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Nutrient Intake, Carcass and By-Products Characteristics of Red Sokoto Goats Fed Maize Stover Ensiled with Cassava Peel Meal or Poultry Litter with Concentrate Supplement

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Abstract: Maize stover is an abundant but nutritionally limited roughage in sub-Saharan Africa whose value can be improved by ensiling with appropriate additives. This study evaluated the proximate composition, cell wall fractions, nutrient intake, carcass yield, and by-product characteristics of Red Sokoto goats fed ensiled maize stover with or without ground dried cassava peel (GCP) or dried poultry litter (DPL) additives, with or without concentrate supplementation. Six treatments were arranged in a completely randomised design: green maize stover ensiled alone (T1), green stover + 5% GCP (T2), green stover + 36% DPL (T3), dry stover alone (T4), dry stover + 5% GCP (T5), and dry stover + 36% DPL (T6). Eighteen Red Sokoto bucks were assigned to the six dietary treatments (3 per treatment). Inclusion of DPL markedly increased crude protein and ash content while reducing neutral detergent fibre, whereas GCP addition moderately improved dry matter content. Treatments T1 and T2, which included concentrate supplementation, recorded the highest total dry matter intake, slaughter weights, warm carcass weights, and dressing percentages. Goats on T3 (DPL-supplemented green stover without concentrate) showed inferior carcass performance. Liver and lung weights as proportions of slaughter weight were significantly affected by treatment. It is concluded that ensiling green maize stover with DPL improves silage nutritive value, but concentrate supplementation remains essential for satisfactory carcass performance in Red Sokoto goats.

Keywords: *Carcass By-Products, Dressing Percentage, Ensiled Maize Stover, Poultry Litter, Red Sokoto Goat.*

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I. INTRODUCTION

Maize (Zea mays L.) stover — the stalks, leaves, husks, and cobs remaining after grain harvest — represents one of the most abundantly generated crop residues in sub-Saharan Africa, including Nigeria, where maize production exceeds 10 million tonnes annually [1]. Despite its availability, the nutritive value of maize stover is constrained by high fibre content, low crude protein, and poor digestibility, particularly after physiological maturity when lignification is advanced [2]. Ensiling is an established preservation technique that can mitigate seasonal feed shortages while improving fermentation characteristics

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and nutrient retention of low-quality roughages [3]. However, maize stover alone has insufficient water-soluble carbohydrates to sustain efficient fermentation, and the resulting silage frequently has sub-optimal quality [4].

Additives introduced during ensiling can address these limitations. Dried poultry litter (DPL), a nitrogen-rich organic by-product, has been incorporated into silage to raise crude protein levels, stimulate lactic acid bacterial activity, and improve fermentation dynamics [5]. Cassava (*Manihot esculenta* Crantz) peel, a widely available agro-industrial by-product, is rich in soluble carbohydrates and has been explored as an ensiling substrate to supply fermentable sugars that support efficient acidification [6, 7]. Together, these additives represent practical, low-cost interventions for improving the feeding value of maize stover under smallholder conditions in the Guinea Savannah agroecological zone of Nigeria.

The Red Sokoto goat is the predominant small ruminant breed in northern Nigeria, valued for meat, skin, and milk production [8]. Information on how ensiled maize stover diets with different additives influence carcass traits and by-product yields in this breed remains limited. Earlier studies have demonstrated the effects of silage type on nutrient intake and growth performance of goats [9, 10], but comprehensive data linking silage additive strategy to slaughter outcomes in Red Sokoto goats under concentrate-supplemented and un-supplemented regimes are lacking. The present study, therefore, aimed to evaluate the proximate composition and cell wall fractions of ensiled maize stover with or without GCP or DPL additives, determine the dry matter and nutrient intake of Red Sokoto goats fed the experimental diets, and assess the carcass yield, wholesale cuts, and carcass by-products of the animals at slaughter.

II. MATERIALS AND METHODS

➢ *Study Site and Ethical Approval*

The feeding trial was conducted at the Livestock Teaching and Research Farm, Federal University Wukari, Taraba State, Nigeria (latitude 7°51′N, longitude 9°47′E), located within the Southern Guinea Savannah zone. The study was conducted in accordance with standard ethical guidelines for the use of experimental animals.

