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Effect of Addition of Milk Thistle Seed Powder on the Productive, Biochemical, and Liver Enzyme Characteristics of Broiler Chicken

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Abstract | The study aimed to determine the effect of adding different levels of milk thistle seed powder as a dietary supplement on the productive and biochemical characteristics of broiler chickens. For this purpose, a total of 180 Ross 308 chickens were randomly distributed into 12 cages with 4 experimental treatments. Each treatment consisted of a total of 45 birds in replicates (15 birds per replicate). The results of the experiment showed a significant difference ($p \leq 0.05$) in live body weight, total weight gain, and cumulative conversion coefficient in the 5 g, 10 g, and 15 g treatments in a dose-dependent manner compared to the control treatment. The results also showed better productive performance in the 5 g, 10 g, and 15 g treatments compared to the control treatment. In addition, the addition of milk thistle seed powder showed a significant ($p \leq 0.05$) superiority in total protein, albumin, globulin, and ALT concentrations compared to the control treatment. We conclude that the addition of milk thistle seed powder to feed in cumulative amounts (5, 10, and 15 g/kg of feed) improved production traits (live body weight, weight gain, feed intake, feed conversion ratio, and production index) and biochemical traits. These results highlight that the addition of milk thistle seed powder as a feed additive can improve the productive performance of animals.

Keywords | Milk thistle seeds, Broiler chickens, Productive and biochemical traits, Ross 308

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INTRODUCTION

In recent years, restrictions and bans on the use of antibiotics in the poultry industry have led to the expanded use of antioxidants and growth-promoting compounds, as medicinal plants and their derivatives containing antimicrobial compounds, antioxidants, and growth promoters have been replaced by antibiotics in poultry feed (Roy and Ruiz, 2024; Brenes and Roura, 2010; Al-Jebory *et al.*, 2024; Ajafar *et al.*, 2024a, b). Medicinal plants, herbs, and herbal preparations contain biologically active components such as essential oils, tannins, glycosides, flavonoids, terpenes, gums, and organic acids (Ailli *et al.*, 2023). In addition, they promote the secretion of digestive enzymes, which increases the appetite of domestic birds. They are also beneficial and have no undesirable side effects on animal production (Nazari *et al.*, 2024).

One such plant is milk thistle, a beneficial medicinal plant belonging to the Asteraceae family (Samee *et al.*, 2023). It is widely used in poultry feed (Stastnik *et al.*, 2020). Milk thistle contains proteins, sugars, amines, saponins, and mucilage, as well as compounds such as histamine, cholesterol, and certain vitamins (A, K, B12, C, and E) (Wizard, 2004). Milk thistle seeds contain 20-30% protein and many essential amino acids, as well as essential fatty acids, predominantly oleic and linoleic acids (Marceddu *et al*., 2022). The main biologically active component of milk thistle seeds is silymarin, which consists of flavonolignan compounds comprising silibinin, isosilibinin, silidenin, and silicristin (Ranjan and Gautam, 2023). Silymarin has antioxidant, anti-inflammatory, and antiviral properties and reduces cholesterol and blood lipids (Bahmani *et al*., 2015).

Tavakolinasab *et al*. (2020) have pointed to the possibility of using herbs and plants in various forms (fresh, dried, ground, soaked, syrup, extract, or essential oils). Milk thistle contains many medically active compounds that are concentrated in the seeds and then the leaves (Bahmani *et al*., 2015). The results of studies on the use of milk thistle seeds varied. In a study conducted by Šťastník *et al*. (2016), the experiment was divided into three groups: the first group was a control group without any additives; the second group used milk thistle seeds at a rate of 5%/kg of feed; and the third group used milk thistle seeds at a rate of 10%/kg of feed. The results showed a significant superiority of the first group over the other groups in terms of live body weight and weight gain. Meanwhile, Bendowski *et al*. (2022) have conducted an experiment feeding broiler chickens milk thistle seed extract administered through drinking water to study its effect on the productive traits of broiler chickens. The first, second, and third treatments were at ratios of C=0, SM1=0.24, and SM2=0.36 g/day/chickens), with 102 chicks allocated and the experiment lasting 42 days. The researchers found a significant difference in live body weight and weekly weight gain for groups SM1 and SM2 compared to group C. A significant difference was also observed in fat percentage, which was highest in group C and lowest in group SM2.

