Soursop Leaf and Pumpkin Pulp Diets Concerning Performance, Nutrient Utilization and BloodProfile of Goats.

Abstract

Assessed growth performance, nutrient utilization and blood constituents of goats fed diets containing fluted pumpkin pulp and different proportions of soursop leaf powder.We used twenty- four West African dwarf female goats of about 7 to 8 months old 7.00 ± 0.15kg. They were randomly allotted to four dietary treatmentswith three replicates of two goats. The compared diets contained; 6% dried fluted pumpkin pulp withoutsoursop leaf powder (control, PPM_1), 6% dried fluted pumpkin pulp with 2% soursop leafpowder(SLP_2), 6% dried fluted pumpkin pulp with 2.5% soursop leaf powder(SLO_3) and 6% dried fluted pumpkin pulp with 3% soursop leaf powder (SLW_4). The resultsshowed that diet $PPM_1$was significantly ($P<0.05$) higher in feed conversion ratio, digestibility of ether extract, gross energy intake, total nitrogenand energy output, creatinine, urea, serum enzymes, total cholesterol and low-density lipoprotein.$SLOP_3$revealed significantly ($P<0.05$) better in final, total & daily body weight gain,dry matter, crude protein and crude fiber digestibility, nitrogen retention, digestible and metabolizable energy, packed cell volume, haemoglobin, red and white blood cells, serum total protein, albumin, glucose, and high-density lipoprotein. Feed and nitrogen intake as well as triglyceridesindicated significant($P<0.05$) higher values inSLW_4. Using 6% dried fluted pumpkin pulp with 2.5 or 3% soursop leaf powder in diets enhanced nutrient utilization for better performance and health status ofgoats

Keywords: *Blood, goats, performance, pumpkin-pulp, soursop leaf*

1 Introduction

Goats have been identified to play a crucial role in nutritional security for supporting mankind in increasing animal protein availability for human sustainability. Theirbiological values and domestic demand asthe choicest milk and meat for consumers have been rankedhigher than sheep and cattle [1]. Therefore, the need to increase goat productionis a consequence of its capacity to generate income and improve the living standardsof rural subsistence-farming communities [2] .Thedegree to which goats survive to marketable age is one of the key indicators fortheir efficientproductivity. However, nutritional constraints remain a concern, because they limit; animal digestion andgrowth rate and weaken animals against parasitic and infectious diseases that bring about high mortality.Tropics experience seasonal dry periods thatdecrease the quantity and quality of available forages for ruminant livestock. Goats raised in thistropical region are predominantly faced with nutritional stress, due toadecrease in the quality of grazing pastures[3]. Conventional feeds that supplement poor forages areexpensiveas a result ofhigh grain prices and less diversified animal feeds. One possible way to mitigate this incessant challenge ravaging ruminant livestock production is to explore alternate feed resources that are not consumed by man butcan be used as feeds for livestock.

Fluted pumpkin (*Telfairia occidentalis*) belongs to the genus *Cucurbita*and thefamily of *Cucurbitaceae*.The pulp is a by-product of the pumpkin seed which is relatively abundant,most especially in areaswhere they are produced. Thefluted pumpkin pulp is beneficial and economical as a feed resourcefor animals that provide considerable benefits to goat farmers [4]. However,the inclusion of natural additives to poor quality feeds is currentlyused by most rural farmers to improve better sustainability of goat farming in Nigeria.They have valuable potentials that are profitable in theaspect of boosting the immune system, biodegradable and biocompatible[5].

Soursop *(Annona muricata)* belongs to the family of *Annonaceae*. It is aherbplant that hasgoodnatural multiple nutritive values with secondary metabolites that justify its application as phyto-additive[6]. It also possesses great potentialas anti-microbial and anti-inflammationswith bioactive components that modulate rumen to regulate micro-flora for better digestion and inhibition of lipids[7]. However, there is relatively little information regarding the effect of soursop leaf powdersupplementation on feed utilization and performance of goats. Thus, the study was designed to determine the effect of soursop leaf powder on growth, nutrient retention and blood constituents of goats-fed diets containing dried fluted pumpkin pulp.

2Materials and Methods

2.1Location of study

The study was conducted at the Small Ruminant Unit of the Livestock Teaching and Research Farm of Ambrose Alli University, Ekpoma.The area lies on longitude 6.09^{0}E and latitude 6.42^{0}N within the humid climatic zone of Nigeria. The average annual rainfall and temperature of the region are about 1556mm and 31^{0}C respectively, while therelative humidity of the lactation is about78%on average.

