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The role of Moringa oleifera powder in improving the productive performance and physiological condition of Japanese quail

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Abstract

The study aimed to determine the effect of adding moringa seed powder to Japanese quail diets on productive performance and carcass characteristics. Seventy-two-day-old unsexed chicks from the College of Agriculture and Forestry/Department of Animal Production were used and reared on land in the first week, and the experiment continued for 42 days until sexual maturity. The birds were divided into three treatments with three replicates: a control treatment and two treatments fed with 2 g and 3 g of moringa seeds, respectively. The results showed that there were no significant differences in the initial body weight, and a significant increase in the body weight and rate of weight gain in the second treatment compared to the other treatments, with a significant decrease in the amount of feed consumed and a significant improvement in the feed conversion ratio in the third and sixth weeks when 2 gm moringa was added. There were no significant differences in the relative weight of the carcasses, the carcass weight and dressing percentage, and the relative weight of the heart, liver, and gizzard. As for hematology, a significant increase in the number of red blood cells and the volume of packed cells was observed in the third treatment compared to the other treatments, and there were no significant differences in hemoglobin concentration, with significant differences in some red cell indicators.

Keywords: Japanese quail, Moringa, Body weight, Feed intake.

Introduction

Poultry is an important source of low-cost animal protein. However, its sustainability is threatened by rising feed costs, as feed usually constitutes about 60-70% of production costs, and the largest part of it is protein, such as soybean meal and fishmeal (1). The focus on corn and soybeans is linked to forests and price fluctuations (2). While the European Union has banned antibiotics that are considered growth promoters, other countries such as China and India have restricted them due to microbial resistance (3). This prompted breeders to search for natural alternatives (4). Moringa has emerged as an alternative due to its drought resistance and suitability for food security and poverty alleviation, and its cultivation has been recommended in drought-prone areas (5). Therefore, researchers focused on improving poultry production performance, especially during the summer, due to the negative impact on production performance (6). The quail is distinguished by its high feed conversion efficiency, low space requirements, and rapid reproduction rate among birds (7). It also reaches physiological maturity early, around 40-45, and is considered one of the fastest maturing domestic birds (8). As the world moves towards reducing the use of antimicrobial growth promoters, interest has increased in adding plant-based

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feedstuffs, including moringa, whose leaf extracts have been studied in recent research as an alternative to these promoters (9). Recent studies have focused on using a sustainable, natural feed alternative in poultry diets that is both highly nutritious and affordable (10). Due to the rising cost of traditional feeds, the use of the Moringa plant has become prominent, as it is one of the most important medicinal and nutritional plants that has garnered significant attention in recent years because of its high nutritional value and diverse therapeutic properties. With the miracle tree (11). Its leaves, seeds, and flowers contain nutrients. It contains protein and fats, mostly unsaturated fatty acids, primarily oleic acid, in addition to many bioactive compounds such as flavonoids. And phenols (12). The use of moringa seeds as a protein substitute has been noted by researchers (13).

It improved growth and intestinal health in chickens, and another study indicated that adding moringa seeds at a rate of 5-10% to the feed gave positive results, while productive performance declined when the percentage exceeded 10% (14). The seed cake remaining after oil extraction is considered part of the Moringa seeds, one of the most important tropical plants (15). Its high nutritional value means it contains a high percentage of proteins, including essential amino acids, vitamins, and minerals such as iron and calcium, as well as some antioxidants (16). These compositions make it an ideal ingredient for improving the nutritional value of poultry feed and contribute to enhancing overall health and productivity. Moringa seeds are considered one of the most important parts, distinguished by their unique benefits (17). Moringa seeds are considered a nutritional supplement in poultry feed as they promote digestive health and reduce the negative effects of oxidative stress resulting from environmental conditions (18). It was found that birds fed on diets containing moringa were more resistant to poisoning due to the natural antioxidant compounds in moringa seeds (19). Several studies have shown that moringa seeds improve growth rates in poultry because the amino acids and proteins they contain contribute to tissue building and weight gain, and the vitamins and minerals play a role in improving basic bodily functions (20). Therefore, using moringa seeds represents an innovative solution to enhance support for the poultry industry in a natural, economically valuable, and sustainable way (21).