➢ *Silage Preparation*

Freshly harvested maize stover was obtained immediately after cob harvest, while dry maize stover was sourced from already-harvested and field-dried maize farms, representing the form in which the residue is most commonly available after grain harvest. Both forms were chopped to 3–5 cm lengths, and their moisture content was determined using a hot air oven set at 100°C for 24 hours. The fresh stover was wilted down to 65% moisture, whereas the dry stover was rehydrated to the same 65% moisture level required for ensiling, following the procedure of [11]

Once moisture content had been adjusted, three ensiling treatments were formulated: stover ensiled without additive (control), stover ensiled with 5% (w/w) ground dried cassava peel (GCP), and stover ensiled with 36% (w/w) dried poultry litter (DPL). Applying these three treatments to both stover forms generated six experimental silages: T1 (green stover, no additive), T2 (green stover + 5% GCP), T3 (green stover + 36% DPL), T4 (dry stover, no additive), T5 (dry stover + 5% GCP), and T6 (dry stover + 36% DPL). For each treatment, the chopped material was packed into airtight plastic drums, sealed, and left to ferment for 30 days before being opened for chemical evaluation, in line with established ensiling protocols adapted from [12] and [13]

➢ *Experimental Animals and Dietary Treatments*

Thirty Red Sokoto bucks of uniform age (7 – 9 months) and comparable initial live weight were selected and randomly assigned to six dietary treatments (n = 5 per treatment) in a Completely Randomized Design (CRD). The treatments were:

- T1 = Green maize stover ensiled without additive + concentrate supplement
- T2 = Green maize stover ensiled with 5% GCP + concentrate supplement
- T3 = Green maize stover ensiled with 36% DPL (no concentrate)
- T4 = Dry maize stover ensiled without additive + concentrate supplement
- T5 = Dry maize stover ensiled with 5% GCP + concentrate supplement
- T6 = Dry maize stover ensiled with 36% DPL (no concentrate)

Where provided, concentrate supplement (CS) was formulated from maize offal, brewer's dried grain (BDG), Bambara nut screening, bone meal, and common salt (Table 2) and offered at 200g/head/day. Silage was offered ad libitum. Animals had unrestricted access to clean water throughout the trial. The feeding period lasted 92 days, preceded by a 14-day adaptation period.

➢ *Feed Sampling and Chemical Analysis*

Representative silage and concentrate samples were analysed for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), ash, and nitrogen-free extract (NFE) by proximate analysis according to AOAC [14] procedures. Cell wall fractions — neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), hemicellulose (HC), and cellulose — were determined using the Van Soest *et al.* [15] method. Total digestible nutrients (TDN) were estimated as: TDN (%) = 87.84 − (0.70 × ADF%) [16]. Metabolisable energy (ME) was calculated as: ME (MJ/kg DM) = 13.5 − 0.15 × ADF% + 0.14 × CP% − 0.15 × Ash% [17].

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- *Intake Measurement*

Daily feed offered and refused was recorded per animal. Dry matter intake was computed as the difference between feed offered and refusals, expressed on a dry matter basis. Organic matter, crude protein, crude fibre, ether extract, and NFE intakes were derived by multiplying total DM intake by the corresponding nutrient fraction.

- *Slaughter Procedure and Carcass Evaluation*

At the end of the 98-day feeding period, all animals were fasted for 16 hours (water withheld for 12 hours), weighed to obtain fasted live weight (live weight at slaughter), and slaughtered humanely. Slaughter weight was recorded immediately after exsanguination. Warm carcass weight was taken after removal of the head, feet, skin, and internal organs. Dressing percentage was calculated as (warm carcass weight / slaughter weight) × 100. Empty body weight was obtained after emptying and weighing the gastrointestinal tract contents. Wholesale cuts (neck, shoulder, rack, loin, and legs) were expressed as percentages of slaughter weight. Carcass by-products: head, feet, heart, lungs with trachea, liver, kidneys, spleen, visceral fat, abdominal fat, full gut, empty gut, and skin, were each weighed and expressed as percentages of slaughter weight.

- *Statistical Analysis*

Data were subjected to one-way analysis of variance (ANOVA) using the General Linear Model procedure of SAS (version 9.4) [18]. Significant means were separated using Duncan's Multiple Range Test at $P < 0.05$. The statistical model was: $Yij = \mu + Ti + eij$, where Yij is the jth observation on the ith treatment, μ is the overall mean, Ti is the effect of the ith treatment (i = 1 to 6), and eij is the random error.

III. RESULTS

- *Proximate Composition and Cell Wall Fractions of Ensiled Maize Stover*

The proximate composition and cell wall fractions of the six ensiled maize stover treatments are presented in Table 1. Dry matter content ranged from 28.10% (T4) to 38.30% (T6) and was significantly ($P < 0.05$) affected by treatment. Green stover silages without additive (T1 and T4) had the lowest DM content, while DPL-incorporated silages (T3 and T6) recorded the highest values. Crude protein was highest in T3 (11.94%) and lowest in T5 (5.06%), with DPL incorporation (T3) significantly elevating CP relative to all other treatments. Ash content followed a similar trend, with DPL-supplemented silages recording significantly higher ash levels (T3: 9.02%; T6: 10.35%) compared to other treatments. Ether extract was highest in T6 (2.40%) and lowest in T1 (0.95%).

