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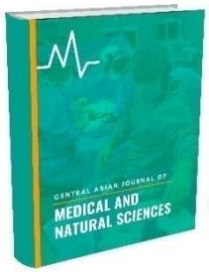

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THE ROLE OF QUINOA IN IMPROVING THE PERFORMANCE AND OXIDATIVE STATUS OF BROILER CHICKEN

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Abstract: The current work was aimed to estimate the role of quinoa in improving the performance and oxidative status of broiler chicken. The study used male broiler chicks (Ross308) that were 10 days old. Day-old weight was calculated by averaging the weight of the chicks after they were weighed. Five treated groups were allocated to them. Ten duplicates in each group were fed for forty days. The findings demonstrated that after 21 days, the broilers of T5 (728 g) gained the most body weight in comparison to T1 (671 g). The findings additionally demonstrated a significant influence ($p \leq 0.05$) on feed intake between T5 (1149) and T1 (1113g) after 21 days, as well as a significant effect ($p \leq 0.05$) between T1 and T5 in the first 49 days. The levels of RBC (2.29 ± 0.04), Hb (12.95 ± 0.42), PCV (31.82 ± 0.17) and MCV (40.69±0.25) in fifth group show high significant changes ($P < 0.05$) compared with control male broiler (2.14 ± 0.03; 10.18 ± 0.13; 28.37 ± 0.13 and 35.81±0.37 respectively). The counts of RBC, Hb, PCV and MCV in other treatments show significant changes ($P < 0.05$) compared with control male broiler. The levels of MDA (1.13 ± 0.09), GSH (0.391 ± 0.012) and enzyme catalase (1.63 ± 0.08) in fifth group show high significant changes ($P < 0.05$) compared with control male broiler (1.45 ± 0.12; 0.271 ± 0.015 and 1.21 ± 0.03 respectively). The levels of MDA (1.35

± 0.17; 1.31 ± 0.11; 1.21 ± 0.12 respectively), GSH (0.329 ± 0.013; 0.347 ± 0.021; 0.374 ± 0.014 respectively) and catalase (1.36 ± 0.09; 1.35 ± 0.05; 1.43 ± 0.06 respectively) in other treatments show significant changes ($P < 0.05$) compared with control male broiler. The current study's findings support the notion that broilers' performance and oxidative state are improved when quinoa seed extract, a natural antioxidant, is included in their diet.

Key words: Quinoa; oxidative status; broiler chicken; MDA; GSH.

Because they contain naturally occurring chemical substances that are highly interesting for use in human and animal nutrition and treatment, medicinal herbs have gained importance in the fields of animal and agricultural production. Research have demonstrated that medicinal plants can cure a wide range of illnesses, and the potent substances extracted from these plants can also enhance food quality [1]. The Andean pseudocereal quinoa (Chenopodium quinoa Willd.) is farmed in Canada, Europe, North Africa, and India and has been consumed in South America for centuries [2–3]. Quinoa consumption has risen dramatically in recent years due to its unique dietary benefits and phytochemical concentration, as noted [4]. Its rich nutritional profile piqued the curiosity of the scientific community. Because it has a perfect balance of vital amino acids and is extremely rich in proteins, lipids, fiber, minerals, and vitamins. Quinoa's cutting edge quality is its gluten-free nature, making it an excellent choice for those with celiac disease [5]. Despite the many advantages quinoa offers to customers, farmers grow very little of it because of limited consumer awareness of its benefits and expensive input costs. The human community has to exert significant pressure on quinoa's growth right now because it's a pseudo cereal with a rich nutritional profile that is vital to human health. The functional benefits for humans are made possible by this greatly expanded profile material [6-7]. The main portions of the plant that are edible are the seeds of quinoa, which are high in lysine, methionine, and carbs (77.6%), protein (12.9%), fats (6.5%), and carbohydrates [8]. Compared to cereals like oats, wheat, corn, and rice, it has a higher carbohydrate content [9]. Furthermore, compared to wheat and rice, its seeds have higher levels of Fe, Ca, K, Cu, Mg, and Mn [10]. Quinoa is full in phytochemicals that are high in antioxidants, including fiber, amino acids, polyunsaturated fatty acids, different vitamin types, various minerals, the saponins, phytosterols, phenolics, betalains, and glycine betaine. Over the past 20 years, quinoa has been used to generate a wide range of culinary and nutraceutical products and methods. Moreover, research has shown that taking supplements of quinoa has a major good impact on digestive, cardiovascular, and metabolic health [11–14]. So, the current work was aimed to estimate the role of quinoa in improving the performance and oxidative status of broiler chicken.