2.2Experimental diets

Green maturedsoursop leaf was obtained from their naturally growing plantwithin the Teaching and Research Farm environment. They were air-driedunder awell-ventilated shed until the leaves were crispy to thetouch, while retaining their greenish coloration. Thereafter, they were milled to pass through a 0.15mm sieve to obtainsoursop leafy powder and stored inairtight bags at room temperature. Matured harvested fluted pumpkin fruits were cut open and seeds and pulp were separately removed before pulp was sun-dried and crushed into a fluted pumpkin pulp meal. However, soursop leaf powderand fluted pumpkin pulp meal with other feedingredients were used to prepare the supplementary diets as shown in Table, 1. Succulent elephant grass obtained within the farm was choppedto small lengths of about 4 to 5cm and served as a basal diet. The basal and supplementary diets were offered in a ratio of60: 40 to the animals respectively. The prepared supplementary diets were composed as follows;PPM_1(6% dried fluted pumpkin pulp without soursop leaf powder and served as the control group), SLP_2(6% dried fluted pumpkin pulp with 2% soursop leaf powder),SLO_3(6% dried fluted pumpkin pulp with 2.5% soursop leaf powder)andSLW_4(6% dried fluted pumpkin pulp with 3% soursop leafpowder) were the inclusion levels in differenttreatment diets

Table 1.Gross composition (%DM) of the supplementary diets

Ingredients	Treatment Diets			
	PPM_1	SLP_2	SLO_3	SLW_4
Wheat offal	47.00	44.00	41.00	38.00
Dried brewers grain	33.00	32.50	32.00	31.50
Rice bran	5.00	8.00	11.00	14.00
Dried flutedpumpkin pulp	6.00	6.00	6.00	6.00
Broken bean /husk	5.50	4.00	4.00	4.00
Soursop leaf powder	-	2.00	2.50	3.00
Bone meal	2.00	2.00	2.00	2.00
Vitamin premix	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00

2.3Animal andmanagement;

Twenty-four West African dwarf female goats of about 7 to 8 months oldand 7.00 ± 0.15kgwere used. On their arrival, they were confined for a preliminary period of fourteendays to allow themtoadapt to the environment and dewormed against internal and external parasites. After the quarantine period, goats were randomly allocated to the four treatment diets giving six animals per treatment. Thus, each treatment was replicated three times with two goats per replicate in a completely randomized design. They were housed in individual semi-open partitioned pens,equipped with feeders, water troughs and saw dust that was changed twice weekly. Diets that were offered to each goat twice daily(8:00-am and 4:00-pm) werecalculated based on 5% dry matter of their body weight. The ratio of the basal diet of elephant grassto each of the supplementary diets was used to determine the proportion of each diet that was offered to the goat.The amount of diet supplied to each animal was adjusted daily based on the voluntary intake ofthe animal with an estimated leftover of 15%. They also had free access to drinking water and the duration of the experiment was 90 days exclusive of the 14 days ofacclamation.

2.4Experimental procedures and measurements

2.4.1Growth performance

The average daily feed intake was determined by the difference between the amount of feed offered and leftovers. The initial body weight of goats was weighed and recorded at the onset of the experiment. Subsequently, weekly weights using themeasuretech® hanging scale. Weeklyweights were taken before morning feeding to estimate change in body weight. Total body weight was obtained by the difference between the final and initial body weight. The average daily weight gain was calculated from the weeklyweight of individual goats over the entire period of the trial. However, daily feed intake with body weight gain was used to calculate the feed conversion ratio.

2.4.2Nutrient digestibility, nitrogen retention, and energy metabolism

The growth study was preceded by a 14-day metabolic trial to determine the apparent nutrient digestionof the diets. Three goats with similar body weights were randomly chosen from each treatment group and housed separately in individual metabolic cages designed for feeding, and watering with separate collections of feces and urine. Feed offered, leftover,voided feces and urine were collected and recorded daily for 14days, which includes 7 days of total collection after a 7-day adaption period. Thereafter, a sub-sample of about 10% of thetotal fecal output was bulked, properly mixed and pooled for each animal before beingstored in a plastic container in the freezer (-20%) for later analysis. Urine from each animal was also collected in a plastic containercontaining 100 ml of 3.6 mol/L H_2SO_4.The collected urine was strained through a layer of grass wool to remove detached hair fragments and other solid contaminants. The volume was measured and then diluted to 5 L using tap water and a sample of 20 ml wascollected and pooled for each animal to prevent loss of nitrogen due to volatilizationbefore being stored at -20^{0}C for total nitrogen determination. Nutrient Digestibility(ND) of the diet was calculated for dry matter, crude protein, crude fiber, ether extract, ash, and nitrogen-free extract from each treatment diet using the equation proposed by [8]

$$ND\ \% = \frac{\text{Total amount of nutrients in feed– Total amount of nutrients in feces}}{\text{Total amount of nutrients in feeds}} \times 100$$

Nitrogen and energy retention were calculated by standard procedures outlined for direct estimation of animal digestion [8]. Nitrogen balance was determined as the differences between nitrogen intake and nitrogen excreted from feces and urine. The nitrogen retention percentage was estimated from the nitrogen balance expressed as a percentage of nitrogen intake.

The gross energy (GE) of the diets, feces and urine were measured using an adiabatic bomb calorimeter (C200, IKA Works Inc. Staufen, Germany). The GE intake was calculated as the GE of the feed in dry matter multipliedby the dry matter (DM) of the feed intake, while fecal energy (FE) output was determined as the GE of the feces in DM multiplied by the quantity of the feces in DM. Urineenergy (UE) output was determined as the GE of the urine in DM multiplied by the quantity of the urine in DM. Digestible energy (DE) intake was calculatedas the difference between GE intake and FE output divided by GE intake expressed as apercentage.

