

Supplementation of Conventional Feed with Roasted Seeds of *Leucaena leucocephala* (Lam) Wit: Effects on Production Performance and Health of Local Chickens in Burkina Faso

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Abstract

In Burkina Faso, conventional poultry feeds are expensive and remain largely inaccessible in rural areas. This study evaluated the effect of supplementing pullet diets with roasted *Leucaena leucocephala* seed meal on growth performance, carcass characteristics, hematological and biochemical parameters in local chickens. Fifty 8-week-old local chicks were allocated to five groups of 10 birds each, corresponding to three experimental diets with replicates: 0% (LG0), 2% (LG2 and LG2r) and 4% (LG4 and LG4r) roasted seed flour inclusion. The nutritional value of this flour was assessed using standard methods. Morpho biometric profiles were measured, blood parameters analyzed using the ABX PENTRA C200 automated analyzer and coccidia oocysts quantified by the modified flotation method. Roasted *Leucaena leucocephala* seeds proved rich in protein (33.19%), total sugars (38.10%) and minerals (phosphorus, potassium, sodium). Analysis of qualitative traits revealed that local chickens predominantly featured gray plumage (25%), red wattles (80%), pink skin (90%) and black feet (40%); along with a red crest (82.33%) and orange-red eyes (85%). The 4% supplementation level yielded the highest live weight (1111 g), lowest feed conversion ratio, and best carcass yield (90.58%; $P > 0.05$), especially in LG4 females compared to controls. However, none of these growth and slaughter parameters reached statistical significance compared to the 2%

group, as these overall performances masked disparities between males and females. Roasted *Leucaena leucocephala* seed induced no adverse changes in hematological or biochemical blood parameters. The 2% dose was the most effective, inducing an 80% inhibition of the coccidial oocyst load, an effect primarily observed in males. No treatment-related mortality was recorded throughout the study. In conclusion, the results of this study demonstrate that the supplementation of up to 4% roasted *Leucaena leucocephala* seed meal into the diets exerts a favorable effect on the growth performance and health status of local chickens, despite sex-related variations.

Keywords

Local Chicken, *Leucaena leucocephala*, Growth Performance, Blood Parameter, Coccidial Oocysts

1. Introduction

Poultry production, which is accessible to all social classes, represents a key sector for development and plays a central role in reducing poverty and food insecurity in developing countries, particularly in Burkina Faso [1]. Poultry products provide highly digestible proteins with high nutritional value, along with readily available energy and essential micronutrients [2] [3].

In Burkina Faso, poultry production is dominated by local chickens, with an estimated population of 33.02 million heads in 2024, corresponding to a utilization rate of 62.2% [4]. These birds are primarily raised in traditional or extensive systems (71.87%) [4], characterized by small-scale operations (1 to 50 birds) that rely mainly on family labor [5] [6]. Most birds are free-ranging and forage independently in environments that are poor in essential nutrients, often insufficient to meet their dietary requirements. Additionally, 98.27% of the poultry receive little or no supplementary feed [7]. However, the population of local chickens has declined from approximately 62.475 million heads in 2017 to 33.02 million in 2024, representing a reduction of about 47.2% [4] [8].

This downward trend undermines the sector capacity to satisfy the growing demand for poultry products. Several factors may explain this decline, among which nutritional deficiencies are identified as a major constraint [6].

Feed constitutes a fundamental component of all poultry production systems. However, and generally accounts for about 60% to more than 70% of total production costs [9] [10].

Nutrient-rich feed ingredients for poultry, including maize, soybean and fish meals, as well as essential vitamins and minerals, remain expensive and largely inaccessible, particularly in rural areas [11] [12]. Price volatility, driven by climatic factors, transportation costs and global market dynamics along with competition from human consumption, substantially increases the cost of poultry rations [11] [12]. Protein-rich feed resources, including soybean and fish meals, are largely

imported from neighboring countries such as Senegal and Ghana [13].

This reality negatively affects poultry productivity in Burkina Faso. There is therefore a need to explore locally available, accessible, nutritious and low-cost feed resources to improve productivity.

Several plant genetic resources have been investigated in particular *Leucaena leucocephala* (Lam), *Moringa oleifera* (Lam), *Cassia tora* (Linn.), *Hibiscus sabdariffa* (Linn.), *Mucuna pruriens*, etc., capable of improving the zootechnical performance and health of chickens. (Linn.) [14]-[16].

Leucaena leucocephala and *Moringa oleifera* were distinguished by their nutritional and medicinal properties and are commonly used in poultry production for their anti-inflammatory, antibacterial, antiparasitic and antioxidant effects [17] [18]. Several studies have also shown that the incorporation of *Leucaena leucocephala* into chicken diets improves growth, digestibility, laying performance, egg yolk pigmentation, carcass coloration, egg mass and egg quality, as well as the efficiency of utilization of crude protein and metabolizable energy [19]-[21].

Leucaena leucocephala seeds also have an interesting nutritional profile, including proteins and essential amino acids such as lysine and methionine, essential fatty acids, energy, vitamins and minerals [22] [23]. These nutritional and medicinal properties, together with the availability of *Leucaena leucocephala*, would justify its use to improve the zootechnical performance and health of chickens.

This study evaluates the impact of supplementing the diet of local chickens with roasted *Leucaena leucocephala* seeds on their productivity and health.

2. Material and Methods

2.1. Experimental Site and Study Period

The study was conducted at the experimental animal facility of Nazi BONI University (UNB) in Nasso (Latitude: 11° 12' North, Longitude: 4° 26' West), located approximately 15 km northwest of Bobo-Dioulasso, Burkina Faso. The regional climate is South-Sudanian, characterized by a distinct dry season (October to April) and a rainy season (May to September). Experimental trials took place from November 2024 to February 2025, coinciding with the peak of the dry season. During this period, ambient temperatures ranged from 18°C to 34°C. According to the National Meteorological Agency (ANAM), annual rainfall in the area totaled between 1000 and 1200 mm in 2024, while 800 to 1000 mm were recorded from April 1st to August 31st, 2025 [24] [25]. The vegetation consists of wooded, tree-savanna, and shrub dominated landscapes [26]. The topography is gently undulating, featuring a southern rocky ridge, low-lying wetlands, and extensive arable plains. Soils exhibit high agricultural potential. The hydrographic network encompasses around twenty springs, with the largest being Guinguette spring in Nasso village [27].

2.2. Breeding Facility

The breeding facility (16 × 10 × 4.5m; L × W × H) was comprised three compart-

ments and a feed storage area. The compartment designated for this experiment ($1.5 \times 1.5 \times 1.6$ m) was partitioned into five identical wire-mesh pens ($1.5 \times 1.5 \times 1.6$ m), each fitted with feeders and drinkers (6l capacity). The facility featured natural ventilation and lighting. Chickens were housed on wood shavings litter (approximately 15 cm thick).

2.3. Experimental Chicks

The experiment commenced with 8-week-old local chicks subjected to a one-week acclimation period. At the beginning of the trial, birds were sorted and allocated to experimental pens to homogenize weights within each group, ensuring that the maximum weight variance between individuals in the same pen did not exceed 50 g. The initial mean body weights (PMi) $\pm$ SD were 341.00 g for the control group (LG0), 236.85 g $\pm$ 25.67 for the 2% supplementation group (LG2), and 315.50 g $\pm$ 30.40 for the 4% group (LG4). Subsequent growth statistical modeling included initial body weight as a covariate to isolate the true effect of dietary supplementation. Stocking density during the trial was 10 chicks/m². The experimental subjects were never vaccinated.

2.4. Collection of Plant Material Preparation

Flour from dried and roasted seeds of *Leucaena leucocephala* served as the plant material. Seeds were collected directly from trees in Bobo-Dioulasso and Nasso village (Burkina Faso), followed by winnowing to eliminate impurities. Roasting was performed using the protocol of Aliu *et al.* (2021) [28], modified as per Iwu-chukwu *et al.* (2024) [29]. Seeds underwent roasting for 10 mn at 110°C to 120°C. A sweet aroma was emitted after 2 mn, concurrent with a color change from brown to reddish-brown. Subsequently, roasted seeds were milled into flour and stored in airtight containers at ambient temperature until analysis.

