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Effects of Nutrients Utilization on Feeding Fortified Sweet Potato Vines with Roasted Soy Bean Meal at Different Time Regimes by Dairy Goats

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Abstract: **In Kenya, Napier grass (NP) and sweet potato vines (SPV) are some of the main source of feeds for dairy goats in low-inputs farming systems. The two, contains both high moisture and rumen degradable protein (RUP) which have negative effects in the utilization of nutrients. These effects can be reduced by fortifying the fodder diets with different amount of roasted soybean meal (RSBM). The objective of the current study was to investigate the amount of RSBM that is suitable for optimal utilization of nutrients in the two fodders. Three (3) diets were formulated as follows A= Control, B= Control Diet+ 3.25% RSBM and C= Control Diet+ 6.5% RSBM. The diets were offered to three Kenya Alpine and Toggernburg does in three feeding times. Data on apparent digestibility of the diets composition, rumen ammonia Nitrogen and nitrogen balance were recorded and analysed. In Kenya Alpine diet A and B had the highest (P<0.05) dry matter (DM) and organic matter (OM) apparent digestibility and C the lowest (P<0.05). In Toggernburg does diet A had the highest (P<0.05) DM and OM digestibility and C the lowest (P<0.05). In Toggernburg feeding time regime β had the highest (P<0.05) nitrogen free extracts apparent digestibility and α lowest (P<0.05). On nitrogen balance diet C had the highest (P<0.05) while C had the lowest (P<0.05) in Kenya Alpine. In addition, trial diet C had the highest (P<0.05) nitrogen balance while A had the lowest (P<0.05) in Toggernburg.**

Keywords: **Fortified, Sweet Potato Vines, Roasted Soybean Meal, Time Regimes, Dairy Goats.**

I. INTRODUCTION

In Kenya, Napier grass (NP) and sweet potato vines (SPV) are some of the main source of feeds for dairy goats in low-inputs farming systems [1]. The two forages are usully fed when in “fresh” form, a stage when protein content of the plants is at the optimal. Coincidentally this is the stage when the fodders have both high moisture and rumen degradable proteins (RDP) content [2]. High moisture content is a major limitation in the utilization of the forages as it limits the feed intake while RUP generate ammonia nitrogen which in excess, is poisonous to the body. As a way of minimizing the negative effects found in the forages based diets. The diets can be fortified with different amount of roasted soybean meal (RSBM) so as to reduce moisture content and increase rumen undegradable proteins (RUP) to meet high nutrient utilization in dairy goats. The objective of the current study was to investigate the amount of RSBM that would be suitable in optimal utilization of nutrients in NP and SPV based diets for dairy goats. There are effects in feed utilization when RSBM is fed as a protein supplement to dairy animals [3].

II. MATERIALS AND METHODS

Experimental Site and Dietary Ingredients

The experiment was conducted at the Animal Unit of Kenya Agriculture and Livestock Organization, (KARLO) - Embu Centre. The Centre lies on the South Eastern slope of Mount Kenya at 00°33.18'S; 037°53.27'E; 1420m above sea level where half an acre of Napier grass (NG) and Sweet potato each were grown according to the recommended agronomic practices. Sweet potato (both vines- SPV and roots-SPR) at harvested on maturing at the age of five months while NG was cut at a height of 150 cm and about 20 litres of molasses (ML) was purchased locally. A batch of 20 kg of SBM was put in a mixer, made from a closed drum fixed on a stand with a handle, was placed on top of glowing embers and was heated to 150^{o}C for 45 minutes with the mixer being continuously rotated to ensure uniform roasting.

Experimental Animals

Three each Kenya Alpine and Toggernburg lactating does were acquired from farms in Embu and Tharaka Nithi Counties respectively. The does were ear tagged, weighed and baseline data on age, days in-milk and parity was recorded as summarized in Table, 1.

