ^b	32.86 ^a	1.17
MCV (fl)	26.01 ^b	26.08 ^b	27.99 ^a	0.01
WBC ($\times 10^6/\mu\text{l}$)	16.58 ^a	11.06 ^b	10.02 ^c	1.20
Neutrophil (%)	35.67 ^a	30.99 ^b	28.98 ^c	0.02
Lymphocytes (%)	56.21 ^c	58.75 ^b	60.92 ^a	0.40
Monocytes (%)	1.99 ^b	2.86 ^a	2.99 ^a	0.20

^{a, b, c} means within the same row with different superscripts differ significantly ($P < 0.05$). SEM = Standard error of mean.

Table 3, indicates the haematological parameters of goats fed varying levels of yam peels and cowpea husk. Past reports revealed that haematological constituents are always a reflection of animals responsiveness to their initial and external environment [17], hence this constituents are important in diagnosing the functional status of an exposed animal to suspected toxicant. However, haematological parameters observed in this study were all significantly ($P < 0.05$) influenced across the dietary treatments. Packed cell volume (PCV) and haemoglobin (Hb) concentration were significantly ($P < 0.05$) highest in diet C (29.32% and 11.05g/l) and lowest in diet A (23.96% and 7.56g/l). This observed differences implied that the quality of diet C test ingredients were properly utilized by the goats for the compensatory accelerated production of PCV and formation of Hb concentration. Red blood cell (RBC) among treatment effects was not significantly ($P > 0.05$) difference between diet B (10.01 $\times 10^6/\mu\text{l}$) and C (10.92 $\times 10^6/\mu\text{l}$) but diet A (8.24 $\times 10^6/\mu\text{l}$) was significantly ($P < 0.05$) lower than diets A and B. The highest RBC recorded in diet C corresponded with the highest values of PCV and Hb concentration observed in diet C, suggesting their superiority in terms of their capability of supporting high oxygen carrying capacity of the blood and absence of anaemia related diseases which might be due to iron deficiency. The PCV, Hb and RBC values recorded in this study aligned with the values reported by Okoruwa *et al.* [10] for West African dwarf bucks fed *Pennisetum purpureum* and unripe plantain peels.

The mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were significantly ($P < 0.05$) highest in diet C (8.62pg and 32.86g/dl) and lowest in diets A (6.98pg and 29.99g/dl) and B (7.98pg and 30.01g/dl). The mean corpuscular volume (MCV) of 26.01, 26.08 and 27.99fl that were obtained for diets A, B and C respectively followed the same trend as observed in MCH and MCHC. The reduction in MCH, MCHC and MCV

values at highest substitution rate of yam peels and low inclusion level of cowpea husk in diet A confirmed the low PCV, Hb and RBC on diet A, which further attested to the possible susceptibility to diseases or physiological stress on the health status of the studied goats. Previous haematological studies of nutritional efforts brought knowledge that haematological parameters are major and reliable indicators of various sources of stress in animals [18].

White blood cell (WBC) was significantly ($P < 0.05$) highest in diet A (16.58 $\times 10^6/\mu\text{l}$) and lowest in diet C (10.02 $\times 10^6/\mu\text{l}$). This implies that goats on diet C remained healthy, because increase in number of WBC counts above the normal range as observed in diet A was an indication of goats fighting against the presence of foreign body in circulating system. Konlan *et al.* [2] reported that WBC offer explanation for defence mechanism of animal. The significant ($P < 0.05$) highest values for neutrophil that was observed in diet A (35.67%) compared to diet B (30.99%) and C (28.98%) further explained the destruction of inflammatory diseases that would have affected the goats. The higher values for lymphocytes and monocytes obtained in diet C (60.92 and 2.99%) compared to diets B (58.75 and 2.86%) and A (56.21 and 1.99%) suggested that their immune system that were not impaired, hence they did not react to any reaction [19].

CONCLUSION

This study supports the notion that agro-industrial by-products are excellent sources of basal diets to livestock in the off season. Hence, the use of yam peels and cowpea husk in this study have demonstrated their potential as sources of readily available energy and protein that would go a long way in improving goats performance and infilling feed shortage gaps during the dry season without any adverse effect on goats productivity. These improvements on energy utilization and haematological indices by West African dwarf goats proved to be more

pronounced, effective and efficient in diet C compared to diets A and B.