2.5. Experimental Diet Formulation

2.5.1. Nutritional Analysis of *Leucaena leucocephala* Seed

The total protein content was quantified using the Kjeldahl method [30]. Sample underwent oxidative digestion to convert organic nitrogen to mineral nitrogen (N). Protein levels were calculated with the standard conversion factor: Proteins = N $\times$ 6.25

The total sugar content was determined using the phenol-sulfuric acid method described by Dubois *et al.* (1956) [31]. Yellow-orange chromophores develop during the reaction, with their formation assessed through absorbance measurements at 485 mn.

Lipids from samples (10 g) were extracted over 6h using the Soxhlet apparatus with 200 ml petroleum ether, following the AOAC (1990) [32].

Phosphorus (P) content was measured using the BRAY (1945) method [33]. A mineralized extract (1 ml) was added to a mixed reagent solution containing ascorbic acid, ammonium molybdate, and potassium anti-monyl-oxy-tartrate.

Phosphate ions react with molybdate to form a blue phosphomolybdate complex, with absorbance determined at 880nm using a UV-visible spectrophotometer. Color intensity is directly proportional to phosphorus concentration. Total potassium (K) and sodium (Na) contents were evaluated by flame photometry, comparing emission intensities from sample atoms against standard solutions immediately following mineralization [34]. The pH was measured using a pH-meter.

2.5.2. Experimental Feed

Three experimental diets were formulated based on the inclusion rate of roasted *Leucaena leucocephala* seed meal: 0% (LG0, serving as the control), 2% (LG2), and 4% (LG4). To ensure experimental rigor, the LG2 and LG4 diets were prepared in duplicate, yielding a total of five treatment groups: LG0, LG2, LG2r, LG4, and LG4r (where “r” denotes the replicate). All diets shared an identical commercial pullet feed base produced at the experimental station, differing solely in their respective *Leucaena leucocephala* content. The composition of the pullet feed is presented in **Table 1**.

Table 1. Pullet feed composition.

Ingredients	Pullets (% of ration)
Corn	60
Wheat bran	10
Oyster shell	10
Fish	5
Soybean meal	10
KLC (Koudijs Layer Concentrate)	5
Total	100

2.6. Experimental Condition

A total of 50 chicks were randomly assigned to five pens corresponding to two dietary treatments (2% and 4% roasted *Leucaena leucocephala* seed flour, $n = 2$ replicates each) and one control group (0% *Leucaena leucocephala*). Each pen housed 10 (ten) unsexed chicks. Water was provided ad libitum throughout the trial. The initial feed ration was set at 80 g/chick/day, based on their body weight. Feed refusals were weighed daily to calculate actual feed intake. Growth performance was monitored over 10-week period, with weekly individual body weights measurements. This protocol ensured precise nutrient intake control and reliable growth assessment.

2.7. Computation of Growth Performance Parameters

Throughout the duration of the trial, growth parameters were computed according to the methods outlined by Bouatene *et al.* (2011) [35].

2.7.1. Live Weight

Chicks from each pen were individually weighed by placing them in a bag suspended from a precision balance (10 kg capacity). Average live weight was calculated using the following formula: Live Weight (g) = Σ individual weights in the lot/number of individuals per lot.

2.7.2. Consumption Index (CI)

The Consumption Index represents the ratio of mean feed intake over a specified period to the corresponding mean body weight gain during that interval.

CI = Average feed consumption (in g)/Average weight gain (in days).

2.7.3. The Average Daily Gain (ADG)

The AGD serves as a key zootechnical indicator measuring average daily growth in animals. It quantifies the rate of weight gain or loss per day over a defined period. Weekly weigh-ins enabled ADG determination by dividing total weight gain over the interval by the corresponding number of days.

ADG = (PVf – PVi)/number of days (PVf: final average live weight; PVi: initial average live weight).

2.7.4. Individual Food Consumption (IFC)

IFC quantifies feed consumed per animal over a specific timeframe. It was determined by subtracting refused feed from the amount provided.

CAI (g/subject/day) = QAD (g) – QAR (g)/Duration of period (d) $\times$ number of subjects (QAD: Quantity of feed distributed; QAR: Quantity of food refused).

2.7.5. Mortality Rate

The mortality rate is calculated as the number of deaths relative to the initial batch size, expressed as a percentage. Mortality rate (%) = (Number of deaths/Initial batch size) $\times$ 100.

2.8. Morpho-Biometric Measurements

The morphobiometric traits were characterized in order to verify the impact of supplementation with roasted *Leucaena leucocephala* seeds on the production performance and typology of experimental local chickens.

Twenty chickens (2 males and 2 females per lot) were randomly selected to determine quantitative and qualitative body measurements. These measurements were taken in the morning at the 10th week of the experiment on subjects aged 20 weeks, following the methods defined in FAO (2013) [36].

The measurement results of male chickens receiving *Leucaena leucocephala* doses (2% and 4%) were compared to those of control males. The measurement results of female chickens receiving *Leucaena leucocephala* doses (2% and 4%) were compared to those of control females.

2.8.1. Quantitative Traits

Standardized tools (caliper, measuring tape, precision balance) were utilized to

measure tarsus length, drumstick diameter, wing length, thoracic circumference, body length, comb height, wattle length, comb length, spur length, beak length, wingspan of wings and live weight.

2.8.2. Qualitative Traits

Qualitative traits were assessed through visual observation, following the protocols described in FAO (2013) [36]. Phenotypic characterization of experimental chickens relied on the visual examination of four local chickens per cage (2 males and 2 females), totalling twenty subjects. The studied qualitative attributes include colour (plumage, feet, skin, wattles, eyes and comb), appearance (plumage and comb), feather distribution and beak shape.

2.9. Evaluation of the Effect of Toasted Dried Seed Extract Flour on Biochemical, Hematological Parameters and Coccidia Rates in Local Chickens

2.9.1. Blood Sample Collection, Transport and Analysis

Blood was collected early in the morning by puncture of the brachial vein from each selected chicken immediately prior to slaughter. In cases of subcutaneous hematoma formation, sampling was performed on the contralateral wing. Animals were randomly selected within each treatment group, with a balanced sex ratio (2 males and 2 females per group; $n = 20$ chickens total). Samples were obtained using 5 mL syringes and distributed into EDTA-coated tubes for hematological analyses and dry tubes for biochemical parameters. Samples were promptly transported from the farm to the laboratory in a cooled cooler containing ice packs prior to analysis. The analyses were performed at the Human Hematology-Biochemistry Laboratory using the ABX PENTRA C200 automated biochemistry analyzer at the Institute of Sciences and Techniques (INSTech) in Bobo-Dioulasso (Burkina Faso). Blood parameter results from the groups treated with roasted dried *Leucaena leucocephala* seed meal were compared to those of the control group.

2.9.2. Coprological Analysis for the Detection of Coccidia Oocysts by Optical Microscopy

Fecal samples were collected directly from the cloaca to prevent external contamination. Sampling was performed on chickens that underwent blood collection prior to slaughter (2 males and 2 females per group). Samples were transported in an insulated cooler with ice packs to the Laboratory of Research and Teaching in Animal Health and Biotechnology (LARESBA) for processing. Each sample received 5ml of 2.5% potassium dichromate ($K_2Cr_2O_7$) solution for refrigerated preservation pending examination. A modified flotation technique was employed to concentrate oocysts [37]. Oocysts were identified using an optical microscope with a $\times 40$ objective. The number of oocysts per gram of feces (OPG) was determined using the following formula: $OPG = (N \times \text{dilution factor})/V$ [38].

N represents the total number of oocysts counted; V is the volume of the counting grid (0.3 ml), and the dilution factor equals 150. Oocyst inhibition for each

treated group (LG2 and LG4) was determined relative to the control group (LG0) baseline (100%).

The following formula is used:

$$\%I = \frac{\text{OPG in the control group} - \text{OPG in the test group}}{\text{OPG in the control group}} \times 100$$

% I: The oocyst inhibition rate.

2.10. Carcass Characteristics

At the end the trial, 20 chickens (4 per lot: 2 females and 2 males) were euthanized to assess carcass traits. Subjects underwent exsanguination via jugular vein incision, scalding in hot water, and manual feather removal. Pre-slaughter live weights and hot carcass weights were recorded. Carcass yield (CY in %) was computed as the ratio of carcass weight to live weight at slaughter, multiplied by 100.

$$\text{CY (\%)} = \text{Empty carcass weight (g)} / \text{Live weight at slaughter (g)} \times 100$$

2.10.1. Weigh of Selected Internal Organs

Organs from the thoracic (heart) and abdominal (Liver, spleen, gizzard and testicles) cavities were dissected, excised and weighed individually for each subject and dietary treatment to evaluate the effects of ration supplementation on their development.

