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Full Length Article

Effects of Dietary Strawberry (*Fragaria x ananassa*) Leaf Powder on Growth Performance, Body Components and Digestive System of Broiler Chicks

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ABSTRACT

The purpose of this study was to determine, the effects of dry strawberry (*Fragaria x ananassa Duch.*) leaves (SL) powder on growth performance, mortality rate and body components of broiler chicks. In total, 144 mixed sex male and female broiler chicks (1-d old) were used and divided into four treatment groups; 0 (control), 5, 10 and 20 g SL were added to per kg basal diet. Body weight and feed intake were recorded weekly and daily gain and feed conversion ratio were calculated weekly. Forty two days old broiler chick were humanly slaughtered to determine the possible changes in daily gain, body components and morphological changes in digestive parts. The results showed that SL had no effect on growth performance, body components and digestive parts in broiler chicks (P>0.05) with respect to any beneficial and detrimental effects, suggesting that SL powders can be used in broiler diets. © 2012 Friends Science Publishers

Key Words: Strawberry leaves; Broiler chicks; Body components; Digestive parts

INTRODUCTION

There has been a great tendency in use of plant extracts or powders in animal nutrition, because of the awareness of human and animal health. Commercially, plant powders and their extracts have been used in poultry nutrition has been widespread. The importance of plants extracts has been attributed to their effective physiological and pharmacological substances, natural antioxidants and trace mineral contents with vitamin presence. Researchers have found out alternative additives to improve growth performance in poultry production. Aromatic and medicinal plants are alternative mainly to growth promoter as antibiotics, but today they have not been studied enough for this purpose (Kutlu, 2007; Tuncer, 2007). They need to be studied more for residual free poultry and animal products. Plant extracts may improve feed efficiency, increase carcass quality, reduce slaughter age of broiler chick and decreased their breeding cost (Javed *et al.,* 2009). As a supplement or an additive, the vegetative parts of aromatic and medicinal plants are used to get powder or extracts to be included in the poultry diets. Only these plants but also some agricultural plants have a great potaintial to be used the same purpose, because of its aromatic and medicinal charactheristics. This kind of plants are lemon, orange, olive, strawberry and other endemic plants.

Strawberry leaf includes tannins, flavonoids, a small amount of ascorbic acid and essential oil. Flavonoids are antioxidant compounds neutralize harmful effects of previously consumed substances in the body, especially in liver, adipose tissue and epithel tissue. Strawberry leaves are used as appetiser, cholesterol and blood pressure lowering, gastrointestinal disorders, diuretic, stricture, get strong of sight and tooth, expel kidney stones and intestinal worms, anemia, hepatisis, strengthen nerve and immune system, intestinal and liver activity, diarrhoea suppressant, arthritis and speeding up metabolism in folk medicine (Kümeli, 2006; Anonymous, 2010, 2011a, b).

Many human diseases are caused or negatively affected by free radicals. The natural defense of the human organism againts free radicals is not always sufficient mainly due to the significant exposition to free radicals from external sources in the modern world. The dietary intake of antioxidants plays an important role in the protection of the human organism againts free radicals. Many clinical and epidemiological studies show a connection between the antioxidant activity of the substances present in the diet and the prevention from such diseases as cardiovascular diseases or carcinogenesis (Hughes, 2000; Kris-Etherton *et al*., 2002; Lindsay & Astley, 2002). In broiler production the sudden death sendrom usually occurs when the chick weights higher than 3.0 kg in finisher period. There has been a limited study the effects of antioxidants sources on chick heart health.

World strawberry production has dramatically increased in recent years. Strawberry production was

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4.178.152 tonnes in 2009, while it was 3.996.813 tonnes in 2007 in the World (FAOstat, 2009). For example, in Turkey, the strawberry production was 150.000 tonnes in 2003 but it was 299.940 tonnes in 2010 (TUİK, 2010). However strawberry leaves have not been used efficiently; expect vegetative turf material in soil fertilisation. When literature are investigated in detail, these agricultural by product have not been used in animal nutrition even though it has a great potential to be used as feed additive in livestock diets due to its multifunction properties as given above.

