

Research Article

The Effects Different Inclusion Levels of *Gliricidia sepium* on Sasso Chickens' Carcass Characteristics and Meat Quality

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Abstract

The study was conducted to assess carcass yield and meat quality of Sasso chickens using *Gliricidia sepium* leaf meal (GLM) as a replacement for Soybean meal (SBM). Two hundred (200) day-old Sasso chicks were brooded for 21 days and then randomly allocated to five treatment groups using a completely randomized design, with each treatment replicated three times. The experiments diets included the standard control diet with 0% GLM (T0) containing 100% soybean meal, and four experimental where soybean meal was progressively replaced with *Gliricidia* leaf meal (GLM) at 25% (T1), 50% (T2), 75% (T3), and 100% (T4). All diets were subjected to proximate analysis. Results showed that slaughter weight differed significantly ($P<0.05$). The T1 with 25% inclusion of GLM achieved the highest and slaughter weight 2038.2 g, respectively. In addition, the 25% inclusion had the highest DP (70.0%) and breast weight (398.3 g). High Dry Matter (DM) was observed in chickens fed T1 (26.8% of GLM) and the trend decreased as the level of GLM inclusion increased in the diet. The CP levels were highest in 25% GLM inclusion 26.2%. The highest EE, was observed in 75% GLM (1.4%). Furthermore; the results indicated that meat color differed significantly in terms of yellowness ($p<0.05$). Breast and drumstick had the highest yellowness values and were observed in 100% GLM (13.9) and 75% GLM (12.1), respectively. The highest cooking loss was observed in 100% GLM (33.1%). Low meat pH was exhibited in treatment with 50% GLM (pH=5.9). The study concluded that, replacing a portion of SBM with GLM up to 75% did not alter the carcass yield, most of the meat chemical composition and overall meat quality.

Keywords

Carcass Composition, Chemical Composition, Sasso Chickens, Soybean Meal, *Gliricidia Sepium*

1. Introduction

Sasso chickens being dual-purpose chickens, are gaining popularity especial in urban and peri-urban areas. These birds have a short production cycle; 8 to 9 weeks for meat and around 18 to 19 weeks for egg laying. The strain can be reared intensively or semi-intensive thus makes them well-suited for smallholder and resource-constrained farmers [1]. Sasso

strain is relatively new strains in Tanzania and has been promoted as an alternative to local chicken since they have good scavenging ability. However, there is a scarcity of information on the effect of management on meat quality characteristics. The strain has been advocated for small to medium scale farmers who are at time resource constrained.

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Under smallholder situation these birds need to be supplemented for them to optimize their production potential. Nonetheless, feed shortages remain the biggest challenges and the availability is seasonal. Majority of the stallholder farmers cannot afford the commercial feeds due to ever rising cost [2]. Such a situation contributes negatively to the growth of the poultry sector as it affects chickens' productivity and farmers' economic returns. Thus, improper nutrition in terms of quality and quantity of feeds in Sasso Chicken production can result into inefficient feed conventional, reduced carcass weight, and undesirable meat quality characteristics, including abnormal pH levels, poor texture, reduced juiciness and tenderness, as well as an inconsistent meat color. Moreover, inadequate feeding can lead to higher production costs, increased mortality rates, and greater vulnerability to diseases. These challenges pose threats to the long-term viability of dual-purpose chickens farming [3]. With the rising demand for poultry meat in Tanzania, there is a need to explore sustainable and affordable alternative feed ingredients to enhance Sasso production. Conventional protein sources like soybean meal and fishmeal are in most cases too expensive and unsustainable [3, 4].

To address feed shortages, the use of alternative feed resources has emerged as a practical and increasingly adopted solution. A key strategy involves incorporating leaf meals from multipurpose trees; such as *Gliricidia sepium*, *Moringa oleifera*, and *Leucaena leucocephala* into livestock diets. These plant-based protein sources are not only nutritionally rich but also widely accessible in tropical and subtropical regions, making them especially suitable for poor-resource smallholder farmers in rural areas in developing countries [5]. Beyond their high protein levels, these leaf meals also supply vital nutrients like vitamins and minerals, supporting balanced poultry diets and improving flock health [6]. Therefore, utilizing such alternative feed options plays a crucial role in mitigating feed scarcity and promoting sustainable livestock production.