Metabolizable energy (ME) was determined by 82% of DE intakes as reported by[9].The metabolizability (qm) was calculated as ME/GE for each treatment diet [10]

2.4.3Blood collection and analysis

After the metabolic trial, 10ml ofblood sample was collected from each goat the following day through jugular venipuncture, using disposable heparinized syringes into sterilized evacuated collection tubes before morning feeding. Sub-samples of 5ml were drawn into labeled sterilized universal bottles containing ethylene diamine tetra-acetic acid(EDTA)as an anti-coagulant to determine hematological traits. Packed cell volume (PCV) was determined with Wintrobe'smicro-hematocrit while red blood cell (RBC) and white blood cell (WBC) were determined with improved Neubauerhemocytometer while differential counts of the WBC such as lymphocytes, eosinophils, neutrophils,monocytes, andbasophilswere determined by making differential smear using wright stain and percentage. The hemoglobin concentration (Hb) was determined using the cyanomethaemoglobin method. The erythrocytic indices, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscularhemoglobin concentration (MCHC) were computed as described by[11]

The other 5ml sub-samples were transferred into anti-coagulant-free plastic tubes andgently inverted a couple of times, kept in an ice box to allow coagulation at room temperature. They were later centrifuged for 15 minutes at 890xg at 4^0C and maintained for 8 hours in the refrigerator at 4^0C beforebiochemicalanalysis and separation of supernatantserum. The plasma was also transferred to a storage tube labeled with the date and animal identification and stored at -20^0C until analysis.

The biochemical constituents of the serum samples estimated included total protein and albumin that were analyzed by using commercial kits (Biuret method, Chemelex, SA Barcelona), but globulin was calculated by subtracting albumin from total protein serum.Ureain serum sample was estimated using the diacetylmonoxime method, creatinine was determined by theJaffe reaction method and blood glucose was obtained by enzymatic colorimetric test. All analyses followed the procedures described by[12] Serum glutamate oxaloacetate transaminase (SGOT), Serum glutamate pyruvate transaminase (SGPT), Alanine aminotransferase (ALT), Aspartate aminotransferase (AST),total cholesterol,high-density lipoprotein (HDL) andtriglyceride concentrations were measured using procedures given by Green Cross MS in Korea as described by [13] Thelow-density lipoprotein (LDL) and very low-density lipoprotein (VLDL) were calculated usingequations below as presented by [14]

LDL = Total cholesterol – (HDL + VLDL)

$$VLDL = \frac{Triglycerides}{5.}$$

2.5Chemical analysis

Dry matter was determined by drying the fluted pumpkin pulp,soursop leaf, feed, orts, and fecal samples in an air-forced oven at 135^0C for 2 h [15]; crude ash content was measured by placing the samples into a muffle furnace at 550 ^{0}C for 24h. Nitrogen was determined using the Kjeldahl method, using selenium as a catalyst [15], and crude proteinwas calculated using the formula 6.25 x N. The ether extract was measured by calculating the weight loss of the dry matter on extraction with diethyl ether using the soxhlet extraction apparatus for 8 h [15].Crude fiber was determined using Tecator Line (FT122 Fibertee TM). The concentration of phytate was determined according to Fredlund *et al.* (1997). Total tannin was determined colorimetrically as described in [15]while total saponin and oxalates were also quantified using colorimetry [15].

2.6Statistical analysis

Data generated from growth, digestibility, nitrogen and energy retention as wellas blood constituents were subjected to analysis of variance using the general linear model (GLM) procedure [16] to determine the effects of the treatment diets on parameters. Where significant difference occurs, means were separated by Duncan's multiple range tests [17].

3Results

In the feed ingredients examined (Table 2), soursop leaf powder (SL) recorded ahigher content of crude protein, ether extract and nitrogen-free extractbut relatively lower ash values as compared with dried flutedpumpkin pulp (FPP) and elephant grass(EG). However, FPP recorded higher values in dry matter and ashwhile EG had the highestcrude fibercontent than other feed ingredients. All treatment diets were variable according to types and varying levels of feed ingredients used. Treatment diets SLP_2, SLO_3 and SLW_4 had higher and similar values for dry matter, crude protein, ether extract and nitrogen-free extract than PPM_1. On the other hand, crude fiber and ashwere relatively higher in dietPPM_1. Above all, oxalate and phytate showed no remarkable difference among feed ingredients and treatment diets. However, diet PPM_1had the lowestcontent oftannin and saponin.

Table 2: Proximate and phytogenic composition(%DM) of dried fluted pumpkin pulp meal,souroup leaf powder, elephant grass and treatment diets of goats.

