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Effect of partial replacement of Soya meal with *Albizia lebbeck* seed meal on the growth performance, egg quality and haemato-biochemical constituents of Nera black hens

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ABSTRACT

This experiment was undertaken to examine the effect of partial replacement of Soya meal with *Albizia lebbeck* seed meal on the growth performance, egg quality and haemato-biochemical constituents of Nera black hens. Two hundred Nera black laying hens, 20 weeks of age was randomly assigned into four groups of 50 birds with five replicates, each replicate was further divided into 10 birds each. The experiment lasted for 60 days and the group consists of diet 1 (control): basal diet only, *Albizia lebbeck* seed meal was partially used to replace soya meal at 5 %, 10 % and 15 % in diet 2, 3 and 4 respectively. Feed and fresh water were made available at all times and a completely randomized experimental design was used. Experimental outcome revealed that feeding different levels of *Albizia lebbeck* seed meal increased ($p<0.05$) body weight gain, feed consumption as well as feed conversion ratio. Similarly, feeding *Albizia lebbeck* seed meal enhanced ($p<0.05$) total egg weight, hen day egg production, hen day housed production, egg width, egg length, shell weight, albumen weight, albumen height, yolk weight, yolk colour and haugh unit. Partial replacement of soya meal with *Albizia lebbeck* seed meal increased ($p<0.05$) the concentration of hematocrit, haemoglobin, red blood cell, white blood cell, lymphocytes, monocytes, eosinophils, serum total protein, triglycerides and significantly decreased ($p<0.05$) cholesterol concentration. The serum levels of alanine transaminase and aspartate aminotransferase were not influenced ($p>0.05$) by the treatment. In conclusion, feeding different levels of *Albizia lebbeck* seed meal up to 15 % improved growth performance, egg qualities, egg production and blood parameters without causing any detrimental effect on the health status of birds. Therefore, a higher level of replacement is recommended for laying hens.

Keywords: *Albizia lebbeck*, growth, performance, egg, production, soya meal, blood

1. INTRODUCTION

High protein feed ingredient has always been a major factor in poultry nutrition which has to be maintained in the feed in order for birds to grow, produce eggs and

retain good health (Harriet, 2025). Over the years, soya bean meal has been the leading source of plant protein in poultry feeds mainly because of its ideal amino acid composition, high digestibility and availability in the global market (Hernandez and Alagbe, 2025). Nevertheless, the worldwide poultry industry is encountering a series of escalating challenges uniformed by supply chain disruptions, trade uncertainties and environmental regulations all closely linked to the industry's dependence on Soybean meal (Harriet, 2025). This situation has prompted Animal nutritionist in search for potential alternative to soya meal especially with the increase growing population which give rise to competition between human being and animals (Alagbe, 2017). *Albizia lebbeck* seed has been considered as a rich protein source that can be utilized in the production of feed for birds.

Albizia lebbeck is a robust deciduous tree belonging to the family Leguminosae (Fabaceae). The genus consists of about 50 species which are widely distributed in Asia, Africa, and Australia, as well as tropical and subtropical America (Chitra and Balasubramanian, 2016; Umar et al., 2019). The leaves, seeds, stem bark and roots of *Albizia lebbeck* have several pharmacological properties and it has been traditionally utilized in the treatment of gastro-intestinal diseases, night blindness, bronchitis, pyrexia, anorexia, skin infections, snake bites and leprosy (Ali et al., 2018; Priyanka et al., 2013; Kasture et al., 2000). According to Rotimi et al. (2001); Meshram et al. (2016), *Albizia lebbeck* seeds is rich in protein, minerals and several phyto-components such as, alkaloids, tannins, flavonoids, phenols, saponins, glycosides and steroids. Proximate analysis of *Albizia lebbeck* seed meal by (Mohammad et al., 2010; Ueda et al., 2003) showed that it contained; crude protein (27.30 %), ether extract (7.30 %), crude fibre (37.50 %) and carbohydrate (19.40 %). A report by Rotimi et al. (2008) also showed that Albizia seeds have crude fat (6.40 %), crude protein (38.60 %), crude fibre (2.11 %), ash (5.60 %) and carbohydrate (43.19 %). The presence of calcium (195.63 mg/100 g), phosphorus (103.2 mg/100g), magnesium (109.20 mg/100g), potassium (900 mg/100g), sodium (295.0 mg/100g), copper (21.3 mg/100g), iron (91.88 mg/100g) and zinc (6.71 mg/100g) were not left out in the seeds as reported by Hassan et al. (2007); Malaikolundhan et al. (2020).