TABLE 1: Measurements of Various Variables for Lactating Kenya Alpine and Toggernburg Goats

	Kenya Alpine					
Goat	Age (months)	Weight (kg)	Days in-milk (days)	Parity	Fecundity	Milk yield during adaptation (ml)
1	45	46	40	3	1	671.7
2	48	32	35	3	2	741.7
3	60	33	20	6	1	785.0
	Toggernburg					
1	72	37.5	45	6	2	631.0
2	36	27.5	30	3	1	372.0
3	35	32.2	25	3	1	960.0

The does were later transported to the experimental site (KARLO- Embu Centre, Animal Unit) and on arrival the does were injected with tetracycline and put in separate pens according to the breed where they were provided with control trial diet, water and multi-mineral licks in *ad libitum*. Subsequently, they were drenched with an anti-helminthic and sprayed with an accaricide and quarantined for a period of 7 days. After the period, does were separated and placed into individual pens with a feed trough and a watering bucket for the feeding trial.

Ingredients Rumen Degradability

About 10 grams (g) of NG, SPV, SPR and (ML) were collected in triplicate and oven dried at 65ºC for 48 hours. The samples except ML were ground using a Wiley Mill with a 1 mm screen for chemical analysis method (AOAC, 1990). Later about 5 g of samples were placed in nylon bags, size 6.5 x 14 cm with a pore size of 41 µm width ratio to length between 1:1 (i.e. square) and 1:2.5. The bags were tightly tied at random onto three plastic tubes using nylon strings, each holding four bags and were incubated in the rumen of a fistulated mature steer on Rhodes grass hay, for a 16 hour period. Another 3 g of the samples were analysed for CP and recorded as initial (I).

After the period, the bags were removed and immediately immersed into a bucket of water and shaken vigorously for several times. The bags were later untied from the plastic tube and washed under running tap water while rubbing gently between thumb and fingers until the running water was clear. The residues in bags were dried in an oven at 60°C and weight recorded until a constant weight was obtained. The final weight of the residue in the bags was recorded as (R). The residue were later analyzed for CP content (R) using the Kjeldahl method [4]and rumen undegradable protein% (RUP %) calculated as; RUP % =I-R/I (g)*100.

Preparation of Trial Diets and Feeding

The trial diets were formulated based on both total crude protein (CP) and Rumen Undegradable Protein (RUP) content of the ingredients. Three iso-nitrogeneous trial diets (15% CP calculated) were formulated as summarized in Table 2.

TABLE 2: Ingredient Content (%DM) and Calculated Crude Protein (CP) (%) Level of Three Trial Diets

	Trial Diets		
Ingredient (%)	A	B	C
NG	39.96	40.69	39.87
SPV	34.64	25.91	12.21
SPR	20.41	19.27	20.00
ML	4.97	5.03	5.10
RSBM	0.00	9.10	22.82
Total	100.00	100.00	100.00
CP (Calculated)	15.00	15.00	15.00

NG= Napier Grass, SPV= Sweet Potato Vines, SPR= Sweet Potato Roots, ML= Molasses and PSBM=Processed Soybean Meal by Roasting

Diet A= Control, Diet B= Control Diet+ 3.25% RSBM and Diet C= Control Diet+ 6.5% RSBM

Diet (A) (control) was formulated with (0%) roasted SBM, B (3.25%) and C (6.5 %) of the total CP (Table 2). The ingredients were compounded into a Total Mixed Ration (TMR) and fed to each of three lactating Kenya Alpine and Toggernburg does according to live weights [5]. Each ration was fed to the various does at different feeding times (regimes) (α, β & γ) that is α (morning at 8.00 am), β (mid-day at 12.00), and γ (evening at 4.00 pm) according to two Graeco-Latin Square designs were used in feeding the three lactating Kenya Alpine and Toggernburg does the three trials diets in three feeding (times) regimes for three periods as summarized in Table 3

TABLE 3: Graeco-Latin Design Used in Feeding Kenya Alpine and Toggenburg goats (1, 2 &3) the Three Trials Diets (A, B &C) at Three Feeding Times (Regimes) (α, β & γ) in Three Periods I, II and III.

Kenya Alpine does			
Periods	1	2	3
I	Aα	Bβ	Cγ
II	Cβ	Aγ	Bα
III	Bγ	Cα	Aβ
Toggernburg does			
I	Cβ	Aγ	Bα
II	Bγ	Cα	Aβ
III	Aα	Bβ	Cγ

α =(Morning at 8.00 am), β= (Mid-day at 12.00), and γ= (Evening at 4.00 pm).

The computed means were subjected to analyses of variance (ANOVA) to test for any significant differences (P=0.05) on response variables. Means were separated using Fisher's least significance difference (lsd) procedure [6].

