SOME PHYSIOLOGICAL CHANGES RELATED TO FENUGREEK SEEDS SUPPLEMENTATION TO BROILER CHICK'S DIET.

A. H. H. Ali and Z. S. H. Ismail

Animal and poultry Production Department, Faculty of Agriculture, South Valley University, Qena, Egypt

(Received 5/11/2011, Accepted 25/1/2012)

SUMMARY

One hundred and twenty unsexed one-day old; Ross broiler chicks were used and randomly divided into 5 treatments X 3 replicates X 8 chicks. Chicks were fed starter diet (from 0-3 weeks of age) and grower diet (from 4-6 weeks of age). The basal diets had 24 and 22% crude protein and 3009 and 3135 Kcal ME/kg diet for the starter and the grower diet, respectively. The experiment was included five treatments, treatment 1; chicks were fed on basal diet without any addition (control). Whereas, in treatments 2, 3, 4 and 5 chicks were received 0.5%, 1.0%, 1.5% and 2.0% ground fenugreek seeds, respectively. Body weight, daily gain, feed intake, feed conversion, immune responses and some blood serum constituents of broiler chicks were determined. Fenugreek supplementation to broiler chick's diet had an adverse effect ($P<0.05$) on body weight, daily body weight gain and feed conversion at starter period. On the other hand, fenugreek supplementation decreased ($P<0.05$) serum cholesterol concentration, and increased ($P<0.05$) antibody titers at 7 weeks of age. Whereas, supplementing the basal diet with fenugreek had insignificant effect on feed consumption, carcass characteristics and all remaining Physiological parameters (total protein, albumin, globulin, albumin/globulin, glucose, total lipids, GOT, GPT and alkaline phosphatase).

Keywords: *chicks, fenugreek, daily gain, feed conversion, immune, blood*

INTRODUCTION

Fenugreek (*Trigonella foenum graecum*) is an annual member of the leguminosae pea family or (Fabaceae) whose seeds and leaves are used not only as food but also as an ingredient in traditional medicine. Like other legumes, it is a good source of dietary protein (approximately 20-30%) for consumption by human and animals, the fatty acids ranged from 5-10% which are predominantly linoleic, linolenic, oleic and palmatic acids. It had 45-65% total carbohydrates with 15% of galactomannan (a soluble fiber) also, it contains flavonoids, saponins and more calcium, phosphorous, iron, magnesium, potassium, zinc and manganese (Schryver, 2002, Nasra *et al.* 2010 and Rabia 2010). It contains vitamins such as A, pyridoxine, niacin, riboflavin, thiamine and others (Jayaweera, 1981, Petit *et al.*, 1995 and Bilal *et al.* 2003). In addition, it contains amino acids such as arginin and 4-hydroxyisoleucine which has been shown to stimulate insulin secretion and improve glucose tolerance in normal and diabetic animals as the result of direct β- cell stimulation (Sauvaire *et al.*, 1998; Broca *et al.*, 1999 and Schryver, 2002). Fenugreek contains potent antioxidants that have beneficial effects on the liver and pancreases making it useful in the treatment of high cholesterol and digestive orders (Duke, 2000 and Rihab, 2011). Fenugreek contains phytoestrogens which are of great interest because of their estrogenic effects (Mazur *et al.*, 1998). Also, it have been recognized as a potential source of diosgenin, a basic compound in the hemisynthesis of steroidal sapogenins such as cortison and sex hormones (Brenac and Sauvaire, 1996 a and b). Fenugreek leaves and seeds have been used extensively to prepare extracts and powders for medicinal uses (Basch *et al.*, 2003). The objective of the present study was to evaluate some physiological changes related to fenugreek seeds supplementation to broiler chick's diet.

MATERIALS AND METHODS

This study was carried out at the Poultry Farm, Department of Animal and Poultry Production, Faculty of Agriculture, South Valley University, Qena. It was designed to evaluate the effects of ground

Fenugreek (*Trigonella foenum greacum*) addition into broiler diets on the productive performance (body weight, daily gain, feed intake and feed conversion) and immune responses of broiler chicks.

1. Chicks and Housing:

One hundred and twenty unsexed one-day old; Ross broiler chicks were obtained from a commercial local source and used in this study. Chicks were randomly divided into 5 treatment groups. Each treatment had 3 replicates with 8 chicks each (5 treatments X 3 replicates X 8 chicks = 120 chicks). Chicks in each replicate within each treatment had nearly similar initial live body weight. Chicks were reared in two-tier wire floor battery in a windowless house. The chicks of each replicate were allocated in a cage with slatted floor of iron.

