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Effect of Seed Powder of a Herbal Legume Fenugreek (*Trigonella foenum-graceum* L.) on Growth Performance, Body Components, Digestive Parts, and Blood Parameters of Broiler Chicks

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Abstract.- The aim of this study was to investigate the effects of dietary *Trigonella foenum-graceum* L. seed powder (TFGSP) on growth performance, blood glucose, protein and lipid profile of broilers (Ross-308). One hundred ninety two, 1-d old mixed sex broiler chicks were allocated to 5 dietary treatments in which 0, 5, 10, 20 and 40 g TFGSP doses per kg commercial broiler diet were added for a period of 42 days. The results showed that body weight and the breast weight decreased after TFGSP treatment compared to control ($P<0.05$). Feed intake decreased after 5 g TFGSP treatment while 40 g TFGSP treatment decreased feed efficiency and leg weight compared to control ($P<0.01$). There was no significant difference in weights of digestive system parts, except duodenum weight and lipid oxidation between control and treatment groups. A 20 g TFGSP treatment enhanced blood glucose level ($P<0.01$), but decreased triglyceride level ($P<0.01$) compared to control. At 40 g TFGSP the blood cholesterol decreased ($P<0.05$) but LDL level increased compared to control ($P<0.01$). In conclusion, TFGSP addition to broiler diet decreased appetite and, consequently, reduced growth performance, more likely, attributting to the enhanced blood glucose level.

Key words: *Trigonella foenum-graceum* L., broiler chicks, lipid oxidation, blood parameters.

INTRODUCTION

Recently, growth promoters have been banned in animal nutrition, although use of some anticoccidials is allowed until 2014 in developed countries. Plant extracts are alternative to antibiotic and anticoccidials, but they have not been used effectively so far due to lack of sufficient studies (Kutlu, 2007; Tuncer, 2007). There has been an increasing trend towards using natural feed additives in the world.

Trigonella foenum-graecum L. (TFG) growing naturally in sandy, alluvial and clay soils is generally distributed in North Africa, Eastern Mediterranean and is cultivated all over the World (Anonymous, 2011a). TFG, an annual legume, is one of the herbs having multi-functional characteristics (Anonymous, 2011b; Mehrafari *et al.*, 2011). In folk medicine, TFG is used as an appetiser (Anonymous, 2011a). Previously, it has also been reported to have anti-microbial hypoglycemic, hypolipidemic, hypocholestoremic and antioxidant effect on animals (Petit *et al.*, 1993; Stark and Madar, 1993; Ajabnoor and Tilmisany, 1998; Devasena and Menon, 2002; Hannan *et al.*, 2003; Thirunavukkarasu *et al.*, 2003; Xue *et al.*, 2007). Nazar and El Tinay (2007) reported that its seeds contained 28.4% protein, 9.3% crude fibre and 7.1% crude fat. TFG seeds contain 7.5% total lipids, of which neutral lipids constituted 84.1%, glycolipids 5.4% and phospholipids 10.5% (Leela *et al.*, 2008). Whole TFG seed contains about 1.7-4.8% saponins (Anonymous, 2003, 2007).

TFG seed has many chemical compounds *viz.*, N, N'-dicarbazyl, glycerol monopalmitate, stearic acid, beta-sitosteryl glucopyranoside, ethyl-alpha-D-glucopyranoside, D-3-O-methyl-chiroinsitol and sucrose (Shang *et al.*, 2002), flavonoids vitexin, tricin, naringenin, quercetin and tricin-7-O-beta-D-glucopyranoside (Shang *et al.*,

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1998), saponins Xa, Xb, XIb, XIIa, XIIb, XIIIa, Ia, Ib, and Va, glycoside D, trigonelloside C, and compound C (Murakami *et al*., 2000), Iia, Iib, IIIa, IIIb, glycoside D and trigofoenoside A (Yoshikawa *et al*., 1997).

Petit *et al.* (1993) reported that oral administration of TFG seed extract (10 and 100 mg/day per 300 g body weight) enhanced feed intake with motivation to eat in rats and also induced hyperinsulinemia and hypocholesterolemia. Petit *et al*. (1995) reported that TFG seed extract containing steroid saponins increased feed intake and hypocholesterolemia in rats. In addition, Nakhla *et al*. (1991) investigated the effects of TFG seed saponins in Hisex-type chicks and observed saponin administration depressed body weight.

