Adding curcumin powder to the diet of broiler breeders and determining its effect on textural characteristics.

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Abstract

The study period is 14 weeks from 1/11/2023 to 8/2/2024 in the field of "Department of Animal Production College of Agriculture Al-Qasim Green University. The study aims to add curcumin powder to the feed of a Broiler Breeder "and to know its effect on tissue traits. 25 roosters, 60 weeks old, Ross-308 hybrids were used in the study. The roosters were fed the standard feed in the Broiler Breeder index. The roosters were divided into four groups: five roosters per treatment, each with five replicates and one rooster per replicate. Group (T1) is a control group fed on a basic diet without adding curcumin powder. Groups (T2, T3, and T4) were fed on a diet containing "250, 300, and 350 mg of curcumin powder/kg feed, respectively, from the first day of the study until 14 weeks. In the last week of the study, three roosters (3 replicates) were slaughtered for each treatment and the testes were extracted and then their histological traits were estimated. The study's results showed that Treatment T4 significantly excelled ($p \leq 0.01$) compared to the rest of the treatments in absolute and relative testicular weight, germinal cell diameter, seminiferous tubule cavity fungus, and total seminiferous tubule diameter. Significantly excelled ($p \leq 0.01$) for T4 treatment compared to T1 treatment in the volume density rate and relative weight of the components of the seminiferous tubule of the testes, which included (sperm progenitors, spermatocytes, sperm precursors, total sperm-forming cells, Sertoli cells, tubular vacuoles, seminiferous tubule lumen, basement membrane, and total seminiferous tubule components). The results also indicated a significant excel ($p \leq 0.01$) for T4 treatment compared to T1 treatment in the volume density rate and relative weight of the components of the interstitial tissue (muscle cells, blood vessels, interstitial spaces, total components of the interstitial tissue(. The results did not indicate any significant differences between the treatments for volume density measurements and the relative weight rate of Leydig cells.

Keywords: curcumin powder, broiler breeders, and textural characteristics .

Introduction

Fertility and hatching have a great economic impact in the poultry industry. Sexual maturity of roosters is at 25 weeks of age, and at 40 weeks of age, fertility rates have reached their maximum. Stull problems of low fertility begin after 45-50 years of age of roosters, and this problem is considered important in Broiler Breeder flocks [6]. The importance of roosters lies in the ratio of males to females, which is one rooster for every 10 hens. The decrease in fertility and hatching with the advancement of roosters is due to the small size of the testicles or their atrophy, low levels of testosterone in the blood, increased body weights, taxic stress, and low sexual desire [3,10]. To maintain a high fertility rate, we must work on increasing sperm production and forming an active state and increasing their storage in the vaginal glands after the first productive year [8]. Some substances are considered natural feed additives that enhance the ability of old and stressed roosters to improve fertilization and hatching [9]. Curcumin is a natural phenolic

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compound found in the root of the turmeric plant (Curcuma. spp.) that belongs to the ginger family. Curcumin is also called diferuloylmethane with the formula C21H20O6. It has natural benefits, including being an active antioxidant, scavenging free radicals, and improving poultry growth and fertilization [12, 16]. Adding curcumin to rooster feed led to a decrease in sperm abnormalities, an increase in the diameters of the seminiferous tubules, an increase in the size of the testicles, and an increase in testicle levels in the blood of roosters. A decrease in the weight of the testicles from the normal size leads to a decrease in testosterone production and a decrease in sperm production, and thus, a decrease in the reproductive performance of old roosters [14]. And raised the levels of antioxidants such as "glutathione peroxidase (GPx)" and "superoxide dismutase (SOD)" [7]. Curcumin also enhanced the reproductive performance of old roosters. It improved the performance of laying hens by increasing egg production and its good qualities, egg size, color, and yolk size [17,1]. Our current study is to find out the effect of curcumin and which levels are best to achieve the best size of the components of the seminiferous tubule, interstitial tissue, and testicle size, which improves the fertility and hatching rate (reproductive performance) of old roosters .

