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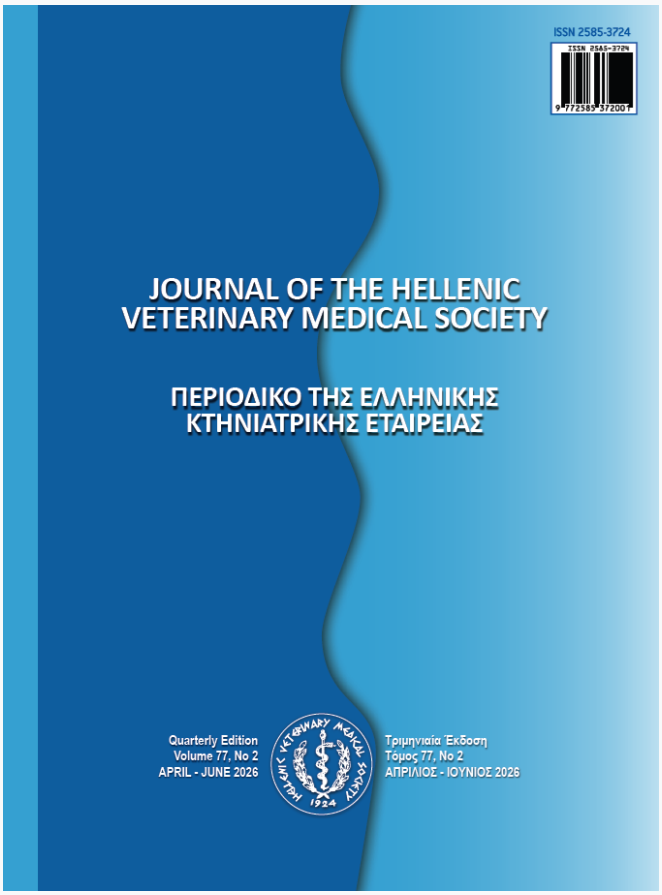

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Research article
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The effects of mesquite feeding on performance, carcass, immunity, blood and antioxidant parameters in broilers

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ABSTRACT: The present study was conducted to evaluate the effect of different levels of mesquite fruit powder (*Prosopis farcta*) on performance indicators, carcass characteristics, immune system, biochemical parameters and blood antioxidant status in broiler chickens. First, the analysis of the constituent components was performed in the laboratory. Totally, 160 broiler chickens of the Ross 308 strain were studied in a completely randomized design with four dietary treatments including basal diet (control) and diets containing 1, 2 and 3% mesquite powder. Each treatment consisted of four replications and each replication consisted of 10 birds. The 42-day rearing period was divided into three starter, grower and finisher periods under standard management and appropriate to the welfare of the flock. The results of this study showed that the addition of mesquite powder did not have any negative effects on feed intake, body weight and feed conversion ratio (FCR) during the rearing period. Results of blood parameters, significant decrease in blood glucose concentration and significant increase in high-density lipoprotein (HDL) and total antioxidant capacity (TAC) levels were obtained in the mesquite-fed treatments ($P<0.01$). Also, liver enzyme activity was linearly and significantly decreased ($P=0.01$). Although carcass weight and internal organs were not significantly affected by the dietary treatments, numerical improvements in carcass quality traits including breast and thigh weight were evident in the mesquite-fed treatments. On the other hand, no significant effect was observed on immune responses including antibody titer against SRBC and the weight of immune organs including spleen, bursa of Fabricius and pancreas. Overall, the findings of this study showed that the use of mesquite powder up to 3% in the diet of broiler chickens can lead to non-significant improvement in growth performance, lipid profile modification and blood antioxidant status, without adverse effects on general health, immune responses and carcass quality of birds. These results indicate the potential of mesquite as a natural and safe additive in broiler poultry nutrition.

Keyword: Antioxidant; Broiler chicken; *Prosopis farcta*; Growth

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INTRODUCTION

Global warming has led to the production of common plant-based foods facing many challenges, and the cost and risk of production are worrying given the current state of nutrition management. The prevalence of drought and the increase in severe water and environmental stresses in many climates are leading to many areas becoming unusable for the production of high-value agricultural products and heading towards degradation and desertification (Seidavi et al., 2023; Hosseintabar-Ghasemabad et al., 2024). It is reported that more than one-third of the Earth's land surface (49 million km2) is located in arid or semi-arid climates that receive less than 400 mm of annual rainfall, and 20% of the world's population lives in these areas. Climate change is progressing in such a way that many groundwater aquifers around the world are being degraded in quantity and quality, and the expansion of arid and semi-arid regions is beyond the progress and development of countries (Gutiérrez et al., 2018; Ruiz-Nieto et al., 2020). In recent decades, the use of edible plants and natural compounds in livestock and poultry nutrition has attracted the attention of researchers as a suitable alternative to chemical additives and antibiotics (Sateri et al., 2017; Seidavi et al., 2017; Sigolo et al., 2019; Hosseini-Vashan et al., 2025; Delfani et al., 2025). One of the most important reasons for this trend is the concerns about drug residues and the negative effects of antibiotics on human health and the emergence of microbial resistance (Namiki, 1990). In this regard, the use of plants with bioactive compounds such as flavonoids, tannins and saponins, which have antioxidant, antibacterial and metabolic health-improving effects, can be a safe and efficient approach (Stoilova et al., 2007). Ruiz-Nieto et al. (2020) believe that the genus Prosopis (*Prosopis* spp.) is considered an important and valuable species in arid regions due to its ability to fix soil nitrogen and adapt to drought seasons and can be considered as a valuable feedstock in the nutrition of wild and domestic animals in harsh conditions. These plants are considered a rich and valuable source of protein, fiber, sugars and a series of phytochemical compounds, which have good potential in the perspective of domestic animal nutrition. Overall, its nutritional properties and ability to grow in water-deficiency conditions make it a potential source of energy and protein for animal feed, especially in arid and semi-arid regions. However, specialized studies on the use of this plant in animal nutrition are limited and require further research and development, given the potential and necessity of these resources (Ruiz-Nieto et al., 2020). Mesquite (*Prosopis farcta*) is a species native to arid and semi-arid regions. Reports indicate that consuming the extract or powder of this plant can reduce blood fat and sugar, improve lipid profiles, and increase antioxidant levels in the body (Ranjbar Heidari et al., 2012; Aziznia et al., 2019). Also, due to its diverse phenolic and flavonoid compounds, this plant has a high ability to inhibit free radicals and prevent lipid peroxidation (Afshari & Sayyed-Alangi, 2017). Several studies have shown that mesquite plant extracts can play a significant role in reducing cholesterol, triglyceride, and LDL levels and increasing HDL. For example, oral administration of mesquite seed extract in hyperlipidemic rats significantly improved blood biochemical parameters and reduced liver tissue lesions (Mohammad Pour Zehab et al., 2018). In addition, the antibacterial properties of this plant against important pathogens such as Salmonella Typhimurium and Staphylococcus aureus have been reported, indicating its potential in promoting the health of the digestive tract of poultry and reducing the risk of infectious diseases (Tajbakhsh et al., 2015). Given that the poultry industry is particularly in need of safe and effective additives to improve growth, feed conversion ratio, carcass quality and general health of chickens, the use of indigenous plant resources such as mesquite can be a practical answer to this need. Evidence has shown that the addition of different levels of herbal extracts or powders to broiler chicken diets not only affects growth performance (body weight, feed intake and feed conversion ratio), but can also improve hematological, biochemical parameters and antioxidant capacity (Cardozo et al., 2010). Therefore, a detailed study of the effect of different levels of mesquite powder (1, 2 and 3%) in broiler chicken diets can provide valuable information to improve sustainable production and reduce dependence on chemical additives. Based on the available evidence, it is hypothesized that adding different levels of mesquite powder to broiler diets can significantly improve performance indicators (body weight, feed intake and feed conversion ratio, blood parameters (blood glucose, cholesterol, triglycerides, HDL and LDL, biochemical indicators and antioxidant capacity). Therefore, the main objective of this study was to evaluate the effect of different levels of mesquite powder (1, 2 and 3%) in broiler diets on performance indicators, weight caraccas, feed intake, feed conversion ratio, blood parameters, biochemical and antioxidant capacity.