Materials & Methods

Quinoa seed extract (QSE)

The aqueous extract was made using the procedure described in [15], which involved dissolving 25 g of quinoa powder in 250 ml of distilled water (1:10), and then stirring the liquid for a while using a vibrator. After 30 minutes at a speed of 150 m/min, let the mixture soak in the refrigerator for 24 hours. Then, strain it through multiple layers of gauze to remove any remaining insoluble plant material, and then filter it once more using Whatmann No. 1 filter papers and after that use a device to dry the filtrate. In order to prepare the concentrations that are used in the study, the extract was dried under refrigeration (lyophilization) (ALPH 1-2 LD pluo). The extract was then turned into a dry powder, which was then stored in an airtight, sterilized container in the refrigerator at 4°C until it was needed [16]. This process was repeated in a sequential manner under the same conditions until a sufficient amount of extract was obtained.

Broiler chicks

The study used male broiler chicks (Ross308) that were 10 days old. Day-old weight was calculated by averaging the weight of the chicks after they were weighed. Five therapy groups were allocated to them. Ten duplicates in each group were fed for forty days. The following five dietary interventions were employed in this study: Baseline diet (control), T2: 100 kg of baseline diet + 10 g of quinoa powder, T3: 100 kg of basal diet + 20 g of quinoa powder, T4: 100 kg of basal diet + 30 g of quinoa powder, and T5: 100 kg of basal diet + 40 g of quinoa powder. Every diet was composed of necessary components that met the nutritional needs of birds as advised by the National Research Council.

Blood and serum samples

After 40 days of treatment, five milliliters of blood were drawn at random from the jugular veins of ten birds. Two milliliters of the blood were then placed into test tubes, one of which (2 milliliters) was filled with EDTA for hematological studies, and the other (3 milliliters) was filled with tube (without anticoagulant) that was left obliquely until coagulation, at which point the clot was gently removed from the test tube using a glass rod. Three test tubes containing the serum were kept at 20 degrees Celsius. The biochemical analysis was performed on these serum samples.

Hematological studies

The enhanced Neuber hemocytometer was used to calculate the total red blood cell count (RBC). Using the cyanomethaemoglobin technique, the hemoglobin (Hb) and packed cell volume (PCV) were calculated. The formulas (HbCx100)/PCV were used to get the mean corpuscular volume (MCV) [17].

Oxidative status

utilizing a spectrophotometer, MDA was determined utilizing the colorimetric reaction with thiobarbituric acid (TBA). GSH level was calculated by adding 0.5 milliliters of 5,5dithio-bis-(2-nitrobenzoic acid) (DTNB) to 2.3 milliliters of buffer and 0.2 milliliters of the sample. A spectrophotometer was used to evaluate the combination [18]. The Biovision-USA kit technique was used to assess catalase.

Statistical analysis

The data were statistically evaluated using SAS (2004)'s general linear model for analysis of variance, and significant differences between means were found using Duncan's multiple range test with a 5% probability [19].

Results & Discussion

Performance of broilers

Table 1 displays the results of the dietary addition of varying levels of quinoa powder on body weight gain. Table 2 shows a significant difference ($p \leq 0.05$) in body weight gain between T1 and the other treatments over all time periods. After 21 days, the broilers of T5 (728 g) gain the most body weight in comparison to T1 (671 g). The feed intake between T5 (1149) and T1 (1113g) after 21 days was shown to have a substantial influence ($p \leq 0.05$), and between T1 and T5, there was also a significant effect ($p \leq 0.05$) in the first 49 days. The results showed that T5 had the maximum feed intake and body weight gain during all times when quinoa powder was at its highest level. These findings may be connected to changes in blood metabolites. It's possible that T5's increased feed intake and decreased feed conversion ratio are the causes of their body weight increases. The broilers' increased hunger may be the cause of their increased feed intake. It has been previously documented that adding plant or herbal extracts to the diet of broilers can promote their growth by increasing their feed intake, secreting gastrointestinal fluids, and improving the digestion and absorption of nutrients [20]. Our findings concur with those of Wang et al. [21], who found that broiler performance is enhanced by the addition of antioxidants to the diet because these compounds have a good impact on health and nutrient digestibility.