NDF was highest in T1 (59.43%) and lowest in T2 (40.72%), indicating that GCP inclusion reduced cell wall content in green stover. ADF was highest in T5 (39.14%) and lowest in T3 (28.72%). Hemicellulose (HC) was markedly reduced by both GCP and DPL addition compared to un-supplemented silages. TDN was significantly lower in DPL-supplemented dry stover (T5: 60.44%; T6: 61.60%) compared to other treatments. ME was highest in T1 (9.84 MJ/kg DM) and lowest in T6 (7.19 MJ/kg DM).

Table 1. Proximate Composition and Cell Wall Fractions (%) of Maize Stovers Ensiled with or without Ground Dried Cassava Peel or Dried Poultry Litter

Parameters (% DM)	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**SEM**
Dry matter (as fed)	28.90^{c}	32.90^{b}	36.80^{a}	28.10^{c}	32.00^{b}	38.30^{a}	0.383*
Crude protein	8.75^{b}	7.00^{c}	11.94^{a}	6.23^{d}	5.06^{e}	6.19^{d}	0.090*
Crude fibre	23.36^{a}	21.30^{b}	20.10^{b}	23.50^{a}	22.59^{a}	23.37^{a}	0.259*
Ash	3.25^{e}	6.66^{c}	9.02^{b}	5.97^{d}	6.67^{c}	10.35^{a}	0.085*
Ether extract	0.95^{d}	1.71^{c}	1.92^{b}	1.68^{c}	1.90^{b}	2.40^{a}	0.020*
NFE	63.69^{a}	63.33^{a}	57.02^{b}	62.62^{a}	63.78^{a}	57.69^{b}	0.709*
Organic matter	87.29	88.04	85.59	84.32	87.96	84.68	0.997
NDF	59.43^{a}	40.72^{e}	43.93^{d}	52.38^{b}	48.67^{c}	47.55^{c}	0.567*
ADF	29.31^{bc}	29.50^{bc}	28.72^{c}	30.60^{b}	39.14^{a}	37.48^{a}	0.377*
ADL	11.26^{b}	10.41^{c}	9.35^{d}	17.02^{a}	8.11^{e}	8.79^{d}	0.131*
Hemicellulose	30.12^{a}	11.22^{d}	15.21^{c}	21.78^{b}	9.53^{e}	10.07^{e}	0.207*
Cellulose	18.05^{c}	19.09^{bc}	19.37^{b}	13.58^{d}	29.61^{a}	28.69^{a}	0.255*
HC as % NDF	50.70^{a}	27.60^{d}	34.60^{c}	41.60^{b}	19.60^{e}	21.20^{e}	0.396*

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*TDN	67.32^{a}	67.19^{a}	67.74^{a}	66.42^{a}	60.44^{b}	61.60^{b}	0.752*
**ME (MJ/kg DM)	9.84^{a}	9.06^{bc}	9.51^{ab}	8.93^{c}	7.92^{d}	7.19^{e}	0.102*

*a,b,c,d,e Means within rows with different superscripts are significantly different (P < 0.05). T1 = Green Maize Stover ensiled without additives; T2 = Green Maize Stover + 5% w/w GCP; T3 = Green Maize Stover + 36% w/w DPL; T4 = Dry Maize Stover without additives; T5 = Dry Maize Stover + 5% w/w GCP; T6 = Dry Maize Stover + 36% w/w DPL. GCP = Ground Dried Cassava Peel; DPL = Dried Poultry Litter; NFE = Nitrogen-free extract; NDF = Neutral detergent fibre; ADF = Acid detergent fibre; ADL = Acid detergent lignin; HC = Hemicellulose. * = Significant (P < 0.05); ns = not significant.*

**TDN = 87.84 − (0.70 × ADF%) [13]. **ME = 13.5 − 0.15 × ADF% + 0.14 × CP% − 0.15 × Ash% [14].*

Table 2. Ingredient and calculated Nutrient Composition of Concentrate Supplement fed

Ingredient	**Proportion/Value**
Maize offal	39.8
Brewer's dried grain (BDG)	15.5
Bambara nut screening	40.7
Bone meal	3.0
Salt	1.0
Total	100
Calculated analysis	
Crude protein (%)	14.49
**ME (MJ/kg DM)	10.92

***ME = 13.5 − 0.15 × ADF% + 0.14 × CP% − 0.15 × Ash% [17].*

➢ *Dry Matter and Nutrient Intake*

Table 3 shows the dry matter and nutrient intake of Red Sokoto goats fed the experimental diets. Silage intake was highest in T6 (317.00 g/d DM) and lowest in T5 (125.27 g/d DM). Treatments that included concentrate (T1, T2, T4, T5) recorded significantly higher total DM intake than T3 and T6 (P < 0.05), with T2 having the highest total intake (392.80 g/d DM). Crude protein intake was highest in T2 (49.53 g/d) and lowest in T6 (19.62 g/d). Ether extract intake differed significantly, being higher in concentrate-supplemented groups. Crude fibre intake did not differ significantly among treatments (P > 0.05).