MATERIALS AND METHODS

Preparation, Preparation and Analysis of the Test Ingredient

The test ingredient of the present study was the mesquite plant with the scientific name *Prosopis farcta*, which was obtained from Darvash Giah Khazar medicinal herbs complex company (LTF) (Iran-Guilan-Rasht). The samples were ground for laboratory analysis and biological tests. Analysis of a series of specific compounds of mesquite compounds based on the Institute of Standards and Industrial Research of Iran (ISIR) method was measured in Viromed Laboratory (Rasht-Gilan-Iran) for protein (107031), fat (10700), ash (2706), dry matter (8438), NDF (8917), ADF (8917), total sugar (89862), starch (2303), calcium (107011), phosphorus (513), and in Tekno Azma Laboratory (Tehran-Iran) for fatty acids (1312612) and phytosterol and tocopherol compounds (9760), respectively, and reported in Tables 1.

Table 1. Analysis of some reported laboratory chemical compounds for mesquite (*Prosopis farcta*)

Items	Values
Crude protein (%)	10.60
Crude fat (%)	1.72
Ash (%)	4.50
Dry matter (%)	90.21
Starch (%)	11.60
Sugar (%)	9.10
NDF (%)	30.90
ADF (%)	28.60
Calcium (%)	0.55
Phosphorus (%)	0.19
Total sterol (mg/kg)	824.61
Compostrol (%)	8.44
Cholesterol (%)	0.49
Stigma-sterol (%)	11.54
Beta-sitosterol (%)	58.30
Delta-5-auna-sterol (%)	9.27
Delta-7-auna-sterol (%)	4.09
Delta-7-stigma-stanol (%)	3.67
Other sterols	3.62
Alpha-tocopherol (ppm)	536.60
Gamma-tocopherol (ppm)	-
Delta-tocopherol (ppm)	-
Total tocopherol (ppm)	536.60
C12:0	1.08
C14:0	0.59
C16:0	19.82
C16:1	0.69
C17:0	0.31
C17:1	0.12
C18:0	5.81
C18:1c	36.43
C18:2c	28.44
C18:3c	3.16
C20:0	0.60
C20:1	0.20
C22:0	0.84
C24:0	0.36

Treatment and management of poultry farming

The experimental design of the present research study was based on a completely randomized design using 160 Ross 308 broiler chickens with a similar average weight (40 ± 1 g) in cages with dimensions of (1.5×1.5×2), so that the experimental unit treatments included the first treatment (control group at 0%), the second treatment (1% mesquite group), the third treatment (2% mesquite group) and the fourth treatment (3% mesquite group), respectively, in 4 replications and each replication included 10 birds with corn and soybean meal-based diets formulated with the help of Amino Feed 5.0 software from Evonik according to Table 2 during three periods: starter (1-11 days of age), grower (12-21 days of age) and finisher (22-42 days of age). The research was carried out in Pakdasht Farm, located at 352648.3 N and 514332.1 E (Tehran-Iran) in the winter of 1403. Other matters were managed according to the recommendations of the reference and the breeder‘s guide catalog for temperature, light, bedding and vaccination, and the birds had complete freedom to consume drinking water and food throughout the period. The diet items in Table 1 are for the experimental diets in percentage and only for metabolic energy in kilocalories per kilogram and for anion and cation balance or DCAB of the diet in milliequivalents per kilogram and for bulk weight in kilograms per cubic meter. The content of metabolizable energy values (AME_n) of the studied plants was estimated

based on the equation proposed by the World Poultry Science Association (WPSA).

Statistical analysis

The data obtained from this study were analyzed using SAS statistical software (version 9.4). First, the normality of the data and the homogeneity of variances were examined using the Shapiro-Wilk (for normality) and Levene (for homogeneity of variance) tests. After ensuring that the assumptions of the analysis of variance were established, the data were analyzed in a completely randomized design with 4 treatments (including a control group and 3 treatments containing different levels of mesquite plants). Duncan's multiple range test was used to compare the means of the treatments at a significance

Table 2. Components of experimental treatments diets and nutrient calculations for broiler chickens

Items	Starter period (1-11 d)				Grower period (12-21 d)				Finisher period (22-42 d)			
Ingredients (%)	**T_1**	**T_2**	**T_3**	**T_4**	**T_1**	**T_2**	**T_3**	**T_4**	**T_1**	**T_2**	**T_3**	**T_4**
Corn	51.27	50.75	50.23	49.71	57.31	56.53	55.75	54.98	63.94	63.16	62.38	61.61
Mesquite	0.00	1.00	2.00	3.00	0.00	1.00	2.00	3.00	0.00	1.00	2.00	3.00
Soybean Meal 44%	42.93	42.41	41.89	41.37	35.52	35.44	35.36	35.28	28.55	28.47	28.39	28.31
Vegetable oil	2.00	2.00	2.00	2.00	2.50	2.50	2.50	2.50	3.00	3.00	3.00	3.00
Methionine	0.33	0.33	0.34	0.34	0.27	0.27	0.27	0.27	0.22	0.22	0.22	0.22
Lysine Hydrochloride	0.14	0.15	0.17	0.18	0.15	0.16	0.16	0.16	0.18	0.18	0.18	0.18
Threonine	0.08	0.08	0.09	0.10	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07
Valine	0.00	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Choline Chloride	0.04	0.04	0.05	0.05	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07
Monocalcium Phosphate	1.09	1.09	1.09	1.09	0.91	0.91	0.91	0.90	0.69	0.69	0.69	0.69
Calcium Carbonate	1.17	1.18	1.18	1.18	1.02	1.02	1.03	1.03	0.87	0.88	0.88	0.88
Sodium Bicarbonate	0.22	0.23	0.24	0.25	0.21	0.22	0.22	0.23	0.23	0.23	0.24	0.24
Sodium Chloride (Salt)	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20
Premix	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Phytase Enzyme	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Bentonite	0.28	0.00	0.00	0.00	1.26	1.11	0.96	0..81	1.49	1.34	1.19	1.04
Nutrient composition calculations of assay diets												
Metabolizable energy	2587	2587	2587	2587	2933	2933	2933	2933	3040	3040	3040	3040
Crude protein	23.50	23.36	23.21	23.06	20.59	20.60	20.60	20.61	17.93	17.94	17.95	17.96
Lysine	1.25	1.25	1.25	1.25	1.10	1.10	1.10	1.10	0.96	0.96	0.96	0.96
Methionine + cysteine	0.93	0.93	0.93	0.93	0.81	0.81	0.81	0.81	0.71	0.71	0.71	0.71
Threonine	0.83	0.83	0.83	0.83	0.72	0.72	0.72	0.72	0.63	0.63	0.63	0.63
Tryptophan	0.26	0.25	0.25	0.25	0.22	0.22	0.22	0.22	0.18	0.18	0.18	0.18
Arginine	1.45	1.44	1.43	1.41	1.25	1.25	1.25	1.25	1.06	1.06	1.06	1.06
Isoleucine	0.89	0.88	0.87	0.87	0.77	0.77	0.77	0.77	0.66	0.66	0.66	0.66