REFERENCES

1. Tsado DN, Aremu A, Egena SSA, Ismah O; Assessment of bodyweight of savanna brown goat, castrates, non-castrates and females using linear measurement. 34 Annu. Conf. of Nig. Soc for Anim. Prod. 2009; 500–503.
2. Konlan SP, Karikari PK, Ansah T; Productive and blood indices of dwarf rams fed a mixture of rice straw and groundnut haulms calorie or supplemented with concentrates containing different levels of shea nut cake. *Pakistan Journal of Nutrition*, 2012; 11(6): 566–571.
3. Bawala TO, Akinsoyinu AO; Nutritional evaluation of browsers, Glyricidal sepium and *Ficus thoningii* foliage in goat diet: Energy utilization and requirement. Proc. 37th Ann. Conf. Anim. Sci. Asso. of Nig. (ASAN). Univ. of Agric. Abeokuta, Nigeria. 2002; 174–176.
4. Ososanya TO, Alabi BO, Sorunke AO; Performance and digestibility of cornvob and cowpea husk diets by West African dwarf sheep. *Pakistan J. Nutri*, 2013;12(1): 85–88.
5. Okoruwa MI, Adewumi MK; Effect of replacing *Panicum maximum* with dried pineapple pulp on nutrient digestibility and nitrogen balance of West African dwarf sheep. *Nig. J. Anim. Sci.*, 2010; 32: 108–115.
6. Siyanbola MF, Amao EA; Effect of replacement of yam (*Dioscorea* spp) peel meal for maize (*Zea mays*) on growth performance, carcass characteristics and blood chemistry of finisher broilers. *J. Agric. and Bio. Sci.*, 2011; 2(1): 018–021.
7. Akinmutimi AH, Odoelam VO, Obasiekong SF; Effect of replacing maize with ripe plantain and yam peels in the diet of weaner rabbits. *J. Anim. Vet. Adv.*, 2008; 5: 737–740.
8. National Research Council (NRC); Nutrient Requirement of swine .10th revised edition, National Academy press, Washington, DC, USA. 1998.
9. Byanet O, Adamu S, Salami SO, Obadiah HI; Haematological and plasma biochemical parameters of the young grasscutter (*Thyromomys swinderianus*) reared in northern Nigeria. *Journal of Cell and Animal Biology*, 2008; 2(10): 177–181.
10. Okoruwa MI, Adewumi MK, Igene FU; Thermophysiological response of West African dwarf (WAD) bucks fed *Pennisetum purpureum* and unripe plantain peels. *Nig. J. Anim. Sci.*, 2013; 15: 168–178.
11. AOAC; Official Method of Analysis. 16th ed. Association of Official Analytical. Washington DC, USA. 2002.
12. SAS; Statistical Analysis System User's guide. Statistics version. 8th edition. Cary, NC: SAS Institute. 2003.
13. Gatemby RM; Sheep. Revised edition. Tropical agricultural series. Macmillan Publishers Ltd. 2002; 8–9.
14. Okoruwa MI, Igene FU, Isika MA; Replacement value of cassava peels with rice husk for guinea grass in the diet of West African dwarf (WAD) sheep. Canadian Centre of Science and Educational, *Journal of Agricultural Science*. 2012; 4(7): 254–261.
15. Ahamefule FO, Ibeawuchi JA, Iemere JC; Digestibility and nitrogen balance studies in West African dwarf sheep fed fortified cassava peels meal-poultry waste diets. *J. Appl. Chem. Res.* 2001; 7: 69–74.
16. Johnson DE, Ferrell CH, Jenkins TG; The history of energetic efficiency research: Where have we been and where are we going. *J. Anim. Sci.* 2003; 55: 1190–1199.
17. Isikwenu JO, Udeh I, Ifie I; Haematological response, performance and economic analysis of cockerel chicks fed enzyme supplemented brewer's dried grains groundnut cake-based diets. *Pakistan Journal of Nutrition.*, 2012; 11(6): 541–546.
18. Waziri MA, Ribadu AY, Sivachelvan N; Changes in the serum proteins, haematological and some serum biochemical profiles in the gestation period in the Sahel Goats. *Vet. Arhiv*, 2010; 80(2): 215–224.
19. AACC (American Association for Clinical Chemistry). 2011. White blood cell differential count. Lab tests. Online. <http://labtestsonline.org/understanding/analytes/differential/tab/test>.