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RESEARCH ARTICLE

Nutrients Utilization and Haematological Indices of Sokoto Red Goats Fed Maize Cob Replacing Maize Bran with Cowpea Husk Basal Diet

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Abstract

Experiment was conducted to determine the effects of feeding maize bran, maize cob and cowpea husk on feed utilization and hematological indices of Red Sokoto goats. Twenty four (24) bucks with average age and weight of 12 months and 12.00 Kg respectively were randomly subjected to six (6) dietary treatments each having four replicates. The diets consisted of maize cob replacing maize bran at 0, 10, 20, 30, 40, and 50% levels designated as T_1, T_2, T_3, T_4, T_5 and T_6 respectively in a Randomized Complete Block Design (RCBD. Cowpea husk was given to all animals *ad libitum* as basal diet. Adaptation period of 14 days was followed by 84 days of data collection. Animals were confined in metallic metabolism cages for metabolic trial for 14 days. Feeds and faecal samples were analyzed for their proximate composition using standard procedures. Urines were collected to determine their nitrogen contents. Parameters determined were dry matter intakes, weight gains, digestibility, feed efficiencies, protein/nitrogen intakes and retention. Haematological indices considered were packed cell volume (PCV), red blood cell counts (RBC), white blood cell counts (WBC), total protein (TP), Albumin, Globulin and blood glucose/urea. Dry matter intake (DMI) and Faecal output (FO) were significantly ($P<0.05$) affected with treatments T_1 and T_6 having the highest and least DMI of 408.86 g and 313.57 g respectively. Faecal output had T_1 (134.64 g) highest and T_4 (110 g), the least. No significant difference occurred across treatments for protein intakes, faecal protein/nitrogen, nitrogen retention and retention as percentage of intakes. For hematological indices, values for PCV, RBC, WBC, Blood urea, blood protein and glucose fell within the normal ranges for healthy goats. In conclusion, the diets up to 50% maize cob inclusion were found to supply the needed nutrients which enabled the animals utilize feeds effectively, increased weights and maintain the normal healthy blood profiles.

Keywords: Feeds; Utilization; Haematological Indices; Red Sokoto Goats

Introduction

In most parts of the world, protein is specially the major nutrient deficient in people's diets. It is reported that an average Nigerian consumes about 5.5 g of animal protein per day which is by far lower than the recommended 77 g per day [1]. The low level of animal protein intake in Nigeria is due to the low level of productivity of our livestock and high cost of animal protein.

In Nigeria, goats contributed about 24% of meat supply [2]. Therefore, the development of a virile goat industry will lead to increased level of animal protein intakes of our people. This will require the development of highly productive animals through genetic improvement, proper health care and nutrition.

In producing maize flour for human consumption, maize bran, a by-product of the industry is available for animal feed. Maize bran is high in cell wall content, Neutral Detergent Fibre (NDF) (60%), primarily hemi-cellulose (90% of NDF). Such feed with high cell wall content but poorly lignified will have increased surface area for microbial activity in the rumen and thus increased digestibility when ground [3]. It is reported that maize bran has crude protein (CP) content of 10.18%, 12.73%, with Crude fibre (CF) of 27.10%, Neutral Detergent fibre (NDF) of 45.1% and energy content of 6.32 Kcal/g GE and 250 Kcal/kg ME coupled with its 88% feeding value of maize, it can be used in feeding ruminants as an energy source [4-7].

Maize cob is generally used as fire wood in small scale farms but wasted on large scale farms [8]. It is readily available since the cobs are shelled at home stead or granaries which therefore, do not require transportation. It has medium density and easy to store.