Feeding and Sample Collection

The three (3) trial diets were offered in three feeding times (regimes) daily to the does. The lactating Kenya Alpine and Toggernburg does were placed in individual metabolism cages containing a feed trough while water and mineral lick were offered *ad libitum*. The rations were offered for an adaptation period of 14 days followed by a five-day period of data and sample collection. During the period, faeces and urine of each doe voided during each 24-hour day were collected by anchoring a mosquito net under the slated floor of the metabolic cages to trap the faeces. Urine was collected on plastic paper anchored beneath the mosquito net with a sagging opening at the center. The urine passed through the opening into funnel fixed on the cover of bucket. About 10% of a urine sample of the total collected in the bucket each day was taken. The urine samples were mixed with with 0.1N H_2SO_4 acid at a ratio of 1:4 before preserving them under -4^{o}C for nitrogen analysis. Feed samples were collected by taking 10% of the trial diets from feeding troughs for each day. The feed samples were stored at -4^{o}C for nutrient analysis according [4].

Rumen fluid was collected on 20th day of the trial period, by inserting a speculum inside the mouth of doe and a lubricated rubber tube inserted through it into the rumen via the esophagus. About 250 ml ruminal fluid was drawn using an electric pump at 0, 3, 6, 9 and 12 hours post-feeding trial diets. The rumen fluid was strained through 4 layers of cheesecloth and a pH was taken using a pH reader. The liquor was later acidified to a pH of 2 with 50% H_2SO_4 and later frozen at -20^o C for ammonia nitrogen (NH-N) analysis according [4].

Rumen Liquor and Urine Ammonia Nitrogen

About 5 ml (initial-I) of rumen fluid was pipetted into a distillation flask and 3 drops of universal indicator solution was added followed by 10 ml sodium tetraborate solution. The contents were distilled until 30ml was collected and distillate was titrated using g 0.1 M HCl. A standard ammonium sulphate was also titrated. The amount of ammonia liberated was recorded (ml). To convert into percentage ammonia liberated, the following formula was used, ammonia liberated (mL)/I*100.

Nitrogen Balance

Nitrogen balance was calculated by subtracting milk and urine protein from digestible CP.

III. RESULTS

Dry Matter, Crude Protein and Rumen Degradability of the Ingredients

Results of dry matter, crude protein and rumen degradability of the ingredients of trial diets are summarized in Table, 4.

TABLE 4: Dry Matter (DM), Crude Protein (CP) and Rumen Dry Matter Degradability of Dietary Ingredients

	Ingredients				
Parameter (%)	NG	SPV	SPR	ML	RSBM
DM (%)	17.6	16.4	41.1	70.1	96.5
CP (%DM)	12.2	20.0	6.4	2.5	48.3
Rumen DM degradability (%)	36.0	78.0	88.0	100.0	27.6

NG= Napier Grass, SPV= Sweet Potato Vines, SPR= Sweet Potato Roots; ML= Molasses and RSBM= Roasted Soybean Meal.

Nutrient Composition of Trial Diets

Results on nutrient composition of the three trial diets are summarized in Table, 5.

TABLE 5: Dry Matter and Nutrient Composition (%DM) of the Trial Diets

		Diet	
Nutrients (%)	A	B	C
DM	40.7	41.2	42.0
OM	89.0	89.3	89.5
CP	13.8	14.1	14.2
NFE	28.5	32.2	32.9
CF	44.7	40.9	40.3
EE	1.9	2.0	2.1
Ash	11.0	10.8	10.5
GE (Kj)	16.1	16.2	17.1

DM= Dry Matter, OM= Organic Matter, CP= Crude Protein, NFE= Nitrogen Free Extract, CF= Crude Fibre, EE= Ether Extract. Gross Energy=Gross Energy, Kj=Kilojoules

Diet A= Control, Diet B=Control Diet+ 3.25% PSBM And Diet C= Control Diet+ 6.5% PSBM

Nutrient Intake

Results on nutrients intake for both lactating Kenya Alpine and Toggernburg does fed on the three trial diets are summarized in Table, 6.