2.10.2. Carcass Color Assessment (Skin Color and Adipose Tissue)

Skin and adipose tissue yellowness intensity was scored using the Kaijage *et al.* (2003) [39]. scale, ranging from 1 to 4: 1 = no yellow coloration; 2 = light to moderate yellow; 3 = pronounced yellow; 4 = intense to dark yellow.

2.11. Ethics Committee

This experimental study was approved by the Ethics Committee of Université Joseph Ki-Zerbo under the number CEEA-UJKZ/2021-07.

2.12. Statistical Analysis

Tables and figures were generated using Excel 2023 software, which was also employed to calculate means and standard deviations. Statistical analysis was conducted with IBM SPSS Statistics 25, Prism (version 2005) and JAMOV (version 2.6.44) software. Weekly live weight, ADG, feed intake, and feed conversion ratio were analyzed considering dietary treatment as the fixed factor and week as the repeated factor, using pen means as the experimental unit. Birds were randomly sampled within each pen at each weighing period. Mean comparisons were performed using Tukey's post hoc test at $P < 0.05$.

3. Results

3.1. Nutritional Value

The nutrient contents in proteins, lipids, total sugars and minerals (phosphorus,

potassium and sodium) of raw dried and toasted dried seeds of *Leucaena leucocephala* (LL) are recording in **Table 2**. Crude protein content was ranged from 25.34% to 33.19%. Roasted seeds (LGT) exhibited the highest value (33.19%). Total sugars were varied between 31.56% and 38.10%, with high content in LGT. Lipid contents in both samples were ranged from 6.00% (LGB) to 6.65% (LGT). The highest phosphorus (P) content was observed in LGT (3.84 mg/100 g) compared to LGB (2.52 mg/100 g). Potassium (K) was ranged from 22.31 to 44.62 mg/100 g peaking in raw seeds (LGB). Finally, sodium (Na) was varied from 2.38 to 2.62 mg/100 g, and the highest level in LGB. Significant differences ($P = 0.000$) for nutrient contents were observed between two sample, except for lipids (P -value > 0.05).

Table 2. Nutrient composition of raw seed flour (LGB) and roasted seed flour (LGT) from *Leucaena leucocephala*.

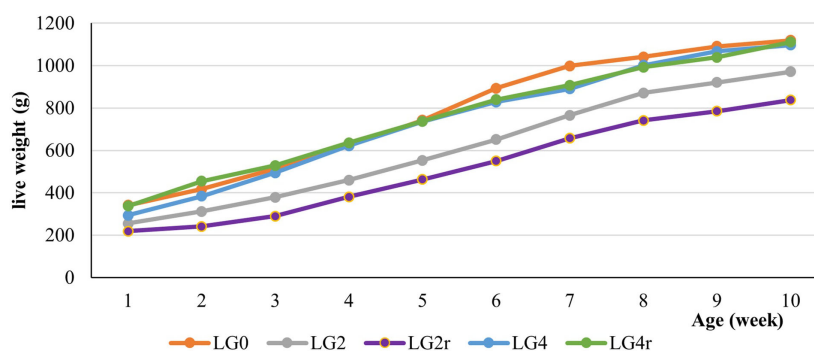
Sample	N (%)	Crud protein (%)	Total sugar (%)	Lipid (%)	P (mg/100 g)	K (mg/100 g)	Na (mg/100 g)	pH
LGB	4.05 ^a	25.34 ^a	31.56 ^a	6.00 ^a	2.52 ^a	44.62 ^b	2.62 ^b	6.49 ^b
LGT	5.31 ^b	33.19 ^b	38.10 ^b	6.65 ^a	3.84 ^b	22.31 ^a	2.38 ^a	6.35 ^a

Means sharing the same column with distinct superscripts letters are statistically different; ($P < 0.05$). N = nitrogen, K = potassium, P = phosphorus, Na = sodium; Raw Seed Flour of *Leucaena leucocephala*: LGB; Roasted Seed Flour of *Leucaena leucocephala*: LGT.

3.2. Effect of Supplementation with Roasted Seeds of *Leucaena leucocephala* on Growth Performance and Carcass Characteristics of Local Chickens

3.2.1. Live Weight

Figure 1 illustrates the effect of adding Roasted *Leucaena leucocephala* (LL) seed flour to the pullet ration on the body weight evolution of local chickens according to their age (experimental week).



LG0 (Roasted seeds of *Leucaena leucocephala* 0%); LG2 (Roasted seeds of *Leucaena leucocephala* 2%); LG2r (Roasted seeds of *Leucaena leucocephala* 2% replica); LG4 (Roasted seeds of *Leucaena leucocephala* 4%); LG4r (Roasted seeds of *Leucaena leucocephala* 4% replica). NB: r = replica. P -value < 0.05 .

Figure 1. Weight evolution of local chickens by treatment during the experiment.

The body weight evolution of chickens from the experimental batches (LG0, LG2, LG2r, LG4 and LG4r) was significantly different ($P < 0.05$) from the 1st to 8th

week of age. However, between the 9th and 10th week of age, no significant difference was observed in the live weight between the control batch (LG0) and the treated batches (LG2, LG2r, LG4 and LG4r) $P > 0.05$. Furthermore, a significant improvement ($P < 0.05$) in weight was observed in chickens from the LG4r treatment (455 g) compared to the other batches LG0 (417 g), LG2 (312 g), LG2r (241 g) and LG4 (384 g) from the 2nd to 4th week of age.

3.2.2. Consumption Index (CI)

The temporal evolution of the feed intake index (CI) in local chickens receiving a diet enriched with flour from dried seeds roasted *Leucaena leucocephala* was presented in **Figure 2**.

From the 2nd to the 7th week (age), a decrease in the feed intake index (CI) was observed across all experimental groups (LG0, LG2, LG2r, LG4, and LG4r). At the 8th week, this decline was more pronounced in subjects receiving rations supplemented with roasted *Leucaena leucocephala* seeds compared to the control group. This reduction was even more marked at the 10th week in the LG4r group. However, no statistically significant differences were found between groups ($P > 0.05$).

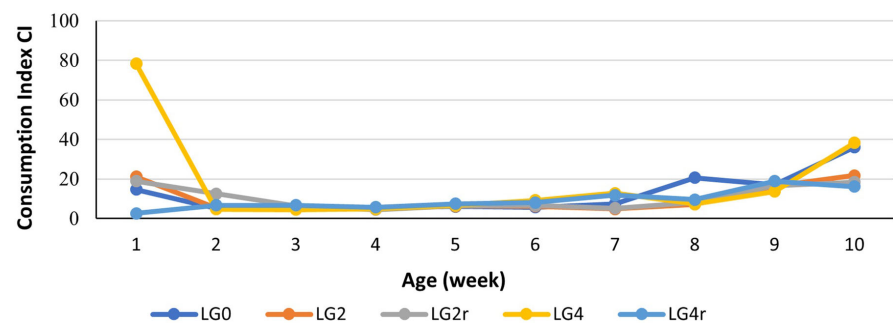


Figure 2. Effect of ration supplementation on the feed intake index (CI) in experimental chickens.

3.2.3. The Average Daily Gain (ADG)

The temporal evolution of average daily gain (ADG) of chicken was shown in **Figure 3**. Rations supplementation with 4% roasted *L. leucocephala* seed flour (LG4 and LG4r) were increased ADG compared to other experimental groups (LG0, LG2 and LG2r) during weeks 1 - 4 and 8 - 10 of the trial. However, statistical analysis revealed no significant differences between groups ($P > 0.05$).

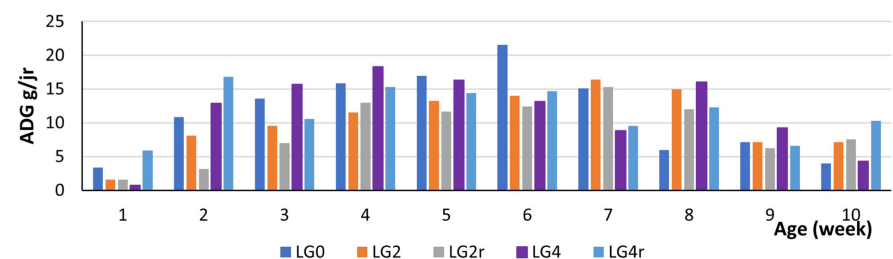


Figure 3. Effect of ration supplementation on average daily gain (ADG) in experimental chickens.