Therefore, this study aimed to determine the effect of adding moringa seed powder to the diet of Japanese quail on the productive performance and carcass characteristics.

Materials and working methods

This study was conducted at the poultry farm of the Animal Production Department, College of Agriculture and Forestry, University of Mosul, with the aim of using Moringa seeds to improve the productive and physiological performance of quail. The study period was from one day old until sexual maturity at 42 days. Two hundred and forty one-day-old, unsexed desert quail chicks were used, obtained from the Animal Production Department, College of Agriculture and Forestry. The chicks were reared on the floor during the first week of life and fed collectively until the second week, at which point they were distributed into cages. Fourteen days of age was considered the starting age for the treatment. The birds were divided into three treatments: the first was the control (**T1**), while the second (**T2**) and third (**T3**) treatments were fed 2 grams and 3 grams of Moringa seeds, respectively. The birds were reared in a semi-open hall in locally made wooden cages. The cages were sterilized before use by washing them with ordinary water and disinfecting them with a 4% iodine solution. They were then exposed to sunlight to eliminate any residue from the previous feeding. Electric lamps were provided inside the hall, some suspended from the ceiling and others from the walls, to ensure all birds received equal illumination. Electric heaters were also provided, and mercury thermometers were used to measure the room temperature and adjust it according to the

birds' age. Ventilation was continuous, and feed and water were provided regularly throughout the study period. Quail are considered disease-resistant birds, so vaccinations were not administered; only vitamins were given. Moringa seeds were obtained from local markets, ground, and added to the feed. The chicks were weighed weekly using a sensitive scale±0.05. Chicks were weighed weekly in groups for each replicate due to the difficulty of numbering them at the end of each week throughout the study. Weight gain was calculated by subtracting the weight at the beginning of the week from the weight at the end of the week. Weekly feed consumption was calculated by subtracting the amount of feed remaining at the end of each week from the amount of feed provided during the week for each replicate. At the end of the study, on day 42, males and females were randomly selected from each replicate, weighed before slaughter, cleaned, and then weighed again to measure the dressing percentage using the following equation: (Prepared carcass weight + Eaten offal weight) / Live weight before slaughter×100. The carcasses were cut into main cuts, including breast and thigh, and secondary cuts, including neck, back, and wings. The relative weight of the carcass cuts was measured: Carcass weight (g) / Carcass weight×100. The ingested internal organs were weighed using a highly sensitive Chinese electronic scale.± 0.05. The organs included the heart, liver, and gizzard, and the relative weight of the heart was measured = weight of heart (g) / weight of prepared carcass (g)×100. The relative weight of the liver and gizzard was calculated in the same way. Blood samples were collected using anticoagulant tubes and anticoagulant tubes for the purpose of isolating serum for biochemical analysis. The study examined the characteristics of live body weight, weight gain, feed intake, and feed conversion ratio. At the end of the experiment (8 birds/treatment, 2 birds/replicate), the birds were slaughtered according to Islamic rites, and blood samples were collected in tubes containing an anticoagulant to measure red blood cell count, packed cell volume, and hemoglobin concentration. A completely randomized design CRD was used. one-way and used Duncan's polynomial test Duncan (22), to compare the differences using the ready-made program SAS (2009)، At a probability level of ($p.\leq 0.05$).

Results and discussion

Table 1 shows the effect of treatment with Moringa seed powder on live body weight. No significant difference was observed between the treatments in initial live body weight (14 days old). However, a higher live body weight was observed at 3 weeks of age in the second treatment compared to the third treatment, with no difference between it and the control treatment. At 6 weeks of age, the results shown in Table 1 indicate that the second treatment (2 g Moringa/kg feed) recorded the highest levels of live body weight compared to the third treatment (3 g Moringa/kg feed) and the control treatment. This indicates that the highest level of Moringa seed powder did not achieve an improvement in body weight and productive performance under the experimental conditions. This is due to moringa containing anti-nutritional factors such as tannins and phytates. When used in high concentrations, these compounds can reduce feed palatability and food intake, bind to protein and some minerals, and inhibit digestive enzymes, reducing the digestion and absorption of nutrients. As a result, the rate of weight gain and production performance decreases. High concentrations of moringa may also give an unpleasant taste or smell that reduces appetite (23). This may be attributed to the fact that higher levels of Moringa did not produce positive responses during this age group, and that the ratio (2 grams of Moringa powder) may achieve a better balance between the active nutritional and plant components. The superiority of the second treatment is also linked to the availability of adequate quantities of the active compounds found in the Moringa plant, such as protein, amino acids, minerals, phenolic compounds, and vitamins, which enhance metabolic activities

and intestinal functions, thus increasing nutrient utilization and promoting bird growth (24).