Table 2. Components of experimental treatments diets and nutrient calculations for broiler chickens

Items	Starter period (1-11 d)				Grower period (12-21 d)				Finisher period (22-42 d)			
Ingredients (%)	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
Valine	0.96	0.96	0.96	0.96	0.85	0.85	0.85	0.85	0.74	0.74	0.74	0.74
Calcium	0.94	0.94	0.94	0.94	0.85	0.85	0.85	0.85	0.73	0.73	0.73	0.73
Av.P	0.47	0.47	0.47	0.47	0.42	0.42	0.42	0.42	0.37	0.37	0.37	0.37
Sodium	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Potassium	1.04	1.04	1.03	1.02	0.91	0.91	0.91	0.91	0.79	0.79	0.79	0.79
Chlorine	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
DCAB	278	276	274	272	241	241	242	242	209	210	210	210
Choline	1.69	1.69	1.69	1.69	1.60	1.60	1.60	1.60	1.48	1.48	1.48	1.48
Crude fat	4.61	4.60	4.60	4.60	5.20	5.19	5.19	5.18	5.82	5.82	5.81	5.80
Linoleic acid	2.19	2.19	2.19	2.19	2.18	2.50	2.49	2.48	2.81	2.81	2.81	2.80
NDF	9.61	9.80	9.99	10.18	9.48	9.69	9.90	10.10	9.45	9.66	9.87	10.07
ADF	4.24	4.35	4.46	4.57	3.97	4.10	4.23	4.36	3.75	3.88	4.01	4.14
Crude fiber	3.14	3.15	3.15	3.16	2.94	2.96	2.99	3.01	2.78	2.80	2.82	2.85
Ash	6.22	6.21	6.21	6.20	6.71	6.58	6.45	6.32	6.20	6.17	5.94	5.81
Starch	32.77	32.95	33.14	33.32	36.56	36.58	36.60	36.63	40.72	40.75	40.77	40.79
Bulk weight	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.60	0.60	0.60	0.60

Experimental treatments: T_1 (control group 0%), T_2 (group 1% mesquite), T_3 (group 2% mesquite) and T_4 (group 3% mesquite).

Premix containing amounts of vitamins and minerals per kg for experimental diets: Vitamin A, 9000 IU; Vitamin E, 18 IU; Vitamin D3, 3000 IU; Vitamin K3, 3 mg; Vitamin B1 (thiamine), 1.8 mg; Vitamin B2 (riboflavin), 6 mg; Vitamin B3 (niacin), 30 mg; Vitamin B6 (pyridoxine), 3 mg; Vitamin B5 (pantothenic acid), 10 mg; Vitamin B9 (folic acid), 1 mg; Vitamin B12 (cobalamin), 0.012 mg; Vitamin H3, 0.24 mg; 500 mg; Choline, 100 mg; Manganese, 100 mg; Zinc, 80 mg; Iron, 10 mg; Copper, 1 mg.

level of 5%. Also, in order to examine the effect of adding mesquite plants compared to the control group, an orthogonal contrast was used between the control treatment and other treatments. The data were analyzed using the GLM method. Linear and quadratic models were evaluated for all traits. If a significant effect was observed, the means were compared using Duncan's test. All results were reported as mean ± standard error of the mean (SEM), and significance levels less than 0.05 were considered significant.

All activities of the present research were carried out under the ethics code IR.IAU.RASHT.REC.1402.017, implementing welfare guidelines appropriate to the Laboratory Animal Ethics Committee of Ra.C., Islamic Azad University, Rasht, Iran.

RESULTS

Performance traits

According to the results of Table 3, in the starter stage of breeding, the evaluation of performance indicators indicated that the use of mesquite powder at levels of one, two and three percent did not have a significant effect on the performance of broiler chickens. The average feed intake in the group receiving the basal diet (487.75 g) was slightly higher compared to the treatments containing one percent (473.25 g), two percent (474.75 g) and three percent (474.25 g) of plant powder. Regarding the final weight, the three percent treatment with an average of 455.25 g showed numerical superiority over the control treatment (431.75 g) and the two percent treatment (431.75 g). Also, the feed conversion ratio in the one and three percent treatments (1.095) was more favorable compared to the control group (1.066). Despite these numerical differences, the analysis of variance of the data indicated that there was no statistically significant difference between the treatments. Examining the trend of changes with linear and quadratic models also did not reveal any significant pattern.

According to Table 4, during the grower period from 12 to 21 days of age, the feed intake values among the different treatments were significantly convergent, ranging from 576 to 584 grams. Although the 3% treatment had the lowest intake

Table 3. Comparison of average performance traits of broiler chickens between 1-11 days of age for different levels of mesquite

Treatments	Feed consumption (g)	Body weight (g)	Feed conversion ratio (FCR)
0% mesquite	487.75	431.75	1.066
1% mesquite	473.25	440.75	1.095
2% mesquite	474.75	431.75	1.078
3% mesquite	474.25	455.25	1.095
SEM	8.60	8.70	0.008
Significance level (P)	0.58	0.16	0.07
Significance of orthogonal effect of control treatment compared to plant groups	0.18	0.06	0.099
Linear model	0.29	0.10	0.08
Quadratic model	0.46	0.34	0.47

with an average of 576 grams, this did not lead to a decrease in body weight in this treatment, and the final weight in the 2% and 3% treatments was more favorable with values of 417.00 and 417.25 grams, respectively, compared to the control group (410.25 grams) and the 1% treatment (407.25 grams). Regarding the feed conversion ratio, the control group and the 1% treatment showed better performance with values of 1.42 and 1.43 compared to the 2% and 3% treatments (1.39 and 1.38, respectively). However, all of these differences were not statistically significant, and the results from orthogonal comparisons and linear and quadratic trend analyses also confirmed this.