3.2.4. Individual Food Consumption (IFC)

The temporal evolution of individual food consumption (IFC) in local chickens was presented in **Figure 4**. Groups LG4 and LG4r (4% roasted *L. leucocephala* seed flour) and the control group LG0 were exhibited higher feed consumption compared to groups LG2 and LG2r (2% roasted *L. leucocephala* seed flour) throughout the trial. The difference was no statistically significant ($P > 0.05$).

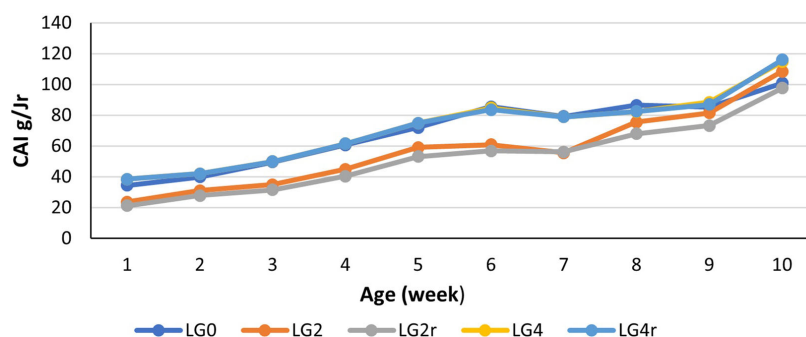


Figure 4. Effect of ration supplementation on Individual food consumption (IFC) in experimental chickens.

3.2.5. Mortality Rate

Throughout the trial period, no mortality was observed in local chickens fed rations supplemented with roasted *Leucaena leucocephala* seed flour.

3.3. Morpho-Biometric Measurements

3.3.1. Quantitative Traits

Table 3 presents the quantitative morpho-biometric parameters of local male and female chickens (10th week of the experiment). Quantitative traits of male and female chickens fed diets supplemented with 2% or 4% roasted *Leucaena leucocephala* seed were evaluated relative to controls ($n = 8$ birds per treatments). The mean live weight of sampled males was 1.44 kg in the control group (LG0M), compared with 1.35 kg in LG2M and 1.34 kg in LG4M. Thoracic perimeter was greatest in LG4M (31.02 cm), followed by LG2M (29.65 cm) and LG0M (29 cm). Body lengths were greatest in LG4M (39.16 cm) and LG0M (39 cm), with the lowest values recorded in LG2M (36.97 cm). Drumstick diameter measured 3.75 cm (LG0M), 3.32 cm (LG2M) and 2.93 cm (LG4M). Wing lengths measured 16.5 cm (LG0M), 16.07 cm (LG0M) and 16.75 cm (LG4M). Mean tarsus lengths in males varied as follows: 11.05 cm (LG0M), 10.3 cm (LG2M) and 10.15 cm (LG4M). Statistical analysis revealed no significant differences (P -value > 0.05) between quantitative trait values among sampled males during the experiment. Body weight measurements showed the highest mean live weight in LG4F (1.24 kg), with no statistically significant differences between groups ($P > 0.05$).

Mean body lengths in LG4F (35 cm) were similar to those in control LG0F birds. However, they were significantly lower in LG2F (32.75 cm) compared to the control group ($P < 0.05$). Mean tarsus lengths were higher in LG4F (9.62 cm) than in controls, but this difference was not significant ($P > 0.05$). Thoracic perimeter

was significantly greater in LG4F (30 cm) compared to controls (26 cm) ($P < 0.01$). Mean wing spans measured 37.5 cm (LG0F) and 37.6 cm (LG2F) compared to 35.37 cm in LG4F; these differences were not significant ($P > 0.05$). Average drumstick diameter in females were 3.3 cm (LG0F), 3.2 cm (LG2F) and 2.65 cm (LG4F), with no significant variation between groups. Mean wing length was significantly greater in control LG0F birds (16.5 cm) compared to LG2F (12.72 cm) and LG4F (12.9 cm) groups ($P < 0.001$).

Table 3. Quantitative morpho-biometric parameters of experimental local male and female chickens.

Parameters	Male (M)			Female (F)		
	LG0M	LG2M	LG4M	LG0F	LG2F	LG4F
Tarsus length (cm)	11.05	10.3 ^{ns}	10.15 ^{ns}	8.9	8.92 ^{ns}	9.62 ^{ns}
Drumstick diameter (cm)	3.75	3.32 ^{ns}	2.93 ^{ns}	3.3	3.2 ^{ns}	2.65 ^{ns}
Wing length (cm)	16.5	16.07 ^{ns}	16.75 ^{ns}	16.5	12.72 ^{***}	12.9 ^{***}
Thoracic circumference (cm)	29	29.65 ^{ns}	31.02 ^{ns}	26	25.75 ^{ns}	30 ^{**}
Body length (cm)	39	36.97 ^{ns}	39.16 ^{ns}	35	32.75 [*]	35 ^{ns}
Comb height (cm)	5.15	1.85 ^{ns}	4.2 ^{ns}	0.7	0.65 ^{ns}	0.75 ^{ns}
Wattle length (cm)	4.3	2.65 ^{ns}	3.47 ^{ns}	0.85	0.8 ^{ns}	1.25 ^{ns}
Comb length (cm)	8.4	4.87 ^{ns}	6.93 ^{ns}	2.3	2.12 ^{ns}	3.45 ^{ns}
Spur length (cm)	0.9	1.07 ^{ns}	0.4 ^{ns}	0	0 ^{ns}	0 ^{ns}
Beak length (cm)	3.5	2.95 ^{ns}	3.35 ^{ns}	2.85	2.97 ^{ns}	3.35 ^{ns}
Wingspan of wings (cm)	40.5	42.87 ^{ns}	41.42 ^{ns}	37.5	37.6 ^{ns}	35.37 ^{ns}
Live weight (kg)	1.44	1.35 ^{ns}	1.34 ^{ns}	1.1	0.94 ^{ns}	1.24 ^{ns}

NB: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; ns (not significant) $P > 0.05$; LG0M (control males: 0% roasted *Leucaena leucocephala* seed flour); LG2M (treatment males: 2% roasted *Leucaena leucocephala* seed flour); LG4M (treatment males: 4% roasted *Leucaena leucocephala* seed flour); LG0F (control females: 0% roasted *Leucaena leucocephala* seed flour); LG2F (treatment females: 2% roasted *Leucaena leucocephala* seed flour); LG4F (treatment females: 4% roasted *Leucaena leucocephala* seed flour).

3.3.2. Qualitative Parameters

The qualitative parameters examined were divided into two distinct types. Specifically, some exhibited phenotypic variation, particularly in plumage color, wattles, combs, skin, eyes and feet (Table 4). On the other hand, other exhibited an invariable phenotype, such as plumage type and distribution, comb shape and beak type (Table 5).

In total, six plumage color variants were identified. The predominant hues were gray (25%), followed by black and red (20% each). The least frequent variants included ermine (15%), white (10%) and pebbled (10%). Furthermore, two wattle colorations were recorded: 80% of the chickens had red wattles, while 20% exhibited a white coloration. The analysis of the combs revealed two distinct colorations. Red dominated in 90% of the chickens, whereas pink accounted for only 10% of cases. The examination of the skin in these poultry revealed a predomi-

nance of pink coloration (90%), complemented by gray hues (10%). For the eyes, two phenotypes were observed, with orange-red clearly dominant (85%) over black (15%). The study of feet color classified the birds into three distinct categories: black predominated (40%), followed by yellow (35%), then white (25%).

Plumage was smooth and uniformly distribution in all chickens (100%), with uniform feather coverage across the body (**Table 5**). Chicken combs were predominantly single-type (99%) and serrated (1%). Normal beak shape was observed in 92% of chickens.

Table 4. Variable quantitative parameters.

