

Effects of Dietary Puncture Vine (*Tribulus terrestris*) Powder in Different Carriers on Growth Performance, Carcass Characteristics and Blood Parameters of Broiler Chicks ^[1]

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Summary

This study was carried out to investigate the effects of dietary powder of Puncture Vine (*Tribulus terrestris* (TT)), carried with cotton oil, cellulose and bentonite on growth performance, carcass characteristics, TBA (thiobarbituric acid) value of breast meat and blood parameters of broiler chicks. In total, 192, day old broiler chicks were divided into 12 groups of 16 chicks each one was one replicate with similar body weights. Treatment birds were fed on their own diets supplemented with 0 (control); 1 g TT; 2 g TT; 0.1 g cotton oil; 0.5 g cellulose; 0.5 g bentonite; 1 g TT with 0.1 g cotton oil; 2 g TT with 0.2 g cotton oil; 1 g TT with 0.5 g cellulose; 2 g TT with 1 g cellulose; 1 g TT with 0.5 g bentonite and 2 g TT with 1 g bentonite per kg diet during 6 weeks. Results showed that there were no significant differences between control and treatment groups ($P>0.05$) with respect to the observed parameters (growth performance, body components, TBA value and blood parameters), except abdominal fat pad. Bentonite control (30.5 g), 1 g of TT carried with bentonite (31.0 g) and 1 g of TT carried with cellulose (31.4 g), increased abdominal fat pad compared to control (26.4 g) ($P<0.01$). It is concluded that future studies on TT as a feed supplement by examining different extraction methods, coverage methods, doses and carriers are needed.

Keywords: Puncture vine, Broiler chicks, Blood parameters, Performance, Lipid oxidation

Farklı Taşıyıcılarla Rasyona Eklenen Demir Dikeni (*Tribulus terrestris*) Bitki Tozunun Etlik Civcivlerde Performans, Karkas Özellikleri ve Kan Parametreleri Üzerine Etkisi

Özet

Bu deneme demir dikeni (*Tribulus terrestris*) bitki tozunun bentonit, selüloz ve pamuk yağı ile taşınmasının etlik civcivlerde büyüme performansı, karkas özellikleri, TBA (tiyobarbütürik asit) değerleri ve kan parametreleri üzerine etkilerini belirlemek amacı ile yürütülmüştür. Benzer ağırlıklara sahip 12 gruptan oluşan, her bir hayvanın bir alt grubu oluşturduğu her grupta 16 olmak üzere toplamda 192 adet günlük erkek etlik civciv kullanılmıştır. Denemedeki etlik civcivlerin her kg yemlerine 6 hafta boyunca 0 (kontrol); 1 g TT; 2 g TT; 0.1 g pamuk yağı; 0.5 g selüloz; 0.5 g bentonit; 1 g TT ile 0.1 g pamuk yağı; 2 g TT ile 0.2 g pamuk yağı; 1 g TT ile 0.5 g selüloz; 2 g TT ile 1 g selüloz; 1 g TT ile 0.5 g bentonit ve 2 g TT ile 1 g bentonit eklenmiştir. Çalışma sonunda, abdominal yağ hariç diğer saptanan parametreler (büyüme performansı, vücut parçaları, TBA değeri ve kan parametreleri) bakımından kontrol ile diğer gruplar arasında herhangi bir önemli farklılığa rastlanmamıştır ($P>0.05$). Abdominal yağ ağırlığı bakımından kontrol (26.4 g) grubuna göre sadece bentonit (30.5 g), bentonit ile birlikte 1 g demir dikeni (31.0 g) ve selüloz ile birlikte 1 g demir dikeni (31.4 g) grupları daha yüksek değerler vermişlerdir ($P<0.01$). Sonuç olarak, demir dikeni, yem katkı maddesi olarak farklı ekstraksiyon yöntemlerinin, kaplama metotlarının, dozlarının ve taşıyıcılarının denendiği çalışmalara ihtiyaç vardır.