Research by Jaffet et al (2010); Singh et al. (2016) also claimed that *Albizia lebbeck* seeds are rich source of amino acids like, histidine, proline, leucine, lysine, methionine, glutamic acid, tryptophan amongst others. This quality attributes makes it a potential replacement for soya meal in the diets of birds. The plant can have the advantage of been able to grow under a variety of climatic conditions making it easy to establish on the field and may be an inexpensive protein source for feeding birds.

Previous studies by Taju et al. (2015); Sisay et al. (2015) have shown that Replacing Soybean meal with processed Kidney bean meal on egg production positively influenced feed intake, hen day egg production, egg weight and egg mass of laying birds. Feeding laying hens fed raw Anthonotha macrophylla seed meal based diet improved egg production and apparent digestibility of nutrients in layers (Ukpabi et al., 2015). Tuleun et al. (2008) also reported that feeding different levels of Mucuna utilis influenced blood parameters and growth performance of laying birds.

Despite the nutritional benefits of *Albizia lebbeck* seeds as well as their other therapeutic properties, there is little information regarding its utilization in poultry feeding as a protein source in the layer ration. As a result, information on effects of Albizia seed meal on growth performance, egg production, egg quality and blood parameters of birds is scanty. Such information is needed in designing promote sustainable farming and developing feeding strategies to improve egg quality and production of layers in resource limited farmers. Therefore, the objective of this study was to determine the effect of partial replacement of Soya meal with *Albizia lebbeck* seed meal on the growth performance, egg quality and haemato-biochemical constituents of Nera black hens.

2. MATERIALS AND METHODS

Location of the experiment

This research was carried out at the Poultry Section, Gandhi College of Agriculture, Rajasthan situated in the North-Western part of India which lies between longitude 23° 03′ to 30° 12′ North and latitude 69° 30′ and 78° 17′ East.

Collection and processing of *Albizia lebbeck* seed meal

Dried and matured pods of *Albizia lebbeck* were collected from Sumitra Research Institute, Gujarat in the month of March, 2025 and sent to the Taxonomy Department, Gandhi College of Agriculture, Rajasthan, India for proper authentication and identification before it was assigned WD/09AH-2025. Collected pods were sorted and seeds were manually removed, toasted under medium heat (60 ℃ for 10 minutes) and stirred continuously in a metal pot. Seeds were air-dried for 4 hours before it was pulverized into powder with a multi-purpose electric blender, stored in an airtight container and kept under room temperature prior to analysis. Proximate analysis pulverized *Albizia lebbeck* seed meal was carried out adopting the method outlined by Association of Analytical Chemist in 2019 and 2012. Amino acid composition was carried out using High Performance Liquid Chromatographs (HPLC S 600 Series, Germany)

adjusted subjected to an injection precision of < 0.5 % variable volume injection (10 µl; typically, 0.25 %), wavelength range (190 to 180 nm), wavelength accuracy (± 2.0 nm), linearity (> 2.0 AU), baseline drift (± 1 × 10^{-5} AU), pressure (60 – 80 %) and temperature of 35 to 55 °C. Phytochemical evaluation of the pulverized seeds was carried out by a procedure that was based on those earlier reports by Harborne (1973) and Sofowora (1993).

