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RESEARCH ARTICLE

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

Metin DURU * Ahmet ŞAHİN **

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* University of Mustafa Kemal, Faculty of Agriculture, Department of Animal Science, TR-31034 Hatay - TURKEY
** University of Ahi Evran, Faculty of Agriculture, Department of Animal Science, TR-40100 Kırşehir - TURKEY

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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. Bentonit 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 taşıyıcılarlarının denendiği çalışmalara ihtiyaç vardır.

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

İletişim (Correspondence)
+90 326 2455845/1343
durumet@gmail.com

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 prosessed 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 harmfull for human health. *Tribulus terrestris* (TT) powder may be natural feed additive of broiler chicks by increasing testosterone level muscle mass and body strength [1-3], most likely due to LH production [4,5].

Tribulus terrestris L. (Zygophyllaceae), called "demir dikeni" 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, carbonhydrate, protein, fructose, sucrose, sterodial saponins (protodioscin (0.17-6.49%) and protogracilin), glycosides and phytosteroids [6-12]. *Tribulus terrestris* powders or extracts have been commonly used in alternative medicine as diuretic, against colic pains, hypertension and hypercholesterolemia for treatment of erectile disfunction, diabetes, tumours, cardiovascular and respiratory diseases and control of blood pressure [13,14]. *Tribulus terrestris* has also an antioxidative effect [15]. Feed supplements containing TT extracts are also currently on sale in USA and Europe with claim of a general stimulating action [16].

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 hens [17] and decreased serum cholesterol level in guinea fowl [18], while increased reproductive performance in White Plymouth Rock-mini cocks [19]. Dietary TT extract (60 and 120 ppm, Ultimate Nutrition) did not decrease growh performance of broiler chicks when given to broiler chicks in commercial diet for 21 days suggesting that the higher TT dose trials are needed [20]. Dietary 360 ppm TT extract decreased liver and intestine (duodenum, ileum + jejunum) weights of broiler chicks [21]. Şahin [22] 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 hypotesised that *Tribulus terrestris* powder would affect growth performance in broiler chicks because of absorbent feature of bentonite [23] and bounding feature of carboxymethylecellulose [24] 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 AOAC [25] method . The levels of Metabolic Energy were calculated with the formula developed by TSE [26].

Whole parts (leaf, stem and prick without flowers) of *Tribulus terrestris L. (Zygophyllaceae*) (TT) collected from Mustafa Kemal Universty campus area in Serinyol-Hatay on July-August 2009 were used after dryed 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 bentonit 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 microscobe 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 D_3 800 IU, Vitamin E 15 mg, Vitamin K_3 2 mg, Vitamin B_1 2 mg, Vitamin B_2 4 mg, Vitamin B_{12} 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*

Table 2. *Some fatty acid compounds of plant powder of Tribulus terestris*
Tablo 2. *Demir dikeni (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 asid
4	6.27	C 18:2 Omega 6 (Cis-8,11,14) Linoleic asid
5	47.88	C 18:3 Omega 3 (Cis-11,14,17) Linolenic asid

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*

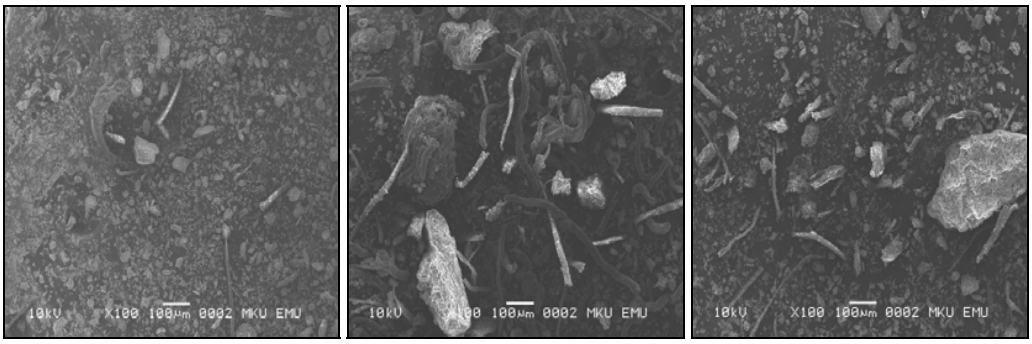
cotton oil, 0.5 g cellulose, 1 g TT with 0.5 g cellulose, 2 g TT with 1 g cellulose, 0.5 g bentonite, 1 g TT with 0.5 g bentonite and 2 g TT with 1 g bentonite were added to per kg broiler diet) of equal mean body weight according to the experimental design given in *Table 3*. Each group included sixteen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

The experimental chicks were kept in individual cages (40×40×40 cm) with continous 24 h day light and 19-24°C room temperature (a gradual decrease from 33°C from day old age to room temperature) in a poultry room. Feed 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 seperated from blood by centrifuge and kept -20ºC 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 +4ºC and the other right part saved -18ºC for TBA value analysis 3rd day and 21th day respectively [28].



Tribulus terestris plant powder with bentonite | *Tribulus terestris* plant powder with cellulose | *Tribulus terestris* plant powder with oil

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

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

The study design was a randomized factorial (4x3). Data were analysed using the GLM procedure of SAS [29] 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 different 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 significancy. TBA value of breast meat was not affected by any treatments significantly *(Table 5)*.

Plasma glucose, calcium, cholesterole, total protein and trigliceride were not affected by any treatment significantly (P>0.05) *(Table 6)*.

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

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

Parameters	Puncture Vine (*Tribulus terrestris*) 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 terestris with different carriers on the carcass characteristic and digestive parts of broiler chicks*

Tablo 5. *Rasyona farklı düzeylerde ve farklı materyallerle karıştırılarak eklenen Demir dikeni (Tribulus terrestris) bitki tozunun etlik civcivlerde karkas özellikleri ve sindirim sistemi bölümleri üzerine etkileri*

Parameters	Puncture Vine (*Tribulus terrestris*) 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				
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 terestris with different carriers on the plasma glucose, calcium, cholesterole, total protein and trigliceride of broiler chicks*

Tablo 6. *Rasyona farklı düzeylerde ve farklı materyallerle karıştırılarak eklenen Demir dikeni (Tribulus terrestris) bitki tozunun etlik civcivlerde plazma glukoz, kalsiyum, kolesterol, total protein ve trigliserid konsantrasyonları üzerine etkileri*

Parameters	Puncture Vine (*Tribulus terrestris*) 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				
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
Cholesterole, 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
Trigliceride, 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 constitutents of broiler diet and enviromental conditions were quite adequate without causing any dietary deficiencies.

Slaugther 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 hypoglicemic 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 jejenum 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 amoung 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 anti-oxidant activity. Also, there has been no idea about the transfering 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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