In a study conducted by Al-Nasrawi *et al*. (2025) where chicken were fed with alcoholic extract of Silybum marianum leaves in drinking water at concentrations of 05.%, 1%, 2% and 3%.The results of the experiment showed a significant increase ($p \leq 0.05$) in the level of glutathione and catalase enzyme concentration in treated compared control group. Additionally, treatments recorded a significant decrease in the level of malondialdehyde (MDA) compared to the control treatment. The results also showed a significant decrease in the concentration of ALT and AST enzymes in treated compared to the control bird groups. These finding highlight the use of Silybum marianum leaves as feed-adative in poultry.

This study aimed to determine the effect of adding different levels of milk thistle seed powder in feed on the productive and biochemical traits of broiler chickens. Additionally, we aim to determine the best levels that achieve the highest positive results for the productivity in poultry.

MATERIALS AND METHODS

This study was conducted at the Department of Animal Production, University of Karbala, Faculty of Agriculture, from November 1, 2024, to December 5, 2024. One hundred and eighty Ross 308 broiler chicks, one day old and not hybridized, were used. The chicks were randomly distributed into 12 cages, with 45 birds per cage, and each treatment included three replicates, with 15 birds per replicate. Feed was provided to the birds *ad libitum* based on Ross blocks, with starter feed provided from 1 to 21 days of age and grower feed from 22 to 35 days of age, as shown in Table 1. The experimental treatments were as follows: First treatment: Control group without any additives. Second treatment: Addition of 5 g of milk thistle seed powder/kg of feed. Third treatment: addition of 10 g of milk thistle seed powder/kg of feed. Fourth treatment: addition of 15 g of milk thistle seed powder/kg of feed. Milk thistle seed powder was prepared after collecting the

Table 1: Percentages of feed components used in the experiment and their chemical composition.

Ingredient	Starter %	Grower %
Corn	38.50	41.15
Soybean meal	44.36	40.11
Wheat	10	10
Concentrate	2.5	2.5
Di Calcium phosphate	0.04	0.0
Calcium carbonate	1.26	1.07
Sunflower oil	2.29	3.15
Sodium chloride	0.17	0.17
Vitamin and mineral supplement	0.5	0.5
DL-Methionine (99%)	0.21	1.2
L-Lysine (99%)	0.09	0.1
Therionin	0.08	0.05
Total	100	100
The calculated chemical analysis	The calculated chemical analysis	The calculated chemical analysis
Me(kcal/Kg)	3000	3.100
C. protein	23	21.5
Ca	0.96	0.78
P	0.58	0.56
Na	0.16	0.16
Dig. Lysine	1.44	1.29
Dig. Methionine	0.77	0.70
Dig. Threonine	0.97	0.88
Dig. Met + Cys	1.08	0.99
DCAB	236.23	220.74
C.F%	89.51	89.56
Fat %	3.10	3.08
Linoleic acid %	1.02	1.09

seeds from the plant, grinding them with an electric grinder, and storing them in glass containers until use. During the 35-day experiment, production traits were measured weekly, including live weight, weight gain, feed consumption, feed conversion ratio, mortality rate, productivity index) based on the method (Aviagen, 2025; Cobb-Vantress, 2022), while some biochemical traits (total protein, albumin, ceruloplasmin, AST, and ALT) were analyzed at the end of the experiment based on the method (Shakeri *et al*., 2023; Stojanović *et al*., 2024). A completely randomized design (CRD) was used to study the effect of different treatments on the studied traits, and the differences between the means were compared using Duncan's multiple range test (Duncan, 1955), and the SAS statistical software (SAS, 2018) was used to analyze the data.

