Comparative Evaluation of Abscised Unripe Mango Fruits, Maize and Samsorg-49 Offals as Dietary Energy Sources on Performance and Methane Emission of Yankasa Ram Lambs

Taofik Adam Ibrahim[1*], Emmanuel Opoola[2], Khalifa Nababa Adamu[1], Ishaka Ademu[1]

• [1] Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria.
• [2] College of Agriculture, Kabba, Ahmadu Bello University, Nigeria.

INTRODUCTION & AIM

- Small ruminant production like sheep in Nigeria contributes to food security, income generation and rural livelihoods.
- However, the sustainability of sheep production is challenged by the high cost and limited availability of quality feedstuffs like maize, sorghum and their by-products (FOA, 2017).
- Abscised unripe mango fruits (AUMF), common waste products from mango orchards, are rich in carbohydrates with polyphenols that exhibit antioxidant activity and can reduce methane emission in ruminants.
- Utilizing AUMF in comparison to maize and Samsorg-49 offals as dietary energy offers a promising approach towards realizing their economic value for mango orchards, nutritional potential and carbon footprints in Yankasa sheep production.
- Also, abscission of unripe mango fruits in Nigeria correspond with the dry season period when the available grazing areas have declined both in quantity and quality, making them good alternative feedstuffs for sheep (Ibrahim et al., 2025).
- Therefore, this study evaluated the effects of dietary inclusion of abscised unripe mango fruit meal in comparison to maize offal and Samsorg-49 offal on the growth performance, nutrient utilisation, methane emission and rumen indices of Yankasa ram lambs.

METHOD

- 12 Yankasa rams, 6–8 months old, averagely 17.33 kg live body weight.
- AUMF were collected from February to April, every batch collected was crushed and dried for 10 days and milled using 10 mm sized sieve.
- 30% dietary inclusion of each test ingredient fed at 5% animal's body weight in an 85-day feeding trial. Rams were weighed fortnightly to monitor growth performance.
- Digestibility and nitrogen balance study, pH analysis (pH200E pH Meter, DRAWELL), volatile fatty acid using HPLC (Agilent 7890A, Agilent Inc., Palo Alto CA), rumen NH_3 (Weatherburn, 1967), rumen gas collection (Ibrahim et al., 2025) and methane determination using CO_2 absorption method (Theodorou, 1994) were all carried out according to laid down procedures.
- Data collected were subjected to analysis of variance using GLM procedure in SPSS 25.0 version. Significant means were compared using Duncan Multiple Range Test at P < 0.05.

Unripe mangos   Dry unripe mango   Milled mangos   Yankasa ram   Rumen gas sampling

RESULTS & DISCUSSION

Table 1. Performance and Methane Emission of Yankasa Ram Lambs Fed AUMFM, Maize and Samsorg-49 Offals as Dietary Energy Ingredients

Parameters	AUMFM	Maize offal	Samsorg49	SEM	P value
Initial weight (kg/ram)	17.25	17.00	17.75	1.24	0.58
Final weight (kg/ram)	26.10	26.50	25.18	1.60	0.08
Total weight gain (kg/ram)	8.85[a]	9.50[a]	7.43[b]	0.54	0.01
Daily weight gain (g/ram)	97.25[a]	104.40[a]	81.59[b]	5.98	0.01
Total feed intake (kg/ram)	70.28	68.65	67.28	6.51	0.67
Daily feed intake (kg/ram)	0.77	0.75	0.74	0.07	0.67
Feed conversion ratio	7.95[ab]	7.27[a]	9.18[b]	0.73	0.04
Feed cost/kg gain (N)	1331	1406	1653	NA	NA
Methane Emission					
3 hr CH_4 efficiency (%)	25.25	31.30	31.40	3.62	0.07
6 hr CH_4 efficiency (%)	24.90	30.55	30.23	2.33	0.05
Average CH_4 efficiency (%)	25.05[b]	30.93[a]	30.82[a]	1.49	0.01