Abbas (2010) reported that 3 g/kg TFG seed decreased body weight at day 42 compared to control, though carcass characteristics remained unchanged. Dietary TFG seeds decreased plasma cholesterol in 42 day old broilers. Şahin *et al*. (2003) however, has reported no effect of TFG on appetite and growth of Awassi lambs. Since no sufficient data exists on the effect of fenugreek seed on growth performance, body components, digestive parts, and blood parameters of broiler chicks, the current study was undertaken to investigate the effects of TFG seed powder on these parameters of broiler chicks.

MATERIALS AND METHODS

One hundred and ninety two, one day-old commercial broiler type chicks (Ross-308) were purchased from a commercial hatchery. They were individually weighed and kept, in floor pens (1.4 m x 1.4 m) in a chicken chamber. They were divided into five dietary treatments with 3 replicates depending on equal mean body weight (39.8±1.8 g per bird). The control group comprised 36 birds and the treatment group each had 39 chicks.

TFGSP were analysed chemically to determine crude protein (AOAC, 2002). The experimental diets were prepared by adding TFGSP as 0 (control), 5 , 10 , 20 and 40 g kg^{-1} to the basal (commercial) diet containing 3171 kcal metabolic energy (ME) kg^{-1} with 234 g crude protein (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 (for 22-34 days), and 3116 kcal ME kg^{-1} with 182 CP (35-42 days) (Table I). The levels of ME were calculated with the formula developed by TSE (1991).

$$ME\ (kcal\ kg^{-1}) = 35.2\ CP + 78.5\ EE + 41\ S + 35.5\ Su$$

ME, metabolic energy; CP, Crude protein (%), EE, ether extract (%); S, starch (%), Su, sugar (%).

Feed and water were offered *ad libitum* throughout the study. In experimental poultry house, continuous 24 h day light and 19-33 C ambient temperature (reducing to 19 C gradually) was obtained for 42 days. Feed intake and body weight were recorded weekly with a sensitive scale (±1 g). Body weight gain (BWG) and feed conversion ratio (FCR) was calculated for each replication during the experimental period.

FCR = Total feed intake / Total body weight gain

BWG = Body weight – Initial weight

On 41-d, blood samples were collected from wing veins of 8 birds from each group. Serum was separated from blood samples by centrifugation at 3000 rpm and kept at -20ºC until analyzed using commercial kits (Diasis Diagnostic Systems) for determination of glucose, triglyceride, total protein, total cholesterol, HDL cholesterol and LDL cholesterol.

On 42-d old, 12 birds (6 ♀, 6 ♂) from each group were slaughtered for determining weights (g) of leg, wing, breast, abdominal fat pad, liver, heart, pancreas, gizzard, intestine, duodenum.

For determination of oxidative deterioration, breast, legs and skin samples were stored at +4 ºC for thiobarbituric acid reacting substances (TBARS) analysis on 1^{st}, 5^{th} and 10^{th} day of shelf life (Tarladgis *et al*., 1960).

The data were analysed by using the GLM procedures of SPSS (11.0). Duncan Multiple Range Test was used to identify the significant differences between the respective means±SEM.

Table I.- Nutritional composition of different types of feed used in the 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
Mineral and Vitamin premix*	0.3	0.3	0.3	0.3
Culculated composition %				
ME, kcal kg^{-1}	3171	3143	3172	3116
Crude protein	23.4	22.9	19.9	18.2
Lysine, %	1.2	1.10	1.00	0.85
Methionine + systine, %	1.90	0.90	0.75	0.60
Ca, %	1.00	1.00	1.00	1.00
P (available).%	0.70	0.70	0.65	0.60
Fenugreek (TFG), analysed				
Crude protein, %	27.37			

*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

RESULTS

The effect of TFGSP on growth performance, body parts, digestive morphology and TBARS values are given in Tables II and III. TFGSP (5, 20, 40 g kg^{-1}) decreased 42-d old body weight in comparison to control group ($P<0.05$). TFGSP reduced daily gain as seen final weights ($P<0.05$). Feed intake, body weight gain and breast weight decreased by 5 g TFGSP treatment compared to control ($P<0.05$). 20 and 40 g TFGSP treatment caused poor feed efficiency ($P<0.05$). Carcass weight reduced in 20 and 40 g TFGSP birds ($P<0.01$) but this result did not reflected to carcass yield ($P>0.05$).