Gliricidia sepium is a fast-growing, perennial leguminous tree widely recognized for its multifunctional role in agroforestry systems, particularly in tropical and subtropical regions. One of its key agronomic advantages lies in its capacity to produce large quantities of high-quality biomass year-round, which serves as a valuable forage resource for livestock [7]. In addition to its forage potential, *G. sepium* contributes significantly to soil improvement through biological nitrogen fixation, thereby enhancing soil fertility and reducing the need for synthetic fertilizers. In Sub-Saharan Africa, *G. sepium* is commonly utilized for a range of agricultural and household uses, including use as livestock fodder, live fencing, shade provision, boundary demarcation, and fuelwood [8, 9]. Its adaptability and high biomass yield make it particularly valuable in smallholder farming systems.

The foliage of *G. sepium* is notably rich in crude protein (CP), with reported values between 21.9% and 24.38% [9, 10], and contains essential amino acids, vitamins, and minerals,

highlighting its potential as an alternative protein supplement in poultry nutrition. Given its favorable nutrient profile, *G. sepium* leaf meal (GLM) has been proposed as a partial replacement for conventional protein sources such as soybean meal in poultry diets. Incorporating GLM into poultry feed could help lower production costs and improve sustainability in regions where conventional protein sources are expensive or scarce [8]. However, its application in monogastric animal diets, such as those of poultry, requires careful consideration due to the presence of anti-nutritional factors (ANFs) and secondary metabolites; such as tannins, saponins, and phenolic compounds that can impair nutrient utilization and animal health at high inclusion levels.

Although *G. sepium* is abundant and readily available in many parts of Tanzania, there is still a notable lack of empirical data on its practical use, the optimal inclusion levels in poultry feeds as well as the effect of such inclusions on carcass yield and meat quality characteristics. Thus, this study aimed to evaluate the effect of *G. sepium* leaf meal inclusion on carcass yield and meat quality characteristics of Sasso chickens.

2. Materials and Methods

2.1. Study Area

The research was conducted at the Lower Farm Poultry Unit (LFPU) in the Department of Animal, Aquaculture, and Range Sciences at Sokoine University of Agriculture (SUA) in Morogoro, Tanzania. SUA is situated on the slopes of the Uluguru Mountains, at an altitude of 660 meters above sea level, at 6°52' S and 37°38'59' E. The area receives yearly rainfall ranging from 500 to 1800 mm, and its ambient temperature ranging from 27 to 31 °C, whereas in cooler months drops to 14 °C [11].

2.2. Source of Experimental Units and Their Management

Sasso chicks were sourced from Silverland Company Limited. Upon arrival, they were weighed and housed in a disinfected brooding facility. During this time, the chicks were fed a commercial starter feed supplied by Silverland Company Limited. After brooding, the birds were transferred to grower pens and received experimental diets (Table 1) for the next nine weeks, thus completing a 12-week trial period. Fresh drinking water was provided in add-lib. Vaccinations against Newcastle disease, Gumboro, and Fowl pox were administered according to the recommended schedule [12].

2.3. Experimental Design and Treatments

A total of 200 (one day) chicks were randomly assigned to five dietary treatments during the grower and finisher phases

using a Completely Randomized Design (CRD), with each treatment replicated three times (each replicate group consisted of 13 chicks). The dietary treatments included: a standard control diet with 0% GLM (T0) containing 100% soybean meal, and four experimental diets where soybean meal was progressively replaced with *Glyricidia leaf meal* (GLM) at 25% (T1), 50% (T2), 75% (T3), and 100% (T4).

2.4. Source of the Feed Stuffs and Feed Formulation

GLM was sourced from areas surrounding the College of Economics and Business Studies (COEBs) at Sokoine University of Agriculture (SUA) in Morogoro. The leaves were detached from the stems and shade-dried for 5 days. After drying, the leaves were ground into a fine meal, which was then incorporated into the diet formulations. The remaining feed ingredients (soybean meal (SBM), maize meal, blood meal, fish meal, sunflower seed cake, cottonseed cake, bone meal, di-calcium phosphate (DCP), premix, limestone, lysine, methionine, and salt) were obtained from the Agro-veterinary

input suppliers in Morogoro municipality.