The protein concentrate was used for broilers produced by the company Provime/ Dutch. Represented energy, crude protein, crude fiber, fat, lysine, methionine + cysteine, calcium and biophosphorus were calculated for each feed material according to the catalog of ROSS broiler 2022 using American UFFDA program. *The chemical analysis of the diet was calculated on the basis of Ross catalog and UFFD program (Aviagen, 2022).

The productive traits of the flocks were measured weekly according to the technical guidelines issued by Aviagen in both the Aviagen (2025) and Ross Performance Objectives and Management Recommendations. The traits studied included: body weight, weight gain, feed consumption, feed conversion ratio, mortality rate, and production efficiency factor (PEF). The following were applied:

Body weight (BW): Body weight was measured weekly using where birds were randomly selected from three spatial areas within each house (front, middle, and rear) to ensure adequate representation of the flock. Birds were weighed collectively using a calibrated digital scale, and individual body weight was calculated by dividing the total weight of the sample by the number of birds weighed. In addition, the coefficient of variation (CV%) for body weight was calculated to assess uniformity within the flock, in accordance with Ross guidelines.

Weight gain: Weekly weight gain was calculated as follows:

$$WG = BWend - BW\ start$$

Feed intake (FI): Feed intake was recorded weekly for each experimental group using the following formula:

$$FI = feed\ offered - feed\ refusals$$

Feed offered and feed residues were recorded daily, and weekly totals were used to calculate cumulative feed intake for the entire experimental period.

Feed Conversion Ratio (FCR): FCR was calculated following the Aviagen recommended equation:

$$FCR = (total\ feed\ consumed)/(total\ body\ weight\ gain)$$

FCR was calculated based on total live weight gain, excluding weight losses due to mortality, because FCR reflects the efficiency of feed utilization by the surviving birds.

Production Efficiency Factor (PEF): The PEF was calculated using the internationally adopted Ross formula:

$$BEF = (final\ body\ weight\ (kg) * livability\ (\%))/(FCR * age(days)) * 100$$

Biochemical parameters were analyzed using serum samples collected from the brachial vein. Blood samples were allowed to clot at room temperature and centrifuged at 3000 rpm for 10 minutes to obtain clear serum. All biochemical traits were quantified using commercial diagnostic kits based on standard spectrophotometric enzymatic methods, following procedures commonly applied in recent poultry physiology studies.

The following biochemical traits were measured:

Total protein (g/100 mL): Serum total protein was determined using the Biuret colorimetric method, in which proteins react with cupric ions in an alkaline medium to form a violet-colored complex. The absorbance was measured spectrophotometrically at 546 nm, and total protein concentration was calculated according to the manufacturer's standard curve.

Albumin (g/100 mL): Albumin concentration was measured using the Bromocresol Green (BCG) dye-binding method. Albumin forms a green-colored complex with BCG at acidic pH, and absorbance was read at 630 nm. This method is widely recognized for its accuracy in poultry serum analysis.

Globulin (g/100 mL): Globulin concentration was calculated indirectly using the following formula:

$$Globulin = Total\ protein - Albumin$$

This calculation method is standard for avian biochemical profiling.

Alanine Aminotransferase (ALT, U/L): ALT activity was determined using kinetic UV enzymatic assays, which measure the rate of oxidation of NADH at 340 nm during the transamination reaction. Enzyme activity was expressed as units per liter (U/L), based on changes in absorbance over time.

Aspartate Aminotransferase (AST, U/L): AST activity was measured using the same kinetic UV spectrophotometric method employed for ALT. The reduction in absorbance at 340 nm resulting from NADH oxidation was used to calculate enzyme activity according to the kit manufacturer's protocol.