Anahtar sözcükler: Demir dikeni, Etlik civciv, Kan parametreleri, Performans, Lipid Oksidasyon



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INTRODUCTION

As alternative medicine, medical and aromatic plants are getting popular in nutrition science and feed manufacturing sector since their appropriate usages have no any side effects on human and animal health. There have been a huge studies in animal nutrition for investigating the effects of plant extracts and powders on the performance of animals as well as on blood parameters in the World. However, there has been a limited commercial feed additives such as genex and origanum etc. As usually known that Turkey has a great potential for medical and aromatic plants and their raw materials have been exported to other countries and imported their processed secondary products to Turkey with higher prices for medicinal and agricultural purposes. For this reason, there has been a need to improve commercial alternative feed additives.

Growth promoters as antibiotics and synthetic hormones have been banned in animal nutrition since they are harmful for human health. *Tribulus terrestris* (TT) powder may be natural feed additive of broiler chicks by increasing testosterone level muscle mass and body strength¹⁻³, most likely due to LH production^{4,5}.

Tribulus terrestris L. (Zygophyllaceae), called "demir diken" or "çoban çökerten" in Türkiye, is an annual herb. This herb as a weed is commonly distributed in agricultural lands as present in ecology naturally. This plant contains alkaloids, resin, peroxidase, diastase, flavonoids, carbohydrate, protein, fructose, sucrose, steroidal saponins (protodioscin (0.17-6.49%) and protogracilin), glycosides and phytosteroids⁶⁻¹². *Tribulus terrestris* powders or extracts have been commonly used in alternative medicine as diuretic, against colic pains, hypertension and hypercholesterolemia for treatment of erectile dysfunction, diabetes, tumours, cardiovascular and respiratory diseases and control of blood pressure^{13,14}. *Tribulus terrestris* has also an antioxidative effect¹⁵. Feed supplements containing TT extracts are also currently on sale in USA and Europe with claim of a general stimulating action¹⁶.

Adding *Tribulus terrestris* extract (10 mg/kg body weight) to drinking water in Brown Lohman hens, Guinea fowl and White Plymouth Rock-mini cocks was studied by several workers. TT extract decreased serum glucose level in Brown Lohman hens¹⁷ and decreased serum cholesterol level in guinea fowl¹⁸, while increased reproductive performance in White Plymouth Rock-mini cocks¹⁹. Dietary TT extract (60 and 120 ppm, Ultimate Nutrition) did not decrease growth performance of broiler chicks when given to broiler chicks in commercial diet for 21 days suggesting that the higher TT dose trials are needed²⁰. Dietary 360 ppm TT extract decreased liver and intestine (duodenum, ileum+jejunum) weights of broiler chicks²¹. Şahin²² reported that TT powder (8 g) can be used as an alternative to antibiotics

with respect to growth performance of broiler chicks.

Up to now, the effects of dietary TT on shelf life of chicken meat have not been studied yet. There has been no study using carriers such as bentonite, cellulose and vegetable oil for plant extracts in poultry nutrition. Also, the effect of TT on protein, fat and mineral metabolism has not studied yet by determining blood parameters of broiler chicks.

In this study, it was hypothesised that *Tribulus terrestris* powder would affect growth performance in broiler chicks because of absorbent feature of bentonite²³ and bounding feature of carboxymethylcellulose²⁴ and carrying feature of cotton oil for fat soluble substances in TT powder. For this reason, the effects of dietary TT powder carried in cotton oil, cellulose and bentonite on growth performance, carcass characteristics, thiobarbituric acid value (TBA) in breast meat and blood parameters of broiler chicks were investigated in detail.

MATERIAL and METHODS

The experiment was conducted by based on protocols by The University of Mustafa Kemal, Ethical Commission Report (No: 2009-4-12/40).

Basal diets were mainly based on corn and soybean. These diets included 3050 kcal kg⁻¹ ME and 239 g kg⁻¹ CP (for 1-10 days); 3150 kcal kg⁻¹ ME and 229 g kg⁻¹ CP (for 11-21 days); 3289 kcal kg⁻¹ ME and 209 g kg⁻¹ CP (for 22-42 days) (Table 1). Crude nutrients in feeds and experimental diets were analyzed using of AOAC²⁵ method. The levels of Metabolic Energy were calculated with the formula developed by TSE²⁶.