Management of experimental bird and design

Two hundred Nera black laying hens of 20 weeks of age was purchased from a breeding farm in Rajasthan in the month of April, 2025. Before the commencement of the study, battery cages (equipped with nipple drinkers and aluminum feeders) and pens were thoroughly disinfected 14 days before the arrival of the birds. On arrival, birds were weighed at the start of the experiment and randomly assigned into four groups of 50 birds with five replicates, each replicate was further divided into 10 birds each. Hens were quarantined for 2 weeks, dewormed against parasites using AlbenCap Plus® (Kamara Veterinary Pharmaceuticals, Gujarat, India) and fed basal diet which was compounded according to the requirements of birds by the Nutritional Research Council (1994). Birds were cared for according to the methods proposed by Indian Society of Animal Production and a completely randomized experimental design was adopted. The experiment lasted for 60 days. Group consists of diet 1 (control): basal diet only, *Albizia lebbeck* seed meal was partially used to replace soya bean meal at 5 %, 10 % and 15 % in diet 2, 3 and 4 respectively. Feed and fresh water were made available at all times and other management practices were strictly followed. The amount of feed consumed per bird was calculated by subtracting the feed refused from feed offered. Feed offered and refused was recorded daily and also weighed end of the experiment. Body weight gain was calculated as the difference between the final and initial body weight. Feed conversion ratio was determined by dividing the total feed consumption by the body weight gain. Mortality was recorded as it occurred. Experimental diet was analyzed using the methods outlined by Association of Analytical Chemist (2016).

Hen day egg production, hen housed egg production and egg weight parameters

Collection of eggs was done twice daily from each replicate between 8:00 and 16:00 hours and weighed immediately using digital sensitive scale. The average egg weight was calculated by dividing the total egg weight to the number of eggs. Hen-day egg production (HDEP) and hen housed egg production as percentage were determined using the formula below:

% Hen day egg production = total number of eggs produced/total number of hens present on that day multiplied by 100

% Hen house egg production = total number of eggs produced/number of hens housed multiplied by 100

Egg quality parameters

Ten eggs were randomly selected from each replicate for egg quality parameters using a Digital egg tester® (DET 6500, Netherlands). The kit was used to determine egg width, egg length, shell weight, albumen weight, albumen height and yolk weight. Yolk colour was determined based on YolkFan® of digital tester which supports 16 YolkFan scales.

Haugh unit score was calculated by the formula:

HU= 100 × log (H – 1.7 W 0.37 +7.6 where W= egg weight

Collection and analysis of blood constituents

At the end of the experiment, 10 mL of blood was collected from the wing vein of five randomly selected birds per replicate into two bottles (5 mL each). Samples for haematology examination were collected into bottles with anticoagulant while those for serum were put into plain bottles without anticoagulant. Collected samples were placed in an ice pack before they were transported to the laboratory for further analysis. Parameters examined for haematology includes, hematocrit count, total erythrocyte count, haemoglobin, total white blood cell, eosinophils, neutrophils, monocytes and lymphocytes. Parameters obtained were analyzed using Fiss Auto-Haemo Analyzer® (HC-880, China). White blood cell count was determined through impedence method, red blood cell (sheath flow impedence method), haemoglobin count (colorimetric method) and the machine is adjusted to a temperature of 15 – 30 ◦C and humidity of 50 – 80 %.

Serum parameters (albumin, globulin, cholesterol, triglycerides, creatinine, ALT and AST) were analyzed using Mobah- auto-chemistry analyzer (Spain). Kit was adjusted to a sample volume of 200 µL and temperature / humidity of 10 to 32 ◦C/ 50 to 90 %.

Statistical Analysis

Data obtained on growth performance, egg quality, hematological and serum biochemical constituents were analyzed using the General Linear Model procedures of SAS (2004). Differences between treatment means were separated using Tukey's test and significant differences were declared at $p<0.05$.

The following model was used for the analysis: Yij = μ + Ti + eij Where, Yij = observation on each bird μ = overall mean effect Ti = effect due to the ith dietary treatments and eij = experimental random error.

3. RESULTS

Table 1 shows the proximate and phytochemical composition of *Albizia lebbeck* seed meal. Proximate analysis of the sample shows that it contains: dry matter (93.11 %), organic matter (98.00 %), crude protein (35.44 %), ether extract (2.67 %), crude fibre (5.01 %), ash (12.00 %) and energy (2490.8 kcal/kg). Phytochemical examination of *Albizia lebbeck* seed meal reveals the presence of phenols (78.92 mg/g), alkaloids (18.60 mg/g), saponins (31.55 mg/g), flavonoids (69.06 mg/g), tannins (12.43 mg/g), glycosides (5.51 mg/g) and steroids (9.05 mg/g).