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TABLE 6: Nutrient Intake (G) of Lactating Kenya Alpine and Toggernburg Does Fed on Three Trial Diets

	Kenya Alpine				Toggernburg			
Parameter	A	B	C	+SE	A	B	C	+SE
DM (g)	1239.0	1219.7	1197.0	4.56	1239.0	1219.7	1197.0	4.56
OM(g)	757.3	759.7	761.5	1.56	691.9	694.1	695.8	1.17
NFE(g)	242.6^{c}	274.4^{b}	280.2^{a}	0.74	221.6^{b}	250.7^{a}	256.0^{a}	1.65
CF(g)	380.7^{a}	348.4^{b}	343.3^{b}	5.42	347.9^{a}	318.3^{b}	313.6^{b}	4.87
EE(g)	16.3^{b}	$16.7a^{b}$	17.6^{a}	0.28	14.9	15.2	16.1	1.42
GE (Kj))	199.5^{c}	197.5^{b}	204.7^{a}	2.44	199.5^{c}	197.5^{b}	204.7^{a}	2.44
RDP(g)	35.3^{a}	30.2^{b}	19.7^{c}	0.18	32.5^{a}	27.8^{b}	18.0^{c}	1.84
RUP(g)	8.8^{c}	13.9^{b}	24.4^{a}	1.61	8.6^{c}	12.5b	22.3^{a}	1.21

Means with different superscripts within the same column are significantly different ($p < 0.05$)
DM= Dry Matter Intake, OM= Organic Matter, NFE= Nitrogen Free Extract, CF= Crude Fibre, EE= Ether Extract, RDP=Rumen Degradable Protein, RUP=Rumen Undegradable Protein

Diet A= control, Diet B=control diet+ 3.25% PSBM and Diet C= control diet+ 6.5% PSBM

There was difference (P<0.05) in nutrient intake except, for dry matter (DM) and organic matter (OM), according to three trial diets in Kenya Alpine (Table, 6). For instance, trial diet A had highest (P<0.05) crude fibre (CF) and rumen degradable protein (RDP) and the lowest (P<0.05) nitrogen free nitrogen (NFE) and rumen undegradable (RUP) intakes (Table, 6). In the same breed, trial diet C had highest (P<0.05) NFE, ether extract (EE), gross energy (GE) while RUP and CF and RDP the lowest (P<0.05) intakes (Table, 6).

There was difference (P<0.05) in nutrient intake except, DM, OM and ether extract (EE), according to trial diets in Toggernburg (Table 6). Trial diet A had highest (P<0.05) CF and RDP and the lowest (P<0.05) NFE and RUP intakes (Table, 6). In the same breed, trial diet C had highest (P<0.05) NFE, gross energy (GE) and, RUP and RDP the lowest (P<0.05) intakes (Table, 6). In same breed, CF intake was lowest (P<0.05) for trial diet C and B while GE intake was lowest (P<0.05) for diet A and B.

Results on nutrients intake for both lactating Kenya Alpine and Toggernburg does according to three feeding times are summarized in Table, 7.

TABLE 7: Nutrient Intake (G) of Lactating Kenya Alpine and Toggernburg Does Fed according to Three Feeding Regimes

	Kenya Alpine				Toggernburg			
	α	β	γ	+SE	α	β	γ	+SE
DM(g)	1218.6	1218.6	1218.6	2.41	1218.6	1218.6	1218.6	2.41
OM(g)	758.5	761.7	759.5	1.30	693.2	691.5	693.9	1.17
NFE(g)	265.7	262.4	263.9	0.68	243.8	242.3	241.6	0.57
CF(g)	355.5	357.5	358.3	4.44	325.6	327.1	326.3	4.73
EE(g)	16.7	16.0	16.3	0.32	15.0	15.4	15.6	0.07
GE (Kj)	198.6	200.4	201.5	2.36	197.6	199.1	198.2	1.02
RDP(g)	28.2	28.3	27.9	0.23	25.0	25.7	26.2	0.55
RUP(g)	15.7	15.7	15.7	1.52	14.3	13.9	14.0	0.21

DM= Dry Matter Intake, OM= Organic Matter, CP= Crude Protein, NFE= Nitrogen Free Extract, CF= Crude Fibre, EE= Ether Extract, RDP=Rumen Degradable Protein, RUP=Rumen Undegradable Protein
α =(Morning at 8.00 am), β= (Mid-day at 12.00), and γ= (Evening at 4.00 pm).