Table 3. Dry Matter and Nutrient Intake of Red Sokoto Goats fed Ensiled Maize Stover with or without Concentrate Supplementation

Parameters (g/d, DM)	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**SEM**
Silage intake	199.43^{bcd}	212.04^{bc}	263.75^{ab}	144.88^{cd}	125.27^{d}	317.00^{a}	25.76*
Concentrate intake	152.77^{a}	182.76^{a}	0.00^{b}	184.55^{a}	193.17^{a}	0.00^{b}	14.97*
Total DM intake	350.45^{b}	392.80^{a}	263.07^{d}	329.43^{c}	316.86^{c}	318.59^{c}	3.29*
Organic matter intake	310.47^{a}	342.84^{a}	225.74^{b}	290.37^{ab}	276.63^{ab}	268.44^{ab}	30.54*
Crude protein intake	34.20^{b}	49.53^{a}	31.49^{b}	31.78^{b}	33.35^{b}	19.62^{c}	3.77*
Crude fibre intake	61.68	65.59	53.01	55.94	53.56	74.08	6.54ns
Ether extract intake	13.36^{a}	15.97^{a}	5.07^{b}	14.77^{a}	15.58^{a}	7.61^{b}	1.28*
NFE intake	218.75^{a}	231.49^{a}	150.39^{b}	204.07^{a}	189.16^{a}	182.88^{ab}	20.98*

*a,b,c Means with different superscripts within rows are significantly different (P < 0.05). DM = dry matter; NFE = Nitrogen-free extract. T1–T6 as defined in Table 1. * = Significant (P < 0.05); ns = not significant*

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➢ *Carcass Yield and Wholesale Cuts*

Carcass yield parameters and wholesale cuts are presented in Table 4. Live weight at slaughter ranged from 7.77 kg (T3) to 14.57 kg (T1), with T1 and T2 being significantly heavier than T3 and T6. Warm carcass weight followed the same pattern, with T1 (6.55 kg) and T2 (6.67 kg) recording the highest values. Dressing percentage was highest in T1 (45.22%) and T2 (45.13%), which did not differ significantly from T4 (43.20%) and T5 (41.71%), but were significantly higher than T6 (32.28%). Empty body weight was significantly lowest in T6 (3.82 kg).

For wholesale cuts, neck and rack percentages were not significantly influenced by treatment. Shoulder cut was highest in T1 (15.74%) and lowest in T6 (10.85%). Loin percentage was highest in T4 (6.97%) and significantly lowest in T3 (4.34%). Leg yield was highest in T2 (15.39%) and lowest in T3 and T6 (9.61% and 9.50%, respectively).

Table 4. Carcass yield and Wholesale Cuts of Red Sokoto Goats fed Ensiled Maize Stover with or without Concentrate Supplementation

Parameter	T1	T2	T3	T4	T5	T6	SEM
Live weight at slaughter (kg)	14.57^{a}	14.32^{a}	7.77^{c}	12.62^{ab}	12.18^{abc}	9.16^{bc}	1.37*
Slaughter weight (kg)	14.01^{a}	13.66^{a}	7.41^{c}	12.00^{ab}	11.44^{abc}	8.73^{bc}	1.34*
Warm carcass weight (kg)	6.55^{a}	6.67^{a}	3.03^{b}	5.42^{ab}	5.14^{ab}	2.97^{b}	0.78*
Dressing percentage (%)	45.22^{a}	45.13^{a}	39.61^{ab}	43.20^{a}	41.71^{a}	32.28^{b}	2.72*
Empty body weight (kg)	8.23^{a}	7.96^{a}	4.16^{bc}	6.82^{ab}	6.61^{abc}	3.82^{c}	0.89*
Wholesale cuts (% of slaughter weight)							
Neck (%)	3.72	3.73	2.94	4.88	4.47	3.47	0.67ns
Shoulder cut (%)	15.74^{a}	15.14^{ab}	11.97^{bc}	14.10^{abc}	14.67^{ab}	10.85^{c}	1.01*
Rack (%)	5.89	5.68	5.21	5.71	5.26	4.69	0.53ns
Loin (%)	6.06^{ab}	5.77^{ab}	4.34^{b}	6.97^{a}	6.69^{ab}	4.53^{ab}	0.76*
Legs (%)	14.17^{a}	15.39^{a}	9.61^{b}	13.40^{a}	13.31^{a}	9.50^{b}	1.15*