2. Diets and management:

The experimental period was divided into two feeding phases, starter (from 0-3 weeks of age) and grower (from 4-6 weeks of age). The basal experimental diets had 24 and 22% crude protein and 3009 and 3135 Kcal ME/kg diet for the starter and the grower diet, respectively (Table 1). Experimental diets were formulated to meet the nutrients requirements of the broiler chicks (NRC, 1998).

Chicks were full access to feed and water during the experimental period. Artificial light was applied to maintain 23 hrs light per day during the experimental period. The environmental temperature was about 32° C during the first week old and it was gradually reduced by about 2° C weekly until about 24° C at the fourth week up to the end of experiment (at 6 weeks of age).

The experiment was included five treatments, treatment 1; chicks were fed on basal diet without any addition (control). Whereas, in treatments 2, 3, 4 and 5 chicks were received 0.5%, 1.0%, 1.5% and 2.0% grounded fenugreek, respectively. Chemical composition of fenugreek is presented in Table (2).

Table (1). Composition of the starter and grower basal diets.

Ingredients	Starter	Grower
Yellow corn	52.59	56.04
Soybean meal (44% CP)	32	30
Corn gluten (60% CP)	9	6
Vegetable oil	2	4
Premix	0.3	0.3
Dicalcium phosphate	2	1.8
Limestone	1	1
Lysine	0.3	0.2
Methionine	0.25	0.125
Choline chloride	0.2	0.175
Salt	0.36	0.36
Total	100	100
Calculated values:		
Crude protein %	24	22
ME (Kcal/kg)	3009	3135
Calcium %	0.91	0.86
Av. Phosphorus %	0.48	0.43
Methionine	0.74	0.55
Lysine %	1.45	1.27

3. Hygiene:

No antimicrobial agents or prevention program were applied in the current study.

4. Productive performance:

Live body weight and feed intake were recorded at 3 and 6 weeks of age for each replicate. Daily body weight gain and feed conversion ratio (gm feed: gm gain) were calculated for each replicate within each period.

Table (2): Chemical composition of Fenugreek

Item	Fenugreek
Crude protein (%)	24.13
Ether extract (%)	7.07
Crude fiber (%)	10.76
Ash (%)	3.68
Nitrogen-free extract (%)	54.36
Moisture (%)	6.74

5. Physiological measurements:

5.1. Blood sampling:

Blood samples were collected from six chicks (chosen randomly) within each treatment at 6 and 7 weeks of age. Samples of about 3 ml of blood were withdrawn from the brachial vein into collecting tube and allowed to clot at 5°C overnight, and then centrifuged at 3000 rpm for 15 minutes. Blood serum was then obtained and stored at –20°C until analysis.

5.2 Immunization and Titration:

At 6 weeks of age, six chicks from each treatment were injected intravenously in the brachial vein with 0.2 ml of 10% suspension of packed sheep red blood cells (SRBC's). Sera were collected on the seventh day post immunization (at 7 weeks of age) and antibody titer against SRBC's was determined using the micro titer procedure described by Van der Zijpp and Leenstra (1980). Titers were expressed as the log2 of the reciprocal of highest dilution giving complete agglutination.

5.3. Blood serum constituents:

Obtained blood serum were subjected to determine: total protein and albumin as described by Kaplan and Szalbo, (1983) and Doumas, (1971), respectively, while serum globulin was obtained by subtracting the values of the albumin from the corresponding values of the total protein (albumin: globulin ratio was then calculated); total lipids (Knight *et al.*, 1972); cholesterol (Allain *et al.*, 1974); serum glutamic oxaloacetic (GOT) and pyruvic transaminase (GPT) were determined according to (Harold, 1975).