RESULTS

The effect of addition of different levels of milk thistle seed powder in feed on the productive performance of broiler chickens

Live body weight (g)

As shown in Table 2, the results highlight the statistical analysis of the effect of adding different levels of milk thistle seeds in feed on the live body weight of Ross 308 broiler chickens during the 5-week experiment. In the first week, there was a significant difference (P≤0.05) in the live body weight of control birds compared to birds treated with 5 g of milk thistle/kg feed, while there were no statistically significant differences between the 5 g and 15 g treatments on the one hand and the control and 10 g treatments on the other. In the second and third weeks of the experiment, we observed a significant advantage (P≤0.05) in the group treated with 10 grams of milk thistle seeds compared to the groups treated with 5 or 15 grams of milk thistle seeds. However, there were no statistically significant differences between the 15 g treatment and all other treated groups. In the fourth week, we observed continued superiority of the 5 g group compared to the control group, while there were no statistically significant differences between the 10 g and 15 g groups and all other treated groups. In the fifth week, we also observed a significant superiority of the second, third, and fourth treatments compared to the first treatment (the control group).

Weekly weight gain (g)

Table 3 shows the results of the statistical analysis of the effect of adding different levels of milk thistle seeds to the feed on the weight gain of broiler chickens during the 5-week experiment, indicating a significant difference (P≤0.05) in the average weight gain of the control group compared to the 10 g group. However, there were no statistically significant differences between the 5 g and 15 g groups on the one hand and the control and 10 g groups on the other. In the second and third weeks, the results of the experiment showed that the 5 g treatment was significantly superior (P≤0.05) in terms of average weight gain compared to the control group, which recorded

Table 2: Effect of adding different levels of milk thistle seed powder to feed on the live body weight (g) of broiler chickens (arithmetic mean ± standard error).

Group	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means
Group	**Body weight (g) First week**	**Body weight (g) Second week**	**Body weight (g) Week 3**	**Body weight (g) Week 4**	**Body weight (g) Week 5**
First treatment	127.00 ± 2.00 a	26017 ± 8.16 b	62833. ± 0.83b	1172.33 ± 4.66b	1880.00 ± 10.00b
Second treatment	125.00 ± 2.00 ab	29433. ± 6.33 a	732.17 ± 22.83a	1278.67 ± 21.33a	2053.33 ± 21.66a
Third treatment	117.83 ±1.66 b	266.00 ±683.b	65383. ±16.16b	1227.33 ±5.66ab	2083.33 ±41.66a
Fourth treatment	123.00±3.00 ab	277.33 ±8.83ab	648.67 ±12.16b	1228.00 ±32.00ab	2066.67 ±33.33a
Moral level	*	*	*	*	*

* Averages with different letters within the same column indicate significant differences (P ≥ 0.05). NS: Not significant

Table 3: Effect of adding different levels of milk thistle seed powder to feed on the weight gain (g) of broiler chickens (arithmetic mean ± standard error).

Group	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means
Group	**Weight gain (g) First week**	**Weight gain (g) Second week**	**Weight gain (g) Third week**	**Weight gain (g) Week 4**	**Weight gain (g) Week 5**	**Total weight gain (g)**
First treatment	90.00 a	133.17 ± 10.16b	368.17 ± 7.33b	549.00 ± 5.50	702.67 ± 14.66b	1843.00 ± 10.00c
Second treatment	88.00 ± 2.00ab	169.33 ± 8.33 a	437.83 ± 29.16a	546.50 ± 1.50	774.67 ± 0.33a	2016.33 ± 21.66b
Third treatment	80.83 ±1.66b	14817. ±8.66ab	387.83 ±23.16ab	573.50 ±10.50	856.00 ±36.00a	2046.33 ±41.66a
Fourth treatment	86.00 ±3.00ab	154.33 ±5.83ab	37133. ±3.33b	579.00 ±19.83	772.00 ±32.00a	1963.00 ±0.00b
Moral level	*	*	*	NS	*	*

* Averages with different letters within the same column indicate significant differences (P ≥ 0.05). NS: Not significant.

Table 4: Effect of adding different levels of milk thistle seed powder to feed on feed consumption (g) in broiler chickens (mean ± standard error).