	Feed ingredients			Treatment diets			
	FPP	SL	EG	PPM_1	SLP_2	SLO_3	SLW_4
Dry matter	90.67	87.46	85.04	69.8	75.9	77.8	79.3
Crude protein	3.05	13.98	8.62	10.5	11.2	11.4	11.9
Ether extract	2.03	2.10	1.09	1.78	2.21	2.01	2.46
Crude fibre	19.49	7.53	31.04	33.0	31.9	32.4	30.1
Ash	9.36	5.79	7.41	6.98	5.59	5.19	4.92
Nitrogen free extract	54.74	58.06	35.88	48.1	49.3	48.9	50.1
Phytogenic components							
Tannin	0.68	0.82	0.76	0.87	1.32	1.71	1.56
Saponin	0.79	0.94	0.72	0.49	0.81	0.85	0.89
Oxalate	0.23	0.19	0.58	0.66	0.66	0.53	0.75
Phytate	0.19	0.30	0.51	0.54	0.59	0.67	0.73

FPP = Fluted pumpkin pulp, SL = Soursop leaf, EG = Elephant-grass

There were noticeable significant ($p<0.05$) differences in mean values for feed intake of goats on the treatment diets (Table 3). Diet SLW_4 appeared higher in value, followed by $SLO_3$and SLP_2 compared to PPM_1. However,an initial body weight did not show any significant differences ($P>0.05$) among diets.The addition of 2.5and 3%soursop leaf powder in diets indicated highersignificant values ($P<0.05$) in thefinal body weight of goats.The inclusionof test ingredients in diets consequently improved the total body weight gain of goats significantly ($P<0.05$), with the highest value recorded in $SLO_3$and the lowest in $PPM_{1.}$ .Daily weight gain was significantly ($P<0.05$) increased with a progressive increase in levels of soursop leaf powder in the experimental diets,butthe feed conversion ratio showed fairly high values ingoats on the controldiet as compared with diets with soursop leaf powder.

Dry matter digestibility was significantly ($P<0.05$) higherin valuesobserved for goats on test diets (SLP_2, $SLOP_3$ and SLW_4) than the control diet (PPM_1). Goats placed on diets $SLOP_3$ and SLW_4 had higher crude protein digestibility as compared with those on diets PPM_1andSLP_2 whichshowed similar and lower significant ($P<0.05$)values. Digestibility of crude fiber was significantly ($P < 0.05$)highest in SLO_3followed by diets SLW_4 and SLP_2 compared to diet PPM_1 which recorded the lowest value. The control diet hada highersignificant ($P<0.05$) value in ether extract digestibility. Digestibility of ash varied significantly ($P< 0.05$) in goats on different treatment diets, with test diets beinghigher in values. However, nitrogen-free extract values that ranged between 65.47 and 74.52% followed the same pattern of variation as noticed in thedigestibility of ash.

Table 3: Effect of soursop leaf powder on growth and nutrient digestibility of goats fed diets Containing fluted pumpkin pulp meal

Parameters	Diets				SEM ±
	PPM_1	SLP_2	SLO_3	SLW_4	
Feed intake(g/day)	239.01^c	252.64^b	254.00^b	265.02^a	1.02
Initial body weight (kg)	7.20	7.14	7.09	7.18	0.09
Final body weight (kg)	9.14^b	9.89^b	10.11^a	10.01^a	0.15
Total weight gain (kg)	1.94^c	2.75^b	3.02^a	2.83^b	0.03
Daily weight gain (g/day)	27.71^c	39.29^b	43.14^a	40.43^a	0.58
Feed conversion ratio	8.63^a	6.43^b	5.89^c	6.56^b	0.07
Nutrient Digestibility (%)					
Dry matter	68.94^b	71.82^a	73.05^a	72.28^a	0.57
Crude protein	67.75^b	70.93^a	71.72^a	70.96^a	0.64
Crude fiber	60.97^c	67.44^b	70.03^a	69.95^b	0.59

Ether extract	63.58[a]	54.44[b]	51.43[b]	50.77[b]	0.48
Ash	55.22[c]	60.23[b]	67.56[a]	66.02[a]	0.61
Nitrogen-free extract	65.47[c]	69.14[b]	74.52[a]	72.38[a]	0.79

[a,b,c] Means in the same row with varying superscripts differ significantly ($P< 0.05$).

The inclusion of soursop leaf powder in diets affected nitrogen retention in goats (Table 4). Nitrogen intake was relatively higher in goats on test diets and significantly ($P< 0.05$) lower in the control diet. Nitrogen excreted in feces and urine (g/day) was significantly ($P< 0.05$) lowerin goats who consumedsoursop leaf powder. Total nitrogen output was highest significantly ($P< 0.05$) in diet PPM_1, followed bySLP_2 and lowest inSLO_3 and SLW_4. Furthermore, nitrogen balance (g/day) and retention (%) were found to be significantly ($P< 0.05$) higher in goats that consumed SLO_3 and SLW_4.