The results were consistent with those of (25), who observed that adding 2% Moringa leaf powder to the diet of Japanese quail increased live body weight at 2 weeks of age compared to the control group.

Table (1) Effect of adding moringa powder on the live body weight (g) of quail

Transactions Standards	T1	T2	T3
Initial body weight (14 days old) (g)	59.16±0.38 A	58.26±0.52 A	58.30± 0.56 A
Body weight at 3 weeks of age (g)	152.53± 1.3 A	153.40± 1.60 A	148.06±0.58 B
Body weight at 6 weeks of age (g)	217.47±1.66 B	232.00± 1.37 A	212.83±1.26B

Values represent mean ± standard error.

Different letters in one row indicate significant differences at the probability level (P ≤0.05).

Table 2 indicates a significant increase in weight gain in the second treatment compared to the third, with no significant differences between it and the control group for the first period of the study. The rate of weight gain across different age groups was also higher in the second treatment compared to the third. This may suggest that a 2g/kg feed ratio of Moringa seed powder was more effective across the different age groups under the experimental conditions. This superiority may also be attributed to the reduced feed intake and increased body weight, indicating better utilization of the nutrients in the powder (26). The improved weight gain may also be attributed to Moringa's protein, phenolic compounds, and flavonoids, which enhance feed utilization, promote gut health, and reduce oxidative stress, thus having a positive effect during the growth phase (27).

The results were consistent with those of (25), who observed that adding 2% Moringa leaf powder to the diet of Japanese quail improved weight gain at an early age, but this effect was not sustained across all age groups. The results also agreed with (28); an improvement in the rate of weight gain was observed when Moringa powder was added to the broiler chicken feed.

Table 3 indicates that adding Moringa seed powder to quail feed significantly reduced feed intake in both the second treatment (2 g Moringa) and the third treatment (3 g Moringa/kg feed) compared to the control group. A decrease in feed intake was also observed in the second treatment compared to the third treatment throughout the trial period. This is attributed to the reduced palatability of the feed due to Moringa's saponins and tannins, which impart a bitter taste. These compounds bind to proteins, reducing amino acid digestion. Furthermore, these substances irritate the digestive tract, thus decreasing nutrient absorption and consequently lowering feed intake, particularly at higher Moringa levels (29).

Table (2) The effect of adding moringa powder on the weekly weight gain rate of quail

Transactions Standards	T1	T2	T3
Average weight gain at age (1-3 weeks) (g)	93.36±1.72 Ab	95.13±1.22 A	89.76±0.64 B
Average weight gain at age (3-6 weeks) (g)	64.93±1.58 B	78.60± 2.54 A	64.76±0.74 B
Weight gain rate (age 1-6 weeks) (g)	158.30± 1.87 B	173.73±1.38 A	154.53±1.37 B

Values represent mean ± standard error.

Different letters in one row indicate significant differences at the probability level (P ≤0.05).

Table (3) The effect of adding Moringa plant powder on the weekly feed intake of quail

Transactions Standards	T1	T2	T3
Amount of feed consumed at age (3 weeks) (g)	**202.21± 1.13 A**	**186.72 ± 0.91 C**	**197.42± 1.18 B**
Amount of feed consumed at age (6 weeks) (g)	**336.67±0.94 A**	**317.51± 1.16 C**	**321.47±0.78 B**
Amount of feed consumed at age (1-6 weeks) (g)	**539.11± 0.60 A**	**505.19± 0.98 C**	**533.85± 1.49 B**

Values represent mean ± standard error.

Different letters in one row indicate significant differences at the probability level (P ≤0.05).