Group	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means
Group	Feed consumption (g) First week	Feed consumption (g) Second week	Feed consumption (g) Week 3	Feed consumption (g) Week 4	Feed consumption (g) Week 5	Total feed consumption (g)
First treatment	143.66a	205.33	471.00 ± 11.00	800.00 ± 0.00a	1080.83 ± 2.83a	2700.83 ± 21.83
Second treatment	140.33 ± 034b	208.50 ± 1.50	483.83 ± 13.83	783.33 ± 1.66b	1090.00 ± 10.00a	2706.00 ± 1.00
Third treatment	131.66 ±1.66d	213.00 ±16.00	453.17 ±13.16	793.33 ±6.66ab	1116.67 ±58.33a	2707.83 ±34.16
Fourth treatment	136.66 ±064c	215.33 ±734	472.17 ±12.16	786.66 ±6.66ab	1037.67 ±68.83b	2648.50 ±57.00
Significance level	*	NS	NS	*	*	NS

* Averages with different letters within the same column indicate significant differences (P ≥ 0.05). NS: Not significant.

Table 5: Effect of adding different levels of milk thistle seed powder to feed on the feed conversion ratio (g feed/g weight gain/bird) for broiler chickens (arithmetic mean ± standard error).

Group	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means	S.E ± Means
Group	Feed conversion ratio (g) First week	Feed conversion ratio (g) Second week	Feed conversion ratio (g) Week 3	Food conversion ratio (g) Week 4	Food conversion coefficient (g) Week 5	Total Food Conversion Factor (g)
First treatment	1.598 ± 0.04	1.551 ± 0.05a	1.281 ± 0.05	1.457 ± 0.01a	1.539 ± 0.02a	1.465± 0.004a
Second treatment	1.597 ± 0.04	1.237 ± 0.06b	1.120 ± 0.11	1.433 ± 0.007ab	1.406 ± 0.01b	1.342 ± 0.01b
Third treatment	1.631 ± 0.05	1.434 ±0.02ab	1.182 ±0.11	1.384 ±0.007ab	1.303 ±0.01c	1.323 ±0.01b
Fourth treatment	1.592 ±0.05	1.403 ±0.02ab	1.271 ±0.11	1.360 ±0.03b	1.341 ±0.03bc	1.349 ±0.02b
Significance level	NS	*	NS	*	*	*

* Averages with different letters within the same column indicate significant differences (P ≥ 0.05). NS: Not significant.

the lowest weight gain and did not differ significantly from the 10 g and 15 g treatments. In the fourth week, there were no statistically significant differences between all treatments in the experiment, while we observed a significant superiority of birds in the 5 g, 10 g, and 15 g treatments compared to the control treatment for the fifth week. As for total weight gain, we observed a significant superiority of the 10 g treatment compared to the 5 g and 15 g treatments, which were significantly superior to the control treatment.

Weekly feed consumption rate (g)

As shown in Table 4, the results of the statistical analysis of the effect of adding different levels of milk thistle seeds to the feed on the weekly feed consumption rate of broiler chickens during the 5 weeks of the experiment showed statistically significant differences (P≤0.05). In the first week, the control treatment recorded the highest feed consumption rate compared to the 5 g treatment, while the 10 g and 15 g treatments recorded lower feed consumption compared to the control and 5 g treatments. In the second and third weeks, we did not observe any statistically significant differences between all treatment groups. In the fourth week, we observed that the birds in the control treatment had the highest feed consumption (P≤0.05) compared to the birds in the 5 g treatment, which had the lowest feed consumption, which in turn did not differ significantly from the birds in the 10 g and 15 g treatments. In the fifth week, we observed that birds in the control treatment and the 5 g and 10 g treatments recorded the highest feed consumption rate (P≤0.05) compared to birds in the 15 g treatment, which recorded the lowest feed consumption rate. As for total feed consumption, we did not observe any statistically significant differences between all treatments.