Materials and methods

Herd management- :

The experiment was conducted in the "Animal Production Department Field - College of Agriculture - Al-Qasim Green University." Curcumin powder was added to the feed of the Broiler Breeder at several levels to determine its effect on some "tissue" qualities of roosters. The date of the experiment began 11/1/2023 and continued until 8/2/2024. For 14 weeks, 20 hybrid ROSS 308 broiler breeder roosters were used in the study. The average weight of each rooster was 5.5 kg. On the last day of the experiment, three replicates of each treatment (3 roosters) were randomly selected and weighed, then slaughtered and the testicles were extracted for histological analysis. The roosters were randomly distributed into wooden cages and soft BRC wires with an area of 0.75 cm wide and 1.0 m long, while the height of the cages was 75 cm. The cages were covered with wooden boards, BRC, and the floor rearing system, and 7 cm high sawdust was used in all cages as floor covering. The lighting system was followed with 14 hours of light and 10 hours of darkness/day, and lighting was from (6 am to 8 pm). Feed was provided to all roosters at 120 g/day, which contained curcumin powder, from the first day of the study, except for the control treatment, which was without adding curcumin powder to the feed. Feed was provided by small feeders attached to the sides of the cages, and 3-liter water troughs were used to provide water freely throughout the period.

Experimental treatments- :

20roosters were randomly distributed in wooden cages in 4 groups; each group had 5 replicates, and each replicate had one rooster. The feeding with the addition of curcumin powder to the treatments was as shown below : -

-1The first treatment T1 = "normal feed without adding curcumin."

-2The second treatment T2 = adding "250 mg/kg/feed" of curcumin powder.

-3The third treatment T3 = adding "300 mg/kg/feed" of curcumin powder.

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-4The fourth treatment T4 = adding "350 mg/kg/feed" of curcumin powder.

The feed used in the study- :

The roosters were fed according to the feed ratios mentioned in the PARENT STOCK Ross 308 guide [18]. The crude protein ratio was (13.5%) and the energy ratio was (1350 kilocalories/kg feed) until the end of the experiment. The feed was given twice, the first at seven and the second at noon.

"Table No. 1 Feed components".

Feed material		Calculated chemical composition		mineral elements	
corn	29.1	Crude protein	13.50	Calcium (%)	0.64
wheat	43.4	Metabolizable energy (kcal/kg feed)	1350	Available Phosphorus (%)	0.49
Soybean Meal 44%	7.5	Methionine (%)	0.29	Sodium	0.19
Wheat Bran	15.8	Lysine (%)	0.61	Potassium	0.40
Sunflower Oil	0.5	Methionine + Cysteine (%)	0.55		
Limestone	1.2				
Premix*	2.5				

Adding curcumin to the feed- :

The curcumin powder used in the experiment was purchased from the pharmacy, and it is a product of the American company NOW. The box was made of yellow powder with several 60 capsules. After emptying the capsules, the material was weighed with a sensitive scale, and the required proportions were mixed with the feed, at first with small amounts of feed, then more and more, until it was mixed with all the feed for each treatment and according to the required quantities.

Estimation of tissue traits-:

On the last day of the experiment, three roosters were randomly selected from each treatment, slaughtered, and the testicles were extracted. The testicles were also weighed separately, and the left one was taken for tissue sectioning. The samples were placed inside a plastic container and immersed in formalin with a concentration of "10%". After less than 24 hours, the formalin was replaced for all samples not to damage the tissue. The samples were sent to the "College of Veterinary Medicine / University of Al-Qadisiyah," and the testicular tissue was cut according to the method [4]. and the samples were cut according to the following method- :

sections were taken from the testicles, anterior, middle, and then posterior.

-2The sample was passed through ascending concentrations of ethyl alcohol, first from 50% - up to 100%, i.e. a range of 10% between one concentration and the other for 60 minutes for each concentration.

-3The sample tissue was placed in "Xylene" for 120 minutes to get rid of the amount of

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water inside the sample. This process is called "tissue leaching."

-4The sample is placed in paraffin wax, then the wax is placed with the tissue in the oven at a temperature of 60-65°C for three periods of 60 minutes until the tissue is saturated with wax, and then the tissue is immersed in wax in cubes until the wax solidifies later. The Rotator Microtome is used, where the sample is cut to a thickness of 5 microns, then the slide is placed in a water bath to facilitate spreading it on the glass slide.

-5Some albumin, xylol mixture, and phenol are added to the samples (glass slides) as drops for fixation and drying.

-6The glass slides are placed in an oven at a temperature of 70-80°C for about 20 minutes to remove the wax from them completely. A slide holder is used for this purpose.

-7Then, the slides are placed inside the xylol for half an hour to melt the wax inside the tissue. 8- The slides are placed in decreasing ethanol concentrations, ranging from 100 - 80%, for 3 minutes for each concentration. 9- Then, the slides are placed in staining containers containing "Hematoxylin" for 5 minutes. Then, immersed in water for 4 minutes, then immersed twice in "Eosin 1% Stock alcoholic" for one minute only, then exposed once to water for 60 seconds.