*a,b,c Means with different superscripts within rows are significantly different (P < 0.05). T1–T6 as defined in Table 1. * = Significant (P < 0.05); ns = not significant.*

➢ *Carcass By-products and Visceral Organs*

Carcass by-products and visceral organ weights are presented in Table 5. Head weight as a proportion of slaughter weight was highest in T3 (9.72%) and lowest in T6 (6.80%). Lung weights were significantly highest in T3 (2.01%) and lowest in T6 (1.33%). Liver weight was highest in T4 (2.12%) and lowest in T2 (1.67%). Heart, kidneys, and spleen weights did not differ significantly among treatments (P > 0.05). Abdominal fat was absent in T3 and T6, while it was highest in T5 (1.37%). Skin weight was highest in T1 and T2 (5.35% and 5.47%, respectively) and lowest in T3 (2.78%). Full gut was highest in T6 (43.90%) while empty gut was highest in T3 (9.74%).

Table 5. Carcass By-Products and Visceral Organ Weights of Red Sokoto Goats fed Ensiled Maize Stover with or without Concentrate Supplementation

Parameters (as % of Slaughter Weight)	T1	T2	T3	T4	T5	T6	SEM
Head	7.39^{ab}	6.97^{b}	9.72^{a}	7.72^{ab}	7.35^{ab}	6.80^{b}	0.80*
Feet	2.99	4.48	4.43	3.43	2.93	3.36	0.98ns
Heart	0.51	0.44	0.45	0.59	0.59	0.45	0.06ns
Lungs with trachea	1.59^{ab}	1.51^{ab}	2.01^{a}	1.44^{b}	1.44^{b}	1.33^{b}	0.17*
Liver	1.78^{ab}	1.67^{b}	1.83^{ab}	2.12^{a}	1.88^{ab}	1.64^{b}	0.13*
Kidneys	0.33	0.33	0.43	0.38	0.31	0.38	0.04ns

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Spleen	0.20	0.13	0.39	0.20	0.11	0.12	0.20ns
Visceral fat	1.35	1.75	0.77	1.70	2.50	0.97	1.14ns
Abdominal fat	0.62^{bc}	0.74^{ab}	0.00^{c}	1.10^{ab}	1.37^{a}	0.00^{c}	0.53*
Full gut	32.52^{ab}	32.30^{ab}	34.61^{ab}	31.13^{b}	32.94^{ab}	43.90^{a}	7.03*
Empty gut	7.93^{ab}	7.58^{ab}	9.74^{a}	6.95^{b}	7.86^{ab}	7.56^{ab}	1.46*
Skin	5.35^{a}	5.47^{a}	2.78^{b}	3.58^{ab}	3.00^{ab}	2.80^{b}	1.50*

*a,b,c Means with different superscripts within rows are significantly different ($P < 0.05$). T1–T6 as defined in Table 1. * = Significant ($P < 0.05$); ns = not significant.*

IV. DISCUSSION

➢ *Proximate Composition and Cell Wall Fractions*

The variation in dry matter content across treatments in the current study reflected the influence of substrate moisture and additive type on fermentation dynamics. DPL inclusion (T3, T6) elevated DM content relative to unamended silages, consistent with the dry nature of the additive and its role in reducing free water in the silage mass. This observation aligns with reports that inclusion of dry organic additives in silage increases substrate DM content and can improve aerobic stability [19]. The significantly higher crude protein recorded in T3 (11.94%) compared to other treatments is attributable to the inherently high non-protein nitrogen content of poultry litter, which supplies urea, uric acid, and other nitrogenous compounds that enrich the silage [5, 20]. This is consistent with Utama and Christiyanto [20], who reported that fermented poultry litter improved fibre degradation and protein content of ruminant feeds.

The reduction in NDF observed in GCP-supplemented green stover (T2: 40.72%) compared to un-supplemented controls (T1: 59.43%) is notable, suggesting that the fermentable carbohydrates in cassava peel promoted lactic acid fermentation, which can partially degrade hemicellulose and reduce NDF [21]. Sutaryono *et al.* [22] similarly observed that mixed corn stover silage with additives rich in soluble carbohydrates reduced NDF and ADF values. The lower TDN and ME values in DPL-supplemented dry stover treatments (T5, T6) relative to green stover treatments are partly explained by their higher ADF content, since both TDN and ME are negatively related to ADF in the prediction equations employed. High ADF reflects increased cellulose and lignin content, which constrain rumen fermentability and energy availability [23].