Table (1): the performance of broilers as affected by diet include of quinoa powder

Parameters	Treatments (10 – 21 days)				
	T1	T2	T3	T4	T5
Body weight (gain g/bird)	671	695	711	716	728
Feed intake, (g/bird)	1113	1125	1137	1142	1149
Feed conversion ratio	1.66	1.62	1.6	1.59	1.58

Table (2): the performance of broilers as affected by diet include of quinoa powder

Parameters	Treatments (22 – 49 days)				
	T1	T2	T3	T4	T5
Body weight (gain g/bird)	2437	2485	2519	2551	2618
Feed intake, (g/bird)	5315	5326	5367	5418	5449
Feed conversion ratio	2.18	2.14	2.13	2.12	2.08

Hematological studies

The levels of RBC (2.29 ± 0.04), Hb (12.95 ± 0.42), PCV (31.82 ± 0.17) and MCV (40.69±0.25) in fifth group exhibits highly significant ($P < 0.05$) differences from the control male

broiler (2.14 ± 0.03; 10.18 ± 0.13; 28.37 ± 0.13 and 35.81±0.37 respectively). Table 3 displays substantial differences ($P < 0.05$) in the counts of RBC, Hb, PCV, and MCV between the treated and control male broilers. Darwish et al. studied the antianemic efficacy of a phytogenic diet augmented with quinoa in rats induced with iron deficiency anemia [22]. The optimum course of action for restoring organ weights, body weight, serum profile (iron, zinc, protein, and ferritin), and blood cell counts was shown to be fortification with 10% quinoa. Red blood cell counts and PCV are connected. The PCV rate increases with increased red blood cell counts [23]. It was discovered that the PCV percentage was significantly increased by quinoa seed extract, and that the PCV percentage and hemoglobin concentration increased with the percentage of quinoa seed extract in the diet, which appears to be correlated with the counts of red blood cells [24]. Thus, a higher proportion of quinoa seed extract in the diet was linked to an increase in hemoglobin content in the current study.

Table (3): The levels of hematological parameters in male broiler

Parameters Groups	RBC (10^6/mm^2)	Hb (g/10ml)	PCV %	MCV %
T1	2.14 ± 0.03 b	10.18 ± 0.13 c	28.37 ± 0.13 b	35.81±0.37 c
T2	2.23 ± 0.03 a	10.37 ± 0.21 c	29.13 ± 0.24 ab	35.59±0.61 c
T3	2.26 ± 0.05 a	11.52 ± 0.47 b	29.45 ± 0.12 ab	39.12±0.51 ab
T4	2.24 ± 0.02 a	11.48 ± 0.15 b	29.82 ± 0.14 ab	38.49±0.42 b
T5	2.29 ± 0.04 a	12.95 ± 0.42 a	31.82 ± 0.17 a	40.69±0.25 a

When two letters are similar, there are no significant differences; when they differ, there significant changes.

Oxidative status

The levels of MDA (1.13 ± 0.09), GSH (0.391 ± 0.012) and enzyme catalase (1.63 ± 0.08) in Fifth group exhibits highly significant alterations ($P < 0.05$) in comparison to the male broiler control group. (1.45 ± 0.12; 0.271 ± 0.015 and 1.21 ± 0.03 respectively). The levels of MDA (1.35 ± 0.17; 1.31 ± 0.11; 1.21 ± 0.12 respectively), GSH (0.329 ± 0.013; 0.347 ± 0.021; 0.374 ± 0.014 respectively) and catalase (1.36 ± 0.09; 1.35 ± 0.05; 1.43 ± 0.06 respectively) in other treatments show significant changes ($P < 0.05$) compared with control male broiler as shown in table (4). Antioxidants are important because of their capacity to combat reactive oxygen species (ROS). When those ROS react with lipids, proteins, carbohydrates, and vitamins, they start oxidation reactions that result in the production of hazardous chemicals, the destruction of vitamins, important fatty acids, and amino acids, as well as the generation of carcinogens [25]. Quinoa was administered, and this reduced the MDA and inre. This discovery implies less lipid peroxidation when quinoa seeds are used. Rats given black currant juice had comparable results [26]. By interacting with lipids and hydroxyl radicals and transforming them into stable molecules, plant extracts with antioxidant qualities added to food aid in prolonging the shelf life and enhancing the quality of meat products [27].

Table (4): The levels of MDA, GSH and CAT in serum

Parameters Groups	MDA (mmol/l)	GSH (mol/l)	Catalase (mmol/l)
T1	1.45 ± 0.12 b	0.271 ± 0.015 c	1.21 ± 0.03 c
T2	1.35 ± 0.17 ab	0.329 ± 0.013 b	1.36 ± 0.09 b
T3	1.31 ± 0.11 b	0.347 ± 0.021 b	1.35 ± 0.05 b
T4	1.21 ± 0.12 bc	0.374 ± 0.014 a	1.43 ± 0.06 b
T5	1.13 ± 0.09 c	0.391 ± 0.012 a	1.63 ± 0.08 a

Similar letters mean there are no significant differences, different letters mean there are significant differences

Conclusion

The current study's findings support the notion that broilers' oxidative state and performance are improved when quinoa seed extract, a natural antioxidant, is included in their diet. For both producers and consumers, the outcomes of the economic study, as well as the findings on meat quality and the enhancement of anti-oxidative qualities, are crucial.

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