Table 1: Proximate and phytochemical composition of *Albizia lebbeck* seed meal

Parameters	**Concentration (%)**
Proximate analysis	
Dry matter	93.11
Organic matter	98.00
Crude protein	40.44
Crude fibre	5.01
Ether extract	2.67
Ash	12.00
Energy (Kcal/kg)	2490.8
Phytochemicals	Concentration (mg/g)
Phenols	78.92
Alkaloids	18.60
Saponins	31.55
Flavonoids	69.06
Tannins	12.43
Glycosides	5.51
Steroids	9.05

Amino acid analysis of *Albizia lebbeck* seed meal is presented in Table 2. Serine had the highest concentration of 10.48 % followed by arginine (8.31 %), histidine (7.33 %), lysine (6.08 %), glycine (3.85 %), glutamine (3.11 %), methionine (3.09 %), threonine (2.41 %), proline (2.11 %), valine (2.05 %), isoleucine (2.04 %), leucine (1.72 %), alanine (1.08 %), aspartate (1.02 %), tryptophan (0.88 %) and cysteine (0.52 %) respectively.

Table 2: Amino acid analysis of *Albizia lebbeck* seed meal

Parameters	**Concentration (%)**
Proline	2.11
Cysteine	0.52
Arginine	8.31
Valine	2.05
Tryptophan	0.88

Threonine	2.41
Phenylalanine	2.06
Lysine	6.08
Leucine	1.72
Isoleucine	2.04
Methionine	3.09
Histidine	7.33
Serine	10.48
Glycine	3.85
Glutamine	3.11
Aspartate	1.02
Alanine	1.08

Table 3 shows the chemical composition of experimental diet. Dry matter of experimental diet varied from 88.61 – 89.34 %, crude protein (16.76 – 17.33 %), crude fibre (5.62 – 6.37 %), ether extract (2.51 – 2.61 %), ash (8.61 – 9.18 %) and energy (2723.9 – 2788.1 Kcal/kg).

Table 3: Ingredient and chemical composition of experimental diet (% DM)

Ingredients	**Diet 1 (0 %)**	**Diet 2 (5 %)**	**Diet 3 (10 %)**	**Diet 4 (15 %)**
Maize	55.00	55.00	55.00	55.00
Wheat bran	12.00	12.00	12.00	12.00
Soya meal	22.00	20.9	19.80	18.7
Albizia lebbeck seed meal	0.00	1.10	2.20	3.30
Limestone	6.50	6.50	6.50	6.50
Bone meal	3.50	3.50	3.50	3.50
Lysine	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25
Premix (Mineral/Vitamin mixture)	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30
Total	100.0	100.0	100.0	100.0
Chemical composition (% DM)				
Dry matter	88.61	89.34	89.24	89.21
Crude protein	17.33	16.84	16.80	16.76
Crude fibre	5.62	6.16	6.24	6.37
Ether extract	2.61	2.56	2.53	2.51
Ash	8.61	9.12	9.15	9.18
Energy (kcal/kg)	2788.1	2723.9	2725.6	2729.2

Each 2.5 kg of vitamins/ Minerals premix mixture contains 12,000 IU vitamin A; 8,000 IU Vit.D3;250 g vitamin E; 10 g Vit.K3; 100 g vitamin B1; 15 g vitamin B2 ;20 mg vitamin B12 ; 1.0 g vitamin B6; 50 g Niacin ;10 g Pantothenic acid ;10g Folic acid;60 mg Biotin ; 350 g Choline chloride; 80 g Zinc; 40 g Copper; 0.70 g Iodine ; 20 g Iron; 0.5 g Selenium; 80g Manganese ;0.50 g Cobalt

Table 4 shows the growth performance of Nera black hens fed different levels of *Albizia lebbeck* seed meal. Partial replacement of soybean meal with *Albizia lebbeck* seed meal improved ($p<0.05$) body weight gain and total feed consumption. Increase in *Albizia lebbeck* seed meal decreased ($p<0.05$) the feed conversion ratio of birds.