Energy utilization was also influenced by different proportion of soursop leaf powder in diets (Table,4). Differences were registered significantly ($P<0.05$) in gross energy intake in goats among treatment diets. Higher values were recorded for PPM_1, followed by SLP_2 before SLO_3 and SLW_4which had lower values. However, a remarkable differencewas also pronounced significantly ($P<0.05$) for fecal energy output in goats placed on diet PPM_1. Urinary energy was considerably lower in goats fed diets SLO_3 and SLW_4. .Total energy output values followed the same trends as fecal and urinary energy, although their values were not strictly comparable. Digestible and metabolizable energy intake values appeared higher significantly ($P<0.05$)in goats on test diets (SLP_2, SLO_3 and SLW_4) than goats placed on control group (PPM_1) that had lower value. Metabolizability indicated no significant difference betweenvalues.

Table 4: Nitrogen retention and energyutilization of goats fed diets containing different inclusion levelsof soursopleafpowder.

Parameters	Diets				
	PPM_1	**SLP_2**	**SLO_3**	**SLW_4**	**SEM ±**
Nitrogen (N) intake (g/day	10.50[b]	11.2[a]	11.4[a]	11.7[a]	0.11
Fecal N-output (g/day)	3.00[a]	2..35[b]	2.01[b]	2.24[b]	0.03
Urinary N-output (g/day)	1.01[a]	0.94[b]	0.56[b]	0.74[b]	0.02
Total N-output (g/day)	4.01[a]	3.29[b]	2.57[c]	2.98[c]	0.04
N- balance (g/day)	6.49[c]	7.91[b]	8.83[a]	8.72[a]	0.06
N-retention of intake (%)	61.81[c]	70.63[b]	77.46[a]	74.53[a]	0.98

Energy ((MJ/g/day/DM)					
Gross energy	3948.25[a]	3686.54[b]	3299.79[c]	3169.48[c]	1.20
Fecal energy	979.84[a]	799.92[b]	696.42[c]	701.55[bc]	0.87
Urinary energy	216.43[a]	168.49[b]	102.55[c]	134.22[c]	1.05
Total energy output	1196.27[a]	968.41[b]	798.97[c]	835.77[c]	0.92
Digestible energy	1353.29[c]	1566.03[b]	1972.38[a]	1790.91[a]	1.73
Metabolizable energy	1109.70[c]	1284.15[b]	1617.35[a]	1468.55[ab]	0.99
Metabolizability (qm)	0.28	0.35	0.49	0.46	0.24

[a,b,c] Means in the same row with varying superscripts differ significantly (P < 0.05)

Hematological parameters of goats were significantly (P<0.05) influenced by treatment diets exceptfor eosinophils, monocytes, basophils and mean corpuscular volume that were not affected as pointed out in Table 5. However,packed cellvolume haemoglobinand red blood cellvalues appeared to be higher in goats on test dietsSLP$_2$, SLO$_3$ and SLW$_4$. Goats on diets SLP$_2$, SLO$_3$, and SLW$_4$ had higher values of white blood cells.Lymphocyte and neutrophil values were highest in diets SLO$_3$ and SLW$_4$, followed by SLP$_2$ and PPM$_1$which had the lowest values. Mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration values were found to be improved in goats on diets with soursop leaf than those on diet without soursop leaf powder.

Significant(P<0.05) differences were observedin all serum biochemical indices of goats except globulinwhich wasunaffectedby the treatment diets. Total protein and albumin values registered for goats on diets withsoursop leaf powder were significantly(P<0.05) better. Glucose and triglyceride values were highest in animals placed on diets SLO$_3$ and SLW$_4$, followed by SLP$_2$ before PPM$_1$which appeared to be thelowest. There were significant (P<0.05) variations in creatinine and urea among treatment diets, these variations were higher in the control group than those that were offered test diets.

Table 5: Mean values for hematological, serum biochemical, and lipid profile of goats fed experimental diets.

	Diets				
Parameters	**PPM$_1$**	**SLP$_2$**	**SLO$_3$**	**SLW$_4$**	**SEM ±**
Hematological indices					
Packed cell volume (%)	27.01[b]	29.45[a]	31.01[a]	30.98[a]	0.64
Hemoglobin (g/dl)	5.01[b]	6.79[a]	7.02[a]	6.95[a]	0.05
Red blood cell (x10^6/ml)	5.47[b]	6.04[a]	6.10[a]	6.08[a]	0.07
White blood cell (x10^6/ml	5.98[c]	7.98[b]	8.62[a]	8.43[a]	0.09