-10Exposing the slides to two concentrations of alcohol, "80% and 100%", for 60 seconds for each concentration.

-11The slides are dried from alcohol, and the slide cover is fixed on their surface; this is done using "Canada balsam" to become ready for reading.

Estimating the volume density of the components of the seminiferous tubule- :

According to the absolute weight of the testicle from the direct weight after its extraction from the body, the diameters (the tubule, its cavity and germ cells) were calculated, and according to the method [19], the volume density and their relative weights of the seminiferous tubules of the testicle were estimated as follows.

A regular microscope with a digital camera was used to photograph the required tissue section using a double Visopan screen microscope with a magnification of 400X. A copy was made to be an exact copy in the form of software using Photoshop, so the transparency consists of 228 points for the image. Then the number of points projected onto the component was calculated. By dividing the number of points of each component (Weible Grid) Thus, we extract the bulk density of a particular component by "288". The result is multiplied by 100 The volume density of the components of the seminiferous tubule was extracted, which included sperm progenitors, sperm cells, sperm precursors, the total number of cells forming sperm, Sertoli cells, tubular vacuoles, the lumen of the seminiferous tubule, the basement membrane, and the volume density of the components of the interstitial tissue, which are muscle cells, Leydig cells, blood vessels, interstitial spaces, and the total components of the interstitial tissue.

Statistical analysis-:

The statistical program “Statistical Analysis System - SAS (Stroup, 2018)” was used to analyze the study data and determine the effect of the different groups on the characteristics that were studied according to the “completely randomized design (CRD)” and to compare the significant differences between the means of the groups using the Duncan test (1955). "Polynomial.

Mathematical model of the experiment- :

$Yij = \mu + Ti + eij$

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Yij: the value of the jth view of transaction i .
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μ: the general average of the studied trait.
Ti: effect of treatment i.
Eij: Random error that is normally distributed with a mean equal to zero and a variance of σ2e .

Estimating the relative density of the seminiferous tubule components- :

According to the relative weight of the testicle through the absolute weight of the testicle / total weight * 100. As for calculating the relative weight (components of the seminiferous tubule of the testicle), through the following relationship- :

The relative weight of a specific component (%) = Volumetric density of the component × Relative weight of the testicle .(%)

According to the previous method for measuring volume density [19], the relative weights of the seminiferous tubules of the testicle were estimated. The relative components of the seminiferous tubule of the testicle were estimated, which included sperm progenitors, sperm cells, sperm precursors, total sperm-forming cells, Sertoli cells, tubular vacuoles, seminiferous tubule lumen, and basement membrane. With an estimate of the relative components of the interstitial tissue, which are muscle cells, Leydig cells, blood vessels, interstitial spaces, total components of the interstitial tissue, and the ratio of the total components of the seminiferous tubule / total components of the interstitial tissue. By a program that calculates the distance between the two points to measure them and choose the required unit of measurement .

Results and discussion- :

Effect of adding different percentages of curcumin powder to the feed on some histological traits of broiler breeder roosters.

Table 2 shows that adding curcumin powder to the feed of broiler breeder roosters and its effect on the absolute and relative weight of the testicle %, the diameter of germ cells, and the diameter and lumen of the seminiferous tubule (micron), indicating that the results of the table indicate that in the absolute testicle weight trait, treatment T4 significantly excelled on all treatments ($P \leq 0.01$), followed by treatment T1, which significantly excelled on treatments T2 and T3, between which we did not find significant differences. In the relative testicle weight, treatment T4 significantly excelled on all treatments ($P \leq 0.01$), and there were no significant differences between the rest of the treatments. In germ cell diameter, treatment T4 Significantly excelled ($P \leq 0.01$) in all treatments and treatment T3 Significantly excelled ($P \leq 0.01$) in treatments T1 and T2, while treatment T2 Significantly excelled ($P \leq 0.01$) in treatment T1 (control treatment). As for the diameter of the seminiferous tubule lumen, treatment T4 Significantly excelled ($P \leq 0.01$) to all treatments and treatment T2 Significantly excelled ($P \leq 0.01$) to treatments T1 and T3, between which we did not find a significant difference. In the total seminiferous tubule diameter trait, the results indicated a significantly excelled($P \leq 0.01$) for treatment T4 compared to the rest of the treatments, which did not differ significantly between them .