Colour types	Effectifs	Pourcentage (%)
Plumage		
White	2	10%
Black	4	20%
Pebbled	2	10%
Ermine	3	15%
Gray	5	25%
Red	4	20%
Wattles		
White	4	20%
Red	16	80%
Combs		
Red	8	90%
Pink	2	10%
Skin		
Pink	18	90%
Gray	2	10%
Eyes		
Black	3	15%
Orange-red	17	85%
Feet		
White	5	25%
Black	8	40%
Yellow	7	35%

Table 5. Invariant qualitative parameters.

Qualitative traits	Observations
Beak shap	Normal
Comb types	Simple and serrated
Plumage types	Smooth
Plumages distribution	Normal

3.4. Evaluation of the Effect of Roasted Seed Extract Flour on Biochemical, Hematological Parameters and Coccidia Rates in Local Chickens

3.4.1. Evaluation of the Effect of Roasted Seed Extract Flour on Biochemical, Hematological Parameters in Local Chickens

The hematological parameters of male and female chickens are described in **Table 6**.

Compared to the control group ($\text{RBC} = 3.38 \times 10^6/\mu\text{l}$), erythrocyte count (RBC) was lower in the LG2M ($2.44 \times 10^6/\mu\text{l}$) and LG4M ($2.77 \times 10^6/\mu\text{l}$) groups. The hemoglobin (HGB) level in LG4M (11.92 g/dl) was closer to that of the control (12.3 g/dl), whereas the LG2M value (10.12 g/dl) was lower. Hematocrit (HCT) was highest in the control group (48.8%), followed by LG4M (38.65%) and LG2M (33.1%). These differences (RBC, HGB and HCT) were not statistically significant ($P > 0.05$). Platelet (PLT) statistically significantly decreased ($P < 0.05$) from $38.5 \times 10^3/\mu\text{l}$ in LG0M to $23.5 \times 10^3/\mu\text{l}$ in LG4M and $19.75 \times 10^3/\mu\text{l}$ in LG2M. Leucocyte count (WBC) significantly increased in LG4M ($127.02 \times 10^3/\mu\text{l}$, $P < 0.001$) compared to the control ($107.25 \times 10^3/\mu\text{l}$) and LG2M ($107.42 \times 10^3/\mu\text{l}$). Similarly, lymphocyte count (LYM) was significantly higher in LG4M ($113.70 \times 10^3/\mu\text{l}$, $P < 0.05$) than in the control ($98.84 \times 10^3/\mu\text{l}$) and LG2M ($96.49 \times 10^3/\mu\text{l}$).

In female, erythrocyte count (RBC) was higher in the LG2F group ($2.78 \times 10^6/\mu\text{l}$) than in LG4F ($2.64 \times 10^6/\mu\text{l}$), compared to the control LG0F ($2.36 \times 10^6/\mu\text{l}$). The hemoglobin (HGB) levels were slightly higher in LG4F (11.15 g/dl) and LG2F (11.05 g/dl) than in the control (10.45 g/dl). Hematocrit (HCT) was highest in LG4F (35.57%), followed by LG0F (33.2%) and LG2F (31.4%). Platelet count (PLT) was higher in LG2F ($25.5 \times 10^3/\mu\text{l}$) than in LG0F ($19 \times 10^3/\mu\text{l}$) and LG4F ($20 \times 10^3/\mu\text{l}$). These differences (RBC, HGB, HCT, and PLT) were not statistically significant. Leucocyte count (WBC) and lymphocyte (LYM) counts were significantly higher ($P < 0.05$) in LG4F ($124.77 \times 10^3/\mu\text{l}$ and $144.55 \times 10^3/\mu\text{l}$) compared to the control LG0F ($110.66 \times 10^3/\mu\text{l}$ and $103.28 \times 10^3/\mu\text{l}$) and LG2F ($119.70 \times 10^3/\mu\text{l}$ and $100.48 \times 10^3/\mu\text{l}$).

Table 6. Hematological parameters of male and female chickens fed experimental.

Parameter	Male			Female		
	LG0M	LG2M	LG4M	LG0F	LG2F	LG4F
RBC ($\times 10^6/\mu\text{l}$)	3.38	2.44 ^{ns}	2.77 ^{ns}	2.36	2.78 ^{ns}	2.64 ^{ns}
HGB (g/dl)	12.3	10.12 ^{ns}	11.92 ^{ns}	10.45	11.05 ^{ns}	11.15 ^{ns}
HCT (%)	48.8	33.1 ^{ns}	38.65 ^{ns}	33.2	31.4 ^{ns}	35.57 ^{ns}
VGM (μm^3)	143.95	135.42 ^{ns}	139.42 ^{ns}	140.65	130.97 ^{ns}	135 ^{ns}
TGMH (pg)	36.65	41.5 ^{ns}	40.65 ^{ns}	44.05	39.77 ^{ns}	42.35 ^{ns}
CCMH (g/dl)	25.75	30.62 ^{ns}	30.92 ^{ns}	31.3	30.37 ^{ns}	31.4 ^{ns}
IRD-CV (%)	8.75	8.05 ^{ns}	9.15 ^{ns}	8.85	8.37 ^{ns}	16.22 ^{ns}
IRD-SD (μm^3)	49.15	41.47 ^{ns}	48.8 ^{ns}	48.8	38.95 ^{ns}	44.07 ^{ns}

Continued

PLT ($\times 10^3/\mu\text{l}$)	38.5	19.75*	23.5*	19	25.5 ^{ns}	20 ^{ns}
THT (%)	0.03	0.01 ^{ns}	0.02 ^{ns}	0.01	0.02 ^{ns}	0.02 ^{ns}
VMP (μm^3)	8.8	8.7 ^{ns}	8.9 ^{ns}	8.4	8.75 ^{ns}	8.6 ^{ns}
IDP (μm^3)	11.15	12.42 ^{ns}	11.55 ^{ns}	11.9	11.35 ^{ns}	9.17 ^{ns}
P-LCC ($\times 10^3/\mu\text{l}$)	10	5.25 ^{ns}	6 ^{ns}	4.5	7.25 ^{ns}	5.25 ^{ns}
P-LCR (%)	26.95	26.2 ^{ns}	25.27 ^{ns}	23.95	27.75 ^{ns}	26.22 ^{ns}
WBC ($\times 10^3/\mu\text{l}$)	107.25	107.42 ^{ns}	127.02**	110.66	119.70 ^{ns}	124.77*
NEU ($\times 10^3/\mu\text{l}$)	6.71	5.25 ^{ns}	11.07 ^{ns}	5.14	14.10 ^{ns}	8.19 ^{ns}
LYM ($\times 10^3/\mu\text{l}$)	98.84	96.49 ^{ns}	113.70*	103.28	100.48 ^{ns}	114.55*
MON ($\times 10^3/\mu\text{l}$)	0.37	1.38 ^{ns}	0.57 ^{ns}	0.26	1.70 ^{ns}	0.54 ^{ns}
EOS ($\times 10^3/\mu\text{l}$)	0.52	0.95 ^{ns}	0.58 ^{ns}	0.67	2.13 ^{ns}	0.76 ^{ns}
BAS ($\times 10^3/\mu\text{l}$)	0.56	1.01 ^{ns}	0.97 ^{ns}	0.82	1.07 ^{ns}	1.07 ^{ns}
GCI ($\times 10^3/\mu\text{l}$)	0.25	0.33 ^{ns}	0.11 ^{ns}	0.17	0.28 ^{ns}	0.17 ^{ns}

NB: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; ns (not significant) $P > 0.05$; RBC: Red Blood Cells; HGB: Hemoglobin, HCT: Hematocrit; PLT: Platelets; WBC: White Blood Cells; MCV: Mean cell volume; MCV: Mean cell hemoglobin; MCHC: Mean cell hemoglobin concentration; MON: Monocytes; EOS: Eosinophil; BAS: Basophil. LG0M (control males: 0% roasted *Leucaena leucocephala* seed flour); LG2M (treatment males: 2% roasted *Leucaena leucocephala* seed flour); LG4M (treatment males: 4% roasted *Leucaena leucocephala* seed flour); LG0F (control females: 0% roasted *Leucaena leucocephala* seed flour); LG2F (treatment females: 2% roasted *Leucaena leucocephala* seed flour); LG4F (treatment females: 4% roasted *Leucaena leucocephala* seed flour).

The biochemical parameters of male and female chickens are shown in **Table 7**.