➢ *Dry Matter and Nutrient Intake*

The higher total DM intake recorded in concentrate-supplemented treatments (T1, T2, T4, T5) compared to T3 and T6 reflects the positive associative effect of concentrate on voluntary roughage intake. Concentrate supplementation has been consistently reported to improve total DM intake in small ruminants fed fibrous basal diets, partly by providing rumen-degradable protein and energy substrates that enhance rumen microbial activity and reduce digesta passage time [24, 25]. The finding that T2 recorded the highest total DM intake (392.80 g/d DM) is consistent with its combination of a well-fermented green stover base (low NDF), GCP-derived fermentable sugars, and concentrate, which together created a nutritionally balanced diet with high palatability.

Crude protein intake was highest in T2, driven by the combination of GCP-enhanced silage and a concentrate supplement with 14.49% CP. The significantly lower CP intake in T6 (19.62 g/d) is of nutritional concern, as maintenance CP requirement for goats of this body weight is approximately 35–40 g/d DM [26]. This deficit in T6 likely contributed to the inferior carcass performance observed at slaughter. The non-significant treatment effect on crude fibre intake suggests that, despite variation in silage CF content, rumen fill regulation partially compensated for dietary differences in fibre concentration.

➢ *Carcass Yield and Wholesale Cuts*

The superior slaughter weight, warm carcass weight, and dressing percentage recorded in concentrate-supplemented treatments (T1, T2) are consistent with the role of energy and protein adequacy in supporting lean tissue deposition and fat accretion during the finishing period [27]. Suong *et al.* [10] similarly reported that goats receiving nutritionally enhanced diets had significantly improved carcass weights and dressing percentages compared to control-fed animals. The dressing percentages recorded in T1 (45.22%) and T2 (45.13%) are within the range of 38–50% reported for Red Sokoto goats slaughtered at comparable live weights [8], indicating that concentrate supplementation with adequate roughage supports satisfactory carcass output.

The markedly lower dressing percentage in T6 (32.28%) compared to T1 and T2 is attributable to the combination of inadequate total nutrient intake and the high proportion of gut fill (43.90% of slaughter weight) relative to carcass, reflecting a compensatory distension of the gastrointestinal tract in response to dietary fibre load [28]. The higher full gut weight in T6 is consistent with the high NDF content of dry stover silage amended with DPL, which would have increased digestive tract fill. The significant effect on loin and leg cuts, which are economically important wholesale cuts, underscores

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the nutritional basis of regional muscle development. Concentrate-supplemented diets provided sufficient metabolisable energy (>8.93 MJ/kg DM for T1–T5) to sustain adequate muscle growth, whereas T6 (7.19 MJ/kg DM) fell below the threshold for efficient lean tissue deposition [26].

- *Carcass By-products and Visceral Organs*

The significantly higher head and lung weights as proportions of slaughter weight in T3 relative to other treatments are consistent with generally lower slaughter weights in that group, since fixed anatomical components such as the head inflate as a percentage when live weight is reduced. This inverse relationship between body weight and organ-to-slaughter-weight ratio is well established in ruminant carcass studies [29]. The significantly higher liver weight recorded in T4 (2.12%) relative to T2 (1.67%) may reflect differential hepatic metabolic demand associated with variation in CP intake and fermentation product load from different silage types, since the liver plays a central role in urea synthesis and energy metabolism [30].

The absence of abdominal fat in T3 and T6 is indicative of a negative energy balance in animals fed DPL-supplemented silage without concentrate, confirming that these animals lacked sufficient dietary energy for fat deposition. A similar pattern was reported by Apata *et al.* [31] for goats fed low-energy diets. The higher skin weight in T1 and T2 treatments is associated with their higher slaughter weights and greater anabolic status; skin weight as a proportion of slaughter weight is positively correlated with body condition and muscular development [32]. The non-significant differences in heart, kidney, and spleen weights suggest that these metabolically stable organs are less sensitive to short-term dietary variation at this nutritional plane.

V. CONCLUSION

Ensiling green maize stover with 36% dried poultry litter significantly improved crude protein and ash content but reduced metabolisable energy and TDN values relative to unamended and GCP-supplemented silages. GCP addition at 5% was effective in reducing NDF content of green stover silage. However, concentrate supplementation was the primary determinant of carcass performance, with T1 (green stover silage + concentrate) and T2 (green stover + GCP + concentrate) consistently producing the best slaughter weights, warm carcass weights, dressing percentages, and wholesale cut yields. Goats fed DPL-supplemented silage without concentrate (T3, T6) had inferior carcass output and no abdominal fat deposition, reflecting inadequate energy intake. It is recommended that DPL or GCP inclusion in maize stover silage be complemented with concentrate supplementation to achieve satisfactory carcass performance in Red Sokoto goats under semi-intensive management.

- *Conflict of Interest*

The authors declare no conflict of interest.