Main ingredients were analyzed for dry matter, crude protein (CP%), crude fiber (CF%), ash content, and metabolizable energy (ME) values at Tanzania Veterinary Laboratory Agency (TVLA) in Temeke, Dar-es-salaam Tanzania. The analysis was conducted using a near-infrared reflectance spectrophotometer (NIRS Systems 5000, Firmware Version 156, USA), which was specifically calibrated for concentrate mixed ration formulations (tmrgpfe.eqa) based on the NIRS methodology described by Aufrère and Michalet-Doreau (1988). The analyzed formulations included GLM, SBM, maize meal, blood meal, fish meal, sunflower seed cake, cottonseed cake, bone meal, DCP, premix, limestone, lysine, methionine, and salt. Laboratory analysis data were used to formulate the diets to meet the nutritional needs of the birds, providing 12 MJ ME and 220 g CP per kg of dry matter for the grower phase, and 13 MJ ME with 190 g CP per kg of dry matter for the finisher phase, as outlined in Table 2. The ME content of the concentrate diet (Starter and T0=Control) was also analyzed using the same NIRS system at the TVLA laboratory in Temeke.

Table 1. Proximate composition of the formulated feeds, including commercial feed (T0).

	Dry Matter (%)	Crude Protein (%)	Crude Fiber (%)	Crude Fat (%)	Ash (%)	Starch	ME Kcal/kgDM
Starter Feed (Commercial)	91.2	23.8	3.3	3.4	9.6	37.8	2837.0
Grower Feed.							
T0	91.7	21.5	9.69	13.5	10.9	24.8	2930.6
T1	91.0	21.9	10.0	13.0	11.2	18.5	2921.1
T2	90.4	21.2	10.9	13.0	11.9	15.6	2844.5
T3	90.0	20.9	14.0	12.7	12.9	145.0	2811.0
T4	90.6	19.6	15.2	12.6	13.4	16.3	2662.7
Finisher Feed.							
T0	90.3	18.5	5.1	7.4	11.7	26.3	3244.0
T1	90.3	18.9	6.6	6.9	13.5	20.8	3100.5
T2	89.2	18.3	6.4	6.9	13.7	24.5	3057.4
T3	89.0	18.0	10.5	5.8	13.0	15.6	2686.6
T4	89.0	17.8	8.5	5.7	12.1	20.8	2662.7

3. Data Collection

3.1. Carcass Characteristics

At the end of the 12-week trial, 45 chickens (9 from each

treatment) were randomly taken for slaughter. Birds were fasted for 12 hours and weighed before slaughter, after a five-minute bleeding period, the birds were eviscerated and the carcass was weighed. The dressing percentage (DP) was computed followed by dissection into individual carcass components (Breast, Thigh, Drumstick, heart, liver and abdominal fats). Weights of the carcass and carcass parts were

recorded. Weights of non-carass components such as the intestines, liver, gizzard, heart, and spleen and abdominal fat were also recorded. Dressing percentage (DP) was calculated as a proportion of the live body weight using the following formula:

$$DP = \frac{Wt \text{ of carcass}}{Live \text{ body } Wt} \times 100 \quad (1)$$

3.2. Measurement of Meat Color

The inner surfaces of the breast, drumstick, and thigh were utilized for meat color evaluation. A portable colorimeter (MINOLTA CR 200b, Osaka, Japan) operating on the CIELAB color system was used to measure the meat's lightness (L^*), redness (a^*), and yellowness (b^*) values.

3.3. Measurement of pH and Temperature

The pH and temperature of each bird's breast muscle were measured 45 minutes post-slaughter using a spear-tip digital portable pH meter (Knick Portamess® 910, Germany) and a thermometer, respectively.