Table 5 reveals egg production of Nera black hens fed different levels of *Albizia lebbeck* seed meal. Total egg weight among birds was lower among birds which received diet 1 (16.21 kg) than diet 2 (21.233 kg), diet 3 (21.53 kg) and diet 4 (22.01 kg) ($p<0.05$). Hen day egg production and hen day house production value ranged from 49.38 – 69.18 % and 45.07 – 67.22 % respectively. However, values obtained were significantly ($p<0.05$) affected by the treatment.

Table 4: Growth performance of Nera black hens fed different levels of *Albizia lebbeck* seed meal

Parameters	Diet 1 (0 %)	Diet 2 (5 %)	Diet 3 (10 %)	Diet 4 (15 %)	SEM
Initial body weight (kg)	1.52	1.52	1.52	1.52	0.06
Final body weight (kg)	1.73b	1.82a	1.84a	1.88a	0.20
Body weight gain (Kg)	0.21b	0.30a	0.32a	0.36a	0.13
Total feed consumption (kg)	9.61b	10.22a	10.23a	10.23a	0.95
Feed conversion ratio	2.91a	2.21b	2.18b	2.11c	0.01

[a,b,c]: Means within a row with different superscripts are significantly different ($p<0.05$); diet 1: basal diet only; Treatment 2,3 and 4, *Albizia lebbeck* seed meal was used to replace soya at 5 %, 10 % and 15 % ; SEM: Standard error of mean

Table 5: Egg production of Nera black hens fed different levels of *Albizia lebbeck* seed meal

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Total egg weight (kg)	16.21b	21.33a	21.53a	22.01a	1.37
Hen day egg production (%)	49.38b	68.05a	69.11a	69.18a	2.65
Hen house egg production (%)	45.07b	65.02a	67.18a	67.22a	2.09

[a,b,c]: Means within a row with different superscripts are significantly different ($p<0.05$); diet 1: basal diet only; Treatment 2,3 and 4, *Albizia lebbeck* seed meal was used to replace soya at 5 %, 10 % and 15 % ; SEM: Standard error of mean

Table 6 reveals the effects of feeding different levels of *Albizia lebbeck* seed meal on egg quality parameters of Nera black hens. Replacement of soya meal with *Albizia lebbeck* seed meal improved ($p<0.05$) egg weight, egg length, shell weight, albumen weight, albumen height, haugh unit, yolk weight, yolk length, yolk colour and yolk index. No significant difference was found in egg width ($p>0.05$).

Table 6: Effects of feeding different levels of *Albizia lebbeck* seed meal on egg quality parameters of Nera black hens

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Egg width (mm)	30.65b	33.91a	34.08a	34.15a	1.71
Egg length(mm)	42.16b	52.64a	53.01a	53.67a	2.83
Shell weight (g)	4.44b	5.91a	6.07a	6.24a	0.02
Albumen weight (g)	19.42b	25.86a	26.17a	26.25a	1.62
Albumen height (mm)	5.29b	6.84a	6.92a	7.18a	0.03
Haugh unit	70.02b	86.03a	87.15a	87.69a	3.09
Yolk weight (g)	13.08b	15.12a	15.65a	15.80a	0.42
Yolk length (mm)	36.76b	42.05a	42.11a	42.17a	0.96
Yolk height (mm)	10.02b	14.07a	14.55a	15.07a	0.02
Yolk color	5.84b	10.44a	11.82a	12.06a	0.01
Yolk index	0.18c	0.25b	0.28b	0.31a	0.01

[a,b,c]: Means within a row with different superscripts are significantly different ($p<0.05$); diet 1: basal diet only; Treatment 2,3 and 4, *Albizia lebbeck* seed meal was used to replace soya at 5 %, 10 % and 15 % ; SEM: Standard error of mean

Table 7 displays the effects of feeding different levels of *Albizia lebbeck* seed meal on haematological parameters of Nera black hens. Replacement of soya meal with *Albizia lebbeck* seed meal increased ($p<0.05$) hematocrit, total leucocyte count, total erythrocyte count, haemoglobin, lymphocytes, monocytes, eosinophils and neutrophils compared with the control. Neutrophil/lymphocyte ratio decreased ($p<0.05$) as the level of *Albizia lebbeck* seed meal increases across the treatments.