Feed conversion ratio (g feed/g weight gain/broiler chicken)

Table 5 shows the results of the statistical analysis of the effect of adding different levels of milk thistle seeds to the feed on the feed conversion ratio of broiler chickens during the 5 weeks of the experiment. No statistically significant differences were observed between all treatments during the first week of the experiment. In the second week, birds in the 5 g treatment recorded the best feed conversion ratio, with a significant difference (P≤0.05) from the control treatment, which in turn did not differ significantly from the birds in the 10 g and 15 g treatments. We also observed no statistically significant differences between all treatments during the third week of the experiment, while in the fourth week, we observed from the results of the experiment that the 15 g treatment recorded the best feed conversion ratio with a statistically significant difference (P≤0.05) compared to the control treatment, which in turn did not differ significantly from the 5 g and 10 g treatments. In the fifth week, we observed that the 5 g and

10 g treatments recorded the best feed conversion ratio, followed by the 15 g treatment, with a significant difference from the control treatment. As for the cumulative feed conversion ratio, we observed that birds in the 5 g and 10 g treatments recorded the best cumulative feed conversion ratio, with a significant difference ($P \leq 0.05$) from the control treatment.

Production index

Figure 1 shows the effect of adding different levels of milk thistle seed powder to feed on the production index of broiler chickens during the 5 weeks of the experiment, where the treatments of 5 g, 10 g, and 15 g recorded the highest production index with a statistically significant difference ($P \leq 0.05$) compared to the control treatment, which recorded the lowest production index.

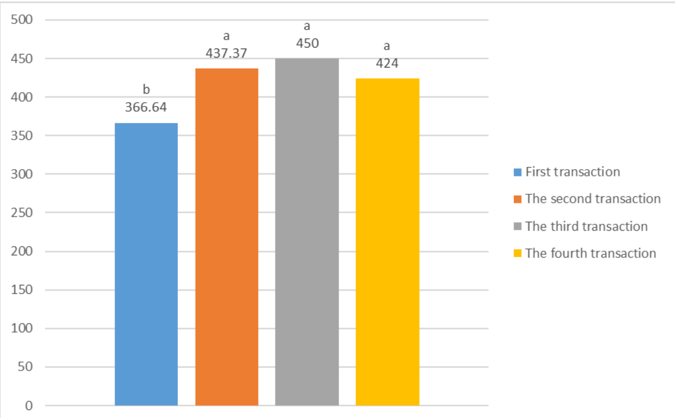

Figure 1: The production index for broiler chickens.

The effect of adding different levels of milk thistle seed powder to feed on certain biochemical characteristics and liver enzymes in broiler chickens

Table 6 shows the effect of adding different levels of milk thistle seed powder to feed on some biochemical traits and liver enzymes in the blood serum of 5-week-old broiler chickens. The results of statistical analysis showed that total protein concentration (g/100 ml) and albumin concentration (g/100 ml) improved significantly ($P \leq 0.05$). with the 15 g treatment recording the highest total protein concentration, followed by the 5 g and 10 g treatments, compared to the control treatment, which recorded the lowest concentration. As for globulin concentration, we note that the 10 g and 15 g treatments continued to outperform the 5 g treatment, which in turn outperformed the control treatment, which recorded the lowest globulin concentration. The control treatment recorded the highest concentration of ALT enzyme, with a statistically significant difference ($P \leq 0.05$) from the 5 g, 10 g, and 15 g treatments, which recorded the lowest concentration. As for the AST enzyme concentration, the results of the statistical analysis showed no statistically significant differences between all treatments in the experiment.