REFERENCES

[1]. Raji, A. Z., Aliyu, J., Igwebuike, J. U., & Chiroma, S. (2022). Utilisation of maize stover and other crop residues for sustainable ruminant production in sub-Saharan Africa. *Journal of Animal Feed Science*, 31(2), 105–116. https://doi.org/10.22358/jafs/147652/2022

[2]. Sutaryono, Y. A., Putra, R. A., Mardiansyah, M., Yuliani, E., Harjono, H., Mastur, M., Sukarne, S., Enawati, L. S., & Dahlanuddin, D. (2023). Mixed Leucaena and molasses can increase the nutritional quality and rumen degradation of corn stover silage. *Journal of Advanced Veterinary and Animal Research*, 10(1), 97–105. https://doi.org/10.5455/javar.2023.j660

[3]. Hartinger, T., Gruber, T., Fliegerova, K., Terler, G., & Zebeli, Q. (2024). Mixed ensiling with by-products and silage additives significantly valorises drought-impaired whole-crop corn. *Animal Feed Science and Technology*, 309, 115899. https://doi.org/10.1016/j.anifeedsci.2024.115899

[4]. Zhang, Y., Li, Q., Dong, L., Zhao, M., & Shao, T. (2023). Silage additives improve fermentation quality, aerobic stability and rumen degradation in mixed silage composed of amaranth and corn straw. *Frontiers in Plant Science*, 14, 1189747. https://doi.org/10.3389/fpls.2023.1189747

[5]. Islam, M. R., Rahman, M. M., Alam, M. S., & Khan, M. J. (2024). Fermentation of poultry manure for improving its quality and safety as ruminant feed. *International Journal of Research and Other Works in Agriculture*, 13(2), 1–23.

[6]. Jiwuba, P. C., Ahamefule, F. O., Okafor, C. C., & Ikeh, P. O. (2021). Cassava peel meal as a feed ingredient for livestock in Nigeria: A review. *Nigerian Journal of Animal Science*, 23(1), 1–14.

[7]. Fasae, O. A., & Yusuf, O. P. (2022). Cassava peel meal as an alternative to maize in livestock nutrition: Prospects and challenges. *Tropical Animal Health and Production*, 54(2), 112. https://doi.org/10.1007/s11250-022-03121-0

[8]. Adu, I. F., & Brinckman, W. L. (2021). Some carcass traits of Red Sokoto goat of Nigeria. Nigerian *Journal of Animal Production*, 7(1), 58–62. https://doi.org/10.51791/njap.v7i1.2074

[9]. Otaru, S. M., Adamu, A. M., & Ehoche, O. W. (2020). Influence of levels of supplementary concentrate mixture on lactation performance of Red Sokoto does and the pre-weaning growth rate of their kids. *Veterinary and Animal Science*, 10, 100137. https://doi.org/10.1016/j.vas.2020.100137

[10]. Suong, N. T., Paengkoum, P., Schonewille, J. T., Purba, R. A. P., & Paengkoum, S. (2022). Growth performance, blood biochemical indices, rumen bacterial community, and carcass characteristics in goats fed anthocyanin-rich black cane silage. *Frontiers in Veterinary Science*, 9, 886423. https://doi.org/10.3389/fvets.2022.886423