According to the results of Table 5 for the finisher period from 22 to 42 days of age, although the 3% treatment had the highest feed consumption with an average of 2807 grams, this increase in consumption was not accompanied by an improvement in body weight and this treatment recorded the lowest weight among the treatments with an average of 1527 grams. In contrast, the control treatment achieved a weight of 1547 grams with an average of 2796 grams of feed. The feed conversion ratio in the 3% treatment (1.838) was also numerically superior to the other treatments (from 1.807 to 1.811). Despite these numerical differences, the results of statistical analysis confirmed the absence of significant differences between the different treatments. Also, examining the linear and quadratic effects of different plant levels

Table 4. Comparison of average performance traits of broiler chickens between 12-21 days of age for different levels of mesquite

Treatments	Feed consumption (g)	Body weight (g)	Feed conversion ratio (FCR)
0% mesquite	584	410.25	1.42
1% mesquite	583	407.25	1.43
2% mesquite	582	417.00	1.39
3% mesquite	576	417.25	1.38
SEM	13.90	12.20	0.025
Significance level (P)	0.97	0.91	0.44
Significance of orthogonal effect of control treatment compared to plant groups	0.81	0.80	0.51
Linear model	0.69	0.58	0.16
Quadratic model	0.86	0.89	0.61

on the studied traits did not reveal any significant trend.

The results of Table 6 for the entire period from 1 to 42 days of age, although direct comparison of means did not show any statistically significant difference between treatments, trend analysis indicated a significant effect of increasing the level of plant powder on feed intake and body weight. As the plant level increased from zero to three percent, feed intake increased linearly from 3906 g to 4107 g and body weight from 2437 g to 2565 g (with significance levels of 0.023 and 0.03, respectively). In addition, for the body weight trait, a significant quadratic relationship was also observed (0.023), indicating the presence of a curvilinear pattern and possibly a peak point for this trait. These findings indicate that although the difference between individual treatments was not evident in the test of comparison of means, the addition of mesquite powder, especially at the three percent level, resulted in a significant trend in a gradual improvement in growth performance throughout the entire period. Feed conversion ratio varied between 1.60 and 1.614 among treatments, and its changes were not significant.

Quantitative carcass traits

Based on the findings of this study in Table 7, the application of different levels of mesquite powder in the diet of broiler chickens did not have any statistically significant effect on all quantitative indicators related to the carcass and internal organs of broilers.

Table 5. Comparison of average performance traits of broiler chickens between 22-42 days of age for different levels of mesquite

Treatments	Feed consumption (g)	Body weight (g)	Feed conversion ratio (FCR)
0% mesquite	2796	1547	1.808
1% mesquite	2782	1545	1.807
2% mesquite	2798	1546	1.811
3% mesquite	2807	1527	1.838
SEM	47.10	43.10	0.033
Significance level (P)	0.99	0.98	0.89
Significance of orthogonal effect of control treatment compared to plant groups	0.99	0.88	0.77
Linear model	0.82	0.76	0.53
Quadratic model	0.82	0.84	0.68

Table 6. Comparison of average performance traits of broiler chickens between 1-42 days of age for different levels of mesquite

Treatments	Feed consumption (g)	Body weight (g)	Feed conversion ratio (FCR)
0% mesquite	3906	2437	1.603
1% mesquite	3938	2452	1.606
2% mesquite	3973	2462	1.614
3% mesquite	4107	2565	1.600
SEM	54.00	35.00	0.018
Significance level (P)	0.10	0.08	0.96
Significance of orthogonal effect of control treatment compared to plant groups	0.14	0.19	0.85
Linear model	0.023	0.03	0.98
Quadratic model	0.36	0.023	0.66

The recorded values for the live weight of birds among the various treatments fluctuated in a relatively close range from 2347 to 2398 grams, indicating a significant uniformity between the different experimental groups. The empty carcass weight, which is considered one of the key parameters in determining slaughter efficiency, was numerically higher in the treatments containing mesquite than in the control group; such that the treatments of one and three percent with an average of 1788 grams and the treatment of two percent with an amount of 1785 grams were in a more favorable condition compared to the control group which had a figure of 1728 grams. In the valuable carcass components section, the breast weight in the 1% treatment showed a significant numerical superiority with an average of 657 grams compared to the control group with 612 grams and the 3% treatment with 633 grams. On the other hand, the thigh weight in the 3% mesquite treatment with a value of 512 grams was higher compared to the other treatments including the control (473 grams), 1% (482 grams) and 2% (492 grams). Regarding abdominal fat, although the control group had the highest amount with an average of 29.05 grams and the 1% treatment had the lowest amount with 22.63 grams, this difference was not statistically significant. The weight of internal organs including heart with a fluctuation range of 9.3 to 11.4 grams, gizzard with a variation range of 32.03 to 37.3 grams, stroma with values of 6.5 to 7.82 grams and liver with a range of 42.8 to 49.5 grams also had a negligible standard deviation among the different treatments and the changes observed in them did not have any statistical difference. The results obtained from the orthogonal comparison between the control group and the treatments receiving the plant, along with the analysis of the change trend using linear and quadratic models, all indicated the absence of any significant effect of different levels of mesquite powder on carcass traits and internal organs. These findings indicate that the addition of this plant material up to a level of three percent in the diet, despite causing minor numerical changes in some traits, could not exert a significant positive or negative effect on the qualitative and quantitative characteristics of the carcass of broilers, and the results obtained indicate the absence of a significant difference of the mesquite plant additive on the indicators studied.

Blood parameters

Based on the findings of this study, the results of Table 8 for blood biochemical parameters, the use of different levels of mesquite powder in the diet of broiler chickens had a statistically significant effect on several blood biochemical parameters. In the case of blood glucose, a significant decrease was observed with increasing levels of mesquite powder. The control treatment with a value of 176.5 mg/dL was significantly higher than the 2% treatment with a value of 171.5 mg/dL and the 3% treatment with a value of 167.7 mg/dL (P=0.01). Also, a significant difference was observed between the 2% and 3% treatments, such that the 3% treatment with a value of 167.7 mg/dL was significantly lower than the 2% treatment with a value of 171.5 mg/dL. In the case of high-density lipoprotein (HDL), a significant increase was observed with increasing levels of mesquite powder. The control treatment

Table 7. Comparison of average carcass traits of broiler chickens for different levels of mesquite (g)

Treatments	Live body	Body without feathers	Carcass	Breast	Thigh	Abdominal fat	Heart	Gizzard	crop	Liver
0% mesquite	2390	2013	1728	612	473	29.05	10.70	33.85	6.50	47.80
1% mesquite	2347	2088	1788	657	482	22.63	10.50	32.03	7.12	49.50
2% mesquite	2370	2018	1785	652	492	25.38	9.30	37.30	7.23	45.00
3% mesquite	2398	2100	1788	633	512	31.75	11.40	32.40	7.82	42.80
SEM	47	55	60	26	24	5.30	1.07	2.28	0.59	2.90
Significance level (P)	0.87	0.56	0.86	0.60	0.68	0.63	0.59	0.38	0.49	0.41
Orthogonal effect	0.74	0.39	0.41	0.26	0.41	0.69	0.81	0.98	0.22	0.55
Linear model	0.83	0.44	0.52	0.64	0.24	0.65	0.85	0.94	0.14	0.16
Quadratic model	0.47	0.94	0.64	0.23	0.83	0.24	0.31	0.51	0.98	0.51