Lymphocytes (%)	43.67[c]	50.62[b]	54.96[a]	52.87[ab]	0.76
Eosinophils (%)	2.19	2.35	2.08	2.31	0.08
Neutrophils (%)	40.01[c]	45.96[b]	49.55[a]	47.02[a]	093
Monocytes (%)	0.25	0.42	0.61	0.58	0.03
Basophils (%)	0.30	0.37	0.41	0.45	0.02
MCV (fl)	34.01	34.58	34.95	34.70	0.67
MCH (pg)	7.99[c]	9.98[ab]	10.16[a]	10.07[a]	0.55
MCHC (%)	30.89[b]	31.95[a]	32.07[a]	32.01[a]	0.86
Serum biochemical indices					
Total protein (g/dl)	6.52[b]	6.89[ab]	7.39[a]	7.06[a]	0.05
Albumin (g/dl)	2.79[b]	3.45[a]	3.65[a]	3.40[a]	0.03
Globulin (g/dl)	3.55	3.44	3.74	3.66	0.04
Glucose (mg/dl)	62.49[c]	68.72[b]	72.01[a]	70.11[a]	0.79
Triglyceride (mg/dl)	20.23[b]	22.57[ab]	22.90[a]	22.99[a]	0.62
Creatinine (mg/dl)	1.07[a]	0.86[b]	0.73[b]	0.70[b]	0.01
Urea (mg/dl)	12.75[a]	8.62[b]	7.85[c]	7.09[c]	0.45

[a,b,c] Means in the same row with varying superscripts differ significantly (P < 0.05), MCV= Mean corpuscular volume, MCH = Mean corpuscular hemoglobin, MCHC = Mean corpuscular hemoglobin concentration.

As indicated in Table 6, are results for serum enzymes and lipid profile of goats feddiets containing soursop leaf powder and fluted pumpkin pulp.Animals placed on diets with test ingredientsystemically decreased significantly (P<0.05) in mean values for serumglutamate oxaloacetate transaminase (SGOT) and serum glutamatepyruvate transaminase (SGPT).Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) followed the same pattern of variation as observed for SGOT and SGPT.

Total cholesterol values recorded for goats in this study were significantly (P<0.05) varied by treatment effect, goats on diets with 2.50% (SLO_3) and 3.00% (SLW_4) soursop leaf powder inclusion were significantly (P< 0.05) lower than goats on diets without soursop leaf powder (PPM_1) and 2% inclusion of soursop leafpowder(SLP_2). However, high-density lipoprotein (HDL) was increased significantly (P< 0.05) across treatment diets as soursop leafy powder inclusion levels were increasing progressively in test diets. On the other hand, low-density lipoprotein (LDL) values decreased significantly (P< 0.05) as theaddition of soursop leafy powder increased in the treatment diets of goats.Very low-density lipoprotein (VLDL) values were not significantly influenced by treatment diets in this study.

Table 6: Effect of soursop leaf powder inclusion onserum metabolites and lipid profiles of goats fed diets containing fluted pumpkin pulp.

Parameters	Diets				
	PPM$_1$	**SLP$_2$**	**SLO$_3$**	**SLW$_4$**	**SEM ±**
Blood serum enzymes					
SGOT (U/L)	45.04^a	32.83^b	32.01^b	31.03^b	0.87
SGPT (U/L)	20.21^a	16.32^b	15.95^b	15.28^b	0.39
ALT (U/L)	25.99^a	20.85^b	19.93^b	19.67^b	0.46
AST (U/L)	69.83^a	62.53^b	60.47^c	60.01^c	0.74
Lipid profile					
Total cholesterol (mg/dl)	70.03^a	65.27^b	62.13^c	61.99^c	0.96
HDL (mg/dl)	30.96^c	33.57^b	35.72^a	36.01^a	0.85
LDL (mg/dl)	35.02^a	27.21^b	21.58^c	21.32^c	0.45
VLDL (mg/dl)	4.05	4.51	4.58	4.60	0.07

^{a,b,c} Means in the same row with varying superscript differ significantly ($P < 0.05$). SGOT = Serum glutamate oxaloacetate transaminase, SGPT = Serum glutamate pyruvate transaminase, ALT = Alanine aminotransferase, AST = Aspartate aminotransferase, HDL = High-density lipoprotein, LDL = Low-density lipoprotein, VLDL = Very low-density lipoprotein.

4Discussion

Proximate composition and anti-nutritional factors of fluted pumpkin pulp, soursop leaf powder and elephant grass were comparable with range values reported in literature by[4]; [7]; [18]respectively. The phytogenic levels in these plantspecies were considered low and safe with regards to phytogenic poisoning critical values of 7.3–9.0mg/g noted by [19].Variationsobserved in the nutrient content of treatment diets could probably be due to the reflection of different feed components that supplied nutrients to diets. However, it was interesting to know that crude protein values recorded in dietswere above the 8% CP minimum value required for goat maintenance [20]

The test ingredient seems beneficial as it was able to reduce the level of anti-nutritional factors and possibly increase the ability of the animals to properly modify and improve feed efficiency for better nutrient supply, absorption and utilization by animals. This resulted in higher significant final, total, and average daily weight gain in animals on the test diets. This inference was consistent with the earlier report by [18] that efficient feed utilization by animals supplies an adequate balance of nutrient requirements at the site of metabolism for heavy weight gain. Daily weight gain values recorded in the work was comparable with the mean value(38.64g/day) reported by [21]. Obvious variation in daily feed intake at similar growth stage of the animals could be related to the type as well as physical nature of diet components, length of time spent on diet and acceptability with other unknown contributing factors of the feeds. It is worth mentioning that the feed conversion ratio (FCR) which measures feed intake per unit weight gain was lowest in diet $SLOP_{3,}$ indicating better feed efficiency. However, the higher weight gain and FCR recorded in diets with test ingredientsattest tothe superiority of the diets.