6. Statistical Analysis:

Data collected were statistically analyzed by the analysis of variance with the General Linear Model (GLM) procedure of the SAS Institute (SAS, 1996). All statements of significance are based on the 0.05 level of probability. Significant differences among treatments were performed using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Body weight and daily gain:

Data of body weight at 3 and 6 weeks of age and daily body weight gain at 0-3, 4-6 and 0-6 weeks are listed in Table (3). Obtained data revealed that, supplementing the broiler diet with fenugreek had significant effect on body weight at 3 and 6 weeks of age. Chicks in the treated groups had lower ($P<0.05$) body weight than those in the control group. The same is true for daily body weight gain. The pronounced decreases in body weight and body weight gain were noticed in the groups, which supplemented with 1.0, 1.5 and 2.0% fenugreek. These results are in agreement with those outlined by Rabia (2010). Francis *et al.* (2002) reviewed that there are numerous reports of positive and negative effects of dietary saponins. Dietary saponins depressed growth, feed consumption in gerbils and egg production in poultry (Sim *et al.* 1984; Terapunduwat & Tasaki, 1986; Potter *et al.* 1993; Jenkins & Atwal, 1994). These negative effects have been ascribed to several properties of saponins such as reduced feed intake caused by the astringent and irritating taste of saponins (Oleszek *et al.* 1994), reduction in intestinal motility (Klita *et al.* 1996), reduction in protein digestibility (Shimoyamada *et al.* 1998) and damage to the intestinal membrane and inhibition of nutrient transport.

Table (3). Averages ± (SE) of body weight (gm) and daily body weight gain (gm) as affected by the addition of fenugreek into broiler chick diets.

Item	Body weight		Daily body weight gain (weeks)		
	21 days	42 days	0-3	4-6	0-6
Control	831.25[a]±3.61	2378.27[a] ±16.24	37.20[a] ±0.17	73.67[a] ±0.70	55.44[a] ±0.39
T 0.5	804.17[b] ±2.08	2370.83[a] ±11.02	35.91[b] ±0.10	74.60[a] ±0.55	55.26[a] ±0.26
T 1.0	779.17[c] ±7.51	2272.92[ab] ±12.67	34.72[c] ±0.36	71.13[ab] ±0.45	52.93[ab] ±0.30
T 1.5	777.08[c] ±11.60	2247.92[b] ±63.36	34.62[c] ±0.55	70.04[ab] ±2.58	52.33[b] ±1.51
T 2.0	779.17[c] ±2.08	2206.25[b] ±30.83	34.72[c] ±0.10	67.96[b] ±1.46	51.34[b] ±0.73

Means within each column bearing different letter(s) are significantly (P<0.05)

2. Daily feed consumption and feed conversion:

Obtained data in Table (4) showed that during the periods from 0-3, 4-6 and 0-6 weeks of age, fenugreek supplementation had insignificant effect on feed intake and feed conversion at starting, growing and whole experimental period except in the starter period which the values of feed conversion were adversely affected (P<0.05) in the treated groups supplemented with 1, 1.5 and 2% fenugreek than the control group and remain treated group. These findings are in harmony with those obtained by Rabia (2010). El-Kaiaty *et al.* (2002) and Radwan (2003) reported that there were no effect of supplemented fenugreek on feed consumption for laying hens and broilers, respectively. The adverse effect of fenugreek on feed conversion at starting period may be due to the negative effects of saponins such as reduced feed intake caused by the astringent and irritating taste of saponins (Oleszek *et al.* 1994), reduction in intestinal motility (Klita *et al.* 1996), reduction in protein digestibility (Shimoyamada *et al.* 1998) and damage to the intestinal membrane and inhibition of nutrient transport especially in the first ages and after that the checks may be adapted or be more tolerance to the fenugreek saponins.

Table (4). Averages ± (SE) of daily feed intake (gm) and feed conversion as affected by the addition of fenugreek into broiler chick diets.

Item	Daily Feed consumption (weeks)			Feed conversion (weeks)		
	0-3	4-6	0-6	0-3	4-6	0-6
Control	56.42± 0.62	137.31± 2.93	96.86± 1.37	1.52[b] ±0.01	1.86± 0.03	1.75± 0.02
T 0.5	55.20± 0.09	135.22± 2.08	95.21± 1.04	1.54[b] ±0.00	1.81± 0.02	1.72± 0.02
T 1.0	55.59± 0.09	136.31± 1.82	95.95± 0.95	1.60[a] ±0.02	1.92± 0.04	1.81± 0.03
T 1.5	55.59± 0.37	136.11± 2.95	95.85± 1.30	1.61[a] ±0.03	1.95± 0.03	1.83± 0.03
T 2.0	55.81± 0.70	133.73± 3.32	94.77± 2.01	1.61[a] ±0.02	1.97± 0.07	1.85± 0.05