Nutrient Apparent Digestibility

Dry matter and nutrient apparent digestibility for both lactating Kenya Alpine and Toggernburg does fed on the three trial diets are summarized in Table, 8.

TABLE 8: Dry Matter And Nutrient Apparent Digestibility (%) in Lactating Kenya Alpine and Toggernburg Goats Fed on Three Diets

	Kenya Alpine				Toggernburg			
	A	B	C	+SE	A	B	C	+SE
DM	62.4[a]	59.1[a]	57.8[b]	1.05	60.4[a]	56.5[b]	52.6[c]	1.20
OM	77.8[a]	76.1[a]	73.7[b]	0.98	74.5[a]	71.2[b]	66.8[c]	1.03
CP	67.0	67.5	67.4	1.66	72.4	75.9	78.1	1.66
NFE	79.0	83.7	83.4	1.51	70.6	76.2	73.7	1.02
CF	50.1[c]	62.8[b]	67.6[a]	0.86	55.0[b]	58.9[a]	58.7[a]	0.74
EE	73.8[c]	76.4[b]	80.5[a]	1.55	70.3[c]	74.0[b]	76.2[a]	1.77
Ash	64.5	62.2	60.9	0.45	59.4	57.0	61.50	0.62
DE	70.1[c]	74.5[b]	77.3[a]	0.19	60.1[c]	65.6[b]	72.9[a]	0.61

There was difference (P<0.05) in DM, OM, CF, EE and energy apparent digestibility in Kenya Alpine according to three trial diets (Table, 8). For instance, trial diet A and B had the highest (P<0.05) DM and OM apparent digestibility and C the lowest (P<0.05) (Table, 8. In the same breed, trial diet A had highest (P<0.05) CF, EE and energy apparent digestibility levels and C the lowest (P<0.05) (Table 8).

There was difference (P<0.05) in DM, OM, CF, EE apparent digestibility and DE in Toggernburg does (Table, 8). For instance trial diet A had the highest (P<0.05) DM and OM digestibility and C the lowest (P<0.05) (Table, 8). In the same breed, trial diet B and C had highest (P<0.05) CF digestibility and A the lowest (P<0.05). Trial diet A had highest (P<0.05) EE and energy apparent digestibility levels and C the lowest (P<0.05) (Table, 8).

Results on apparent digestibility for both lactating Kenya Alpine and Toggernburg does fed on the three feeding times (regimes) are summarized in Table, 9.

TABLE 9: Dry Matter and Nutrient Apparent Digestibility (%) in Lactating Kenya Alpine and Toggernburg Goats according to Three Feeding times

	Kenya Alpine				Toggernburg			
	A	β	γ	+SE	A	β	γ	+SE
DM	59.8	59.0	58.5	1.02	56.5	56.5	56.5	0.06
OM	75.9	75.9	74.3	0.98	71.3	69.2	70.8	1.02
CP	66.9	68.1	67.3	1.63	72.5	74.5	75.5	1.52
NFE	82.0	82.0	82.0	1.30	73.0b	76.2a	71.3b	1.47
CF	59.2	61.2	60.7	0.86	56.1b	60.2a	57.5ab	1.88
EE	76.9	77.7	76.4	1.32	73.2	73.5	74.5	1.77
Ash	62.5	62.0	62.2	0.49	59.3	61.1	59.0	0.64
DE	72.5	74.0	73.9	0.19	65.2	66.0	66.0	0.65

Means with different superscripts within the same column are significantly different ($p < 0.05$).

DM= Dry Matter, OM= Organic Matter, CP= Crude Protein, NFE= Nitrogen Free Extract, CF= Crude Fibre, EE= Ether Extract, DE=Digestible Energy

α =(Morning at 8.00 am), β= (Mid-day at 12.00), and γ= (Evening at 4.00 pm).

There was difference (P<0.05) in NFE and CF apparent digestibility in Toggernburg according to three feeding times (Regimes) (Table, 9). For instance, feeding regime β had the highest (P<0.05) NFE apparent digestibility and α lowest (P<0.05) (Table, 9). Feeding regime β had the highest (P<0.05) CF apparent digestibility and γ lowest (P<0.05) (Table, 9).