3.4. Determination of Cooking Loss, Shear Force Value (tenderness) and Water Holding Capacity

Cooking loss percentage (CL%) and meat tenderness were assessed following the method described by [13]. Meat samples from the breast, thigh, and drumstick were weighed and sealed in polyethylene plastic bags, then cooked in a water bath maintained at a constant temperature of 70 °C for one hour. After cooking, the samples were cooled under running cold water for two hours and reweighed to determine the weight difference. CL% was calculated using the following formula:

$$CL\% = \frac{Wt \text{ before cooking} - Wt \text{ after cooking}}{Wt \text{ before cooking}} \times 100 \quad (2)$$

To determine shear force, strips measuring approximately 2 × 2 × 1 cm were cut from the breast muscle, aligned parallel to the muscle fibers. These samples were tested using a Warner-Bratzler shear blade attached to a Zwick/Roell (Z2.5, Germany) device. Shear force values were recorded in newtons (N).

To determine the water holding capacity (WHC%), a small sample of meat (2 g) was weighed and then placed between filter papers in a compression device. Pressure was applied for 5 minutes followed by re-weighing of meat. Then WHC% was computed as follows:

$$WHC\% = \frac{Initial \text{ } Wt - Water \text{ loss}}{Initial \text{ } Wt} \times 100 \quad (3)$$

3.5. Carcass Chemical Composition Analysis

The carcass was finely minced using a meat grinder equipped with a 5 mm plate, then stored at -4 °C for subsequent analysis. The chemical composition of the minced meat was determined through wet proximate analysis to evaluate dry matter (DM), ash, crude protein (CP), and fat content (ether extract, EE). Dry matter was measured using the oven-drying method at 105 °C [14]. Ash content was determined by incinerating the samples in a muffle furnace at 550 °C for three hours [15]. Crude protein was analyzed using the Kjeldahl method with a 2200 Foss Tecator Kjeltac distillation unit (Foss, Höganäs, Sweden) according to [16]. Fat content was assessed using the Soxhlet extraction method with the Soxtec System 2050 (Foss, Höganäs, Sweden) following AOAC (2000) procedures. [17]

3.6. Statistical Analysis

Prior to analysis, the normality of the data was evaluated using the Shapiro-Wilk test. The response variables were subjected to one-way Analysis of Variance (ANOVA) to assess the effects of different dietary treatments on carcass traits and meat quality in broiler chickens. Differences between group means were evaluated using Tukey's test at a significance level of 5%, and results were expressed as mean ± standard error of the mean (SEM). Statistical analysis was performed using R software version 4.3.2 (2023). The following was a statistical model used:

$$Y_{ij} = \mu + T_i + e_{ij} \quad (4)$$

Where;

Y_{ij} = Response (such as thigh, drumstick weight), of the i th treatment level,

μ = Overall mean effect,

T_i = Effect due to different levels of GLM,

e_{ij} = Error term.

4. Results

4.1. Effects of GLM Inclusion on Carcass Traits of Sasso Chickens

The results for carcass characteristics of Sasso chicken under different treatments are presented in Table 2. The results showed that the dietary treatment significantly affected the slaughter (fasted) weight, carcass weight, and breast weight ($p < 0.05$), with the highest value being observed in T1 (25%) and the lowest being in T4 (100%).

The study revealed that 25% GLM yielded significant higher values for slaughter and carcass weights ($p < 0.05$). In addition, the results indicated that in part's weights, dietary treatment significantly affected only breast weight ($p < 0.05$) and T100 showed the least value.

Table 2. Least square mean $\pm$ sd. error for the effect of replacing soybean with GLM on carcass composition of Sasso chicken meat.