Means within each column bearing different letter(s) are significantly (P<0.05)

3. Serum Total protein, albumin, globulin and albumin/globulin ratio:

Data of serum total protein, albumin, globulin and albumin/globulin ratio at 6 and 7 weeks of age are listed in Table (5). Obtained data showed that supplementing the broiler diet with fenugreek had insignificant effect on total protein, albumin, globulin and albumin/globulin ratio at 6 and 7 weeks of age. These findings are in full agreement with those obtained by Rabia (2010) who indicated that feeding fenugreek seeds at 3 g/kg of the diet were not significantly affected to total protein, albumin, globulin, albumin/globulin ratio.

4. Glucose, cholesterol and total lipids:

Data of serum glucose, cholesterol and total lipids at 6 and 7 weeks of age are listed in Table (6). Fenugreek supplementation had insignificant effect on glucose and total lipids levels at 6 and 7 weeks of age. Broiler chicks fed on the diet supplemented with 1, 1.5 or 2% fenugreek recorded the lowest (P<0.05) value of cholesterol at both 6 and 7 weeks of age. These results are in agreement with those outlined by Rabia (2010) who stated that feeding fenugreek, parsley and basil seeds were not significantly

affected to glucose contents, but serum cholesterol was significantly effected ($p<0.05$) by adding these materials. El- Husseiny *et al.* (2002) noticed that addition of fenugreek to broiler diet decreased total cholesterol values compared to control group. Significant cholesterol-lowering activity has been demonstrated in several animal studies and human studies with diabetic volunteers Gupta & Gupta (2001). Fenugreek in the form of unroasted and roasted powdered seeds was given in low (2 g/kg) and high (6 g/kg) dose to normal and alloxan-induced diabetic rats. Both the unroasted and roasted forms produced a significant fall in various serum lipids like total cholesterol, triglycerides, LDL and VLDL cholesterols in normal rats; decreased their raised levels and increased HDL cholesterol in the diabetic rats Khosla *et al.*,(1995), Hugues *et al.*, (2010). Safaa (2007) concluded that supplemented dietary with 2% of either garlic or fenugreek in Lohmann Brown laying hens have benificial effects on cholesterol metabolism that resulted in the reduction of serum and egg yolk cholesterol, serum LDL-cholesterol concentrations and in an increase of serum HDL-cholesterol without affecting hens productivity or egg quality.

Table (5). Averages ± (SE) of serum total protein (TP), albumin (Alb.), globulin (Glo.) and albumin/globulin (Alb./Glo.) ratio as affected by the addition of fenugreek into broiler chick diets.

Item	TP (g/dl)		Alb. (g/dl)		Glo. (g/dl)		Albumen/globulin	
	6	7	6	7	6	7	6	7
Control	6.41± 0.25	6.21± 0.26	2.07± 0.09	1.89± 0.08	4.34± 0.34	4.33± 0.34	0.49± 0.06	0.45± 0.06
T 0.5	6.39± 0.28	6.22± 0.30	2.10± 0.12	1.92± 0.10	4.29± 0.16	4.30± 0.19	0.49± 0.01	0.44± 0.01
T 1.0	6.36± 0.07	6.41± 0.08	2.05± 0.16	1.85± 0.18	4.31± 0.20	4.56± 0.13	0.48± 0.06	0.41± 0.05
T 1.5	6.34± 0.33	6.41± 0.24	2.05± 0.20	1.86± 0.21	4.29± 0.51	4.54± 0.42	0.50± 0.10	0.42± 0.08
T 2.0	6.48± 0.20	6.71± 0.08	2.08± 0.18	1.89± 0.17	4.40± 0.17	4.82± 0.11	0.47± 0.05	0.39± 0.04

Francis *et al.* (2002) reviewed that a number of studies have shown that saponins from different sources lower serum cholesterol levels in a variety of animals including human subjects (Southon *et al.* 1988; Harwood *et al.* 1993; Potter *et al.* 1993; Matsuura, 2001 and Al-Habori & Raman, 1998). Large mixed micelles formed by the interaction of saponins with bile acids account for their increased excretion when saponin-rich foods such as soyabean, lucerne and chickpea are consumed (Oakenfull, 1986; Oakenfull & Sidhu, 1990). The resulting accelerated metabolism of cholesterol in the liver causes its serum levels to go down. The ethanol extract of de-fatted fenugreek seeds inhibited taurocholate and deoxycholate absorption in vitro, in a dose-dependent manner in everted intestinal sacs (Stark & Madar, 1993). Decreased intestinal cholesterol absorption induced by some saponins, however, was seen to be without interference with the entero-hepatic

Table (6). Averages ± (SE) of serum glucose, cholesterol and total lipids as affected by the addition of fenugreek into broiler chick diets.