No significant differences were observed in the blood biochemical profiles of local male chickens across treatments LG0M (control), LG2M (2%) and LG4M (4%), with $P > 0.05$ for the most parameters analyzed. AST (Aspartate Aminotransferase) activity was lower in *Leucaena leucocephala* treated groups (LG2M: 226.22 U/l; LG4M: 224.72 U/l) compared to the control (LG0M: 250.15 U/l), while ALT (Alanine Aminotransferase) remained stable across all groups (3.8 - 3.9 U/l). Total Bilirubin (TBIL) concentrations were reduced in treated groups (LG2M: 1.74 $\mu\text{mol/l}$; LG4M: 1.64 $\mu\text{mol/l}$) than in the control (2.03 $\mu\text{mol/l}$), as was Direct Bilirubin (DBIL) (LG2M: 0.31 $\mu\text{mol/l}$; LG4M: 0.59 $\mu\text{mol/l}$ than LG0M: 0.90 $\mu\text{mol/l}$). Enzymatic creatinine (6.3 $\mu\text{mol/l}$) and urea (0.58 - 0.62 mmol/l) levels showed no variation across treatments. Blood glucose (GLUCOSE PAP) exhibited minor fluctuations (LG2M: 12.20 mmol/l; LG0M: 13.07 mmol/l; LG4M: 14.26 mmol/l), whereas magnesium remained consistent (0.92 mmol/l). Total protein concentrations were highest in LG4M (44.5 g/l) followed by LG2M (41.25 g/l), relative to LG0M (40.3 g/l), with albumin slightly was decreased in the treated groups. Na^+ (LG2M: 152.25 mmol/l; LG4M: 151.32 mmol/l) and Cl^- (LG2M: 112.55 mmol/l; LG4M: 113.17

mmol) levels showed modest declines compared to the control (153.2 and 115.55 mmol/l), respectively. K^+ was elevated in LG4M (4.92 mmol/l) and LG2M (4.55 mmol/l) relative to LG0M (3.92 mmol/l). Ionized calcium (nCa^{2+}) decreased markedly in LG4M (0.79 mmol/L) and LG2M (1.14 mmol/l) compared to the control (1.45 mmol/l). Blood pH was mildly alkaline across all treatment groups, recording 7.53 (LG0M), 7.50 (LG2M) and 7.56 (LG4M).

AST and ALT activities were higher in *Leucaena leucocephala* treated groups (LG2F: AST = 252 U/l, ALT = 4.83 U/l; LG4F: AST = 224.72 U/l, ALT = 3.83 U/l) than in controls (LG0F: AST = 187.65 U/l, ALT=2.85 U/l), but differences were not significant ($P > 0.05$). ALP (Alkaline phosphatase) was increased significantly ($P < 0.001$) in treated groups (LG2F: 1131.42 U/l; LG4F: 1277.87U/l relative to LG0F: 682.61 U/L). TBIL was decreased in treated groups (LG2F: 1.98 μ mol/l; LG4F: 1.64 μ mol/l) compared to LG0F: 2.49 μ mol/l. DBIL was increased slightly at 2% inclusion (LG2F: 0.76 μ mol/l compared to LG0F: 0.71 μ mol/l) but was declined at 4% (LG4F: 0.60 μ mol/l); these variations were not significant ($P > 0.05$). Enzymatic creatinine (6.3 μ mol/l) and urea (0.62 - 0.68 mmol/l) remained stable across groups. Blood glucose was varied slightly (13.17 - 14.26 mmol/l), while magnesium was remained stable (0.93 - 1.01mmol/l). Total protein increased in LG2F (51.32 g/l) and LG4F (44.5 g/l) relative to LG0F (22.7 g/l), with higher albumin in LG2F (15.9 g/l); however, differences were not significant ($P > 0.05$). Na^+ concentrations was remained comparable between LG0F (154 mmol/l) but decreased in LG4F (151.32 mmol/l). Cl^- levels were higher in control LG0F (116.9 mmol/l) than treated groups. K^+ remained stable across groups. Ionized nCa^{2+} dropped sharply in LG4F (0.79 mmol/l) relative to LG2F (1.51 mmol/l) and LG0F (1.56 mmol/l). Blood pH was increased progressively: LG0F (7.41), LG2F (7.46), LG4F (7.57).

Table 7. Effect of dietary treatments on the biochemical parameters in male and female chickens.

Parameters	Male			Female		
	LG0M	LG2M	LG4M	LG0F	LG2F	LG4F
AST (U/l)	250.15	226.22 ^{ns}	224.72 ^{ns}	187.65	252 ^{ns}	224.72 ^{ns}
ALT (U/l)	3.8	3.92 ^{ns}	3.82 ^{ns}	2.85	4.82 ^{ns}	3.82 ^{ns}
Total Bilirubin (μ mol/l)	2.03	1.74 ^{ns}	1.64 ^{ns}	2.48	1.98 ^{ns}	1.64 ^{ns}
Direct Bilirubin (μ mol/l)	0.9	0.31 ^{ns}	0.59 ^{ns}	0.71	0.76 ^{ns}	0.59 ^{ns}
Total Protein (g/l)	40.3	41.25 ^{ns}	44.5 ^{ns}	22.7	51.32 ^{ns}	44.5 ^{ns}
Creatinine Enz (μ mol/l)	6.3	6.3 ^{ns}	6.3 ^{ns}	6.3	6.3 ^{ns}	6.3 ^{ns}
ALP (U/l)	1266.2	1401.825 ^{ns}	1277.87 ^{ns}	682.61	1131.42***	1277.87***
GGT (U/l)	11.5	27 ^{ns}	19.3 ^{ns}	10.5	25.87 ^{ns}	19.3 ^{ns}
Urea (mmol/l)	0.58	0.58 ^{ns}	0.62 ^{ns}	0.65	0.67 ^{ns}	0.62 ^{ns}
Magnesium (mmol/l)	0.92	0.92 ^{ns}	0.92 ^{ns}	1.01	0.96 ^{ns}	0.92 ^{ns}

Continued

Glucose PAP (mmol/l)	13.07	12.20 ^{ns}	14.26 ^{ns}	13.17	13.2 ^{ns}	14.26 ^{ns}
Calcium AS (mg/dl)	9.79	10.84 ^{ns}	10.95 ^{ns}	14.41	12.16 ^{ns}	10.95 ^{ns}
Albumin (g/l)	14.5	13.35 ^{ns}	14.27 ^{ns}	14.4	15.9 ^{ns}	14.27 ^{ns}
Na ⁺ (mmol/l)	153.2	152.25 ^{ns}	151.32 ^{ns}	154.5	154 ^{ns}	151.32 ^{ns}
K ⁺ (mmol/l)	3.92	4.55 ^{ns}	4.92 ^{ns}	4.79	4.95 ^{ns}	4.92 ^{ns}
Cl ⁻ (mmol/l)	115.55	112.55 ^{ns}	113.17 ^{ns}	116.9	113.95 ^{ns}	113.17 ^{ns}
nCa ²⁺ (mmol/l)	1.45	1.14 ^{ns}	0.79 ^{ns}	1.56	1.51 ^{ns}	0.79 ^{ns}
pH	7.53	7.50 ^{ns}	7.56 ^{ns}	7.41	7.46 ^{ns}	7.57 ^{ns}

NB: *** P < 0.001; ns (not significant) P > 0.05. LG0M (control males: 0% roasted *Leucaena leucocephala* seed flour); LG2M (treatment males: 2% roasted *Leucaena leucocephala* seed flour); LG4M (treatment males: 4% roasted *Leucaena leucocephala* seed flour); LG0F (control females: 0% roasted *Leucaena leucocephala* seed flour); LG2F (treatment females: 2% roasted *Leucaena leucocephala* seed flour); LG4F (treatment females: 4% roasted *Leucaena leucocephala* seed flour).

3.4.2. Impact of Roasted *Leucaena leucocephala* Seeds on Oocyst Excretion Inhibition in Local Chickens

The results of the evaluation of the effect of roasted *Leucaena leucocephala* seed flour on oocyst burden, compared to the control group, are presented in **Table 8**.