at 36.1 mg/dL was significantly lower than the 1% and 2% treatments at 37.5 and 38.75 mg/dL, and the 3% treatment at 40.77 mg/dL (P = 0.01). There was also a significant difference between the 1% and 2% treatments and the 3% treatment. Total antioxidant capacity (TAC) also showed a significant increase in response to different levels of mesquite powder. The control treatment at 682.7 nmol/mL was significantly lower than the 1% treatment at 699.3 nmol/mL, the 2% treatment at 714.7 nmol/mL, and the 3% treatment at 723 nmol/mL (P = 0.001). Also, significant differences were observed between the different mesquite-containing treatments, with the 3% treatment at 723 nmol/mL being significantly higher than the 2% treatment at 714.7 nmol/mL and the 1% treatment at 699.3 nmol/mL. In the case of the enzyme alanine aminotransferase (ALT), a significant decrease was observed in the linear model (P = 0.01), as it decreased with increasing mesquite powder levels from 16.32 units/L in the control treatment to 13.62 units/L in the 3% treatment. Although the comparison of means between treatments was not significant, there was a decreasing trend. In the case of low-density lipoprotein (LDL), a numerical decrease was observed with increasing mesquite powder levels, as it decreased from 99.6 mg/dL in the control treatment to 94.8 mg/dL in the 3% treatment. This decrease was significant in the linear model (P = 0.012). The atherogenic index also showed a numerical decrease but was not statistically significant. Triglycerides showed a slight but non-significant decrease, from 75.73 mg/dL in the control treatment to 73.1 mg/dL in the 3% treatment. Other biochemical parameters including uric acid, albumin, total protein, phosphorus and aspartate aminotransferase (AST) did not show significant changes in response to the different treatments. The results of the orthogonal comparison between the control group and the plant-receiving treatments also confirmed the significant effect of different levels of mesquite powder on the parameters of glucose (P = 0.01), high-density lipoprotein (P = 0.01) and total antioxidant capacity (P = 0.01). These findings indicate that adding mesquite powder to the diet, especially at a level of 3%, can have a positive and significant effect on improving the metabolic profile and antioxidant status of broiler chickens.

Immune System

According to the results of Table 9 for parameters related to the immune system, the use of different levels of mesquite powder in the diet of broiler chickens did not have any statistically significant effect on the evaluated indicators of the immune system of birds. The values recorded for the antibody titer against SRBC on day 35 among the different treatments ranged from 1.5 to 1.75 and on day 42 between 5 and 5.5, indicating a significant uniformity between the experimental groups. The weight of the pancreas, which is considered one of the important organs in hormonal immunity, varied between 4.87 and 5.5 grams in different treatments

Table 8. Comparison of mean blood parameters of broiler chickens for different levels of mesquite

Treatments	Glu	Chol	HDL	LDL	AI	TG	UA	Alb	TP	P	ALT	AST	TAC
0% mesquite	176.5^{a}	161	36.1^{c}	99.6	2.76	75.73	5.61	2.09	4.41	4.15	16.32	351.1	682.7^{d}
1% mesquite	173.7^{ab}	157	37.5^{b}	98.4	2.62	75.2	5.57	2.12	4.43	4.22	14.75	349.8	699.3^{c}
2% mesquite	171.5^{b}	153.5	38.75^{b}	96.6	2.49	74.6	5.63	2.17	4.63	4.40	13.97	343.00	714.7^{b}
3% mesquite	167.7^{c}	153.2	40.77a	94.8	2.67	73.1	5.66	2.12	4.50	4.35	13.62	338.8	723^{a}
SEM	0.81	2.90	0.32	1.50	0.10	0.79	0.032	0.034	0.077	0.16	0.88	4.80	2.40
Significance level (P)	0.001	0.25	0.001	0.099	0.21	0.11	0.34	0.45	0.20	0.67	0.08	0.26	0.001
Orthogonal effect	0.001	0.08	0.001	0.06	0.19	0.10	0.79	0.27	0.23	0.36	0.05	0.19	0.001
Linear model	0.001	0.06	0.001	0.012	0.12	0.02	0.19	0.43	0.17	0.29	0.01	0.06	0.001
Quadratic model	0.55	0.53	0.37	0.75	0.11	0.52	0.33	0.23	0.36	0.72	0.051	0.80	0.11

Means with the same letter for each column are not significantly different.

Glu: Glucose, Chol: Cholesterol, HDL: High density lipoprotein, LDL: Low density lipoprotein, AI: Atherogenic index, TG: Triglyceride, UA: Uric acid, Alb: Albumin, TP: Total protein, P: Phosphorus, ALT: Alanine amino transferase, AST: Aspartate amino transferase and TAC: Total antioxidant capacity.

and no significant difference was observed between the groups. The weight of the spleen, as the main center of the cellular immune response, was numerically higher in the treatments containing mesquite than in the control group; In a way, the 3% treatment with an average of 2.75 g and the 1% treatment with an amount of 2.65 g showed a more favorable situation compared to the control group which had a number of 2.27 g. On the other hand, the weight of the bursa of Fabricius, which plays a key role in the development of B lymphocytes, fluctuated between 1.58 and 1.9 g in different treatments and no specific pattern was observed in response to different levels of plant powder. The results obtained from the orthogonal comparison between the control group and the treatments receiving the plant, along with the analysis of the trend of changes using linear and quadratic models, all indicated the absence of any significant effect of different levels of mesquite powder on immune system parameters. These findings indicate that the addition of this plant material up to the level of 3% in the diet, despite causing minor numerical changes in some indicators such as spleen weight, could not have a significant positive or negative effect on the performance of the immune system of broilers.

DISCUSSION

Performance traits

The results of this study showed that the addition of mesquite powder (*Prosopis farcta*) at levels of 1, 2, and 3% in the diet of broiler chickens in the starter, grower, and finisher stages did not cause significant differences in performance indicators, although numerical changes were significant, especially at the 3% level, in some indicators such as body weight and feed conversion ratio. The findings of this study are somewhat consistent with previous studies. Consumption of mesquite seed extract in laboratory animals improved lipid profiles and reduced liver tissue damage, without always observing significant statistical differences in all indicators (Hajinezhad & Rasekh, 2019). This agreement with our results indicates that the effects of mesquite appear more as a gradual and long-term trend than as sudden changes in the short term. The use of different levels of mesquite had a significant effect on body weight, feed intake and feed conversion ratio of broiler chickens in the starter, grower and finisher periods (Varmaghany et al., 2016). The highest weight gain in the growth periods and the total period was related to the control group and the treatment containing 1% mesquite, while the 2% mesquite treatment showed the lowest weight gain. Feed intake was not affected by the treatments and no significant difference was observed between the groups. However, feed conversion ratio was significantly higher in the 2% mesquite treatment, indicating a lower feed conversion ratio at this level. In general, the addition of 1% mesquite to the diet did not negatively affect growth performance, but its 2% level reduced feed efficiency. Studies have shown that the use of mesquite fruit powder in the diet of broiler chickens under heat stress, especially at

Table 9. Comparison of average immune system parameters of broiler chickens for different levels of mesquite