Item	Glucose (mg/dl)		Cholesterol (mg/dl)		Total lipids (g/l)	
	6	7	6	7	6	7
Control	106.36± 6.55	105.73± 5.33	172.00^{a} ± 4.16	170.74^{a} ± 2.93	11.17± 0.41	11.10± 0.41
T 0.5	105.97± 5.25	105.34± 6.82	165.00^{ab} ± 2.89	163.74^{ab} ± 1.44	10.92± 0.22	10.83± 0.23
T 1.0	108.12± 5.88	107.41± 7.34	160.33^{bc} ± 3.18	159.08^{b} ± 1.74	10.81± 0.17	10.58± 0.16
T 1.5	107.40± 6.19	106.70± 7.69	158.67^{bc} ± 1.76	157.41^{bc} ± 1.65	10.77± 0.39	10.50± 0.38
T 2.0	107.45± 6.02	107.16± 6.14	152.00^{c} ± 1.73	150.74^{c}± 3.05	10.60± 0.33	10.29± 0.31

Means within each column bearing different letter(s) are significantly ($P<0.05$)

bile acid recirculation (Harwood *et al.* 1993). Saponins also reduced the more harmful LDL-cholesterol selectively in the serum of rats, gerbils and human subjects (Potter *et al.* 1993; Harris *et al.* 1997; Matsuura, 2001).

5. Glutamic oxaloacetic (GOT), pyruvic transaminase (GPT) and alkaline phosphatase:

Data of serum glutamic oxaloacetic (GOT), pyruvic transaminase (GPT) and alkaline phosphatase at 6 and 7 weeks of age are listed in Table (7). Obtained data illustrated that addition of ground fenugreek had insignificant effect on GPT, GOT or alkaline phosphatase at the 6th and 7th weeks of age. Muralidhara *et al.* (1999) and Bilal *et al.* (2003) have shown that debitterized fenugreek powder did not alter GOT, GPT and alkaline phosphates (ACP) levels either in serum or liver in rats maintained on 1%, 5% and 10% debitterized fenugreek powder up to 90 days.

Table (7). Averages ± (SE) of serum glutamic oxaloacetic (GOT), pyruvic transaminase (GPT) and alkaline phosphatase as affected by the addition of fenugreek into broiler chick diets.

Item	GOT (U/l)		GPT (U/l)		Alkaline phosphatase (U/l)	
	6	7	6	7	6	7
Control	75.19± 2.93	74.96± 3.32	7.82± 1.20	8.20± 1.20	265.61± 2.95	264.85± 3.50
T 0.5	77.23± 4.64	77.01± 5.03	8.23± 0.54	8.61± 0.54	266.79± 1.24	264.51± 1.24
T 1.0	82.67± 3.24	82.44± 3.65	7.57± 0.61	7.95± 0.61	266.28± 1.24	267.04± 0.45
T 1.5	77.94± 4.60	77.72± 4.32	8.03± 0.84	8.41± 0.84	265.07± 2.02	265.83± 3.46
T 2.0	76.74± 5.06	76.51± 4.62	8.22± 1.15	8.60± 1.15	268.54± 1.06	267.78± 2.49

6. Haemagglutinin antibody:

Averages of serum haemagglutinin antibody (Ab) titers at 7 weeks of age are listed in Table (8). Obtained data elucidated that, supplementation of broiler chick diets with fenugreek at levels of 1, 1.5 or 2% had significant ($P<0.05$) effect on Ab. titers at 7 weeks of age. Addition of fenugreek at 1, 1.5 or 2% levels into broiler chick diets elevated ($P<0.05$) Ab. titers compared to control treatment and remain treated group. These results are in agreement with those obtained by Bilal *et al.* (2003) who stated that fenugreek showed an overall stimulatory effect on the specific as well as nonspecific immune functions in mice. Also Khaligh *et al.* (2011) stated that most medicinal plant blends increased ($p<0.05$) antibody titer against Newcastle disease virus at day 33 of age of broiler chicks. Saponin-based adjuvants have the unique ability to stimulate the cell-mediated immune system, as well as to enhance antibody production, and have the advantage that only a low dose is needed for adjuvant activity (Oda *et al.* 2000 and Francis *et al.* 2002).