Following the previous findings, digestibility in goats is governed by many factors that includethe nature and quality of feeds, level of feed intake, salivary secretion, manner of rumen fermentation, and flow rate in gastro-intestine [18] The improvement obtained in dry matter digestibility might be channeled to unlimited nutrient from greater proportion of forage grass that was compensated with appreciable percentage of supplement diet. This nutrient availability couldhave possibly stimulated the activity of cellulolytic rumen floral for better feed ingested and digestibility. The higher crude protein digestibility in test diets showed that phytogenic bioactive components in the test ingredient did not cause harmful effectson theactivities of rumen bacteria but improved digestibility. This is in harmony with a previous study by[21]who observed that secondary components in diets suppress rumen degradation to enhance appreciable quantity of protein availability in post-rumen digestion.Likewisefiber digestion in test diets couldbe linked to the modulation effect that appeared to favor theproper functioning of rumen ecology for high fermentable cell wall fractions and digestibility of fiber. This was earlier observed by [20], who stated that easily digestible features in feeds increase the activity of rumen-degrading microbes that break fiber feed constituents to provide energy for themselves and host animals.Interestingly, it was apparent that the addition of soursop leaf powder to diets was inversely proportional to the digestibility of ether extract. The reason for this inconsistency could presumably depend on the bioactive ingredients in the diets that could have disrupted the activity of enzyme reaction in the rumen by forming an indigestible complex for oil-degrading components. Notwithstanding, there was a considerableincreasein the digestibility of ash and nitrogen-free extract in goats on test diets. This observation further affirmed the positive interaction effect of the feed components that were found to enhance nutrient availability for effective digestion. The low digestion in almost all nutrients in the control diet could be traced to an inhibition of digestive enzyme activity by anti-nutritional factors in fluted pumpkin pulp and their interactions with fibre which adversely reduced cell wall carbohydrates as demonstrated in goats on diet with no soursop leaf powder.

The discrepancy noticed in values of nitrogen intake could mainly be attributed to the difference in contributory effects of the dietary components that tend to increase the protein content of test diets. However, the high numerical values of fecal, urinary, and total nitrogen excreted in the control group could be a result of rapid the breakdown of dietary protein to ammonia which increased nitrogenous excretion[8].It is worth pointing out that all diets in the study had positive nitrogen balance, explaining treatment diets were tolerated with the provision of adequate protein requirement for the animals. The higher nitrogen retention noticed in diets with 2.5 and 3% soursop leaf powder inclusion, could be connected to the presence of optimum anti-microbial effects that delay rumen protein degradation by suppressing bacteria population and making denatured protein absorbed and utilized in the intestine by animals for maintenance and production purposes [22]. Nitrogen retention values obtained in this work were within the reference values reported by[23]

The observed increment in gross energy (GE) intake in the control diet could perhaps be linked with theingestion of the feed components that had a measurable effect on energy concentration. This possibly explains the excessive amount of GE intake by the animal to meet with energy requirements for their body's physiological activities. The higherfecal, urinary, and total energy output noted in the control diet,further buttressed the imbalanced level of energy catabolism that was associated with poor energy utilization in the diet. The improved digestible energy valuesin animals on test diets showed that the phytogenic components in the feeds were activeto make nutrient available for efficient feed utilization and reducedfecal energy. Metabolizable energy (ME) is often usedas a sensitive yardstickfor the determination of the overall energy intake of feed and measuresthe metabolic sum of the process of digestion, absorption,and utilization of feedin energythe unit [24]. Thus, the efficiency with which higher ME was retained and utilized for growth in animals on test diets was influenced by low energy loss as heat. This low heat increment was a function of nutrientadequacy in feeds that gave better ME which was expressed in higher weight gain. However,this depends on theinteraction of two principal factors; the nature of the chemical compounds in which ME was contained and the purpose for which these compounds were used by the animals. The similar values of metabolizability(qm) have laid credence to the work reported by [25]who noted that qm of complete feed is relatively constant and equivalent to about 0.96 MJ/g/day DM.

Blood examination is a scientific way of screening and assessing the nutritional and health status of an animal. Thus, hematology providesan opportunity to clinically investigate the presence of several metabolic needs and other constituents in the body of animals [26]Packed cell volume (PCV) is an indicator of blood volume or blood dilution that may result from thetoxic substance, while hemoglobin (Hb) and red blood cell (RBC) measure the ability to withstand some levels of respiratory stress and oxygen carrying capacity. The positive comparative values of these indices showed that animals were in normal healthy condition and not anaemic. Mean corpuscular volume,mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration values that explainthe bone marrow capacity for blood cell production and diagnosis of anemia were correlated with PCV, Hb, and RBC obtained in this study. This further explains the quality of the balancedfeeds that had no adverse effect on blood and health status. White blood cell (WBC) improves the immunesystem,antibody production, and disease-fighting ability of the animal. The immune response of animals in this study was not negatively affected by test feeds as showed in their values that tallies with average value ($7.68x10^3/m^3$) for goats as reported by[26]. The results of neutrophils and lymphocytes for white blood differential counts imply that goats on these diets tendednot being susceptible to microbial infection or disease condition. Low values of monocytes, eosinophils, and basophils were indications that their immune system was not challenged by toxicsubstances present in the test feeds. However, their values showed good resistance to diseases and did not portend any danger, since they fell within the normal range values of 10-50% neutrophils, 40-75% lymphocytes, 1-5% monocytes, 1-8% eosinophils and 0-3% basophils [11]