According to the study of Wang and Lin (2000), leaves from strawberry (*Fragaria x ananassa D.*) plants were analyzed for total antioxidant capacity (oxygen radical absorbance capacity, ORAC) and total phenolic content. Strawberries had the highest ORAC values during the green stages. Compared with fruits, leaves were found to have higher ORAC values. In leaves, ORAC valuıes ranged from 67.9 to 182.2 μmol of TE/g of fresh leaves (205.0-728.8 μmol of TE/g of dry matter). As the leaves become older, the ORAC values and total phenolic contents decreased. The results showed a linear correlation between total phenolic content and ORAC activity for fruits and leaves.

Strawberry leaves as a source of bioactive compounds with potentially beneficial biological effects have been largely overlooked. Mudnic *et al.* (2009) examined direct, dose-dependent effects of wild strawberry (*Fragaria vesca, L.*) leaves aqueous extract, in two experimental models and animal species, the isolated guinea pig hearts and rat aortic rings. Vasodilatory potential of the wild strawberry leaves extract was compared with vasodilatory activity of aqueous extract of hawthorn (*Crataegus oxycantha, L.*) leaves with flowers, which can be regarded as a reference plant extract with a marked vasodilatory activity. Both extracts induced similar, dose-dependent vasodilation. Maximal relaxation was 72.2±4.4% and 81.3±4.5%, induced by the strawberry and hawthorn extract, respectively. To determine vasodilatory mechanisms of the wild strawberry leaves extract, endothelium-denuded and intact rings exposed to nitric oxide synthase inhibitor L-NAME or cyclooxygenase inhibitor indomethacin were used. In the isolated hearts, the wild strawberry extract was applied at concentrations of 0.06, 0.18, 0.6, and 1.8 mg/100 mL. Heart contractility, electrophysiological activity, coronary flow and oxygen consumption were continuously monitored. The extract did not significantly affect heart rate and contractility, main parameters of the cardiac action that determine oxygen demands, while coronary flow increased up to 45% over control value with a simultaneous decrease of oxygen extraction by 34%. Their results indicate that the aqueous extract of wild strawberry leaves is a direct, endothelium-dependent vasodilator, action of which is mediated by NO and cyclooxygenase products and which potency is similar to that of the hawthorn aqueous extract.

Therefore, his study was carried out to investigate the possible effects of strawberry leaves (SL) on growth performance, mortality reasoned by cardiovascular diseases, body components and digestive system of broiler chicks.

MATERIALS AND METHODS

One day-old mixed sex 144 commercial type broiler chicks (Ross-308) were obtained. They were individually weighed, kept in floor pens (1.4 × 1.4 m) in a chicken chamber and allocated into four dietary groups of equal body weight (control, 5, 10 & 20 g SL groups), treatment groups included 36 birds, which were sub-divided into by three for 3 replication and each included 12 birds.

Strawberry leaves were used after dried and powdered with 1 mm sieve opening mill. The experimental diets were prepared by adding SL powder at the levels of 0 g kg^{-1} (control), 5, 10 and 20 g to the basal (commercial) diet containing 3171 kcal ME kg^{-1} with 234 g CP (for 1-10 days); 3143 kcal ME kg^{-1} with 229 g CP (for 11-21 days); 3172 kcal ME kg^{-1} with 199 g CP (for 22-34 days); 3116 kcal ME kg^{-1} with 182 CP (35-41 days) (Table I).

Feed and water were available *ad libitum* throughout the study. In experimental poultry house, continuous 24 h day light with 33-19°C ambient temperature (reducing to 19°C gradually) was obtained for 41 days. Growth performance was recorded on weekly basis with a sensitive scale (±1 g). At the end of study, when experimental birds were 42-d old, 12 birds (6 males, 6 females) for each group were slaughtered humanly for the determination of body components and digestive parts. During experimental period, the incidences of mortalities were recorded.