Urior and Kategile also reported that the output is good when ground and can be easily mixed with other feed ingredients [8]. The nutrients contents of maize cob have been reported (3% CP, 85% cell wall, 93.96% NDF, 38.01% cellulose and 17 Kcal/g GE [9-11]. Cowpea husk is a legume by-product, a portion of the whole pod which on threshing, remains as wastes when the seeds are removed. The reported nutrients contents of Cowpea husk include dry matter (DM) of 92.29%, 90.83% with crude protein (CP) of 12.69% and 12.25% [4,12]. Also the NDF is 71.44%, 58.91% and 4.5 Kcal/g GE [4,11,13]. It is highly accepted by goats but has a depressing effect on feed intake [4].

Efficiency of feed utilization is a function of feed composition, level of feed intake and production needs [14]. Rate of gain and feed efficiency are equally important characteristics in goat performance. The higher the energy contents of feed, the more favorable the feed efficiency [15].

It is reported that an inverse relationship exists between nutrient consumption and digestibility [16]. There is poor degree of utilization of nutrients with reduced ratio of concentrates in the diet [17]. That nitrogen excreted in urine depends on urea recycling and efficiency of utilization of ammonia produced in the rumen by microbes for microbial protein synthesis. Therefore, the percentage nitrogen digestibility and retention decrease with increase in the level of roughage and decrease in the level of crude protein in the diet.

Ojebiyi, *et al.* also reported that a readily available and fast means of assessing clinical and nutritional status of animals on feeding trials is the use of blood analysis [18]. That ingestion of dietary components has measurable effects on the blood composition. This may be considered an appropriate measure of long term nutritional status of the animals. Therefore, haematological values of farm animals are greatly affected by nutritional status.

Blood analysis is important because it contains a myriad of metabolites and other constituents which provide a valuable medium for clinical investigation and nutritional status of human beings and animals [19]. Blood is used in nutritional evaluation and health survey of animals. According to Yusuf, *et al.,* the blood profile of animals often reflects their nutritional adequacy or otherwise [20]. Therefore, dietary components have measurable effects on blood constituents such that significant changes in their values can be used to draw inferences on the nutritive values of feeds offered to the animals.

Information on the nutrients utilization and its effects on blood indices on red Sokoto goats fed replacement levels of maize cobs for maize bran with cowpea husk basal diet are scanty. The study was therefore carried out to determine the nutrient composition of the feed ingredients, their effects on nutrient availability and utilization and haematological indices of Red Sokoto goats receiving the various feeds.

Materials and Methods

Experimental site

The experiment was conducted at the Teaching and Research Farm of the Faculty of Agriculture, Adamawa State University, Mubi, Nigeria. Mubi is situated in the northern part of Adamawa State on Latitude 90° 11^{I} north of the equator and Longitude 13° 45^{I} east of the Greenwich Meridian at an altitude of 696 m above sea level. It has a land area of 4,728.77 m^2 and population of 245,460, Mubi region falls within the Sudan Savanna vegetation zone of the country [21].

Experimental animals and their management

Twenty four Red Sokoto bucks of average age of 12 months and mean live weight of 12 kg were sourced from the local markets in and around Mubi. Their ages were determined through their dental formulae. They were then housed individually in pens measuring 1.5m^2 and 1.5m high. The floor of the house was of concrete and covered with wood shavings to absorb moisture from the animals' dung and urine. Towards the end of the experimental periods, metallic metabolism cages were used to individually house the animals for digestibility trials.

The animals were quarantined for two weeks during which they were fed the experimental diets for adaptation and dewormed with Albendazol. At the end of the adaptation period, the animals were tagged, randomly allocated to treatments and balanced on weight basis for all the treatments. They were weighed to get the initial weights before embarking on data collection.