Whole parts (leaf, stem and prick without flowers) of *Tribulus terrestris* L. (Zygophyllaceae) (TT) collected from Mustafa Kemal University campus area in Serinyol-Hatay on July-August 2009 were used after dried and milled to get powder. Its fatty acids methyl ester composition was determined by using GC-MS (27) (Table 2).

Tribulus terrestris powder was mixed with bentonite at 50%, with cellulose at 50% and with cotton oil at 10% in weight basis. These rates were determined on the basis of getting unique colour and full coverage. TT powder + bentonite, TT powder + cellulose and TT powder + cotton oil weighed in falcon tubes and centrifuged on 3.000 rpm for 10 min after 10 min vortex vibration. Obtained feed supplement was observed in electron microscope to control its uniformity in particular level (JEOL-JSM-5500LV/ Japan; Fig. 1).

At the beginning of experiment, 192 day old male broiler chicks (Ross 308) were individually weighed and allocated into 12 experimental groups (control, 1 g TT, 2 g TT, 0.1 g cotton oil, 1 g TT with 0.1 g cotton oil, 2 g TT with 0.2 g

Table 1. Chemical composition of experimental broiler diets**Tablo 1.** Denemede kullanılan etlik civciv ve piliç yemlerinin kimyasal kompozisyonu

Feed Ingredients, %	Starter (1-10. day)	Grower (11-21. day)	Finisher (22-42. day)
Corn	52.5	48.3	42.4
Full fat soy	20.5	42.1	43.5
Soy bean meal (5% oil)	13	1.2	-
Corn gluten meal	5	-	-
Boncalit	-	-	3.1
Chicken meal	3.5	4	3.5
Meat-bone meal	3	1.3	1.5
Vegetable oil	-	-	3.1
Guar Flour	-	-	0.7
DCP	0.6	0.9	0.6
Lysine	0.4	0.3	0.1
Methionine	0.4	0.5	0.3
CaCO ₃	0.2	0.6	0.5
NaCl	0.2	0.2	0.2
NaHCO ₃	0.2	0.1	-
Vitamin premix *	0.3	0.2	0.2
Mineral premix **	0.2	0.3	0.3
Calculated Composition ***			
ME (kcal kg ⁻¹)	3050	3150	3289
Lysine, %	1.44	1.48	1.32
Methionine + systine, %	1.1	1.1	0.9
Ca, %	1.1	1.0	0.9
P (available), %	0.5	0.5	0.5
Analyzed Values, %			
Dry matter	90.60	89.54	90.68
Crude protein	23.91	22.89	20.93
Ether extract	8.59	11.73	12.38
Crude fibre	1.18	1.70	1.47
Crude ash	4.80	5.18	5.30

* Provides per kg of diet: Vitamin A 8000 IU, Vitamin D₃ 800 IU, Vitamin E 15 mg, Vitamin K₃ 2 mg, Vitamin B₁ 2 mg, Vitamin B₂ 4 mg, Vitamin B₁₂ 10 mg, ** Provides per kg of diet: Mn 80 mg, Zn 60 mg, Fe 25 mg, Cu 15 mg, Co 0.25 mg, I 1 mg, Se 0.2 mg, Mo 1 mg, Mg 50 mg, *** Calculated

cotton oil, 0.5 g cellulose, 1 g TT with 0.5 g cellulose, 2 g TT with 1 g cellulose, 0.5 g bentonite, 1 g TT with 0.5 g bentonite and 2 g TT with 1 g bentonite were added to per kg broiler diet) of equal mean body weight according to the experimental design given in Table 3. Each group included sixteen birds to make replications. Experiment lasted 42 days.