The oocyst inhibition rate showed high efficacy in treated male chickens, reaching 80% in the LG2M group (n = 8, mean OPG = 500) and 20% in the LG4M group (n = 8, mean OPG = 2000) compared to the control males (LG0M, n = 4, mean OPG = 2500). Conversely, no inhibition was observed in females, where treated groups displayed higher oocyst counts (LG2F: n = 8, mean OPG = 5500, %I = -83.33%; LG4F: n = 8, mean OPG = 6000, %I = -100%) than the control group (LG0F: n = 4, mean OPG = 3000).

Table 8. Oocyst inhibition percentage (%I) according to the incorporation rate of roasted *Leucaena leucocephala* seeds.

Parameter	LG0M	LG2M	LG4M	LG0F	LG2F	LG4F
Total oocyst counts in both chambers	5	1	4	6	11	12
Number of oocysts per gram of feces (OPG)	2500	500	2000	3000	5500	6000
Inhibition percentage (%I)	0	80%	20%	0	-83.33%	-100%

3.5. Carcass Characteristics and Weights of Selected Internal Organs

Carcass and organ characteristics of local chickens from various dietary treatments are shown in **Table 9**. In males, carcass weights were 1021.75 g for LG2M (P < 0.001), 1143.25 g for LG4M (P > 0.05), relative to the control group LG0M at 1274 g. Female carcass weights ranged between 860.75 g and 899.57 g, peaking in the LG4F group (P > 0.05). Adding roasted *Leucaena leucocephala* seed flour to pullet

feed produced no adverse effects on carcass yield, organ weights, or appearance (liver, heart, rat, gizzard and testicles) (Figure 5) in LG2M and LG4M males (compared to LG0M) or LG2F and LG4F females (compared to LG0F) ($P > 0.05$). Peak carcass yield occurred in LG4F female at 90.58%. No statistically significant differences appeared in organ weights across tested dietary treatments ($P > 0.05$). The carcasses from treatments LG0M, LG0F, LG4M and LG4F showed yellow skin coloration (Figure 6; $P > 0.05$). Yellow coloration of abdominal fat was observed in all treated chickens (LG2M, LG4M, LG2F and LG4F) and in control females LG0F, but not in control males LG0M ($P > 0.05$) (Figure 7).

Table 9. Effect of on carcass characteristic of male and female chickens.

Parameters		Male			Female		
		LG0M	LG2M	LG4M	LG0F	LG2F	LG4F
Carcass	Live weight (g)	1440.5	1174.25***	1309.3 ^{ns}	957.5	876.75 ^{ns}	993.12*
	Carcass weight(g)	1274	1021.75***	1143.25 ^{ns}	860	741.75 ^{ns}	899.57 ^{ns}
	Eviscerated carcass weigh (g)	1080.95	839.45**	948.1 ^{ns}	661.3	571.6 ^{ns}	698.1 ^{ns}
	Carcass yield (%)	88.45	86.99 ^{ns}	88.22 ^{ns}	89.81	84.53 ^{ns}	90.58 ^{ns}
	Skin color	2	2 ^{ns}	2 ^{ns}	2	2 ^{ns}	2 ^{ns}
	Belly fat color	1	2 ^{ns}	2 ^{ns}	2	2 ^{ns}	2 ^{ns}
Internal organs (g)	liver	20.75	24.15 ^{ns}	24.95 ^{ns}	17.7	17.32 ^{ns}	18.75 ^{ns}
	heart	7.95	5.5 ^{ns}	7.52 ^{ns}	3.25	3.32 ^{ns}	4.27 ^{ns}
	Rat	2.3	2.3 ^{ns}	2.5 ^{ns}	1.45	1.76 ^{ns}	1.86 ^{ns}
	Gizzard	29.35	33.02 ^{ns}	26.1 ^{ns}	24.25	25.67 ^{ns}	27.66 ^{ns}
	Testicles	15.95	1.82 ^{ns}	11.72 ^{ns}	0	0 ^{ns}	0 ^{ns}

Ns: not significant ($P > 0.05$); *** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$. NB: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; ns (not significant) $P > 0.05$. LG0M (control males: 0% roasted *Leucaena leucocephala* seed flour); LG2M (treatment males: 2% roasted *Leucaena leucocephala* seed flour); LG4M (treatment males: 4% roasted *Leucaena leucocephala* seed flour); LG0F (control females: 0% roasted *Leucaena leucocephala* seed flour); LG2F (treatment females: 2% roasted *Leucaena leucocephala* seed flour); LG4F (treatment females: 4% roasted *Leucaena leucocephala* seed flour).

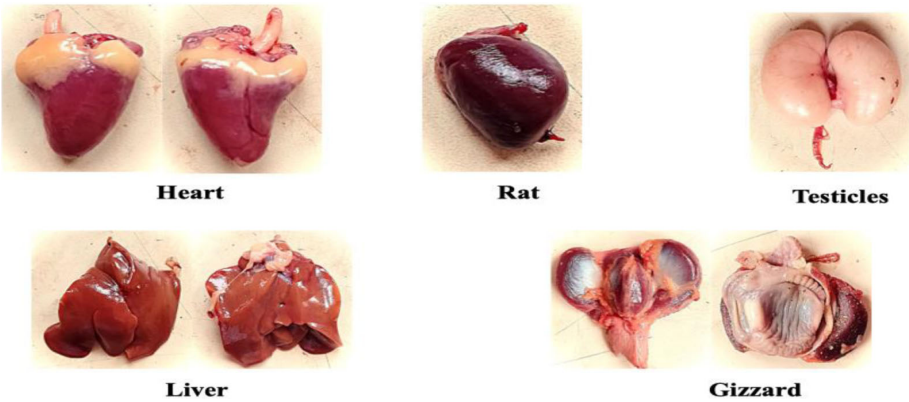


Figure 5. Macroscopic appearance of selected organs in the abdominal and thoracic cavities.



Figure 6. Carcass skin color according to feed rations.

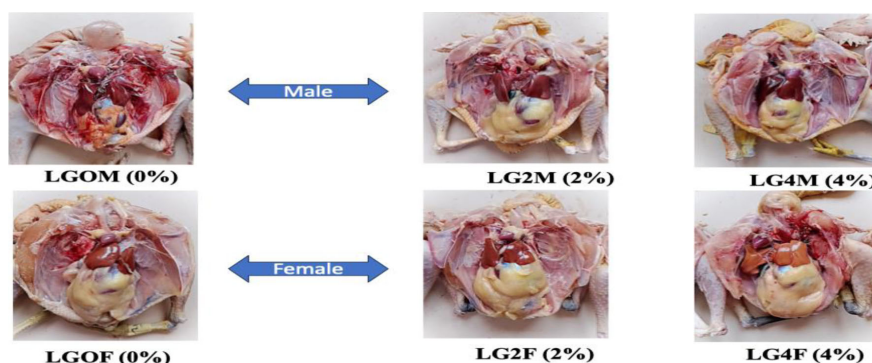


Figure 7. Coloration of abdominal fat by treatment.

4. Discussion

The high protein content (33.19%) and total sugars (38.10%) in the flour derived from roasted *Leucaena leucocephala* seeds offer substantial benefits for promoting muscle and eggs development, weight gain and cellular regeneration in chickens. The lipids present therein enhance the energy density of the feed ration, thereby supporting body maintenance and overall growth in poultry. Furthermore, key minerals such as phosphorus (P) essential for bone mineralization, potassium (K) critical for skeletal development and maintenance; and sodium (Na), which regulates water balance, prove highly advantageous in poultry diets. [40]-[42].

Our findings indicate that the effect of roasted *Leucaena leucocephala* seed meal supplementation on growth performance is highly dependent on the inclusion level during the early growth phases. Specifically, only the 4% roasted level (LG4r group) induced a significant improvement ($P < 0.05$) in body weight from weeks 2 to 4, whereas the 2% inclusion rate (LG2 and LG2r) resulted in numerically lower feed intake and growth. Although the 4% groups (LG4 and LG4r) maintained a numerical superiority in ADG and feed conversion ratio until the end of

the trial, these long-term positive trends did not reach statistical significance ($P > 0.05$). This lack of overall significance could be attributed to the high individual variability within these mixed-sex groups, where inherent sexual dimorphism likely masked the dietary treatment effects.

Thermal denaturation of anti-nutritional factors, particularly mimosine, was achieved through seed toasting [29]. This process enhanced feed appetite, protein digestibility, and metabolizable energy utilization while reducing crude fiber content [29] [43] [44].