Table 7: Effects of feeding different levels of *Albizia lebbeck* seed meal on haematological parameters of Nera black hens

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Hematocrit %	28.94b	31.02a	33.32a	33.51a	1.85
Total erythrocyte count (10^6/µl)	4.94b	6.06a	6.51a	6.59a	0.01
Total leucocyte count (10^3/µl)	8.77b	12.05a	13.04a	13.51a	0.05
Heamoglobin (g/dL)	10.09b	13.41a	13.54a	13.67a	0.12
Lymphocytes (%)	51.21b	64.09a	65.92a	66.01a	0.49
Monocytes (%)	3.91b	5.04a	5.85a	6.07a	0.02
Eosinophils (%)	1.22c	1.85b	1.87b	1.92a	0.02
Neutrophils (%)	41.09a	28.15b	26.07b	24.11b	0.81
Neutrophil/Lymphocyte ratio	0.80a	0.43b	0.39c	0.36c	0.02

[a,b,c]: Means within a row with different superscripts are significantly different ($p<0.05$); diet 1: basal diet only; Treatment 2,3 and 4, *Albizia lebbeck* seed meal was used to replace soya at 5 %, 10 % and 15 %; SEM: Standard error of mean

Effects of feeding different levels of *Albizia lebbeck* seed meal on serum biochemical constituents of Nera black hens is presented in Table 8. Replacement of soya meal with *Albizia lebbeck* seed meal increased ($p<0.05$) the total protein, albumen, globulin and triglycerides. Cholesterol value varied from (95.55 – 102.1 mg/dl) and no difference was found for creatinine, alanine amino transferase (ALT), and aspartate transaminase (AST) ($p>0.05$).

Table 8: Effects of feeding different levels of *Albizia lebbeck* seed meal on serum biochemical constituents of Nera black hens

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Total protein (g/dl)	5.22b	6.14a	6.27a	6.31a	0.02
Albumin (g/dl)	3.05b	3.61a	3.66a	3.68a	0.04
Globulin (g/dl)	2.17b	2.53a	2.61a	2.63a	0.13
Cholesterol (mg/dl)	102.1a	97.51b	96.02b	95.55b	3.74
Triglycerides (mg/dl)	63.07b	72.65a	73.17a	75.02a	2.11
Creatinine (mg/dl)	3.45	3.38	3.61	3.54	0.02
AST (U/L)	50.01	50.08	51.72	51.85	2.80
ALT (U/L)	27.05	28.11	28.17	29.04	0.41

[a,b,c]: Means within a row with different superscripts are significantly different ($p<0.05$); diet 1: basal diet only; Treatment 2,3 and 4, *Albizia lebbeck* seed meal was used to replace soya at 5 %, 10 % and 15 % ; SEM: Standard error of mean; ALT: alanine amino transferase; AST: aspartate transaminase

4. DISCUSSION

Proximate composition of *Albizia lebbeck* seed meal shows that it is rich in protein and can be used as a protein supplement in animal feed (NRC, 1994; Alagbe et al., 2018). Crude protein of *Albizia lebbeck* seed meal used in this study was higher than 38.60 % recorded by Rotimi et al. (2008). Ether extract and ash content obtained was higher than 0.12 % and 9.48 % reported by Hassan et al. (2007). Variation in these results could be attributed to age of plant, geographical location and processing methods (Singh et al., 2022). Results on the phyto-components of *Albizia lebbeck* seed meal showed that it contains a cocktail of bioactive compounds with therapeutic properties viz: anti-inflammatory, antioxidant (Ojediran et al., 2024b), anti-viral (Singh et al., 2021), immuno-modulatory (John, 2024a; John, 2024b), anti-tumor, anti-helminthic (Ojediran et al., 2024a), antifungal, antidiarrheal (Singh et al., 2022), anti-cancer (Singh et al., 2022), antimicrobial (Alagbe, 2024; Hernandez and Alagbe, 2025a), antidepressant, gastro-protective (Muritala et al., 2022), hypolipidemic (Musa et al., 2020), cardio-protective, antinociceptive (Hernandez and Alagbe, 2025b), antifertility (Omokore and