[ab] Means with different superscripts differ significantly at P < 0.05 across rows, SEM = Standard error of mean. AUMFM=Abscised unripe mango fruit meal. NA=not analysed

RESULTS & DISCUSSION

Table 2. Nutrient Digestibility and Nitrogen balance of Yankasa Ram Lambs Fed AUMF Meal, Maize and Samsorg-49 Offals as Dietary Energy Ingredients

Parameters (%)	AUMFM	Maize offal	Samsorg-49	SEM	P value
Dry matter	74.80	70.46	69.10	5.65	0.34
Crude protein	84.45	84.11	82.70	3.08	0.58
Crude fibre	78.88	77.85	73.70	2.78	0.12
Ether extract	89.91	87.75	89.21	2.73	0.45
Crude ash	75.13	66.66	67.43	7.03	0.27
Nitrogen free extract	93.57	90.03	78.38	7.27	0.09
Neutral detergent fibre	74.01	71.93	72.65	4.70	0.68
Acid detergent fibre	70.99	70.17	70.12	5.97	0.54
Lignin	66.71	60.82	61.53	5.19	0.31
Nitrogen balance (g/day)					
Nitrogen intake	15.05	17.54	16.41	2.48	0.23
Nitrogen absorbed	12.18	14.63	12.61	2.05	0.18
Nitrogen retained	8.89	11.35	8.84	2.14	0.12
N-retained as % intake	58.87	61.09	53.87	5.74	0.07

SEM = Standard error of mean. AUMFM=Abscised unripe mango fruit meal

Table 3. Rumen Indices of Yankasa Ram Lambs Fed AUMFM, Maize and Samsorg-49 Offals as Dietary Energy Ingredients

Parameter	AUMFM	Maize offal	Samsorg-49	SEM	P value
pH	6.85	7.40	7.22	0.25	0.07
NH_3 (mg/dL)	21.75	20.33	21.50	4.52	0.76
Volatile fatty acid (g/dL)	19.75	22.33	22.50	4.35	0.54
Expressed as % of volatile fatty acid					
Acetic acid (A)	55.18	56.93	61.38	5.60	0.31
Propionic acid (P)	25.15	20.80	21.33	3.28	0.23
Butyric acid	11.55	15.10	11.45	2.08	0.17
A:P	2.30	2.79	3.01	0.54	0.15

AUMFM= Abscised Unripe Mango Fruit Meal, SEM=Standard error of mean

The weight gain of Yankasa ram lambs fed 30% dietary inclusions of AUMFM was higher (P<0.05) than Samsorg-49 offal while its feed conversion ratio was comparable to both maize and Samsorg-49 offals. However, inclusion of AUMFM had lower (P<0.05) enteric CH_4 production and higher CH_4 efficiency compared to maize and Samsorg-49 offals. There were increasing tendencies on NFE digestibility (P=0.09) and nitrogen utilisation (P=0.06) in AUMFM and maize offal as against Samsorg-49 offal.

CONCLUSION

- Dietary inclusion of AUMFM at 30% in Yankasa ram lamb supported weight gain comparable to maize offal but superior to Samsorg-49 offal.
- Although, nutrient utilizations appeared similar among the three dietary treatments, the AUMFM indicated strong potential as an economical, climate-friendly and sustainable alternative energy ingredients for ruminants, capable of improving performance while reducing greenhouse gas emissions.

FUTURE WORK / REFERENCES

Additional studies should focus on feedlot, dairy animals, poultry and other livestock species on the dietary inclusion of abscised unripe mango fruits.

FAO. (2017). The future of food and agriculture: Trends and challenges. Food and Agriculture Organization of the United Nations.

Ibrahim, T.A.; Ismail, M.; Lawal, M.; Zahraddeen, D.; Hassan, M.R. (2025). In Vitro Gas Production, Methanogenesis, Dry Matter Degradability, and Rumen Metabolites of Ripe and Abscised Unripe Mango Fruits of Three Varieties, in Proceedings of the 3rd International Online Conference on Agriculture, 22–24 October 2025, MDPI: Basel, Switzerland.