The data concerning growth performance, body components and digestive parts were analysed using the One Way ANOVA procedure of SPSS (Windows version of SPSS, release 11.0). Duncan's Multiple Range Test in the same software was used to identify the significant differences between the respective means. Results obtained in this study are presented as means per bird with the standard error of means (SEM).

RESULTS

The results regarding growth performance, body components and digestive parts of broiler chicks are given in Table II, III and IV. Feed intake, body weight gain and feed conversion ratio were not affected significantly by SL powder in broiler chicks during experimental period ($P>0.05$). The lowest feed efficiency (1.77) in 5 SL powder group but was not different than control group ($P>0.05$) (Table II).

According to Table II, 10 g SL powder decreased feed intake about 230 g per bird in economical manner. This reflected the less body gain about 110 g per bird at the end of growing period. This insignificant effect did not affect growth performance but it would prevent sudden death problem in commercial broiler flocks.

Table I: Nutritional composition of feed ingredients in present study

Feed Ingredients (%)	Starter (1^{st}-10^{th} days)	Grower 1 (11^{st}-21^{st} days)	Grower 2 (22^{nd}-34^{th} days)	Finisher (35^{th}-41^{st} days)
Corn	47.0	47.0	54.0	57.0
Full fat soya	32.0	32.0	20.0	15.0
Soybean meal	8.0	8.0	15.3	14.0
Fish meal	4.0	2.0	-	-
Corn gluten meal	4.0	4.0	2.0	1.9
Boncalite	0.9	2.9	2.0	6.3
Vegetable oil	-	-	2.0	1.5
DCP	2.0	2.0	2.5	2.4
$CaCO_3$	0.5	0.5	1.0	1.0
Methionine & Lysine	0.4 & 0.4	0.4 & 0.4	0.2 & 0.2	0.2 & --
$NaHCO_3$ & NaCl	0.2 & 0.3	0.2 & 0.3	0.2 & 0.3	0.1 & 0.3
Premix*	0.3	0.3	0.3	0.3
Calculated composition %				
ME, kcal kg^{-1}	3171	3143	3172	3116
Crude protein	23.4	22.9	19.9	18.2
Lysine, %	1.2	1.10	1.0	0.85
Methionine+systine, %	1.90	0.9	0.75	0.60
Ca, %	1.00	1.00	1.00	1.00
P (available), %	0.70	0.70	0.65	0.60

*Per kg diet included 8000 IU Vitamin A, 800 IU Vitamin D_3, 15 mg Vitamin E, 2 mg Vitamin K_3, 4 mg Vitamin B_2, 10 mg Vitamin B_{12}, 80 mg Mn, 60 mg Zn, 25 mg Fe, 15 mg Cu, 0.25 mg Co, 1 g Iodine, 0.2 mg Se

Table II: Effects of dietary SL powder on growth performance of broiler chicks

Parameters, g $bird^{-1}$	SL powder, g kg^{-1}				SEM	P
	Control	5	10	20		
Initial body weight (g)	39.44	39.95	39.69	39.92	0.14	0.57
Weight gain (g/day)	62.0	60.5	59.4	58.2	0.79	0.41
Feed intake (g/day)	111.4	107.3	105.7	107.1	1.13	0.35
1-21 d						
Body weight at 21 d	895.2	840.1	862.0	885.6	8.41	0.99
Feed intake	1445.7	1271	1345.3	1431.3	31.33	0.16
Body weight gain	855.8	800.1	822.3	845.7	12.75	0.47
FCR (g feed: g gain)	1.69	1.59	1.64	1.69	0.02	0.28
22-42 d						
Feed intake	3121.7	3128.3	2988.4	2959.8	50.30	0.56
Body weight gain	1686.2	1680.4	1613.1	1540.5	39.85	0.51
FCR (g feed: g gain)	1.85	1.86	1.85	1.92	0.02	0.80
1-42 d						
Body weight at 42 d	2581.4	2520.5	2475.1	2426.1	32.66	0.41
Feed intake	4567.4	4399.3	4333.7	4391.1	52.59	0.75
Body weight gain	2542	2480.5	2435.4	2386.2	37.77	0.55
FCR (g feed: g gain)	1.80	1.77	1.78	1.84	0.02	0.55

*SEM: Standard error of difference between means

Slaughter weight, carcass, breast, legs, wings, liver, heart and abdominal fat pad weights and yields were not affected by any treatment with respect to control group (P>0.05) (Table III). Use of 20 g SL powder improved legs yield about 0.7% per bird but was not effected by any treatments significantly (P>0.05). High level dose of SL powder increased abdominal fat pad but this increase was not statistically significant (P>0.05). Use of 5 g SL powder tended to increase the weights of crop and proventriculus compared to control (P>0.05) (Table IV).