Alagbe, 2019), antiplatelet (Adewale et al., 2021), antiprotozoal, cytotoxic (Alagbe, 2024), antimalarial (Shittu et al., 2024; Daniel et al., 2023), anti-rheumatic amongst others. In this current study, concentration of tannins, alkaloids, flavonoids, phenols and saponins were higher than those reported by Muhammad et al. (2010). Discrepancies in result may be linked to differences in locality, species, harvesting method, storage, processing technique amongst others (Hernandez and Alagbe, 2024a).

Albizia lebbeck seed meal is predominant in serine, arginine, lysine and histidine which suggests that they are necessary for growth and optimal immuno-competence (Alagbe and Adegbite, 2019). For instance, arginine is an efficient immune modulator (Alagbe and Oluwafemi, 2019). The other amino acids recorded in this study are also of benefit to maximize growth and feed efficiency of birds (Shittu et al., 2024). The result obtained in this study is in consonance with the reports of Saleem et al. (2019); Adewuyi and Oderinde (2014).

Higher body weight was recorded among hens fed different level of *Albizia lebbeck* seed meal compared to the control. This result suggests that the phyto or bioactive compounds in *Albizia lebbeck* seed meal is capable of stimulating the production of digestive enzymes (lipase, amylase, or protease) and improve the balance of gut flora resulting in efficient digestion of feeds (Alagbe, 2022; Tesfaye et al., 2012). Replacing soya meal with *Albizia lebbeck* seed meal also had positive effect on feed consumption possibly due to its pleasant aroma resulting in better growth performance and improved feed conversion ratio (Safaa et al., 2008b). The feed conversion ratio recorded in this study was similar to the result of Zanu et al. (2012); Bendonkeng et al. (2011); Olabode and Okelola (2014), who discovered that the feed conversion ratio ranges of 2.30 – 2.80 in broilers fed different levels of *Moringa oleifera* leaf meal used as replacement for fish meal.

Replacement of soya meal with *Albizia lebbeck* seed meal increased hen day production, hen house egg production as well as egg weight among birds. This outcome suggests that *Albizia lebbeck* seed meal improved in the nutritional components of the experimental diet due to the presence of amino acids especially methionine and lysine which have been reported to increase egg size and quantity (John, 2024d). A study by Odunsi et al. (2003) has shown that increased in dietary methionine and lysine concentration resulted in high egg production of Isa-brown hens. The result obtained in this study is in agreement with the reports of Nobakht and Moghaddam (2012) when different levels of Costmary was fed to laying hens. Hen day egg production obtained was higher was lower than 60 – 85 % recorded by Olabode and Okebola (2014) when neem leaf meal was supplemented in the diet of laying birds.

Egg length observed in this study was similar to a study by Ukpabi et al. (2015) who found out that egg length of laying hens fed diets containing graded levels of raw *Anthonotha macrophylla* varied from 54.19 – 56.00 mm. This outcome was lower than those presented by Taju et al. (2015) when soya meal was replaced by processed kidney bean meal. Increase in egg width and length among birds fed different levels of Albizia lebbeck seed meal can be attributed to the presence of some amino acid in the sample particularly lysine and methionine, which plays significant role in the size of eggs (John, 2024c). Shell weight of hens fed different levels of *Albizia lebbeck* seed meal was higher compared to the control. This is likely due to high mineral or ash content in *Albizia lebbeck* seed meal especially calcium and phosphorus. According to Omokore and Alagbe (2019), calcium is required for shell thickness of eggs which automatically reflects in their shell weight. There is a direct correlation between albumen height, egg weight and yolk weight. It was observed in this current study that an increase in levels of *Albizia lebbeck* seed meal resulted to an improvement in egg weight, albumen weight and yolk weight. This result is in agreement with the reports of Adem et al. (2013) when raw and processed common Vetch Seed (Vicia sativa) added to rations of laying hens. Yolk index recorded was similar to the result of a study by Laudadio and Tufarelli (2010) who obtained a range of 0.21 – 0.41 when soya bean meal was substituted with treated fava bean in laying birds. This result suggests that the internal qualities of the eggs are good (John, 2024d). Nobakht and Moghaddam (2012) observed a direct correlation between Haugh unit, yolk and albumin content of eggs. Egg yolk colour is a vital parameter in consumer preferences and it also influences human appetite (Amerine et al., 1995). Yolk colour of hens fed different levels of *Albizia lebbeck* seed meal was high compared to the control. This outcome suggests that *Albizia lebbeck* seed meal contained an appreciable quantity of carotene which can act as a yolk colouring agent of eggs. This result agrees with the report of Kwari et al. (2011) when raw or processed sorrel (*Hibiscus sabdariffa*) seed meal was fed to laying birds.