Parameters (g)	Carcass composition					p-value
	T0	T1	T2	T3	T4	
Slaughter weight	1910.5 $\pm$ 198.4 ^{ab}	2038.2 $\pm$ 160.9 ^a	1832.2 $\pm$ 199.0 ^{ab}	1724.0 $\pm$ 156.2 ^{ab}	1250.0 $\pm$ 130.4 ^b	0.032
Carcass weight	1339.0 $\pm$ 149.7 ^a	1430.2 $\pm$ 122.6 ^a	1275.5 $\pm$ 150.6 ^{ab}	1185.0 $\pm$ 120.8 ^{ab}	799.7 $\pm$ 96.0 ^b	0.02
Dressing%	69.8 $\pm$ 0.9 ^a	70.0 $\pm$ 0.5 ^a	69.2 $\pm$ 0.8 ^a	68.3 $\pm$ 1.1 ^a	63.4 $\pm$ 1.3 ^b	0.0003
Heart weight	10.0 $\pm$ 0.9	10.5 $\pm$ 1.2	9.2 $\pm$ 1.2	10.2 $\pm$ 1.1	6.3 $\pm$ 0.8	0.076
Liver weight	45.5 $\pm$ 3.2 ^a	42.0 $\pm$ 4.4 ^{ab}	40.8 $\pm$ 2.4 ^{ab}	33.5 $\pm$ 1.0 ^{bc}	28.2 $\pm$ 1.4 ^c	0.001
Breast weight	370.7 $\pm$ 44.4 ^a	398.3 $\pm$ 36.5 ^a	344.8 $\pm$ 51.4 ^{ab}	309.3 $\pm$ 44.8 ^{ab}	194.3 $\pm$ 27.5 ^b	0.019
Thigh weight	221.5 $\pm$ 25.9	236.3 $\pm$ 20.2	208.3 $\pm$ 25.3	201.5 $\pm$ 17.7	165.0 $\pm$ 5.3	0.172
Drumstick weight	189.5 $\pm$ 23.4	201.8 $\pm$ 19.5	184.5 $\pm$ 27.2	167.3 $\pm$ 22.8	137.3 $\pm$ 6.6	0.196
Abdominal fat weight	31.8 $\pm$ 1.9 ^{bc}	45.2 $\pm$ 3.0 ^{ab}	43.5 $\pm$ 1.0 ^{ab}	47.8 $\pm$ 6.3 ^a	29.8 $\pm$ 2.8 ^b	0.003

Notes: ^{a, b} Means with different superscripts within a row differ significantly at $P \leq 0.001$, T0 = treatment feed with no GLM (0% GLM + 100% soy bean meal, SB), T1 = feed with 25% GLM (25% GLM + 75%SB), T2 = feed with 50% GLM (50% GLM + 50%SB), T3 = feed with 75% GLM (75% GLM + 25%SB), T100 = feed with 100% GLM (100% GLM + 0%SB).

4.2. Effect of GLM Diets Nutrient Profile of Sasso Chicken Meat

The findings indicate that replacing soybean meal (SBM) with GLM in the diet of Sasso chickens had significant effects on most of parameters (DM, CP, and EE) of the carcass chemical composition (Table 3). High DM was observed in chickens fed T1 and T2 and the trend decreased as the level of

GLM inclusion increased in the diet. The CP levels were significantly affected ($p < 0.05$), with the highest value recorded in T1 (26.2%) and the levels decreased thereafter (T2-T4) which were not significantly different from the control diet, (T0). Furthermore, the EE, (representing fat content), was also significantly affected by GLM inclusion ($p < 0.05$). The highest fat content was observed in T3 (75% GLM: 1.4%).

Table 3. Least square mean $\pm$ sd. error for the effect of replacing soybean with *Gliricidia sepium* leaf meal (GLM) on chemical composition of Sasso chicken meat.

Parameter (%)	Carcass chemical composition					p-value
	T0	T1	T2	T3	T4	
DM	25.0 $\pm$ 0.3 ^{bc}	26.8 $\pm$ 0.2 ^a	25.7 $\pm$ 0.2 ^{ab}	25.1 $\pm$ 0.6 ^{bc}	24.0 $\pm$ 0.3 ^c	0.0001
Ash	4.6 $\pm$ 0.2	4.4 $\pm$ 0.2	4.5 $\pm$ 0.2	4.6 $\pm$ 0.1	5.0 $\pm$ 0.2	0.874
CP	24.8 $\pm$ 0.4 ^{ab}	26.2 $\pm$ 0.4 ^a	24.8 $\pm$ 0.0.3 ^{ab}	23.4 $\pm$ 0.2 ^b	24.4 $\pm$ 0.5 ^b	0.0001
EE	0.8 $\pm$ 0.1 ^b	1.2 $\pm$ 0.2 ^{ab}	0.8 $\pm$ 0.0 ^b	1.4 $\pm$ 0.2 ^a	0.7 $\pm$ 0.0 ^b	0.001