Weekly live weight gain and weekly cumulative feed intake obtained during the experimental period were given in Fig. 1 and 2, respectively. These data show that during experimental period, treatment groups did not differ than control group.

Table III: Effects of dietary SL powder on body components of broiler chicks

Parameters, g $bird^{-1}$	SL powder, g kg^{-1}				SEM	P
	Control	5	10	20		
Slaughter weight (g)	2721.4	2565.9	2542.8	2656.8	42.07	0.42
Carcass weight	2049.2	1916.3	1896.5	1996.3	32.68	0.32
Carcass yield (%)	75.30	74.68	74.58	75.14	0.22	0.64
Breast weight	682.7	630.3	630.5	644.5	12.17	0.39
Breast yield (%)	25.09	24.56	24.80	24.26	0.20	0.51
Legs weight	558.8	525.7	519.3	564.2	10.66	0.34
Legs yield (%)	20.53	20.49	20.42	21.24	0.15	0.18
Wings weight	222.0	204.8	210.0	216.8	3.87	0.43
Wings yield (%)	8.16	7.98	8.26	8.16	0.10	0.81
Liver weight	57.5	51.3	52.7	57.0	1.15	0.15
Liver yield (%)	2.13	2.00	2.07	2.15	0.03	0.36
Heart weight	14.7	13.3	16.0	15.6	0.45	0.15
Heart yield (%)	0.54	0.52	0.63	0.59	0.02	0.09
Abdominal fat pad weight	37.3	35.7	34.7	39.8	1.37	0.59
Abdominal fat pad yield (%)	1.37	1.39	1.36	1.50	0.06	0.88

*SEM: Standard error of difference between means
**Weight: g
***Percentage data were obtained according to slaughter weights

Table IV: Effects of dietary SL powder on digestive parts of broiler chicks

Parameters, g $bird^{-1}$	SL powder, g kg^{-1}				SEM	P
	Control	5	10	20		
Crop weight	9.6	10.4	9.2	9.2	0.34	0.54
Crop yield (%)	0.35	0.41	0.36	0.35	0.01	0.45
Proventriculus weight	9.4	10.6	9.4	10.8	0.24	0.06
Proventriculus yield (%)	0.35	0.41	0.37	0.41	0.01	0.17
Gizzard weight	43.8	42.3	43.5	44.9	4.09	0.67
Gizzard yield (%)	1.61	1.65	1.71	1.69	0.03	0.72
Pancreas weight	6.19	5.88	5.18	6.48	0.27	0.39
Pancreas yield (%)	0.23	0.23	0.20	0.24	0.01	0.12
Intestine length	187.8	186.3	187.9	188.5	1.68	0.98
Intestine weight, empty	64.9	62.3	60.2	63.1	0.86	0.25
Intestine yield (%)	2.38	2.43	2.37	2.38	0.04	0.97
Duedonum weight	12.8	10.5	11.3	12.6	0.40	0.11
Duedonum yield (%)	0.47	0.41	0.44	0.47	0.02	0.36
Duodenum length	30.7	29.4	32.2	32.6	0.55	0.14
Ileum+Jejunum weight	52.1	51.8	48.9	50.5	0.68	0.33
Ileum+Jejunum yield (%)	1.91	2.02	1.92	1.90	0.03	0.65
Cecum weight	7.6	6.9	7.1	7.5	0.24	0.69
Cecum yield (%)	0.28	0.27	0.28	0.28	0.01	0.96
Colon weight	5.4	5.1	4.8	4.9	0.24	0.81
Colon yield (%)	0.20	0.20	0.19	0.18	0.01	0.96

*SEM: Standard error of difference between means
**Length: cm, Weight: g
***Percentage data were obtained according to slaughter weights

DISCUSSION

There has been no information in literature on the component of SL powder on growth performance, body components and digestive parts in broiler chicks as having no data on other farm animals. In the present study, it was hypothesized that beneficial content of strawberry leaf powder may enhance the health status of broiler chicks reflecting to growth performance and liveability.