Rumen Ammonia-Nitrogen

Rumen ammonia-nitrogen of lactating Kenya Alpine and Toggernburg does 12 hours post-feeding the three trial diets are summarized in Table, 10.

TABLE 10: Rumen Ammonia-Nitrogen (mg/100m) of Lactating Kenya Alpine and Toggernburg Does 12 Hours Post-Feeding the Three Trial Diets

		Time				
Breed	Ration	0	3	6	9	12
	A	8.3^{a}	9.2^{a}	8.1^{b}	7.5^{a}	7.0
Kenya Alpine	B	7.8^{b}	7.1^{b}	10.6^{a}	6.9^{b}	7.1
	C	7.1^{b}	7.1^{b}	5.6^{c}	6.3^{b}	6.8
	+SE	1.7	1.7	1.3	1.1	1.5
	A	6.7^{b}	8.0^{b}	7.1^{b}	6.4^{b}	6.0
Toggernburg	B	7.2^{a}	9.6a	8.2^{a}	7.2^{a}	6.4
	C	6.8b	7.8b	6.7^{b}	7.0^{a}	7.1
	+SE	1.7	1.5	1.2	1.2	1.6

Means with different superscripts within the same column are significantly different (P < 0.05). A= Control, Diet B=Control Diet+ 3.25% PSBM And Diet C= Control Diet+ 6.5% PSBM

There was significant difference in rumen ammonia-Nitrogen levels in 0, 3, 6 and 9 hours according to three trial diets in the both breeds (Table, 10). For instance, trial diet A had highest (P<0.05) ammonia-Nitrogen levels in 0 (zero), 3 (three) and 9 (nine) hours while B and C the lowest (P < 0.05) in Kenya Alpine (Table, 10). In the same breed, trial diet B had the highest (P < 0.05) ammonia-Nitrogen levels in 6 hours and C the lowest (P < 0.05) (Table, 10). In addition, trial diet B had the highest (P<0.05) ammonia-Nitrogen levels in 0 (zero), 3 (three), 6 (six) hours and 9 (nine) hours while A and C the lowest (P < 0.05) in 0 (zero), 3 (three), 6 (six) hours A alone in 9 (nine) hours in Toggerburg (Table, 10).

Nitrogen Balance

Results on nitrogen balance of lactating Kenya Alpine and Toggernburg does fed on three trial diets are summarized in Table, 11.

TABLE 11: Nitrogen Balance of Three Trial Diets Fed on Kenya Alpine and Toggernburg Dairy Does.

Breed	Ration	Digestible CP (g/day)	Urinal N (g/day)	Milk N (g/day)	N balance
	A	25.7^{c}	2.1^{c}	36.8^{a}	-13.2^{c}
Kenya Alpine	B	32.0^{b}	2.7^{b}	24.9^{b}	4.4^{b}
	C	34.7^{a}	3.1^{a}	22.7^{b}	8.9^{a}
	+SE	8.8	0.1	12.6	1.5
	A	23.5^{b}	1.4^{b}	33.8^{a}	-11.7^{c}
Toggernburg	B	29.2^{a}	1.5^{b}	23.2^{b}	4.5^{b}
	C	31.7^{a}	2.9^{a}	20.0^{b}	8.8^{a}
	+SE	11.5	0.1	9.4	2.2

Means with different superscripts within the same column are significantly different (P < 0.05).
CP=Crude Protein N=Nitrogen
A= Control, Diet B= Control Diet+ 3.25% PSBM and Diet C= Control Diet+ 6.5% PSBM

There was significant difference in nitrogen balance according to trial diets. For instance, trial diet C had the highest (P<0.05) nitrogen balance while C had the lowest (P<0.05) in Kenya Alpine (Table 11). In addition, trial diet C had the highest (P<0.05) nitrogen balance while A had the lowest (P<0.05) in Toggernburg (Table 11).

IV. DISCUSSION

Nutrient Composition

[7]reported dry matter (DM) and organic matter (OM) content of a diet with crude protein (CP) of 17.4% as 57.6 and 92.1% results which are higher than the present study of (40.7-42.0), and about 89.0% respectively (Table,6). The variation could have resulted from high DM content of major ingredients in the diets such as corn silage of 27.0% in the earlier study compared with Napier grass and SPV in the present study of 17.6 and 16.4% respectively (Table, 6). [8] reported DM of diets of whole ensiled forages and ensiled forages and dry hay with a CP of 15.1 and 13.8% as 47.1 and 51.2% respectively a trend similar to the one observed in the present study (Table, 6).