The higher serum total protein and albumin concentration obtained in animals on diets with soursop leafpowder could be traceable to low content of secondary compounds and availability of better nutrient utilization that were able to supply an adequate digestible amount of protein needed to make nitrogen available for rumen microbes. Consequently,this increased protein absorption in the intestine which is responsible for maintaining normal serum protein levels in animals. However, total protein and albumin values obtained in this study, were in line with average range values of 7.02 and 3.18 g/dlrespectively,earlier noted by[23]. Thisindicates that anti-nutritional factors in test diets could not reduce nutrient absorption but proposed intact health hepatic cellular functions. The constant globulin values observed, could probably be due to thegoats adaptation to stress which made themdisease-freeand caused excessive production of antibodies through gamma globulin production[12]. It might be logical to say that the favourable role of test feeds gave way to increased soluble carbohydrate for metabolic efficiency in the stomach which modulated nutritional metabolism. This might probablybe translatedto the improvement in serum glucose and triglyceride that was linked tothe increment in body weight gain of the animals. The low creatinine levels in serum, suggest no muscle or tissue wastage and animals did not survive at the expense of their body reserves. This is proportional to the low urea levels with positive nitrogen balance observed in animals on test diets, reflecting the superiority of the dietary protein that was efficiently utilized and did not cause excessive protein catabolism that is associated with protein deficiency.The[27] noted intheliteraturethat urea tests measure the amount of nitrogen in the serum and high serum urea level is an indication of kidneydysfunction because protein intake and kidney functioning are affected bythe quantityof blood urea nitrogen.

Serum enzymes are found in practically every tissue of theanimalbody, inducing red blood cells that are highly concentrated in cardiac muscle and liver intermediate in skeletal muscle and kidney but much lower concentration in other tissues [28].Theirmeasurements are helpful for diagnosis and following cases of myocardial malfunction, hepatocellular disease and skeletal muscle disorders. They are excellent markers of hepatic liver damage caused by exposure to toxic substances [22]. The reference values of SGOT (14.0 to 123 U/L), SGPT (15 to 44 U/L), ALT (10.3 to 53.3 U/L) and AST (43 to 230 U/L) reported by[4];[12]for goats were within the recorded values obtained in this study. These normal physiological serum enzymelevels imply that the phytogenic bioactive components in the test diets had no debilitating effect on the liver of the animals [13], asserted that the clinically significant risk of serum enzyme activities above normal range is an aberration and indication that animals may suffer from liver diseases. Moreover, the clear low values of serum enzymes, creatinine and cholesterol in conjunction with urea observed in this study could be conventionally used as tools to show that the test ingredients did not interfere with renal and hepatic functions, explainingthe absence of damage in theliver and myocardial.

The residual effect of tannin and saponin in the test diets could be responsible for thescavenging effect of free radicals in the blood that suppressed serum as expressed in low cholesterol[22], observed that acholesterol level of 180mg/dl and below may not result in arteriosclerosis, hence the values registered in this work suggest a safe concentration for good animal health. The increased levels of high-density lipoprotein cholesterol noted in animals on test diets further attest to the good effect of the feeds that could prevent peripheral artery disease and arteriosclerosis[28], found that low and very low-densitylipoproteins are considered bad cholesterol because their high levels can cause a build-up of cholesterol in arteries. However, the reduction of their concentration levels in the test diets could be attributed to high dietary fiber utilization andthe presence of secondary metabolites which could depress hepatic activities of lipoemic and cholesterol enzymes.

5Conclusion

The study discovered that feeding dried flutedpumpkin pulp with different proportions of soursop leaf powder as a dietary supplement to goats can serveas apotential alternative feed that willprovide a more practical approach to their feeding regime. Thus, it is expected that this alternative feedcan go a long way in making animal protein available at affordable prices to an average Nigerian and alsoreduce competition between man and ruminant livestock for feeds, most especially during the dry season.

The efficacy of processing fluted pumpkin pulp and soursop leaf powder in the study diets reducedanti-nutritional factors and provided phytogenic components. This increases nutrient utilization as demonstrated in greater feed ingestion capacity with nutrient digestibility that consequently improved health status and body tissue build-upas seen in growth performance without any negative effect in goats. However, the response in terms of goat improvement was more pronounced in diets that contained 6% dried flutedpumpkin pulp with 2.5 or 3% soursop leaf powder (SLO_3 and SLW_4)

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