High doses of TFGSP significantly reduced breast, legs and wings weights ($P<0.05$). 5, 20 and 40 g TFGSP decreased wings weight compared to control group ($P<0.05$). 20 and 40 g TFGSP tended to numerically decrease abdominal fat pad without any statistical difference. A 40 g TFGSP tended to improve intestine morphology by increasing intestine length, intestine weight, duodenum lenght and weight. A 40 g TFGSP, evidently, lowered the weight of liver which was not statistically significant. Pancreas weight was tended to increase by TFGSP treatment. Other parameters were not affected by TFGSP treatments.

Digestive parts and TBARS values are given in Table III. These parameters were not affected by TFGSP treatments.

Blood parameters of broiler chicks are shown in Table IV. 20 g TFGSP treatment enhanced glucose ($P<0.01$) but decreased triglyceride content of blood as compared with control ($P<0.01$). High doses of TFGSP were significantly decreased total cholesterol ($P<0.05$) but increased LDL level ($P<0.01$).

DISCUSSION

Most studies on TFG have been carried out to explore its chemical content under *in vitro* conditions in rats rather than its physiological

Table II.- Effects of TFG seed powder on growth performance of broiler chicks.

Parameters (g per bird)	TFG seed powder, g kg^{-1}					SEM	P
	0	5	10	20	40		
Growth performance							
Feed intake (g/day)	111.4	101.6	104.7	106.3	106.0	1.25	0.150
Weight gain (g/day)	62.0^{a}	56.0^{b}	57.6^{ab}	55.8^{b}	53.9^{b}	0.95	0.040
1-21 d							
Body weight (21-d)	895.2^{a}	841.4^{ab}	833.3^{ab}	836.1^{ab}	765.4^{b}	14.05	0.026
Feed intake	1445.7	1362.7	1351.4	1458.2	1457.1	19.99	0.100
Body weight gain	855.8^{a}	797.3^{ab}	788.0^{ab}	791.7^{ab}	723.0^{b}	14.05	0.025
FCR (feed:gain)	1.69^{b}	1.71^{b}	1.71^{b}	1.84^{ab}	2.02^{a}	0.05	0.046
22-42 d							
Feed intake	3121.7	2802.9	2941.3	2900.1	2888.9	40.64	0.175
Body weight gain	1686.2	1498.7	1573.6	1496.1	1486.9	29.45	0.157
FCR (feed:gain)	1.85	1.87	1.87	1.94	1.94	0.02	0.536
1-42 d							
Body weight (42-d)	2581.4^{a}	2340.1^{b}	2406.9^{ab}	2332.2^{b}	2252.3^{b}	39.07	0.048
Feed intake	4567.4	4165.6	4292.7	4358.3	4346	50.33	0.158
Body weight gain	2542^{a}	2296.0^{b}	2361.6^{ab}	2287.8^{b}	2209.9^{b}	39.11	0.049
FCR (feed:gain)	1.80^{b}	1.81^{b}	1.82^{b}	1.91^{ab}	1.97^{a}	0.02	0.029

*: SEM: Standard error of difference between means.
a, b: Means in the same row with different superscript letters are significantly different (P<0.05).

effects *in vivo* conditions in farm animals. There have been a few studies on broiler chicks regarding fenugreek seed (Abdel-Rasoul and Yousif, 2003; Abbas, 2010). Nahkla *et al.* (1991) have reported decrease of body weight after administration of TFG seed saponins (500 mg kg^{-1}) in drinking water. In the present experiment, TFG seeds had no significant effect on body weight. TFGSP (20 and 40 g) also showed reduction tendency for abdominal fat pad weight in comparison to control, 5 and 10 g TFGSP treatments.