The experimental chicks were kept in individual cages (40×40×40 cm) with continuous 24 h day light and 19-24°C room temperature (a gradual decrease from 33°C for 3rd day old age to room temperature) in a poultry room. Feed

Table 2. Some fatty acid compounds of plant powder of *Tribulus terrestris***Tablo 2.** Demir diken (Tribulus terrestris) bitki tozunun bazı yağ asidi bileşenleri

% Area		Compound
1	35.99	C 16:0 Palmitic acid
2	3.96	C 18:0 Stearic acid
3	5.90	C 18:1 Omega 9 (Cis-9) Oleic acid
4	6.27	C 18:2 Omega 6 (Cis-8,11,14) Linoleic acid
5	47.88	C 18:3 Omega 3 (Cis-11,14,17) Linolenic acid

Table 3. Experimental design**Tablo 3.** Deneme modeli

Groups	Treatment (g kg ⁻¹ in diet)
1. Group	Feed without any carrier and supplement
2. Group	Feed contains 1 g TT without any carriers
3. Group	Feed contains 2 g TT without any carriers
4. Group	Feed contains 0.1 g cotton oil
5. Group	Feed contains 1 g TT with 0.1 g cotton oil
6. Group	Feed contains 2 g TT with 0.2 g cotton oil
7. Group	Feed contains 0.5 g cellulose
8. Group	Feed contains 1 g TT with 0.5 g cellulose
9. Group	Feed contains 2 g TT with 1 g cellulose
10. Group	Feed contains 0.5 g bentonite
11. Group	Feed contains 1 g TT with 0.5 g bentonite
12. Group	Feed contains 2 g TT with 1 g bentonite

* n=16

and water were available throughout the experimental period. Feed intake and body weight of broiler chicks were monitored weekly. Feed conversion ratio (g feed: g gain) were calculated for each individual bird for each week.

At 41-d age, 8 chicks for each group were used to collect blood samples from their wing veins to determine blood metabolites. Serum was separated from blood by centrifuge and kept -20°C until analyzing. The levels of total protein, cholesterol, glucose, triglyceride and calcium in serum were determined by using their own commercial kits (Diasis Diagnostic Systems) for spectrophotometer (Shimadzu, UVmini-1240) reading.

At 42 d-old, 8 birds from each group were slaughtered humanly for determination of the weights of body components (breast, leg, wing, abdominal fat pad, heart, liver, pancreas and duodenum) based on Ethical Commission Report (No: 2009-4-12/40). Slaughtering weight, carcass weight, carcass yield (g carcass weight x 100: g slaughtering weight) of chicks were recorded.

To determine oxidative deterioration in whole breast sample, the left part of breast meat was saved in +4°C and the other right part saved -18°C for TBA value analysis 3rd day and 21th day respectively²⁸.



Tribulus terrestris plant powder with bentonite

Tribulus terrestris plant powder with cellulose

Tribulus terrestris plant powder with oil

Fig 1. Images of *Tribulus terrestris* plant powder with bentonite, cellulose and oil on electron microscope

Şekil 1. Elektronmikroskopta bentonit, selüloz ve yağ içinde Demir dikenli bitki tozunun görüntüsü

The study design was a randomized factorial (4x3). Data were analysed using the GLM procedure of SAS²⁹ with Duncan's Multiple Range Test used to identify the significant differences between the respective means. Results are presented as means per bird with standard error of means (SEM)³⁰.

RESULTS

The results regarding growth performance, carcass characteristics and blood parameters of broiler chicks are shown in Table 4, 5 and 6. There was no effect of TT powder on feed intake, body weight gain and feed efficiency in broiler chicks during experimental period irrespective to carriers ($P>0.05$) (Table 4).

Carcass, breast, wings, heart, liver, pancreas and

duodenum yields and duodenum length were not affected by any treatment with respect to application, dose and application x dose interaction ($P>0.05$) (Table 5). As if slaughter weight seemed to differ among groups, however, the highest slaughter weight (2508 g, 2 g TT with cotton oil) was not different than control group. Cotton oil, irrespective to TT doses, improved legs yield about 1.5% per bird ($P<0.05$). TT decreased the abdominal fat pad in broiler chicks, except TT doses in cellulose ($P<0.01$). In generally, TT powder, irrespective to carriers, tended to decrease in heart, liver and pancreas yields without any significance. TBA value of breast meat was not affected by any treatments significantly (Table 5).