This thereby promotes a positive trend in average daily gain (ADG) and feed conversion ratio (FCR), particularly in chickens receiving 4% roasted *Leucaena leucocephala* seed meal, with the optimal growth performance achieved within the LG4r group. Furthermore, at this same inclusion level, supplementation yielded the highest carcass dressing percentage, particularly among females in the LG4 group (90.58%; $P > 0.05$) relative to controls. Organ health remained unaffected across treatments. Our findings align with the scientific literature regarding the dose-dependent impact of *Leucaena leucocephala*. Previous studies demonstrated that beyond a critical threshold of 5%, this ingredient induces a decline in growth, feed intake, and nutritional efficiency in chickens [45].

This supports the deleterious effects reported at inclusion rates of 6%, 9%, and 12%, where the persistence of residual anti-nutritional factors (mimosine, tannins) impairs diet palatability and nutrient digestibility. Conversely, the use of low inclusion levels ($\leq 5\%$), combined with appropriate detoxification processes such as roasting, dehulling, or soaking, allows for the effective integration of these seeds into poultry diets without compromising zootechnical performance [45] [46].

Post-slaughter yellow pigmentation of skin and abdominal fat stemmed from xanthophyll (carotenoid) deposition from dietary sources. Pigmentation efficiency correlates with xanthophyll levels in ingredients like maize and avian absorption capacity [47].

A slight but no-significant decrease in red blood cell count (RBC) and haemoglobin (HGB) concentration was observed in treated male chickens (LG2M and LG4M) fed with roasted *Leucaena leucocephala* seeds, compared to the control group (LG0M). Conversely, these parameters were higher in treated females (LG2F and LG4F) relative to female controls (LG0F). Despite these variations, all values remained within reference haematological norms for healthy chickens (RBC: 2.5 to $3.5 \times 10^6/\mu\text{l}$; HGB: 10 to 14 g/dl). However, the elevated hematocrit (HCT) in male controls (LG0M: 48%) exceeded the standard range (30 to 40%) suggesting possible dehydration or stress related to slaughter conditions [48].

Supplementation with roasted *Leucaena leucocephala* seeds (2% and 4%) induced no toxic effects on hematological parameters, although mild anemia may account for the RBC and HGB reduction in treated males. Finally, the significant increase in white blood cell count (WBC) in LG4M males ($127.02 \times 10^3/\mu\text{l}$, $P < 0.01$) and LG4F females ($124.77 \times 10^3/\mu\text{l}$, $P < 0.05$), which remain within the normal range for chickens ($100 - 200 \times 10^3/\mu\text{l}$) indicates an immune response, likely

associated with microbial infection or inflammation [49] [50].

These findings strongly corroborate the work of Akanji *et al.*, (2016) [51], who demonstrated that the inclusion of processed *Leucaena* (soaked or boiled) at 5% does not significantly alter haemoglobin, white blood cells, red blood cells, and mean corpuscular volume in broiler chickens. Similarly, previous studies have shown that thermal treatments, including soaking and roasting, drastically reduce anti-nutritional factors such as phytates and residual mimosine without compromising haematological homeostasis [52]. This stability in blood profiles under thermal processing is further supported by observations in other monogastrics; for instance, restricted levels of treated seed meals maintain red cell integrity because the heat denatures iron-binding phytates and tannins that would otherwise impair erythropoiesis [53] [54]; Consequently, the upward trend in WBC counts within physiological limits in the higher inclusion groups (4%) likely reflects a successful immune modulation rather than systemic leukotoxicity, a phenomenon frequently reported when birds are exposed to low-dose, heat-attenuated bioactive compounds in alternative legumes [55].

A noteworthy finding in our study is the differential anticoccidial effect of *Leucaena leucocephala* seed meal based on the chickens' sex. Indeed, dietary inclusion of roasted seeds induced a drastic reduction in oocyst shedding in males (80% and 20% for the 2% and 4% levels, respectively), whereas no significant reduction was observed in females, indicating that females did not exhibit the same resistance. This higher vulnerability in females suggests sex-linked variations in local immune response or intestinal permeability. It is well-documented that sex steroid hormones can modulate the resistance of poultry to parasitic infections [56] [57].

Furthermore, the higher efficacy of the 2% dose in males compared to 4% might reflect an optimal threshold where bioactive compounds (such as residual tannins or flavonoids) successfully stimulate the immune system or alter the gut microbiota without the potential anti-nutritional stress associated with the 4% inclusion level.

Altogether, these findings point toward a sex-specific sensitivity potentially linked to hormonal immunosuppression or differential intestinal irritation, while remarkably occurring without any hematological toxicity [48] [49].

Hepatic enzymes (AST: 187 - 252 U/l; ALT: 2.85 - 4.82 U/l; GGT: 10.5 - 27 U/l) remained within physiological reference ranges (AST: 150 - 300 U/l; ALT: 2 - 10 U/l; GGT: 5 - 30 U/l), while ALP increased significantly in LG2F/LG4F females (682 to 1278 U/l, $P < 0.001$), consistent with normal bone growth. Total and direct bilirubin (TBIL) levels decreased non-significantly, ruling out hepatic lesions. Renal function remained intact, as serum creatinine stayed constant at 6.3 $\mu\text{mol/l}$ and urea levels were stable (0.58 - 0.67 mmol/l). Total protein concentrations increased in females (51.32 g/l in LG2F compared to 22.7 g/l), suggesting enhanced protein synthesis driven by crude protein content in roasted *Leucaena leucocephala* seeds. Albumin levels remained steady (14 - 16 g/l), ruling out malnutrition [50] [58].

The observation that total protein concentrations increased substantially, while albumin and key liver enzymes (AST, ALT, GGT) remained stable, aligns perfectly with recent trials conducted in poultry. In a study on laying avian species, *Leucaena leucocephala* was demonstrated to be a powerful alternative protein source, exhibiting crude protein levels ranging from 21.9% to 32.5% [59]. When properly processed, its inclusion significantly improves overall crude protein and amino acid intake without compromising feed efficiency [59].

Furthermore, the elevated alkaline phosphatase (ALP) observed in these growing females represents a crucial distinction, consistent with normal bone development. In healthy growing poultry, elevated ALP is the hallmark of active osteoblastic activity and skeletal growth, rather than a marker of hepatic pathology; a fact corroborated here by the stability of reference transaminases (AST/ALT), in agreement with non-ruminant trials by Olarotimi and Adu (2017) [60].

Finally, thermal treatments, such as roasting, substantially reduce active mimosine levels, often decreasing this toxin by more than 90% [61]. The structural degradation of the alkaloid explains why the experimental subjects fed ration supplemented with roasted *Leucaena leucocephala* seed flour thrived, exhibiting preserved renal function (stable creatinine and urea) and intact hepatic function.

Supplementation with roasted *Leucaena leucocephala* seed (2% to 4%) induced no toxic effects on hepatic, renal or metabolic functions in experimental local chickens.

5. Conclusions

In conclusion, this study demonstrates that dietary supplementation with roasted *Leucaena leucocephala* seed meal influences both the growth performance and parasitological status of local chickens. Incorporating this seed meal up to a 4% level promotes a positive trend in overall live weight and feed efficiency, accompanied by a significant increase in carcass yield. However, these growth parameters exhibited high individual variability within the mixed-sex groups, explaining the lack of statistical significance ($P > 0.05$) on average daily gain (ADG).

Regarding health markers, roasting proved to be an essential processing method, and the 2% incorporation dose most effectively reduced the coccidial oocyst load. Crucially, this anticoccidial effect appeared to be strongly sex-dependent, showing pronounced oocyst inhibition in male chickens, whereas females did not exhibit the same resistance. Consequently, while roasted *Leucaena leucocephala* seeds represent a promising alternative protein source for sustainable poultry production, future investigations using strictly sex-segregated groups are warranted to fully clarify these sex-specific growth and parasitological dynamics.

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Authors' Contribution

A. F. Drabo, R. N. T. Meda, and B. K. Koama were involved in the laboratory analyses, the experimentation was conducted at the controlled experimental station, the design of the manuscript, and the writing of the manuscript draft. S. N. L. Da, M. D. Zon, Z. Kabré, E. Zongo, B. S. M'po, and E. S. Kam were involved in the validation of the method and the collection of samples. R. N. T. Meda, Koama, and G. A. Ouedraogo were involved in data visualization, as well as in the review and editing of the manuscript. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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