Abaza (2007) observed that fenugreek seed powder reduced feed intake in Matrouh laying hens. Abbas (2010) found that it decreased feed consumption in broiler chicks. Ullah Khan *et al.* (2009) reported that TFG seed extract had no impact on visceral organs (liver, heart, gizzard, and intestines) of broiler chicks. Fenugreek seeds had no significant effect on slaughter characteristics (carcass, liver, spleen, heart, and gizzard) in Mandarah hens (Awadein *et al*., 2010) as found in this study. In order to see the physiological effects of fenugreek seed powder, longer experimental period will be required since 42 days growing period allowed birds to overcome the possible effects of dietary manipulation due to faster growth and higher consumption rate.

Vats *et al*. (2003) found that dose of 2 g TFG kg^{-1} body weight for 4 weeks in rats led to a decrease in blood sugar levels by 14.4 and 46.64% on 15th and 30th day of the experiment, respectively without changing liver weight. Expect lipid fraction, TFG saponins inhibited glucose-uptake at 0.33 and/or 3.3 mg/mL. In the present experiment, TFGSP decreased nutrient uptake by less feed consumption (Table II). A 20 g TFGSP treatment increased glucose but decreased triglyceride (P<0.01) control. High doses of TFGSP decreased total cholesterol (P<0.05) but increased LDL level (P<0.01) (Table IV). However, Raju *et al.* (2001) reported no reduction in blood sugar of rat after administration of 5% TFG seed powder in diet. They assumed that this could be attributed to the presence of high fiber and saponin content in the seeds of TFG. The high fiber content of diet, probably caused mechanical satiety which led to low soluble carbohydrate consumption.

Table III.- Effects of TFG seed powder on body parts, digestive morphology and TBA values of broiler chicks.

Parameters (g per bird)	TFG seed powder, g kg^{-1} 0	5	10	20	40	SEM	P
Body Parts (g)							
Carcass weight	2049.2^{a}	1879.0^{ab}	1967.0^{a}	1759.7^{b}	1699.3^{b}	32.45	0.002
Carcass yield (%)	75.30	74.13	74.09	72.15	72.04	0.47	0.146
Legs weight	558.8^{ab}	521.3^{abc}	539.0^{ab}	493.5^{bc}	473.8^{c}	9.96	0.045
Wings weight	222.0^{a}	192.8^{b}	214.3^{a}	187.8^{b}	189.2^{b}	3.60	0.002
Breast weight	682.7^{a}	612.0^{bc}	656.8^{ab}	579.5^{cd}	542.2^{d}	12.07	0.001
Abdominal fat pad weight	37.27	36.00	35.00	29.17	29.83	1.39	0.223
Liver weight	57.50	54.17	59.67	55.00	50.50	1.13	0.107
Heart weight	14.67	13.50	14.00	13.00	14.00	0.39	0.740
Pancreas weight	6.19	6.23	6.88	6.84	6.72	0.14	0.374
Digestive tract parts (Empty)							
Gizzard weight	43.8	41.0	43.0	38.5	38.3	1.07	0.335
Intestine weight	64.9	65.5	67.0	69.0	69.8	1.06	0.528
Intestine length	187.8	188.5	196.0	201.3	202.0	2.68	0.264
Duodenum weight	12.8^{b}	14.0^{ab}	12.5^{b}	11.5^{b}	16.0^{a}	0.45	0.022
Duodenum length	30.7	33.3	32.3	30.8	33.5	0.52	0.244
TBA (mg MA/kg)							
Breast meat d 1	0.04	0.05	0.06	0.05	0.04	0.003	0.237
d 5	0.08	0.07	0.09	0.09	0.10	0.004	0.325
d 10	0.37	0.41	0.37	0.42	0.44	0.01	0.246
Legs meat d 1	0.11	0.13	0.12	0.14	0.12	0.003	0.213
d 5	0.22	0.25	0.25	0.27	0.25	0.01	0.187
d 10	0.64	0.67	0.65	0.71	0.69	0.01	0.155
Skin d 1	0.24	0.25	0.24	0.21	0.23	0.007	0.416
d 5	0.44	0.45	0.46	0.42	0.40	0.009	0.255
d 10	0.64	0.62	0.65	0.62	0.60	0.007	0.281

*: SEM: Standard error of difference between means.
a, b, c: Means in the same row with different superscript letters are significantly different (P<0.05).
** Length: cm, Weight: g.