Plasma glucose, calcium, cholesterol, total protein and triglyceride were not affected by any treatment significantly ($P>0.05$) (Table 6).

Table 4. The effects of plant powder of *Tribulus terrestris* with different carriers on the growth performance of broiler chicks

Tablo 4. Rasyona farklı düzeylerde ve farklı materyallerle karıştırılarak eklenen Demir dikenli (*Tribulus terrestris*) bitki tozunun etlik civcivlerde büyüme performansı üzerine etkileri

Parameters	Puncture Vine (<i>Tribulus terrestris</i>) Powder Levels (g kg ⁻¹)												SEM	APP	DOSE	APP X DOSE
	Control			Bentonite			Cellulose			Cotton Oil						
	Dose															
	0	1	2	0	1	2	0	1	2	0	1	2				
IBW, g	39.2	38.9	39.3	39.0	38.9	39.5	39.4	39.0	39.4	39.0	39.5	39.3	0.09	0.84	0.24	0.38
FI (0-3), g	957.2	985.3	992.8	1024.2	1016.9	995.9	985.2	1020.9	1022.3	1029.5	1048.9	979.9	9.74	0.48	0.64	0.81
BWG (0-3), g	702.5	707.9	705.7	721.8	709.9	721.3	710.7	725.5	710.5	721.0	717.5	701.8	6.09	0.91	0.94	0.99
FCR (0-3)	1.36	1.39	1.41	1.42	1.43	1.38	1.39	1.41	1.44	1.43	1.46	1.40	0.01	0.82	0.76	0.70
FI (3-6), g	2906.0	2753.9	2762.4	2719.5	2836.9	2833.8	2686.2	2702.2	2973.5	2799.9	2896.1	2833.1	0.34	0.76	0.50	0.07
BWG (3-6), g	1816.5	1666.6	1637.6	1694.3	1665.6	1710.4	1635.8	1650.3	1835.6	1749.3	1719.9	1776.5	0.82	0.50	0.44	0.86
FCR (3-6)	1.60	1.65	1.69	1.61	1.70	1.66	1.64	1.64	1.62	1.60	1.68	1.59	0.60	0.66	0.26	0.61
FI (0-6), g	3863.2	3739.2	3755.2	3743.7	3853.8	3829.7	3671.4	3723.1	3995.8	3829.4	3945.0	3813.0	25.64	0.73	0.51	0.17
BWG (0-6), g	2519.0	2374.5	2343.3	2416.1	2375.5	2431.7	2346.5	2375.8	2546.1	2470.3	2437.4	2478.3	16.70	0.66	0.34	0.09
FCR (0-6)	1.53	1.57	1.60	1.55	1.62	1.57	1.56	1.57	1.57	1.55	1.62	1.54	0.01	0.93	0.12	0.61

IBW: Initial body weight, FI: Feed intake, BWG: Body weight gain, FCR: Feed conversion ratio, APP: Application

Table 5. The effects of plant powder of *Tribulus terrestris* with different carriers on the carcass characteristic and digestive parts of broiler chicks