Notes: DM=dry matter, CP=crude protein, EE=ether extract ^{a, b} Means with different superscripts within a row differ significantly at $P \leq 0.001$, T0 = treatment feed with no GLM (0% GLM + 100% soy bean meal, SB), T1 = feed with 25% GLM (25% GLM + 75%SB), T2 = feed with 50% GLM (50% GLM + 50%SB), T3 = feed with 75% GLM (75% GLM + 25%SB), T100 = feed with 100% GLM (100% GLM + 0%SB)

4.3. Effect of GLM on Meat Quality Parameters

The results on meat quality parameters are shown in Table 4. There were significant differences in meat color in terms of yellowness ($p < 0.05$). T4 100%GLM and T3 (75% GLM) yielded higher values for yellowness compared to other treatments.

In addition, the results revealed that dietary treatments had

significant effect on cooking loss ($p < 0.05$). Result indicated that, from T0 -T3, there was no marked variation in cooking loss. In the case of tenderness, the highest shear force was observed in T0 and T1, which differed significantly from T2, T3 and T4. Moreover, the finding revealed that pH was significantly affected by dietary treatment ($p < 0.05$); whereby higher values were recorded in T1 and T3. Dietary treatments had no significant effects on shear force and WHC ($p > 0.05$).

Table 4. Least square mean $\pm$ sd. error for effect of replacing soybean with GLM on meat quality characteristics of Sasso chicken meat.

Parameters	Meat quality characteristics					P-value
	T0	T1	T2	T3	T4	
Color						
Briest a*	2.8±0.7	2.3±0.7	2.2±0.7	1.8±0.3	0.9±0.3	0.222
Briest b*	4.6±1.3 ^c	6.0±0.8 ^c	7.6±0.7 ^{bc}	10.2±1.3 ^{ab}	13.9±0.5 ^a	0.0001
Briest L*	55.4±3.7	55.3±1.7	56.8±2.0	57.9±3.2	64.5±4.1	0.223
Drumstick a*	4.7±0.8	5.0±1.6	5.8±2.6	3.8±1.1	7.0±1.3	0.706
Drumstick b*	6.0±0.9 ^b	9.0±1.8 ^{ab}	11.8±1.3 ^{ab}	12.1±1.5 ^a	10.6±1.4 ^{ab}	0.0001
Drumstick L*	57.8±3.1	62.7±2.3	66.1±4.6	62.5±2.2	55.8±2.6	0.162
Thigh a*	7.6±1.0	7.1±1.2	6.0±1.3	6.1±0.7	7.5±0.7	0.583
Thigh b*	7.4±1.1	9.2±1.2	8.4±1.3	10.1±0.7	10.2±0.7	0.31
Thigh L*	58.3±3.4	55.8±2.9	50.0±2.5	52.7±2.3	51.3±1.5	0.178
Other						
Shear force (N)	41.1±2.2	33.8±7.4	36.1±2.3	35.0±1.7	37.4±1.7	0.078
Cooking loss (%)	22.5±2.9 ^b	18.9±0.4 ^b	22.8±1.3 ^b	21.0±1.5 ^b	33.1±4.1 ^a	0.007
WHC (%)	3.6±1.0	3.2±0.5	5.5±1.0	3.7±0.5	6.1±1.1	0.099
pH	5.9±0.0 ^b	6.2±0.0 ^a	5.9±0.0 ^b	6.1±0.0 ^a	6.0±0.0 ^b	0.0001

Notes: ^{a, b, c} Means with different superscripts within a row differ significantly at $P \leq 0.05$

a* = relative redness, L* = relative lightness, b* = relative yellowness, T0 = treatment feed with no GLM (0% GLM + 100% soy bean meal, SB), T1 = feed with 25% GLM (25% GLM + 75%SB), T2 = feed with 50% GLM (50% GLM + 50%SB), T3 = feed with 75% GLM (75% GLM + 25%SB), T100 = feed with 100% GLM (100% GLM + 0%SB), WHC = water holding capacity pH = negative logarithm of the hydrogen ion concentration.