Treatments	Antibody Titr (35 day- SRBC test)	Antibody Titr (42day- SRBC test)	Pancreas (g)	Spleen (g)	Fabricius (g)
0% mesquite	1.50	5.00	5.50	2.27	1.80
1% mesquite	1.75	5.25	5.20	2.65	1.90
2% mesquite	1.50	5.25	4.87	2.20	1.83
3% mesquite	1.75	5.50	5.32	2.75	1.58
SEM	0.53	0.36	0.38	0.28	0.32
Significance level (P)	0.97	0.82	0.71	0.49	0.90
Significance of orthogonal effect of control treatment compared to plant groups	0.79	0.44	0.42	0.46	0.93
Linear model	0.83	0.38	0.63	0.49	0.61
Quadratic model	0.99	0.98	0.34	0.79	0.60

the 5% level, significantly reduced body weight and feed consumption in the finisher period of rearing. Also, feed conversion ratio increased significantly in these treatments, indicating a decrease in feed conversion ratio. These negative effects were mainly attributed to anti-nutritional compounds of mesquite such as tannins, which reduced nutrient digestibility. Although mesquite had less negative effects at lower levels (1–3%), researchers suggested a maximum level of 3% as an acceptable level to balance growth performance and antioxidant status safety (Dashtban et al., 2017). Also, in a study (Aziznia et al., 2019), the high antioxidant property of Prosopis root extract was reported, which could partly explain the relative improvement in performance and body weight at the 3% dietary level; because improving the antioxidant status of poultry in industrial farming conditions plays an important role in increasing growth and reducing oxidative stress. On the other hand, the results of linear and quadratic trend analysis (Table 4) showed that by increasing the level of mesquite powder to 3%, feed intake and body weight were numerically improved. This finding is consistent with the report of Cardozo et al. (2010) which showed that Prosopis extract, as a rich source of phenolic compounds, can provide a gradual and linear improvement in antioxidant capacity and growth of organisms. Addition of mesquite extract to the diet of common carp had a significant effect on growth indices and feed conversion ratio. Treatments fed with 1% and 2% levels showed significantly higher final weight, relative weight gain and specific growth rate compared to the control group. Also, feed intake and feed conversion ratio were significantly increased in these treatments. This improvement in performance is likely due to the increased activity of digestive enzymes such as amylase, lipase and protease in the intestine of fish fed with higher levels of mesquite (Yousefi et al., 2025). Also, studies such as Ranjbar Heidari et al. (2012) have emphasized the medicinal and metabolic properties of *Prosopis farcta* and have stated that this plant is capable of reducing blood sugar and modulating biochemical indices. Such mechanisms can lead to increased energy metabolism efficiency and consequently improved body weight of poultry in the long term, although its effects in short periods may be less obvious. In addition, Namiki (1990) have both emphasized the role of polyphenolic and antioxidant compounds of plants in improving feed quality and health of livestock and poultry. Accordingly, the observed increasing trend in feed consumption and body weight in the 3% treatment (Table 4) can be attributed to the increased availability of these compounds.

Overall, the findings of this study indicate that the addition of different levels of mesquite powder, although not showing significant differences in direct comparison of treatment means, produced a slight improvement in the growth and performance of chickens in a linear and quadratic trend. This confirms the hypothesis that the effect of medicinal plants is more manifested in the form of gradual adjustment of metabolism and general health than in creating significant statistical changes in the short term. Therefore, it can be concluded that mesquite powder, especially at the level of three percent, has good potential for use as a natural additive in the diet of broilers.

Quantitative carcass traits

The results of this study showed that the addition of different levels of mesquite powder *(Prosopis farcta*) up to three percent in the diet of broilers did not have a statistically significant effect on quantitative carcass traits and internal organ weights. The weight of the empty carcass, the valuable parts of the carcass (breast and thigh) and the weight of the internal organs including the heart, liver, gizzard and stroma were within a small fluctuation range and the changes observed in them were statistically insignificant. These findings are consistent with the results of some previous studies on different species of the genus Prosopis. In one study, it was shown that the use of Prosopis juliflora in the diet of broiler chickens did not cause significant changes in carcass components (Girma et al., 2011).

Also, Álvarez-Fuentes et al. (2012) and colleagues (2012) showed in an experiment using Prosopis laevigata that replacing part of the energy sources with this plant had no significant effect on growth performance and carcass composition. In another study, Al-Harthi et al. (2019) and colleagues (2019) reported in their evaluation of the nutritional value of whole mesquite pods in poultry nutrition that this plant, when used at balanced levels, can be considered as an alternative source in the diet without causing negative effects on growth and carcass composition. The results of the present study also confirm these findings that Prosopis affects the metabolic status and meat quality through its bioactive compounds such as tannins and polyphenols and does not affect the direct change in the quantity of carcass components. The findings of this study are consistent with the study of Varramghani et al. (2016) who reported that the

use of 1 and 2% whole mesquite powder in the diet of broiler chickens did not have a significant effect on the percentage of different carcass parts (breast, thigh, abdominal fat) and internal organs (heart, liver, gizzard). They also noted that although carcass and some component values were numerically higher in the mesquite-containing treatments than in the control, these differences were not statistically significant. This could be due to antinutritional compounds in mesquite, including tannins, which may form complexes with proteins and other nutrients, preventing the bird from fully accessing these substances (Varmaghany et al., 2016). On the other hand, Dashtban et al. (2017) study, which investigated the effect of mesquite fruit powder on the performance of broiler chickens under heat stress, also showed that the experimental treatments did not affect the relative percentage of carcass components. Although in their study, the relative weight of breast and thigh increased numerically in some treatments containing mesquite, this increase was not statistically significant. These researchers also reported that the relative weight of internal organs, including heart, liver, and pancreas, was not affected by mesquite treatments (Dashtban et al., 2017). These results are consistent with the present findings, indicating that the use of mesquite at conventional levels (1 to 3%) cannot have a significant effect on carcass indices and internal organs of broiler chickens. In the study by Yousefi et al. (2025) conducted on goldfish (Cyprinus carpio), although it did not directly examine carcass traits, it showed that the use of mesquite extract in the diet can improve growth performance and digestive enzyme activity without having negative effects on the general health of the fish (Yousefi et al., 2025). This can be a confirmation of the harmlessness of mesquite at the levels used, although in the case of poultry, it seems that mesquite could not have a noticeable effect on carcass yield. In general, according to the results of these studies, it seems that the use of mesquite in the diet of broilers at levels of 1 to 3%, although it may affect some functional and metabolic parameters, cannot cause significant changes in quantitative indicators of the carcass and internal organs.

Blood parameters

Based on the findings of this study and consistent with the results of previous studies, the use of mesquite powder (*Prosopis farcta*) in the diet of broiler chickens had significant effects on blood biochemical parameters. The significant reduction in blood glucose concentration in treatments receiving mesquite powder, especially at the 3% level, could be due to the presence of active compounds such as flavonoids (such as quercetin and apigenin) that help improve insulin sensitivity and inhibit glucose absorption in the intestine (Asadollahi et al., 2010; Saad et al., 2005). This finding is also consistent with the results of Dasht-e Ban et al. (2017). who reported that the use of mesquite fruit powder under heat stress conditions reduced blood glucose concentration in broiler chickens.