Parameters	Puncture Vine (<i>Tribulus terrestris</i>) Powder Levels (g kg ⁻¹)												SEM	APP	DOSE	APP X DOSE
	Control			Bentonite			Cellulose			Cotton Oil						
	0	1	2	0	1	2	0	1	2	0	1	2				
SW, g	2529.2 ^a	2474.0 ^{abc}	2362.3 ^c	2524.5 ^a	2401.1 ^{abc}	2451.9 ^{abc}	2374.4 ^{bc}	2395.1 ^{abc}	2522.3 ^a	2480.5 ^{abc}	2473.6 ^{abc}	2508.0 ^{ab}	16.39	0.46	0.40	0.01
CY, %	72.3	72.5	75.2	73.4	76.0	74.3	74.3	74.9	73.8	77.4	72.9	73.3	0.50	0.81	0.98	0.35
Breast, %	26.4	25.2	26.1	25.2	25.6	25.0	26.2	26.4	26.5	26.8	25.4	26.1	0.22	0.38	0.67	0.88
Legs, %	19.8 ^{ab}	19.7 ^{ab}	20.7 ^{ab}	19.5 ^b	21.0 ^{ab}	20.2 ^{ab}	21.1 ^{ab}	21.4 ^a	20.8 ^{ab}	21.3 ^a	21.1 ^{ab}	20.2 ^{ab}	0.15	0.04	0.46	0.17
Wings, %	7.1	7.3	7.9	7.2	7.4	7.7	7.6	7.5	7.9	8.0	7.6	7.8	0.01	0.47	0.19	0.74
Abdominal fat pad, %	1.05 ^{bcd}	1.1 ^{bc}	1.02 ^{cd}	1.2 ^{ab}	1.3 ^a	0.9 ^d	1.02 ^{cd}	1.31 ^a	1.17 ^{abc}	1.01 ^{cd}	1.09 ^{bcd}	0.99 ^{cd}	0.02	0.01	0.001	0.01
Heart, %	0.68	0.65	0.59	0.60	0.59	0.68	0.64	0.63	0.68	0.64	0.59	0.62	0.01	0.65	0.40	0.21
Liver, %	2.50	2.23	2.49	2.22	2.52	2.46	2.40	2.26	2.50	2.50	2.38	2.37	0.03	0.99	0.42	0.13
Pancreas, %	0.26	0.25	0.22	0.24	0.25	0.28	0.26	0.26	0.25	0.26	0.26	0.25	0.01	0.80	0.87	0.33
Duodenum, %	0.69	0.78	0.67	0.67	0.76	0.73	0.75	0.69	0.77	0.79	0.73	0.68	0.02	0.86	0.77	0.23
Duodenum, cm	34.0	36.3	35.7	35.9	35.0	36.6	37.1	34.8	37.0	39.7	33.7	34.2	0.53	0.85	0.58	0.06
TBA (3 d)	0.044	0.058	0.038	0.027	0.041	0.044	0.049	0.044	0.040	0.028	0.045	0.053	0.003	0.67	0.26	0.41
TBA (21 d)	0.044	0.076	0.080	0.028	0.055	0.038	0.050	0.040	0.040	0.025	0.065	0.064	0.005	0.22	0.13	0.67

SW: Slaughter weight (g), CY: Carcass yield (%), TBA: Thiobarbituric acid (mgMA/kg), APP: Application, a-e: with no common superscript show the significant differences between treatments in chicks (P<0.05), Percentage data were obtained according to slaughter weights

Table 6. The effects of plant powder of *Tribulus terrestris* with different carriers on the plasma glucose, calcium, cholesterol, total protein and triglyceride of broiler chicks

Parameters	Puncture Vine (<i>Tribulus terrestris</i>) Powder Levels (g kg ⁻¹)												SEM	APP	DOSE	APP X DOSE
	Control			Bentonite			Cellulose			Cotton Oil						
	0	1	2	0	1	2	0	1	2	0	1	2				
Glucose, mg dl ⁻¹	244.6	242.4	240.2	246.8	249.3	255.1	243.4	234.7	233.4	239.2	231.5	255.2	4.21	0.76	0.86	0.97
Calcium, mg dl ⁻¹	16.4	16.0	18.2	16.3	16.2	16.6	16.5	17.4	16.5	17.8	16.6	18.4	0.35	0.82	0.68	0.93
Cholesterol, mg dl ⁻¹	115.4	128.2	119.9	128.3	111.0	112.7	112.5	113.6	113.4	119.5	120.6	110.9	2.41	0.79	0.73	0.70
Total Protein, g dl ⁻¹	2.4	2.4	3.3	2.9	3.6	3.0	3.1	2.4	3.2	3.3	3.1	2.9	0.09	0.45	0.65	0.26
Triglyceride, mg dl ⁻¹	76.9	75.7	74.8	73.6	66.0	73.0	77.9	77.5	68.1	67.9	68.0	72.2	2.40	0.86	0.94	0.99