5. Discussion

5.1. Interpretation of Carcass Traits Across GLM Treatments

Birds subjected to 25-75% GLM inclusion level exhibited the slaughter weight comparable to control diet. This trend implies that up to 75% inclusion of GLM can not affect most of meat quality characteristics, whereas beyond that does. Low growth observed in birds that received more than 75%

GLM might be due to anti-nutritional factors or reduced palatability at higher inclusions [9]. This result is in line with [8] who reported significant differences in dressed carcass weight of broiler chickens fed different inclusions of GLM, and that the highest dressed carcass weight was recorded at lower inclusion, 10% GLM. However, this finding contradicts with [18] who reported that slaughter weight, and dressed weight of broiler chickens decreased with an increase in levels of GLM.

The study revealed that carcass weight and DP had no marked variation from T0 to T3. This indicates that, that the GLM inclusion up to 75% could match the performance of

conventional diets in terms of carcass yield, whereas at very high inclusion of GLM compromises muscle development; hence carcass yield and DP. The lack of significant differences between T0, T1, T2 and T3 further supports the idea that GLM can be included up to a certain optimal level (75%) without negatively affecting carcass yield efficiency. Similarly, dressing percentage was significantly affected by GLM inclusion, with T4 exhibiting the lowest value compared to the other groups.

The lack of significant differences among T0 to T3 further supports the idea that GLM can be included up to a certain threshold without negatively affecting carcass yield efficiency [9]. The current finding corroborates with [8] who found significant differences in dressed carcass weight of broiler chickens' meat fed GLM at different inclusions. However, the current study contradicts with [19] who found that dressing percentage dropped significantly at 15% GLM compared to control, suggesting that that level of inclusion have had a negative effect in their study.

Furthermore, the result revealed that breast weight was only significantly affected at 100% level of GLM. Since breast muscle represents a major economic portion of the Sasso carcass, thus this finding is important to meat actors. This signifies that GLM can potentially, be included up to 75% without affecting breast weight, beyond which alter its weight. This result contradicts what was reported by [8] and [20] who found no significant difference in breast weights of broiler chickens fed different inclusions levels of GLM. Furthermore, the current study contradicts with [21] who observed that at 25% of GLM inclusion, affected positively the relative weights of some organs including the Pectoralis thoracicus, a major breast muscle. However, the weight of muscle declined as percent of GLM increased further.

5.2. Nutrient Composition in GLM-fed Chickens

The significant effect of GLM on dry matter content reflects changes in the moisture-retention properties of the meat as dietary composition changes. The highest DM values were recorded in 25 and 50% GLM inclusions, beyond which there was a decreasing trend. This pattern suggests that the GLM up to 50% inclusion improve DM of Sasso chicken meat by this enhance meat density and reduce meat moisture content. However, at higher levels (75–100%) there is a possibility of an increased intake of anti-nutritional factors such as tannins and saponins that are present in GLM. These components are known to reduce feed digestibility and water regulation, resulting in higher moisture and thus lower DM in the muscle [18].

Crude protein (CP) content of meat also showed a significant response to GLM inclusion, with the highest CP value observed in T1 (26.2%). Although CP levels declined at higher inclusion levels (T2–T4), these were not significantly different from the control (T0), indicating that at 25% GLM inclusion can enhance protein deposition in meat without negatively affecting it. The increased protein level at 25%

GLM inclusion may be attributed to improved amino acid profile balance. However, at higher levels, the digestibility of protein may decline due to higher fiber content or reduced feed intake [18]. This result is in line with [18] whose finding found that crude protein digestibility remained comparable between the control and the lower inclusion, but declined at the high level.

Moreover, the fat content exhibited no definite pattern; in which T1 and T4 had higher fat content values and the rest had low values. This suggests that GLM inclusion may stimulate fat deposition; possibly through metabolic adjustments or energy partitioning. However, given the relatively low-fat content across all groups, these changes are minor and may not negatively affect meat quality. The current finding corroborates with [19] whose finding noted that abdominal fat content differed between different dietary treatment levels. However, this study contradicts with [22] who found no significant effect on fat content ($p>0.05$).