The significant increase in HDL levels in response to higher levels of mesquite powder indicates the potential role of this plant in improving lipid profiles. Phenolic and antioxidant compounds in mesquite may increase HDL synthesis and facilitate cholesterol transport from tissues to the liver by modulating the activity of enzymes involved in cholesterol metabolism (Gulalp & Karcioglu, 2008; Omidi et al., 2013). Also, numerical reductions in LDL and triglyceride levels, although not statistically significant in some cases, may indicate a positive effect of mesquite on reducing the risk of atherogenic factors. The significant improvement in total antioxidant capacity (TAC) in treatments receiving mesquite powder, especially at the 3% level, indicates the effective role of this plant in strengthening the antioxidant defense system. This finding is consistent with several studies that emphasize the antioxidant properties of active compounds in mesquite (such as flavonoids, tannins, and phenolic acids) (Gholamalipour Alamdari & Taleghani, 2022; Jahromi et al., 2018). Also, the reduction in ALT activity, although insignificant, could indicate a protective effect of mesquite on liver tissue, which is consistent with previous reports on the hepatoprotective effects of Prosopis spp. (Agirman et al., 2022; Safari et al., 2021).

Overall, the findings of this study indicate that the addition of mesquite powder to broiler diets, especially at a level of 3%, can improve metabolic indices (reducing glucose and improving lipid profile) and enhance antioxidant status. These effects are likely due to the presence of bioactive compounds such as polyphenols, flavonoids, and tannins in mesquite, which have hypoglycemic, anti-inflammatory, and antioxidant properties. Therefore, it seems that the use of mesquite powder can be considered as a useful natural additive in poultry diets to improve health and metabolic performance. However, further studies are recommended to determine the exact mechanisms of action and optimize the level of use of this plant in poultry diets.

Immune System

The results from Table 7 show that the addition of different levels of *Prosopis farcta* (mesquite) powder to the diet of broiler chickens did not have a statistically significant effect on immune system indices including antibody titer against SRBC, spleen, bursa of Fabricius and pancreas weights. Although a numerical increase in spleen weight was observed in the treatments containing the plant (especially the 3% treatment with a mean of 2.75 g and the 1% treatment with 2.65 g compared to 2.27 g in the control group), these differences were not statistically significant. These findings may indicate mild or insignificant effects of *Prosopis farcta* on the immune system at the levels used. However, some previous studies have shown that medicinal plants rich in phenolic and flavonoid compounds can have immunomodulatory effects (Gulalp & Karcioglu, 2008). For example, compounds in some plants such as Echinacea can increase macrophage activity and antibody production. The difference in the results of the present study with other studies may be due to differences in the chemical composition of *Prosopis farcta* in different geographical areas, or low levels of biological activity of the compounds in the dry powder of the plant. Also, the lack of significant effects on the bursa of Fabricius and pancreas indicates that this plant does not have a significant effect on B-lymphocyte development or hormonal immune function under normal rearing conditions. These findings differ from the study (Omidi et al., 2013) and colleagues (2012) who reported positive effects of *Prosopis farcta* on lipid parameters in ostriches, but indicate that the biological effects of this plant may be species-specific. Overall, these results suggest that adding up to 3% mesquite powder to broiler diets is safe without negative effects on the immune system, but to observe immune-boosting effects, fortified extracts, higher doses, or stressful conditions (such as heat or infection) may be required to reveal the immunomodulatory potential of this plant.

CONCLUSIONS

Overall, the results of this study indicate that the use of different levels of mesquite (*Prosopis farcta*) powder in the diet of broiler chickens up to 3% did not have a significant effect on most performance traits, carcass and organs, although a positive but non-significant trend was observed in feed intake and body weight in the 3% treatment. However, the addition of this plant significantly reduced glucose levels and increased total antioxidant activity (TAC) in blood serum, indicating its favorable metabolic and antioxidant effects. Also, the significant increase in HDL and reduction in atherogenic index in mesquite-fed groups indicate an improvement in the lipid profile and cardiovascular health of birds. On the other hand, immune indices including antibody titer against SRBC and weight of lymphoid organs did not show a significant difference, indicating the lack of a strong immunomodulatory effect of this plant under normal breeding conditions. These findings suggest that mesquite can be used as a beneficial herbal supplement in poultry diets by improving antioxidant status and lipid and glucose metabolism. However, its effects on growth performance definitely require further studies with higher doses or under stress conditions. Suggestions In order to optimally exploit the positive effects of mesquite, it is suggested that in future studies, enriched or extracted extracts using different methods should be used instead of dry powder of the plant to observe better biological efficacy. Also, conducting experiments under stress conditions such as environmental heat or infection can further reveal the immunomodulatory and antioxidant potential of this plant. Finally, economic evaluation of the use of mesquite on a commercial scale also seems necessary to accelerate the operational use of this plant in the poultry industry.

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STATEMENT OF ETHICS

All the experimental procedures and animal manipulations were approved by the ethical committee of Ra.C., Islamic Azad University, Rasht, Iran (Approval No: IR.IAU.RASHT.REC.1402.017).

CONFLICT OF INTERESTS

No potential conflict of interest was reported by the authors.

REFERENCES

Afshari, A., & Sayyed-Alangi, S. Z. (2017). Antioxidant effect of leaf extracts from Cressa cretica against oxidation process in soybean oil. *Food science & nutrition*, *5*(2), 324-333.

Agirman, E., Celik, I., & Dogan, A. (2022). Consumption of the Syrian mesquite plant (Prosopis farcta) fruit and seed lyophilized extracts may have both protective and toxic effects in STZ-induced diabetic rats. *Archives of Physiology and Biochemistry*, *128*(4), 887-896.

Al-Harthi, M. A., Attia, Y. A., Al-Sagan, A. A., & Elgandy, M. F. (2019). Nutrients profile, protein quality and energy value of whole prosopis pods meal as a feedstuff for poultry feeding. *Italian journal of Animal Science*, *18*(1), 30–38.

Álvarez-Fuentes, G., García-López, J. C., Pinos-Rodríguez, J. M., Aguirre-Rivera, J. R., Jasso-Pineda, Y., & Celestino-Santillán, S. G. (2012). Effects of feeding the seeds of Prosopis laevigata, Acacia schaffneri and Ceratonia siliqua on the performance of broiler chicks. *South African Journal of Animal Science*, *42*(4), 355-359.

Asadollahi, K., Abassi, N., Afshar, N., Alipour, M., & Asadollahi, P. (2010). Investigation of the effects of Prosopis farcta plant extract on rat's aorta. *J Med Plants Res*, *4*(2), 142-7.

Aziznia, H., Keramat, J., & Soleimanian Zad, S. (2019). Antioxidant properties and antimicrobial activity of Prosopis farcta root extract on foodborne bacteria. *Journal of Food Hygiene*, *9*(34).

Cardozo, M. L., Ordoñez, R. M., Zampini, I. C., Cuello, A. S., Dibenedetto, G., & Isla, M. I. (2010). Evaluation of antioxidant capacity, genotoxicity and polyphenol content of non conventional foods: Prosopis flour. *Food Research International*, *43*(5), 1505-1510.

Dashtban, H., Afzali, N., Hosseini-vashan, S. J., & Sarir, H. (2017). The effect of Prosopis farcta on the performance, some blood parameters, immune and antioxidant system of broiler chickens under heat stress conditions. *Research Journal of Livestock Science*, *30*(114), 231-246.