Experimental Diets

There were six treatments with each treatment replicated four times, making a total of twenty four experimental animals. The experimental diets (T) consisted of:

T_1: 90% Maize bran +10% Cotton seed cake, T_2: 80% Maize bran +10% corn cobs +10% cotton seed cake, T_3: 70% Maize bran +20% corn cobs +10% cotton seed cake, T_4: 60% Maize bran +30% corn cobs +10% cotton seed cake, T_5: 50% Maize bran +40% corn cobs +10% cotton seed cake, T_6: 40% Maize bran +50% corn cobs +10% cotton seed cake. The above formed the concentrate diets for the experiment. The corn cobs which were included at graded levels of 0, 10, 20, 30, 40 and 50% in the six diets replaced Maize bran weight for weight. These formed the supplement portions and were fed to the animals at 150g/head/day. The cowpea husk formed the basal diet and was fed *ad libitum*. The experimental diets were as presented in Table 1. Randomized Complete Block Design (RCBD) was employed in the study (Table 2).

Feed				
Nutrients	**MBR**	**CB**	**CSC**	**CPHK**
Dry matter (DM) (%)	88.72	87.65	95.32	90.81
Crude protein (CP) (%)	10.22	4.88	40.20	12.25
Crude fiber (CF) (%)	27.10	41.82	26.20	30.79
Ash (ASH) (%)	3.69	7.90	3.92	7.84
N_2 Free extract (NFE) (%)	51.76	39.80	20.88	42.96
Ether extract EE (%)	7.23	5.60	7.80	6.13
Met. Energy ME (Kcal/g)	6.32	7.22	5.82	4.50

MBR=Maize bran, CB=Corn cob, CSC=Cotton seed cake, CPHK=Cow pea husk

Table 1: Analyzed chemical composition of feed ingredients

TREATMENTS						
Feed	**T_1(10% MC)**	**T_2(10% MC)**	**T_3(20%MC)**	**T_4(30%MC)**	**T_5(40%MC)**	T^6(50%MC)
MCB (%)	0	10	20	30	40	50
MBR (%)	90	80	70	60	50	40
CSC (%)	10	10	10	10	10	10
CPHK	*ad lib*	*ad lib*	*ad lib*	*ad lib*	*ad lib*	*ad lib*
Analyzed Nutrients composition						
Nutrients						
M.E.(Kcal/g)	5.208	5.244	5.280	5.316	5.352	5.388
CP (%)	12.84	12.41	12.20	11.99	11.78	11.58
CF (%)	29.28	29.87	30.46	31.04	31.60	32.25
ASH (%)	6.23	6.39	6.56	6.57	6.90	7.07
EE (%)	6.59	6.51	6.46	6.39	6.33	6.28
NFE (%)	45.06	44.82	44.32	44.01	43.39	42.82

MR=Maize bran, CB-Corn cobs, CSC=Cotton seed cake, CPHK=Cowpea husk, ME=Metabolizeable energy, CP=Crude protein, CF=Crude fiber, EE=Ether extract, NFE=Nitrogen free extract

Table 2: Composition of Experimental Diets

Parameters Measured

Parameters determined were proximate compositions of feed ingredients, daily dry matter intakes, and daily weight changes, digestibility of treatment diets, feed efficiencies, nutrients utilization and hematological indices. Proximate compositions were determined using the methods described by AOAC (2005) [22]. Metabolizeable were determined using bomb calorimeter.

In determining the feed and nutrients utilization, the diets under investigation were given to the animals in known amounts. Each of the animals was restrained in steel metabolism cages designed to collect urine and feces separately. Urine was collected in 10 N H_2SO_4 and the volume for each animal was measured and sampled daily for a period of fourteen days. Fecal outputs were also collected and weighed daily. The proximate compositions of faeces were determined using the methods described by AOAC (2005) [22].

Protein and Nitrogen levels in feed, faeces and urine were determined by standard Kjeldahl procedure [22]. Two samples were collected from each treatment.

Hematological parameters were determined by drawing 10mls of blood from jugular veins of each animal into a sample bottle containing anticoagulant, Ethylene Diamine Tetra acetic Acid (EDTA). These samples were used for the determination of the packed cell volume (PCV), Haemoglobin (Hb) concentration, Red blood cell counts (RBC) and White blood cell counts (WBC). The Total serum protein, Serum albumin, globulin and blood glucose were determined in the blood serum. The serum was obtained by allowing the blood to coagulate in order to separate the serum and cells.