Table (8). Averages± SE of haemagglutinin antibody (Ab) titers against (SRBC's) as affected by the addition of fenugreek into broiler chick diets at 7 weeks of age.

Item	Experimental treatments				
	control	T 0.5	T 1.0	T 1.5	T 2.0
Ab. (log_2)	4.59^{c}±0.24	5.14^{bc}±0.09	5.48^{ab}±0.19	5.71^{a}±0.17	5.87^{a}±0.15

Means within each column bearing different letter(s) are significantly ($P<0.05$)

7. Carcass characteristic:

Results presented in Table (9) indicated that addition of ground fenugreek insignificantly affected all slaughters parameters. These results are in agreement with those obtained by Abaza (2001), Guo *et al.* (2004), Nasra *et al.* (2010) and Rabia (2010) who reported that addition of Medicinal and Aromatic Plants (MAP) had no effects on carcass traits. Moreover, Azoua (2001); El-Husseiny *et al.* (2002) and Hassan *et al.* (2004) found that addition of MAP had significantly higher dressing percentage in broiler than those fed control diets.

Table (9). Averages ± (SE) of carcass characteristic at 49 days of age of chicks as affected by the addition of fenugreek into broiler chick diets.

Item	Control	T 0.5	T 1.0	T 1.5	T 2.0
Liver weight (%)	1.95± 0.16	1.95± 0.14	1.84± 0.04	1.69± 0.10	1.63± 0.15
Gizzard weight (%)	1.84± 0.18	1.86± 0.09	1.92± 0.13	1.90± 0.16	1.87± 0.04
Heart weight (%)	0.48± 0.01	0.47± 0.02	0.44± 0.01	0.45± 0.01	0.45± 0.01
Giblets weight (%)	4.27± 0.33	4.28± 0.10	4.21± 0.09	4.03± 0.07	3.95± 0.19
Dressing percentage	78.32± 0.74	79.67± 0.80	79.08± 0.75	78.89± 0.20	78.70± 0.82
Spleen weight (%)	0.17± 0.04	0.17± 0.03	0.17± 0.03	0.12± 0.01	0.13± 0.02
Intestine Length (cm)	203.15± 5.86	204.67± 7.69	205.67 ± 5.90	203.33 ± 5.46	210.67 ± 3.18
Cecum Length (cm)	18.67± 1.33	22.33± 1.67	21.00± 1.15	20.67± 0.33	22.67± 0.88

REFERENCES

Abaza, I,M.K., (2001). The use of some medical plants as feed additives in broiler diets. Ph.D. Thesis, Faculty of Agriculture, Alexandria University, Egypt.

Al-Habori M. and Raman A., (1998). Antidiabetic and hypocholesterolaemic effects of fenugreek (Review). Phytotherapy Research 12, 233–242.

Allain, C. C.; Poon L. S.; Chan C. S.; Richamand W. and Fu P. C., (1974). Enzymatic determination of total serum cholesterol. Clin. Chem., 20(4): 470.

Azoua, H.M., (2001). Effect of hot pepper and fenugreek seeds supplementation on broiler diets. Ph.D. Thesis, Egypt, pp: 181.

Basch, E., Ulbricht C., Kuo G., Szapary P. and Smith M., (2003). Therapeutic applications of fenugreek. Alt. Med. Rev., 8: 20-27.

Bilal H., Haque R., Parvez S., Pandey S., Sayeed I. and Raisuddin S., (2003). Immunomodulatory effects of fenugreek (Trigonella foenum graecum L.) extract in mice. International Immunopharmacology 3: 257–265.

Brenac, P. and Sauvaire Y., (1996a).Chemotaxonomic value of sterols and steroidal sapogenins in the genus Trigonella. Biochem. Syst, Ecol. 24: 157-164

Brenac, P. and Sauvaire Y., (1996b). Accumulation of sterols and steroidal sapogenins in developing fenugreek pods: possible biosynthesis in situ. Phytochemistry, 41: 415-422.