Nutrients Intake

[9]reported dry matter intake (DMI) of Sidama goats as 2.5- 3.25% (Live bodyweight (BWt) results close to the present studies of 2.5% (BWt) (Table, 7). In the same study, Megersa et al. (2013) reported organic matter (OM) intake as 316-475 g/day which lower than the results in the present study of 691.9-761.5 g (Table 7).

Apparent Digestibility

[10]reported total nutrient digestibility of fresh and sundried sweet potato vines diets in Barki rams as 61.9 and 64.3% respectively which is higher than results in the present study of 52.6-62.4% (Table 9). The variation could have resulted from use of sheep in the earlier study. [9]reported apparently digestibility of dry matter in Sidama goats as 56-74% higher than results in the present studies of 52.6-62.4% (Table 9). The variation could have been caused by replacement of grass hay with SPV in the earlier study. An increase in digestibility of mature grass hay in sheep supplemented with forage legume depends on several factors, of which the level of nitrogen in the rumen is of paramount importance [11].

In the same study, [9]reported organic matter (OM) apparently digestibility as 59-75% which lower than the results in the present study of 67-78% (Table 9). The variation could have been caused by use of few ingredients in the earlier study. In the same study, apparent digestibility was reported as 60-88% which closes to results in the present study of 68-78% (Table 9

Ammonia Nitrogen

In both Kenya Alpine and Toggernburg dairy does, there was variation in rumen ammonia-Nitrogen levels in 0 (zero), 3 (three), 6 (six) and 9 (nine) hours (Table 13) due to variation in the trial diets. The low ammonia-Nitogen levels in 0 (zero), 3 (three) and 6 (six) hours in both lactating Kenya Alpine and Toggernburg dairy does on feeding trial ration C (Table 13) could have resulted from large quantities of PSBM compared to control diet A. Processed SBM could have escaped from the microbial degradation due to protection resulting from roasting unlike SPV which is a major component in control diet A (Table 5). This is closely related to [12] who reported that undegradable or bypass protein is not available for bacterial growth and is the main factor influencing protein degradability resulting into ruminal ammonia-N. In addition, [13] observed that increased dietary UIP levels relatively decreases the ruminal ammonia-N in the rumen. Other authors such [14] has advanced that reduction of crude protein degradability in the rumen results in a reduced ammonia level. While [15] has explained that degradation of peptides and deamination of amino acids in the rumen from reduced proteolysis attributes to lower ammonia concentrations. On contrary, the observed high levels of rumen ammonia on feeding control diet A was as a result of degradation of SPV, major component in the diet, that highly soluble as a result of ruminal microorganism degradation.

This is in agreement with [16] who reported that SPVs have high amount of soluble proteins which easily degrades in the rumen into simple nitrogenous compound like ammonia N. [10]reported mean ruminal Ammonia Nitrogen in Barki ewes as 15.0 and 14.2, six hours post feeding fresh and sundried sweet potato vines respectively which is lower than results in the present study of 8.5 and 7.3 in Kenya Alpine and Toggernburg on control diet (A) respectively (Table 18). The 10% soybean meal, and 13% undecorticated cotton seed meal in the feed mixture concentrate in the earlier studies could have caused the variation.

Nitrogen balance

The positive N-balance observed in trial diet B and C in both lactating Kenya Alpine and Toggernburg goats could have been from substantial amount of PSBM in two diets (Table 5). Probably the PSBM provided the correct protein quality required by the various body activities unlike in control diet which the N-balance was negative (Table 15). This is evident from low levels of digestible CP in the control diet (Table 15).

V. CONCLUSION

Feeding sweet potato vines fortified with roasted SBM at 9.1% resulted in low dry matter intake and high RUP intake. Feeding regimeβ (Mid-day feeding) resulted in high crude fibre and Nitroge free extract (NFE) digestibility. Feeding sweet potato vines fortified with roasted SBM at 22.8 % resulted in high crude fibre digestibility and Nitrogen balance.

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