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Table 2 Effect of adding different percentages of curcumin powder to the feed on "absolute and relative testis weight %, germ cell diameter, seminiferous tubule lumen diameter, and total seminiferous tubule diameter (micrometer) of broiler breeder chickens" (mean ± standard error(

traits	)Mean ± standard error (**Treatments**				
	T1 Average live weight 5403 (g)	T2 Average live weight (g) 4455	T3 Average live weight(g)4823	T4 Average live weight(g)5209	**significant**
Absolute testicular weight	0.33± 19.67b	0.67± 16.33c	0.33± 16.33c	0.33 ± 21.67a	**
Relative testicular weight	0.001± 0.37b	0.016± 0.36b	0.06± 0.34b	0.002± 0.42a	**
Germ cell diameter	0.1030.12±d	0.1210.10± c	0.1360.02±b	0.1760.06± a	**
Sperm tubule lumen diameter	0.120 0.05± c	0.137 0.04±b	0.1180.04 ±c	0.1700.05± a	**
Total seminiferous tubule diameter	0.447 0.06 ±b	0.443 0.06± b	0.4340.06±b	0.538 0.06± a	**

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Different letters indicate significant differences between treatments for one column** (P≤0.01). N.S: indicates no significant differences.

Groups: 1T control treatment without any addition, T2, T3 and T4 treatments adding curcumin powder to the feed at levels of 250, 300, 350 mg/kg feed respective

Table 3 shows the volumetric density rates of the seminiferous tubule components after adding curcumin powder to the treatments, which included (sperm progenitors, sperm cells, sperm precursors, total sperm-forming cells, Sertoli cells, tubular vacuoles, seminiferous tubule lumen, basement membrane, and total seminiferous tubule components). In the sperm progenitor trait, treatment T2 significantly excelled on all treatments (P≤0.01), and treatment T4 significantly excelled on both treatments (P≤0.01). T1 and T3, which had no significant differences. In the trait of sperm cells and the total number of sperm-forming cells, the results showed a significant decrease (P≤0.01) for treatment T1 compared to the rest of the treatments, which did not notice any significant differences between them. In the trait of spermatogonia and basement membrane, treatment T4 Significantly excelled (P≤0.01) compared to treatments T1 and T2 and did not differ significantly from treatment T3. We did not find any

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significant differences between treatments T2 and T3, which were Significantly excelled (P≤0.01) to treatment T1. In the fourth trait (sperm) and the tenth trait, the total number of seminiferous tubule components, the results showed no significant difference between treatments T2 and T3, which decreased significantly (P≤0.01) from treatment T4 and were Significantly excelled (P≤0.01) to treatment T1. As shown by the results of the Sertoli cell trait, T4 treatment Significantly excelled (P≤0.05) over T1 and T2 treatments. It did not differ significantly with T3, which in turn did not differ significantly with T4 treatment. In the tubular vacuole trait, the T4 treatment Significantly excelled (P≤0.05) compared to the rest of the treatments, which did not observe any significant difference between them. The results of the statistical analysis also found that there were no significant differences between the treatments in the seminiferous tubule lumen trait .

Table 3 Effect of adding different percentages of curcumin powder to the feed on the average volumetric density of the seminiferous tubule components of the testicles (%) for broiler breeder chickens" (mean ± standard error.(

traits	Treatments				
	T1	T2	T3	T4	significant
sperm precursors	0.15± 2.92c	0.05± 3.94a	0.02± 3.07c	0.02± 3.50b	**
sperm cells	0.14± 5.56b	0.14± 6.28a	0.14± 6.43 a	0.15± 6.28a	**
spermatides	0.15± 4.09c	0.15± 4.97b	0.02± 5.26 ab	0.15± 5.41a	**
Sperm	0.15± 3.65c	0.02± 4.38b	0.02± 4.39b	0.15± 4.97a	**
total number of cells that make up sperm	16.22 0.24±b	0.51± 19.57 a	0.49± 19.15 a	0.52± 20.16 a	**
Sertoli cells	0.14± 3.20 b	0.14± 3.21b	0.05± 3.50ab	0.15± 3.80a	*
tubular gaps	0.01± 6.14b	0.04± 6.14b	0.01± 6.14b	0.15± 6.44a	*
Lumen of the seminiferous tubule	0.01± 3.51	0.01± 3.52	0.14± 3.80	0.14± 3.80	NS
Basement membrane	0.15± 8.02c	0.03± 8.37b	0.13± 8.52ab	0.03± 8.80a	**
Total components of the seminiferous tubule	c 2.30± 37.09	b 2.02± 40.81	b 2.05± 41.11	a 1.25± 43.0	**

Different letters indicate significant differences between treatments for the same column* (P≤0.05), ** (P≤0.01."(

N.S: indicates no significant differences.