APP: Application

DISCUSSION

Our study was planned to try improve primitive alternative feed additives to gain this purpose. TT powder may be a candidate for being an alternative feed additive. Its usage in broiler diets have been tested in poultry but the obtained results were not clear enough. For this reason, TT was used with bentonite, cellulose and cotton oil to investigate the possible effects on growth performance and blood parameters of broiler chicks. However the present results are similar when compared to the previous studies on TT ^{20,21}. These similar results may be explained as following; (a) the chosen carriers bentonite, cellulose and cotton oil may cover the possible effects of TT, (b) the effective substances in TT powder had not been released to intestine, (c) the chosen doses may be lower, (d) the age of broiler chicks were quite young and consequently the testosterone production of testes might be near to zero due to undeveloped testes as much as being affected by any dietary manipulation, and finally (e) the other constituents of broiler diet and environmental conditions were quite adequate without causing any dietary deficiencies.

Slaughter weight and carcass yield were not affected by treatments (Table 4). 120 ppm TT powder tended to decrease in breast weight without affecting slaughter weight in broiler chicks ²⁰ ($P>0.05$). There were no differences between treatment groups with respect to body components. However, cotton oil, irrespective to TT doses, improved legs yield about 1.5% ($P<0.01$). This might be related to the energy content of cotton oil with carrying effects of fat soluble vitamins to intestine.

Abdominal fat pad was decreased by the high level dose of TT with bentonite and increased by low and high levels of TT carried with cellulose. It may be explained the cover effects of cellulose on TT since TT in other carriers decreased abdominal fat content. This is expectable due to its hypoglycemic and hypocholesteromic effects of TT. However, there has been a contradiction between blood parameters and the biochemical effects of TT ^{17,18}.

TT powder (360 ppm) decreased carcass, liver and heart weights in comparison to control ²¹. In the current study, TT powder did not affect carcass body components.

In a previous study, it was tested that whether TT plant powder can be alternative for antibiotics in broiler chicks or not. Control diet consisted of 0.06% alfamine and 0.025% flavomycine and the other diets consisted of 4, 8 and 12 g TT plant powder. It was seen that carcass yield and feed conversion ratio were decreased but proventriculus, ileum and jejunum weights were increased by TT powder ²². When results compared, the effects of TT powders in different carriers have been still unclear. However, in the present study, no antibiotics were used and the performance of all experimental birds were similar as well as similarity with the previous studies in which antibiotics were used.

In the present study, there was no difference with regard to blood cholesterol and glucose levels among treatment groups ($P>0.05$). The current TT doses did not affect the metabolism of animals. This may be explained that the absorbed substances of TT powder to blood stream was not enough to affect the metabolism of chicks.

There has been a limited study in literature about investigating the effect of dietary plant extracts or powders on shelf life of TBA values. The effects of some medical and aromatic plants such as thyme, mint and fennel on TBA values of stored broiler meat ³¹. Even though TT has a antioxidative effect ¹⁵ TT powders did not affect TBA values in breast meat in the present study. This might be attributed to insufficient active substance in TT for antioxidant activity. Also, there has been no idea about the transferring of active chemicals to body parts. During or after absorption, the metabolic pathway of plant extracts, also, needs to be investigated in further *in vivo* and *in situ* studies.

In general, the insignificant differences may be explained by chemical characteristics of soil collected from, chemical composition of TT, the current plant powder level and the characteristics of present carrier materials. It can be suggested that when decided to use any herb as feed additive, first of all, its chemical extracts have to be identified and determined in quantity. Otherwise, researchers always make speculations and assumptions whether they could find any positive effects of medical and aromatic plants.

Finally, there has been still a need to investigate our huge variety of medical and aromatic plants to develop alternative feed supplements for animal nutrition.

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