The results of the statistical analysis shown in Table 4 indicate a significant improvement in feed conversion ratios at weeks 3 and 6, and throughout the entire period, with the addition of 2 g of Moringa (T2) compared to T3 (3 g Moringa/kg feed) and the control group. This improvement in feed conversion ratio may be attributed to increased nutrient utilization resulting from enhanced protein and energy digestion and absorption. This, in turn, improves gut microbiota balance and reduces oxidative stress, leading to greater conversion of feed into weight gain. Consequently, the amount of feed required to produce one unit of weight decreases compared to the control group. Furthermore, the added amount provides a digestive stimulant effect without significantly increasing tannins and fiber, which can impair feed digestibility (26). The results of the current study are consistent with those of (28) and other studies. (30) noted a significant improvement in feed conversion ratio when Moringa powder was added to the broiler chicken diet.

Table 5 shows that adding Morinka powder to the diet of Japanese quail resulted in a significant increase in red blood cell (RBC) count in birds in treatment 3 compared to treatment 2 and the control group. It also showed an increase in packed cell volume (PCV) and mean corpuscular volume (MCV) in treatment 3 compared to treatment 2 and the control group. However, no significant differences were observed between the treatments in hemoglobin concentration. A decrease in mean corpuscular hemoglobin was observed in treatment 3 compared to the control group, but no significant difference was found between T3 and T2. Conversely, a decrease in mean corpuscular hemoglobin was observed in T3 (3 g Moringa powder/kg feed) compared to T2 (2 g Moringa powder/kg feed) and the control group.

The increased red blood cell count may be attributed to the presence of minerals in moringa, including iron, calcium, zinc, and phosphorus, as well as certain vitamins such as E, C, and B, and some active antioxidant compounds that reduced the damage caused by free radicals (31). Our current results are consistent with the results (9) stating that the addition of Moringa increases the number of red blood cells, as it is possible that the Moringa plant, being a functional plant component, can support and enhance the physiological and health status of birds. It also indicates that the response of blood parameters may vary depending on the type of bird, the plant part used, and the experimental conditions.

Table (4) Effect of adding Moringa plant powder on the weekly feed conversion ratio of quail

Transactions Standards	T1	T2	T3
Feed conversion ratio at 3 weeks of age (g)	2.16±0.04 A	1.96±0.02 B	2.19±0.01 A
Feed conversion ratio at age (6 weeks) (g)	5.19±0.11 A	4.04±0.14 B	4.96±0.06 A
Feed conversion ratio at age (1-6 weeks) (g)	3.40±0.04 A	2.90±0.01 B	3.45±0.03 A

Values represent mean ± standard error.
Different letters in one row indicate significant differences at the probability level (P ≤0.05).

Table (5) Effect of adding Moringa plant powder on the blood profile of 35-day-old quail

Transactions Standards	T1	T2	T3
Red blood cell count	2.05±0.02 b	1.93±0.02b	2.88±0.05 A
Size of packed blood cells	29.35± 0.02 B	25.65±0.14 J	44.25± 0.02 A
Hemoglobin concentration	11.35±1.24 A	9.45±0.02 A	11.30±0.05 A
Average blood cell volume	143.22± 1.87 B	132.94 ± 1.24 C	153.76±2.98a
Hemoglobin level	55.56± 6.83 A	48.98±0.58 Ab	39.26±0.58 B
Red blood cell count	38.68±4.26 A	36.84±0.09 A	25.53±0.11 B

Values represent the mean ± standard error.
Different letters in one row indicate significant differences at the probability level (P ≤0.05).

Conclusion

The results showed that adding moringa seed powder at a rate of 2 g/kg feed (T2) improved the live body weight, weight gain rate, and feed conversion efficiency of quails, while reducing feed consumption, and was better than 3 g/kg (T3) and the control group in most production indicators. On the other hand, the higher level (3 g/kg) did not achieve an improvement in performance, and feed consumption and weight decreased, which is attributed to anti-nutritional compounds such as tannins, phytates, and saponins. As for blood indicators, T3 showed an increase in red blood cells, compact cell volume, and average corpuscular volume, without differences in hemoglobin, with a decrease in average corpuscular hemoglobin. Therefore, it is recommended to use 2 g/kg of moringa seed powder to improve production performance, with the need for additional studies to evaluate health and blood aspects.

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