Packed cell volume was measured for each animal using the micro haematocrit method. Haemoglobin concentration was also measured using the Sahl's (acid haematin) method [23]. Red blood cells were determined with the aid of Neubaur counting chamber (Haemocytometer). Blood smears were used for total white blood cell (WBC) counts determination. Serum samples were also taken and used in the determination of serum urea, total cholesterol, total protein and albumin as described by Fasuyi, *et al.* [24].

All data obtained were subjected to analysis of variance (ANOVA) using the SAS (2001) package [25]. Means were separated using the Duncan's multiple range test Duncan, 1955.

Results and Discussion

The proximate composition of feed ingredients is presented in Table 1.

The effects of treatment diets on nutrients utilization are presented in Table 3. Dry matter intake (DMI) significantly (P<0.05) decreased with increase in maize cob inclusion in the diets. This followed the same trend with fecal output. There was no significant difference (P>0.05) in urinary output and feed digestibility between treatments. In terms of protein intake, fecal protein and nitrogen intake, there was no significant difference (P>0.05) between treatments T_2-T_4. However, there were significant difference (P<0.05) between them and treatments T_1 and T_6. As for nitrogen retention and nitrogen retained as percentage of intake, only treatment T_6 (50% maize cobs) differed significantly (P<0.05) with the rest of the treatments. The performance of the animals confirms the findings of Gibson that goats have high digestive efficiency for cellulose [26]. They are inquisitive feeders with high efficiency in energy and protein conversion. The ability of goats to eat feedstuffs that are not normally eaten by or accessible to other ruminants enhances their overall competitive efficiency.

TREATMENTS								
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**SEM**	**Sig Level**
DMI (g)	407.86^a	366.07^b	349.29^b	363.21^b	352.50^b	313.57^c	10.748	*
FOPT(g)	134.64^a	121.43^b	120.00^b	110.00^c	120.00^b	114.29^c	6.5638	*
U. Vol(mls)	302.86^b	323.57^a	290.00^c	306.07^b	303.21^b	308.57^b	8.9407	*
Dig. (%)	66.75^a	64.89^a	67.54^a	68.71^a	64.11^a	67.32^a	1.705	*
U. N_2 (g)	0.94^b	1.05^a	0.97^b	1.06^a	1.08^a	1.11^a	0.0294	*
PI (g)	35.00^a	30.39^b	28.91^b	30.37^b	28.31^b	23.71^c	23.71	*
FP (g)	6.87^a	5.57^b	5.22^b	5.18^b	5.95^{ab}	6.19^{ab}	0.3131	*
N_2-Int (g)	5.60^a	4.86^b	4.61^b	4.86^b	4.53^b	3.79^c	0.1902	*
F.N_2 (g)	1.09^a	0.89^b	0.83^b	0.84^b	0.94^{ab}	1.01^{ab}	0.0525	*
N_2-Ret (g)	3.57^a	2.92^{ab}	2.84^{ab}	2.91^{ab}	2.51^{ab}	1.69^c	0.2159	*
N retained (% intake)	63.75^a	60.08^{ab}	61.61^{ab}	59.88^{ab}	55.41^{ab}	44.59^c	1.432	*

DMI=Dry matter intake, FOPT=Faecal output, U.Vol=Urinary volume, Dig. =Digestibility, U. N2=Urinary nitrogen, PI=Protein intake, FP=Faecal protein, N2-Int=Nitrogen intake, F.N2=Faecal nitrogen, N2-Ret=Nitrogen retention

Means in the same raw with different superscripts differ significantly (P<0.05)