Table IV.- Effects of TFG seed powder on blood parameters of broiler chicks.

Parameters (mg/dl)	TFG seed powder, g kg^{-1} 0	5	10	20	40	SEM	P
Glucose	165.26^{b}	172.88^{b}	185.56^{b}	214.14^{a}	180.01^{b}	4.43	0.002
Triglyceride	34.22^{ab}	44.60^{a}	43.62^{a}	19.89^{c}	28.19^{bc}	2.50	0.002
Total protein, g/dl	1.47	1.48	1.51	1.39	1.46	0.02	0.147
Total cholesterol	77.84^{a}	69.85^{ab}	69.59^{ab}	78.34^{a}	59.55^{b}	2.30	0.048
HDL-cholesterol	52.24^{ab}	41.37^{b}	54.73^{a}	65.32^{a}	63.83^{a}	2.27	0.003
LDL-cholesterol	102.50^{bc}	90.00^{c}	97.14^{c}	122.38^{b}	128.33^{a}	4.17	0.009

a, b, c: Means in the same row with different superscript letters are significantly different (P<0.05).

Xue *et al.* (2007) found that TFG extract lowered blood glucose, triglycerides, total cholesterol and HDL cholesterol of diabetic rats. TFG reduced blood cholesterol in rabbits (Al-Habori *et al.*, 1998), in Muscovi duckling (El-Ghamry *et al.*, 2002), in laying hens (Abaza, 2007; Safaa, 2007; Awadein *et al.*, 2010) and in broiler chickens (Abdel-Rasoul and Yousif, 2003; Abbas, 2010). In the current study, it has been observed that a 20 TFGSP increased blood glucose but decreased

triglyceride and a 40 TFGSP decreased total cholesterol but LDL-cholesterol increased. Safaa (2007) observed a reduction in serum HDL and LDL-cholesterol level in Lohmann Brown hen fed diets supplemented with 2% fenugreek seeds. The species differences may explain these difference between our findings and the results on literature given here. Similarly, Abaza (2007) and Abbas (2010) observed that TFG had no effect on blood protein as observed in this study.

Saponins are known to have hypocholesterolemic effects. When saponins are ingested they form large mixed micelles with bile salts and significantly reduce serum cholesterol, by increasing fecal excretion of bile salts, thereby inhibiting cholesterol absorption (Anonymous, 2007; Kutlu *et al.*, 2001).

The effect of TFGSP on feed intake of broiler chicks in current experiment is not in line with that of Petit *et al.* (1993). They found out that oral administration of TFG seed extract (daily 10 and 100 mg per 300 g body weight), enhanced feed intake in rats and also induced hyperinsulinemia and hypocholesterolemia, most likely, due to the steroid saponin content of TFG seed (Petit *et al.*, 1995). Pancreas weight increased after TFGSP treatment in our study. This may be related to the hypoglycemic effect of TFG (Mehrafarin *et al.*, 2011; Ajabnoor and Tilmisany, 1998; Alarcon-Aguilara *et al.*, 1988).

TFG seed includes 9 % moisture, 3 % ash, 6 % starch, 20 % gum (Anonymous, 2007), 5.3 % oil, and 24.3 % crude protein (Calık and Bayrak, 1997). In the present experiments, it was assumed that TFGSP would affect appetite and, consequently, increase daily gain. However the results revealed that TFGSP decreased feed intake (appetite) and daily gain of birds. The organoleptic properties of TFGSP doses needs to be investigated in future studies so that their effect on appetite can further be elaborated.

Current TBA values are similar to the observed values in poultry meat by Kolsarıcı and Kırımca (1995). The dietary supplementation of TFGSP had no effect on shelf life of poultry meat as seen in Table III. However, poultry skin was more vulnerable to oxidation compared to breast and legs meat due to its higher fat content.

CONCLUSIONS

TFG decreased appetite, reduced growth performance and enhanced blood glucose level. TFG did not affect the shelf life of poultry meat based on present TBARS values. The effect of TFG should be further studied in broiler chicks both in semi commercial and commercial poultry farms.

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