Fig. 1: Weekly live weight gain changes of broiler chicks treated with SL powder

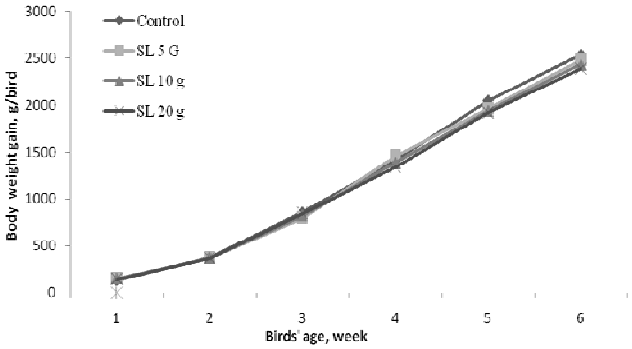
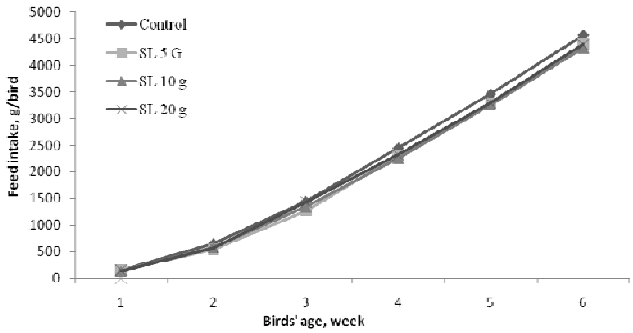


Fig. 2: Weekly cumulative feed intake of broiler chicks treated with SL powder



Katalinic *et al.* (2006) reported that strawberry leaves total phenolic content (related to antioxidant capacity) was found quite strong when measured with the FRAP assay. The antioxidant capacity of strawberry leaves was 123.0 mg/g (Buricova & Reblova, 2008). Mazzio and Soliman (2009) reported that strawberry leaf is has anti-cancer effect and can be one of the alternative medicines. Modun *et al.* (2007) suggested that strawberry leaves (*Fragariae herba folium*) are valuable source of bioactive phytochemicals with potentially beneficial effects on cardiovascular system. Mudnic *et al.* (2009) researched that vasodilatory potential of the wild strawberry leaves aqueous extract was compared with vasodilatory activity of aqueous extract of hawthorn (*Crataegus oxycantha* L.) leaves with flowers, which can be regarded as a reference plant extract with a marked vasodilatory activity. Wild strawberry (*Fragaria vesca* L.) leaves extract doses in two experimental models and animal spices, the isolated guinea pig hearts and rat aortic rings. At the end of this study that the aqueous extract of wild strawberry leaves is a direct, endothelium-dependent vasodilator, action of which potency is similar to the hawthorn aqueous extract. In general, broiler chicks died by sudden death syndrome contributing to heart failure. However, we could not find anything about the effects of SL on mortality rate since there was no difference between control and treated birds with respect to death in the last period of growing period (finishing). Our chicks were all healthy. The was no record of death.

In conclusion, SL did not affect growth performance, body components and digestive parts. The organoleptic properties of SL doses might be investigated in future so that their effect on appetite can be clearer than those in the current study. The insignificant differences might be attributed to the low levels of SL powders. Higher doses of SL with chemical content may be studied further in animal nutrition especially with respect to aromatic and medicinal value to get added value of broiler meat on the concept of functional meat having high content of antioxidant and other beneficial substances.