Groups: 1T control treatment without any addition, T2, T3 and T4 treatments adding curcumin powder to the feed at levels of 250, 300, 350 mg/kg feed respectively.

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Table 4 shows the relative weight of the seminiferous tubule components after adding curcumin powder to the treatments, which included (sperm progenitors, sperm cells, sperm precursors, total sperm-forming cells, Sertoli cells, tubular vacuoles, seminiferous tubule lumen, basement membrane, and total seminiferous tubule components.(

The results showed a significant decrease (P≤0.01) for treatments T1 and T3 compared to treatments T2 and T4, in which we did not observe significant differences between them in the trait Sperm precursors. Treatment T4 also outperformed the other treatments in the following traits (sperm cells, Sertoli cells, tubular vacuoles, seminiferous tubule lumen, and basement membrane) significantly (P≤0.01), and there were no significant differences between them. In the third trait (sperm precursors) and the fourth trait (sperm), we did not find significant differences between treatments T2 and T3, which decreased significantly (P≤0.01) compared to treatment T4 but recorded a significant increase (P≤0.01) compared to treatment T1. As for the two traits (total sperm-forming cells and total seminiferous tubule components of the testicles), the results found a significant decrease (P≤0.01) for treatment T2 compared to treatment T4, while treatment T2 outperformed significantly (P≤0.01) treatments T1 and T3, which did not have significant differences between them

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Table 4: Effect of adding different percentages of curcumin powder to the feed on the relative weight of the seminiferous tubule components of the testicles (%) of broiler breeder chickens (mean ± standard error.(

traits	Treatments				
	T1	T2	T3	T4	significant
sperm precursors	0.06± 1.08 b	0.06± 1.45a	0.02± 1.04b	0.01± 1.48a	**
sperm cells	0.04± 2.05b	0.14± 2.32b	0.08± 2.18b	0.06± 2.66a	**
spermatides	0.06± 1.51c	0.12± 1.84b	0.03± 1.79b	0.06± 2.29a	**
Sperm	0.04± 2.05c	0.14± 2.32b	0.08± 2.18b	0.06± 2.66a	**
total number of cells that make up sperm	6.690.14±c	7.93 0.17±b	7.19 0.15±c	9.09 0.24± a	**
Sertoli cells	0.05± 1.18b	0.10± 1.19b	0.02± 1.19b	0.06± 1.60a	**
tubular gaps	0.01± 2.27b	0.09± 2.27b	0.03± 2.09b	0.06± 2.72a	**
Lumen of the seminiferous tubule	0.03± 1.29b	0.06± 1.29b	0.06± 1.29b	0.05± 1.61a	**
Basement membrane	0.06± 2.97b	0.13± 3.09b	0.04± 2.89b	0.01± 3.73a	**
Total components of the seminiferous tubule	±14.40 0.49 c	±15.70.49b	c0.49±14.6	±18.70.49a	**

Different letters for significant differences between treatments within the same column, ** (P≤0.01." (

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Groups: 1T control treatment without adding T2, T3, and T4 treatments, adding curcumin powder to the feed at 250, 300, and 350 mg/kg, respectively.

The results of Table 5 showed the effect of adding curcumin powder on the volume density rate of the components of the interstitial tissue of the testicles. Treatment T4 recorded a significantly excelled (P≤0.01) compared to the rest of the treatments, while treatment T2 significantly excelled on (P≤0.01) treatments T1 and T3, which had no significant differences. In the measurements of Leydig cells and blood vessels, the statistical analysis results did not indicate significant differences between the treatments. We did not observe a significant difference between treatments 2T and T4, which significantly excelled (P≤0.01). Compared with treatments T1 and T3, treatment T3 Significantly excelled (P≤0.01) compared to treatment T1 in inter-space measurements. In measurements of the total inter-tissue components, treatment T4 recorded a significantly excelled (P≤0.01) compared to the rest of the treatments, and we did not find significant differences between treatments T2 and T3, which were Significantly excelled (P≤0.01) to treatment T1 in measuring the total inter-tissue components .