Delfani, N., Karimi, A., Sadeghi, A.A., Farzinpour, A. (2025). The Effects of Super-Dosing Copper Supplementation on Productive and Reproductive Performance of Breeder Quail Fed a Diet with Reduced Non-Phytate Phosphorus Level. *Iranian Journal of Applied Animal Science, 15*(2), 335-345.

Gholamalipour Alamdari, E., & Taleghani, A. (2022). New bioactive compounds characterized by liquid chromatography–mass spectrometry and gas chromatography–mass spectrometry in hydromethanol and petroleum ether extracts of Prosopis farcta (Banks & Sol.) JF Macbr weed. *Journal of Mass Spectrometry*, *57*(9), e4884.

Girma, M., Urge, M., & Animut, G. (2011). Ground Prosopis juliflora pods as feed ingredient in poultry diet: Effects on growth and carcass characteristics of broilers. *International Journal of Poultry Science*, *10*(12), 970-976.

Gulalp, B., & Karcioglu, O. (2008). The first report of Prosopis farcta ingestion in children: is it serious?. *International journal of clinical practice*, *62*(5), 829-830.

Gutiérrez, M., Biagioni, R. N., Alarcón-Herrera, M. T., & Rivas-Lucero, B. A. (2018). An overview of nitrate sources and operating processes in arid and semiarid aquifer systems. *Science of the Total Environment*, *624*, 1513-1522.

Hajinezhad, M. R., & Rasekh, M. (2019). Effect of Hydro-alcoholic Extract from Prosopis Farcta Leaves on Liver Injury Caused by High-fat Diet in Rats. West Indian Medical Journal, 68(1).

Hosseini-Vashan, S. J., Manochehri, D., Afzali, N., Yonesi, H. N. (2025). Green coffee powder: Effect on growth performance, biochemical blood indices, and intestine morphology in broiler chickens. *Iranian Journal of Applied Animal Science, 15*(2), 317-324.

Hosseintabar-Ghasemabad, B., Di Rosa, A. R., Janmohammadi, H., Slozhenkina, M. I., Gorlov, I. F., Mosolov, A. A., Seidavi, A., & Phillips, C. J. C. (2024). The potential of amaranth grain for feeding to poultry. *World's Poultry Science Journal*, *80*(2), 481-509.

Jahromi, M. A. F., Etemadfard, H., & Zebarjad, Z. (2018). Antimicrobial and antioxidant characteristics of volatile components and ethanolic fruit extract of Prosopis farcta (Bank & Soland.). *Trends in Pharmaceutical Sciences and Technologies*, *4*(3), 177-186.

Mohammad Pour Zehab, M., Shariati-Sharifi, F., Jamshidian, A., & Hajinezhad, M. R. (2018). The effect of Syrian mesquite (Prosopis farcta) seed extract on thioacetamide-induced oxidative stress in rats. *Feyz Medical Sciences Journal*, *22*(1), 25-30.

Namiki, M. (1990). Antioxidants/antimutagens in food. *Critical Reviews in Food Science & Nutrition*, *29*(4), 273-300.

Omidi, A., Ansari nik, H., & Ghazaghi, M. (2013). Prosopis farcta beans increase HDL cholesterol and decrease LDL cholesterol in ostriches (Struthio camelus). Tropical animal health and production, 45(2), 431-434.

Ranjbar Heidari, A., Khayyat-Zadeh, J., & Keshtahgar, M. (2012). Study of root aqueous extract of Prosopis farcta effect on wound healing of diabetic adult male rats. *Journal of Translational Medical Research*, *19*(3), 245-254.

Ruiz-Nieto, J. E., Hernández-Ruiz, J., Hernández-Marín, J., Mendoza-Carrillo, J., Abraham-Juárez, M., Isiordia-Lachica, P. M., & Mireles-Arriaga, A. I. (2020). Mesquite (Prosopis spp.) tree as a feed resource for animal growth. *Agroforestry Systems*, *94*(4), 1139-1149.

Saad, B., Azaizeh, H., & Said, O. (2005). Tradition and perspectives of Arab herbal medicine: a review. *Evidence-based Complementary and Alternative Medicine*, *2*(4), 475-479.

Safari, A., Sharifzadeh, M., & Hassanzadeh, G. (2021). The protective effect of a standardized hydroalcoholic extract of Prosopis farcta (Banks & Sol.) JF Macbr. fruit in a rat model for experimental ulcerative colitis. *Tradit Med Res*, *6*(5), 40.

Sateri, S., Seidavi, A. R., Bouyeh, M., Neumann, P., Kutzler, M., Laudadio, V., Loperfido, F. and Tufarelli, V. 2017. Effect of olive meal and supplemental enzymes on performance traits, blood biochemistry, humoral immunity response and caecal microbiota of broilers. *South African Journal of Animal Science. 47*(6): 804-812.

Seidavi, A. R., Dadashbeiki, M., Alimohammadi-Saraei, M. H., Van Den Hoven, R., Laudadio, V. and Tufarelli, V. 2017. Effects of dietary inclusion level of a mixture of probiotic cultures and enzymes on broiler chickens immunity response. *Environmental Science and Pollution Research. 24*(5): 4637-4644.

Seidavi, A., Hosseintabar-Ghasemabad, B., Gorlov, I. F., Slozhenkina, M. I., Mosolov, A. A., Oteri, M., & Liotta, L. (2023). Feed additives and future perspectives. In *Sustainable use of feed additives in livestock: novel ways for animal production* (pp. 929-961). Cham: Springer International Publishing.

Sigolo, S., Deldar, E., Seidavi, A. R., Bouyeh, M., Gallo, A. and Prandini A. 2019. Effects of dietary surpluses of methionine and lysine on growth performance, blood serum parameters, immune responses, and carcass traits of broilers. *Journal of Applied Animal Research. 47*(1): 146-153.

Stoilova, I., Krastanov, A., Stoyanova, A., Denev, P., & Gargova, S. (2007). Antioxidant activity of a ginger extract (Zingiber officinale). *Food chemistry*, *102*(3), 764-770.

Tajbakhsh, S., Barmak, A., Vakhshiteh, F., & Gharibi, M. (2015). Invitro antibacterial activity of the Prosopis juliflora seed pods on some common pathogens. *Journal of clinical and diagnostic research: JCDR*, *9*(8), DC13.

Varmaghany, S., Jafari, H., & Maghsoudinejad, G. (2016). The effects of prosopis farcta as medicinal plant on growth performance, carcass characteristics and blood metabolites in broiler chickens. *Animal Sciences Journal*, *29*(110), 31-44.

WPSA (World's Poultry Science Association). (1986). European Table of Energy Values for Poultry Feedstuffs. 1st ed. Subcommittee Energy of the Working Group no. 2 Nutrition of the European Federation of Branches of the WPSA. The Netherlands: Wageningen.

Yousefi, M., Adineh, H., Al Sulivany, B. S., Gholamalipour Alamdari, E., Yilmaz, S., Mahboub, H. H., & Hoseini, S. M. (2025). The potential of the inclusion of Prosopis farcta extract in the diet on the growth performance, immunity, digestive enzyme activity, and oxidative status of the common carp, Cyprinus carpio, in response to Ammonia stress. *Animals*, *15*(6), 895.