DISCUSSION

The improvement in certain biochemical characteristics (total protein, albumin, and globulin) and productive characteristics (live body weight) in milk thistle seed powder treatments (5 g, 10 g, 15 g) compared to the control treatment to the fact that milk thistle seeds contain the active ingredient silymarin. This is considered to be a powerful natural antioxidant with high efficacy that protects the body from free radical damage. In addition, silymarin increases the digestibility of nutrients by increasing the activity of digestive enzymes and increasing their absorption through the digestive tract into the bloodstream (Sultan *et al*., 2018; Salman *et al*., 2024). According to the close relationship between live body weight and weight gain, the significant improvement in the total weight gain rate in the 5 g, 10 g, and 15 g treatments is due to the improvement in body weight as a result of the effect of adding milk thistle seed powder to the feed, which had a clear effect on improving the total weight gain of the experimental birds, leading to good growth and sound structural development. As for the significant improvement ($0.05 \geq P$) in the milk thistle seed powder treatments (5 g, 10 g, 15 g) in terms of feed conversion ratio, which is an important indicator of the amount of feed used and its conversion to live weight in broiler chickens, any decrease in this value is evidence of an improvement in feed conversion compared to the first treatment, which can be attributed to the presence of active compounds in milk thistle seeds in addition to the chemical

Table 6:

Treatments	Total protein gm/100ml	Albumin gm/100ml	Globulin gm/100ml	Concentration of ALT Unit/liter	Concentration of AST Unit/liter
Second treatment	3.01±0.10 b	2.40±0.01 b	1.09±0.04 c	29.70±1.15 a	21.20±0.10
Third treatment	4.01±0.09 a	2.65±0.03 a	1.88±0.10 b	21.99±2.17 b	21.01±0.15
Fourth treatment	4.15±0.15 a	2.55±0.06 a	1.80±0.20 a	18.95±0.20 b	21.10±0.14
Significance level	4.95±0.25 a	2.65±0.05 a	2.25±0.05 a	18.96±0.25 b	19.95±0.33
Significant level	*	*	*	*	N.S

* Averages with different letters within the same column indicate significant differences ($P \geq 0.05$). NS: Not significant.

composition of the seeds, which are rich in essential fatty acids such as linoleic acid, oleic acid, and palmitic acid (Majidi *et al*., 2021). This maintains the health and integrity of the digestive system. Plants and herbs used as additives in animal feed or drinking water have been found to increase digestive secretions and maintain digestive health because they contain biologically active components, the most important of which are antioxidants and antimicrobials, which improve growth rates and weight gain, helping to maximize the benefit of the feed consumed and thus improving feed conversion (Rawash *et al*., 2024). The improvement in production performance is positively reflected in the production index, which is an important indicator in evaluating the production performance of broiler chickens (Salman *et al*., 2025). The addition of milk thistle seed powder to feed (5 g, 10 g, 15 g) increased live body weight and vitality, as well as improving feed conversion ratio in the treatments (5 g, 10 g, 15 g), as the productivity index is directly proportional to live body weight and vitality (Alsudani *et al*., 2025; Arkan *et al*., 2025).

CONCLUSION

Adding milk thistle seed powder to broiler feed significantly improved the production traits (live body weight, weight gain, feed consumption, feed conversion ratio, production index) and some blood biochemical traits. The best results were achieved by adding milk thistle seed powder at concentrations of 10 and 15 g/kg feed. Therefore, inclusion of milk thistle seed powder in the poultry feed would be improving performance and productivity.

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NOVELTY STATEMENT

This study provides new insights into the use of milk thistle (Silybum marianum) seed powder as a natural feed additive in broiler nutrition. The research highlights its potential role in improving productive performance, enhancing key biochemical parameters, and modulating liver enzyme activity in broiler chickens. The findings offer a promising alternative approach for supporting poultry health and performance through natural phytogenic sources.

AUTHOR'S CONTRIBUTION

SMG: Designed the experimental work, supervised the animal trial, and contributed to data interpretation and manuscript writing. SA-N: Performed laboratory biochemical analyses, statistical evaluations, and participated in manuscript drafting and revision. AHS: Conducted sample collection, managed animal performance records, and assisted in literature review and manuscript preparation. All authors have read and approved the final version of the manuscript.

Generative AI and AI-assisted technology statement

The authors declare that no Genrative AI was used in the creation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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