Table 5 Effect of adding different percentages of curcumin powder to the feed on the average volume density of the inter-tissue components of the testicles (%) for broiler breeders" (mean ± standard error.(

traits	Treatments				
	T1	T2	T3	T4	significant
Muscle cells	0.25± 7.45c	0.38± 9.06b	0.15± 8.04c	0.25± 10.52a	**
Leydig cells	0.15± 1.46	0.15± 1.46	0.15± 1.60	0.15± 1.60	NS
Blood vessels	0.14± 1.02	0.14± 1.02	0.14± 1.46	0.14± 1.46	NS
Interspaces	0.14± 1.02c	0.14±2.04a	0.15± 1.46b	0.14± 2.04a	**
Total components of the interfacial tissue	0.25±10.95c	0.47±13.58 b	0.37±12.56b	0.24±15.62 a	**

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Different letters in the table indicate significant differences between treatments for one column** (P≤0.01." (
N.S: indicates no significant differences.
Groups: 1T control treatment without adding T2, T3, and T4 treatments, adding curcumin powder to the feed at 250, 300, and 350 mg/kg, respectively.

Table 6 shows us the relative weight of the components of the interstitial tissue after adding curcumin powder to the treatments, where treatment T4 recorded a significantly excelled (P≤0.01) over the rest of the treatments, which had no significant differences between them in the measurements of the relative weight of muscle cells. As for the Leydig cell trait, there were no significant differences between the treatments. In the blood vessels trait, treatment T4 Significantly excelled (P≤0.05) compared to treatments T1 and T2, which did not differ significantly from treatment T3, Which did not differ in turn with the treatments T1 and T2. In the fourth trait (inter-spaces), we did not find a significant difference between the treatments T2 and T4, which Significantly excelled (P≤0.01) compared to the treatments T1 and T3, and in turn, the treatment T3 recorded a significantly excelled (P≤0.01) compared to the treatment T1. The treatment T4 also significantly (P≤0.01) excelled compared to the rest of the treatments in the relative weight rate of the components of the seminiferous tubule of the testicles. We did not find any significant differences between the treatments T1 and T2, which recorded a significant decrease (P≤0.01) compared to the treatment T3 .

Table 6 Effect of adding different percentages of curcumin powder to the feed on the relative weight rate of the components of the seminiferous tubule of the testicles (%) for broiler breeders (mean ± standard error.(

traits	Treatments				
	T1	T2	T3	T4	significant
Muscle cells	0.10± 2.75b	0.15± 3.26b	0.14± 2.73b	0.16± 4.41a	**
Leydig cells	0.05± 0.54	0.03± 0.53	0.06± 0.55	0.06± 0.67	NS
Blood vessels	0.06± 0.37b	0.06± 0.37b	0.06± 0.50ab	0.06± 0.61a	*
Interspaces	0.06± 0.38c	0.07± 0.72a	0.04± 0.50b	0.06± 0.62a	**
Total components of the interfacial tissue	0.02±4.41c	4.87 c0.01 ±	0.15±4.28b	0.14±6.31a	**

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Different letters in the table indicate significant differences between treatments for one column * (P≤0.05), ** (P≤0.01.(
N.S: indicates no significant differences.
Groups: 1T control treatment without adding T2, T3, and T4 treatments, adding curcumin powder to the feed at 250, 300, and 350 mg/kg, respectively.

We see from Tables 2, 3, 4, 5 and 6 that there is an improvement in the histological traits such as the absolute and relative weight of the testis, the diameters of germ cells, the diameter of the tubule lumen, the total diameter of the seminiferous tubule, the total number of sperm-forming cells, the total absolute and relative components of the seminiferous tubule, and the total absolute and relative components of the interstitial tissue. The improvement that occurred in some traits of the testicular tissue may be because curcumin prevents oxidative damage as it works as an antioxidant and works to increase the diameters of the seminiferous tubules and the size of the testis by regulating the path of sensors NRF cells, which is a protein in response to oxidative stress, nuclear factor erythroid -2, has enhanced the capabilities of antioxidants such as CAT, GSH-Px, SOD, and T-AOC [5, 20]. Or the reason may be due to the effect of curcumin on the hypothalamus gland to secrete GnRH, which stimulates the pituitary gland to increase its secretion of FSH and LH hormones, as FSH increases the components of the testicle and LH works to increase the level of testosterone, which also increases the size of the components of the testicle [2]. This conclusion is consistent with what the researchers found in their study. When curcumin was added to the feed of old broiler mothers, there was an increase in the size of the testicle, which is one of the ways to increase the effectiveness of old roosters instead of replacing them. They mentioned that the reason for the increase in the size of the testicles and their components may be because curcumin has increased the level of testosterone, which has a direct relationship with the increase in the weight and tissue of the testicles [13, 15.[

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