Haematocrit and haemoglobin count recorded in this study was within the normal range of 28.00 – 36.00 % and 6.60 – 18.00 g/dL cited by Islam et al. (2004). The result obtained suggests the absence of nutritional stress in birds (Etim et al., 2013). Normal heamatocrit value indicate that birds were not anemic (Etim et al., 2014a; Alagbe et al., 2019). It also indicates that the efficient transportation of oxygen and absorbed nutrients were not compromised (Etim et al., 2014b; Alagbe and Grace, 2019). Red blood cell value was within the reference value [(3.80 – 20.00 (10^6/µl)] reported by Café et al. (2012); Alagbe and Adegbite (2019). Total leucocyte count, monocytes, eosinophils and lymphocytes were within the normal ranges [(7.50 – 12.00 (10^3/µl)], 2.00 – 6.00 %, 0 – 2.00 % and 42.00 – 80.00 % reported by Islam et al. (2004); Riddell (2011) and Thrall (2007). Neutrophil count was within the reference range (19.00 – 45.00 %)

reported by Pampori and Iqbal (2007). White blood cell is responsible for the production of antibodies to prevent the body against infection and disease (Isaac et al., 2013). Monocytes, eosinophils and lymphocytes are important immunological modulator in birds (John, 2024e).

Values of total protein, albumin and globulin obtained in this study were within the normal range of 3.00 – 7.50 g/dl, 2.00 – 4.50 g/dl and 1.85 – 4.00 g/dl cited by (Alagbe, 2017). This result suggests adequacy in protein reserve for growth and production across the treatment (Thrall, 2007). Total cholesterol and triglycerides values observed in the study were within the values (58.00−130.0 mg/dl and 40.09 – 90.00 mg/dl reported by Muritala et al. (2022) for birds fed different levels of phytogenics. Moreover, the values of creatinine (3.38to 3.61 mg/dl) obtained in this study were lower than the normal range (2.00−5.00 mg/dl) reported by Café et al. (2012). This outcome indicates that the kidney and other vital parts of birds were not compromised by the partial replacement of soya meal with *Albizia lebbeck* seed meal. Values of alanine amino transferase and aspartate transaminase were 35.00 – 65.00 U/L and 18.00 – 45.00 U/L cited by Pampori and Iqbal (2007). This suggests that the partial replacement at soya meal with *Albizia lebbeck* seed meal up 15 % was not toxic to affect the liver function of birds (Alagbe, 2017).

5. CONCLUSION

In conclusion, *Albizia lebbeck* seed meal is rich in protein and other phyto-components with therapeutic properties. Replacing soya meal with Albizia meal up to 15 % had positive effect on growth performance, egg quality, hen day egg production, hen housed egg production as well as blood parameters. These phyto-components could stabilize liver cells, detoxify and neutralize the activities of free radicals and delivers a broad-spectrum antimicrobial effect. This research will help to promote animal production and reduce the pressure on conventional feedstuffs like soya bean meal.

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Conflict of interest

The authors declare that they have no conflicts of interests, competing financial interests or personal relationships that could have influenced the work reported in this paper.

Ethical approval

The study was approved by the ethic committee at the Department of Animal Nutrition and Biochemistry, Gandhi College of Agriculture, Rajasthan, India with reference code: GHJ/009A/2025C.

Informed consent

Not applicable.

Data availability

Data that support the findings of this study are embedded within the manuscript.

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