Table 3: Effects of Treatments on nutrients utilization by goats

Table 4 shows the effects of the treatment diets on hematological indices of the experimental animals. The packed cell volume (PCV) for all the animals on the treatment diets ranged from 24-39.5%. This falls within the 22-38% range for healthy goats [20]. The author stated that anything below this range results in anemia. As a result, oxygen carrying capacity of the blood is reduced with consequent increase in pulse rate and heart failure. It is also found that blood urea ranged from 18-25 mg which is within the normal range for goats [27]. It is also found that blood protein and glucose fell in the ranges of 3-5mg/dl and 4-6mg/dl respectively which are in the normal ranges of 3-8mg/dl and 48mg/dl respectively [28]. They stated that feed low in Metabolizeable energy (ME) significantly increase the level of blood urea-nitrogen and serum creatine and lower serum protein concentration. Therefore, since these are in the normal ranges the energy and protein levels are adequate to maintain the normal metabolism of the animals.

TREATMENTS								
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**SEM**	**Sig Level**
PCV (%)	24.50^b	37.75^a	30.00^{ab}	26.50^b	39.50^b	26.26^b	0.5334	*
Hb (%)	11.25^{ab}	15.15^a	14.25^a	8.55_b	13.63^b	7.93^b	0.6328	*
RBC x106	3.85^b	6.50^a	4.70^b	4.65^b	4.75^b	4.58^b	0.4879	*
WBC X109	8.30^d	13.60^a	11.05^{bc}	9.53^{bc}	11.80^a	9.31^{dc}	0.7078	*
Bld prot (mg/dl)	3.65^{ab}	5.13^a	4.25^{ab}	2.96^b	4.29^a	3.78^{ab}	0.3738	*
Total protein mg/dl	3.55	7.25	5.34	3.82	5.02	4.66	0.562	*
Albumen (mg/dl)	1.70^b	4.10^a	2.73^b	2.01^b	2.49^b	2.38^b	0.5957	*
Globulin (mg/dl)	1.85^b	3.15^a	2.61^{ab}	1.81^b	2.53^{ab}	2.28^{ab}	0.4738	*
Glucose (mg/dl)	4.30^b	6.10^a	4.20^b	4.48^b	4.98^b	4.18^b	0.5863	*
Blood urea (mg/dl)	22.69^b	25.00^a	24.36^a	22.55^b	21.88^b	18.00^b	0.5563	*

PCV=Packed cell volume, Hb=Haemoglobin, RBC=Red blood cell counts, WBC=White blood cell counts, Bld prot=Blood protein

Means in the same raw with different superscripts differ significantly (P<0.05)

Table 4: Effects of Treatments on Hematological and serum biochemical indices of the Red Sokoto goats

The globulin level is found to be low, in the range of 2-3mg/dl. Oduguwa, *et al.* reported that level of protein intake has significant effect on total plasma protein [27]. According to the authors, plasma protein partakes in nutrition by functioning as a pool for amino acids and other tissue protein. Lower values for albumin has physiochemical function in maintaining colloidal osmotic pressure which is required to maintain blood volume. In this experiment, the hemoglobin level is 7.93-15.15g/dl across treatments which fall within the normal range of 7.5-15g/dl for healthy goats [29]. This confirms the findings of Yusuf, *et al.* that blood profile of animals often reflects their nutritional adequacy or otherwise. Dietary components have measurable effects on blood constituents such that significant changes in their values can be used to draw inference on the nutritive values of feeds offered to the animals [20].

Lawrence-Azua, *et al.* further stated that blood is an important index of physiological, pathological and nutritional status in the organism and the blood variables most consistently affected by dietary influence are Red Blood Cells (RBC), Packed Cell Volume (PCV) and Plasma proteins [30].

Conclusion

It is concluded that the treatments diets were able to supply the needed nutrients which enabled the animals maintain the normal healthy blood profiles. The animals therefore utilized the feed for maintenance and increase in weights effectively. Therefore, to reduce cost and increase profitability, maize cob with very low or no cost, could replace up to 50% of more expensive maize bran in the diet of Red Sokoto goats.

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