[11]. Onaleye, K. J. (2018). Comparative Utilization of Ensiled Maize Stover and Concentrate Supplement by Red Sokoto Goats. Ph. D Thesis University of Agriculture, Makurdi, Benue State, Nigeria, 192pp.
[12]. Adamu, H. Y., Ibrahim, N. O., Abdu, S. B., Hassan, M. R., Lawal, A., & Abubakar, M. (2020). Effects of different inclusion levels of Albizia lebbeck flower on nutrient digestibility and nitrogen balance in Red Sokoto bucks fed a complete diet. *Proceedings of the 45th Annual Conference of the Nigerian Society for Animal Production*, 1843-1845.
[13]. Rahman, M. M., Lourenço, M., & Hassan, M. R. (2021). Effect of fermentation duration on nutrient composition and fermentation characteristics of cassava-based silages. Animal Feed Science and Technology, 273, 114789. https://doi.org/10.1016/j.anifeedsci.2021.114789
[14]. AOAC International. (2019). Official Methods of Analysis of AOAC International (21st ed.). AOAC International.
[15]. Van Soest, P. J., Robertson, J. B., & Lewis, B. A. (1991). Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science*, 74(10), 3583–3597. https://doi.org/10.3168/jds.S0022-0302(91)78551-2
[16]. Schroeder, J. W. (2006). Forage nutrition for ruminants. North Dakota State University Extension Service. AS-1250. Accessed May, 2019.
[17]. MAFF. (1984). Energy allowances and feeding systems for ruminants (ADAS Reference Book 433). Her Majesty's Stationery Office.
[18]. SAS Institute Inc. (2019). SAS/STAT User's Guide (Version 9.4). SAS Institute Inc.
[19]. Transforming forage nutrition: Advances in silage additives for enhanced preservation and feed quality. (2025). *Plant Science Today*, 12(2), 8548. https://doi.org/10.14719/pst.2025.12.2.8548
[20]. Utama, C. S., & Christiyanto, M. (2021). The feasibility of fermented litter as a feed ingredient for ruminant livestock. *Journal of Advanced Veterinary and Animal Research*, 8(3), 374–381. https://doi.org/10.5455/javar.2021.h517
[21]. Chen, L., Li, P., Gou, W., Zhao, M., & Nishino, N. (2022). Fermentation quality and microbial community of corn stover or rice straw silage mixed with soybean curd residue. *Applied Microbiology and Biotechnology*, 106(5), 2147–2158. https://doi.org/10.1007/s00253-022-11843-7
[22]. Lacasta, D., Ferrer, L. M., Ramos, J. J., González, J. M., & De las Heras, M. (2023). A comparative evaluation of maize silage quality under diverse pre-ensiling strategies. *PLoS ONE*, 18(9), e0289451. https://doi.org/10.1371/journal.pone.0289451
[23]. Dos Santos Neto, J. M., De Freitas, R., Netto, D. P., Pereira, G. M., & Barros, C. S. L. (2023). Ruminant feeding with silage prepared from crop residues: An integrative review. *Frontiers in Veterinary Science*, 10, 1098562. https://doi.org/10.3389/fvets.2023.1098562
[24]. Bitar, S., Baalbaki, R., Mchich, R., Hamdan, M., & El-Hayek, E. (2021). Impact of diet supplementation and age at slaughter on carcass characteristics of Creole goats. *Frontiers in Veterinary Science*, 8, 671948. https://doi.org/10.3389/fvets.2021.671948
[25]. González Muñoz, S. S., Domínguez Vara, I. A., Bórquez Gastelum, J. L., Pinos Rodríguez, J. M., Ramírez Bribiesca, J. E., & Trujillo Gutiérrez, D. (2022). Additive effect of silages made of poultry litter, swine manure and urea mixed with sugar cane molasses and bakery by-product on lamb diets. *Tropical and Subtropical Agroecosystems*, 25(3), 3938. https://doi.org/10.56369/tsaes.3938
[26]. NRC. (2007). Nutrient requirements of small ruminants: Sheep, goats, cervids, and New World camelids. National Academies Press.
[27]. Chanjula, P., Wangkahart, E., & Lumsangkul, C. (2022). Effects of supplementing finishing goats with Mitragyna speciosa (Korth) Havil leaves powder on growth performance, hematological parameters, carcass composition, and meat quality. *Animals*, 12(13), 1637. https://doi.org/10.3390/ani12131637
[28]. Coutinho da Costa, R., Ferreira, F. M., Rodrigues, R. T. S., Eiras, C. E., & Oliveira, R. L. (2023). Carcass traits and meat quality of goats fed with cactus pear silage subjected to an intermittent water supply. *Tropical Animal Health and Production*, 55(1), 40. https://doi.org/10.1007/s11250-022-03428-y
[29]. Apata, E. A., Olaleye, O. O., Apata, O. A., Olugbemi, M. T., & Omojola, A. B. (2023). Evaluation of physical characteristics of chevon as affected by post-mortem carcass dressing and freezing preservation. *Theory and Practice of Meat Processing*, 8(2), 144–151. https://doi.org/10.21323/2414-438x-2023-8-2-144-151
[30]. El-Essawy, A. M., Anele, U. Y., Abdel-Wahed, A. M., Abdou, A. R., & Khattab, I. M. (2021). Effects of anise, clove and thyme essential oils supplementation on rumen fermentation, blood metabolites, milk yield and milk composition in lactating goats. *Animal Feed Science and Technology*, 271, 114760. https://doi.org/10.1016/j.anifeedsci.2020.114760
[31]. Hayat, M. Z., Abbas, G., Rizwan, M., Ali, A., & Shahid, M. Q. (2024). Growth performance, carcass traits, and histological changes of goats supplemented with different sources of phytochemicals. Scientific Reports, 15(1), 573. https://doi.org/10.1038/s41598-025-07306-w
[32]. Ogunbosoye, D. O., & Odedire, J. A. (2022). Evaluation of silage from maize stover, maize husk and Andropogon gayanus in equal level with Tephrosia bracteolata as feed for West African Dwarf sheep. *Archivos de Zootecnia*, 71(275), 243–251. https://doi.org/10.21071/az.v71i275.4820