REFERENCES

Anonymous, 2010. *Çilek Kanserden Koruyup Kuvvet Veriyor*. www.kanser-tedavisi.net/cilek-kanserden-koruyup-kuvvet-veriyor. Accessed: August 6, 2011

Anonymous, 2011a. *Strawberry Leaf Profile*. www.mountainroseherbs.com/learn/strawberry_leaf.php. Accessed: July 4, 2011

Anonymous, 2011b. *Çilek Yaprağı Ne İşe Yarar? Faydaları Nelerdir?* www.kanserinbelirtileri.com/cilek-yapragi-ne-ise-yarar-faydalari-nelerdir.html. Accessed: July 6, 2011

Buricova, L. and Z. Reblova, 2008. Czech medicinal plants as possible sources of antioxidants. *Czech J. Food Sci*., 26: 132–138

FAO Stat, 2009. http://faostat.fao.org/site/567/DesktopDefault.aspx. Accessed: August 8, 2011

Hughes, D.A., 2000. Dietary antioxidants and human immune function. *Nutr. Bull.*, 25: 35–41

Javed, M., F.R. Durrani, A. Hafeez, R.U. Khan and I. Ahmad, 2009. Effect of aqueous extract of plant mixture on carcass quality of broiler chicks. *ARPN J. Agric. Biol. Sci.*, 4: 37–40

Katalinic, V., M. Milos, T. Kulisic and M. Jukc, 2006. Screening of 70 medicinal plant extracts for antioxidant capacity and total phenols. *Food Chem.*, 94: 550–557

Kris-Etherton, P.M., K.D. Hecker, A. Bonanome, S.M. Coval, A.E. Binkoski, K.F. Hilpert, A.E. Griel and T.D. Etherton, 2002. Bioactive compounds in food: Their role in the prevention of cardiovascular disease and cancer. *American J. Med.*, 133: 71–88

Kutlu, H.R., 2007. *Büyüme Uyarıcı Antibiyotiklere Karşı Seçenek Aranıyor*. www.cu.edu.tr/Content/Asp/Turkish/duyuru.asp?id=9384. Accessed: February 13, 2007

Kümeli, T., 2006. *Flavonoidler Nasıl Koruyor?* www.milliyet.com.tr/extra/venus/vitamin/vit001/axvitamin02.html. Accessed: May 26, 2011

Lindsay, D.G., Astley, S.B., 2002. European research on the functional effects of dietary antioxidants. *Mol. Aspects Med.*, 23: 1–38

Mazzio, E.A. and F.A. Soliman, 2009. In vitro screening for the tumoricidal properties of international medicinal herbs. *Phytother. Res.*, 23: 385–398

Modun, D., I. Music, J. Vukovic, I. Brizic, V. Katalinic, T. Bilusic and M. Boban, 2007. Antioxidative capacity and vasodilatatory activity of strawberry leaves extract. *Proc. 5th Croatian Congress of Pharmacology and 2nd Congress of Croatian Physiological Society,* p: 135. Osijek, Croatia

Mudnic, L., D. Modun, I. Brizic, J. Vukovic, I. Generalic, V. Katalinic, T. Bilusic, I. Ljubenkov and M. Boban, 2009. Cardiovascular effects in vitro of aqueous extract of wild strawberry (*Fragaria vesca*, L.) leaves. *Phytomedicine*, 16: 462–469

SPSS, 2001. *SPSS for Windows.* Release 11.00 Version. SPSS Inc., USA

TUİK, 2012. *Diğer Meyveler*. http://www.tuik.gov.tr/VeriBilgi.do?tb_id=45&ust_id=13. Accessed: April 26, 2012

Tuncer, H.I., 2007. Karma yemlerde kullanımı yasaklanan hormon, antibiyotik, antikoksidiyal ve ilaçlar. *Lalahan Hayvancılık Araştırma Enstitüsü Dergisi*, 47: 29–37

Wang, S.Y. and H.S. Lin, 2000. Antioxidant activity in fruits and leaves of blackberry, raspberry and strawberry varies with cultivar and developmental stage. *J. Agric. Food Chem*., 48: 140–146

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