5.3. Meat Quality Influenced by GLM Levels

The significant yellowness observed in the carcass was attributed to presence of carotenoids in GLM. GLM, like other multipurpose trees, is known to contain considerable amounts of carotenoids, xanthophylls, and chlorophyll, which are absorbed and deposited in muscle tissues, especially in diets with reduced or no SBM [6]. This finding conforms with that of [23] who reported that but feet pigmentation increased linearly in broiler chickens fed *Moringa oleifera* leaf meal in Brazil. The current study is in line with [7] whose finding reported that different inclusions of GLM (0, 5, 10 and 15%) improved significantly yolk color in layers. The finding is consistent with other previous findings where increased dietary plant pigments led to enhanced yellowness in poultry meat, skin and egg yolk [24, 25]. The gradual increase in b^* values with higher GLM inclusion suggests that GLM can serve as a natural pigment source in poultry diets, potentially enhancing the visual appeal of meat for consumers.

The results further showed that there was no significant variation in meat tenderness (shear force) across all dietary treatment. This indicates that GLM inclusion in Sasso chicken diets did not alter meat tenderness. It might be argued that, as in control diet; the GLM-containing feed improves enzymatic activities and bioactive compounds that might influence muscle fiber degradation and proteolysis, hence maintaining tenderness positively across all dietary GLM treatments.

Although not statistically significant, the lower shear force values in GLM-fed chickens may suggest a trend toward improved tenderness with GLM inclusion. This could be attributed to possible antioxidant properties of GLM, which may reduce oxidative stress and protein cross-linking in muscle tissue, thereby maintaining tenderness in meat [26]. Additionally, changes in muscle fiber type or collagen solubility due to diet could play a role. The current finding contradicts with the study by [27] who found that roasts from rabbits fed 25% GLM were

preferred based on tenderness scores than those fed up to 50% GLM. Furthermore, this finding contradicts with [28] who highlighted that *Vachellia karroo* leaf meal (VKLM) significantly affected tenderness due to high tannin content, which could increase the shear force.

Difference was also found in meat pH whereby T0, T2 and T4 rendered the meat to be more acidic compared to T1 and T3. Lowered pH observed in this study might be associated with oxidative stress or altered gut microbiota and digestion, which lead to greater lactic acid accumulation and thus a lower pH postmortem. To the contrary, [28] found no significant differences in carcass pH (at slaughter) between different treatment levels of *Vachellia karroo* leaf meal.

Cooking loss was significantly higher in T4 (100% GLM). The increased cooking loss in T4 suggests that full replacement of soybean with GLM may negatively affect the water-binding ability of the meat, possibly due to altered muscle protein composition or lower fat content. This may lead to greater moisture and fat loss during cooking. Partial replacement (T1–T3) maintained cooking loss at levels comparable to the control, indicating that moderate inclusion of GLM does not impair, and may even support, meat juiciness. High cooking loss may also be associated with less stable muscle structures or reduced intramuscular fat, both of which are critical for moisture retention during thermal processing [29]. This result is partly consistent with [30] who found that inclusion of GLM at higher inclusion levels, negatively impacted meat quality, which alter muscle protein deposition that in turn affect muscle structure, hence impacting water holding capacity of meat.

6. Conclusion and Recommendation

This study demonstrates that *Gliricidia* leaf meal (GLM) can be included in broiler diets up to 75% without adversely affecting slaughter weight, carcass yield, meat protein content, or tenderness. Meat yellowness increased with higher GLM levels, highlighting its role as a natural pigment source. However, 100% inclusion negatively affected breast weight, dry matter, and cooking loss, likely due to anti-nutritional factors. The GLM inclusion should lie between 25–75% for balanced meat quality and yield. The study recommends further research on the effects of GLM inclusion in chicken diets on serum biochemical and hematological parameters.

Abbreviations

GLM	<i>Gliricidia sepium</i> leaf meal
SBM	Soybean meal
ANFs	anti-nutritional factors
SUA	Sokoine University of Agriculture
COEBs	College of Economics and Business Studies
DCP	Di-calcium phosphate
EE	Ether extract

DM	Dry matter
CP	Crude protein
CF	Crude fiber
ME	Metabolizable energy
TVLA	Tanzania Veterinary Laboratory Agency
L	Lightness
a*	Redness
b*	Yellowness
CL	Cooking loss percentage
WHC	Water holding capacity
ANOVA	Analysis of Variance
DP	Dressing percent
VKLM	<i>Vachellia karroo</i> leaf meal

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Author Contributions

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Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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