Broca, C., Gross, R., Petit, P., Sauvaire, Y., Manteghetti, M.,Tournier, M., Masiello, P., Gomis, R. and Ribes G., (1999). 4-Hydroxyisoleucine: experimental evidence of its insulinotropic and antidiabetic properties. Am. J. Physiol., 277: 617-623.

Doumas, B. T., (1971). Automated analysis. Bochringer Mannheim Clin. Acta. 31-87.

Duke, J., (2000).The green pharmacy herbal handbook .Annies Remedy

Duncan, D. B., (1955). Multiple ranges and multiple F-test. Biometric, 11: 1042.

El-Husseiny, O.; Shalash S.M. and Azouz H.M., (2002). Response of broiler performance to diets containing hot pepper and / or fenugreek at different metabolizable energy levels. Egypt. Poult. Sci. 22;387-406.

EL-kaiaty , A.M.; Soliman A.Z.M.; and Hassan M.S., (2002). The physiological and immunological effects of some natural feed additives in layer hen diets. Egypt. Poult . Sci. 22: 175-203.

Francis G., Zohar K. , Makkar H. P. S. and Becker K., (2002). The biological action of saponins in animal systems: a review. British Journal of Nutrition 88: 587–605

Guo, F.C., Kwakkel C.R.P., Soede J., Williams B.A. and Verstegen M.W., (2004). Effect of a Chinese herb medicine formulation, as an alternative for antibiotics, on performance of broilers. Br. Poult. Sci., 45: 793-797.

Gupta A, Gupta R. L. B., (2001). Effect of Trigonella foenum-graecum (fenugreek) seeds on glycaemic control and insulin resistance in type 2 diabetes mellitus: a double blind placebo controlled study. J Assoc Physicians India 49: 1057-61.

Harold, V., (1975). Practical Clin. Biochem. 4th Ed.; P294.

Harris WS, Dujovne CA, Windsor SL, Gerrond LLC, Newton FA and Gelfand RA (1997) Inhibiting cholesterol absorption with CP-88,818 (beta-tigogenin cellobioside; tiqueside): Studies in normal and hyperlipidemic subjects. Journal of Cardiovascular Pharmacology 30, 55–60.

Harwood HJ Jr, Chandler CE, Pellarin LD, Bangerter FW, Wilkins RW, Long CA, Cosgrove PG, Malinow MR, Marcetta CA, Pettini JL, Savoy YE and Mayne JT (1993) Pharmacologic consequences of cholesterol absorption inhibition: alteration in cholesterol metabolism and reduction in plasma cholesterol concentration induced by the synthetic saponin b-tigogenin cel-lobioside (CP-88818; tiqueside). Journal of Lipid Research 34, 377–395.

Hassan I. I., Asker A. A. and Gehan El-Shourbagy A., (2004). Influence of some medicinal plants on performance, physiological and meat quality traits of broiler chicks. Egypt. Poult. Sci. J. 24 (I): 247-266.

Hugues C., Gaillard J.,, Farret A., Costa F., Gabillaud I., Mas E., Dupuy

A., Michel F., Cantié C., Renard E., Galtier F. and Petit P. (2010). A fenugreek seed extract selectively reduces spontaneous fat intake in overweight subjects. Euro J Clin Pharmaco. 66: 449 – 455.

Jayaweera D.M.A., (1981). Medicinal plant: Part III. Peradeniya, Sri Lanka: Royal Botanic Garden. p. 255.

Jenkins K.J. & Atwal A.S., (1994) Effects of dietary saponins on fecal bile acids and neutral sterols, and availability of vitamins A and E in the chick. Journal of Nutritional Biochemistry 5, 134–138.

Kaplan, A. and Szalbo J., (1983). Clinical chemistry: interpretation and techniques. 2nd ed. P157.

Khaligh, F., Sadeghi G., Karimi A. and Vaziry A., (2011). Evaluation of different medicinal plants blends in diets for broiler chickens. Journal of Medicinal Plants Research 5(10): 1971-1977.

Khosla, P, Gupta D.D. and Nagpal R.K., (1995). Effect of Trigonella foenum graecum (Fenugreek) on serum lipids in normal and diabetic rats. Indian J Pharmaco (27): 89 – 93.

Klita P.T., Mathison G.W. & Fenton T.W., (1996). Effect of alfalfa root saponins on digestive function in sheep. Journal of Animal Science 74, 1144–1156.

Knight, J. A.; Anderson S. J., and Rawle J. M., , (1972). Chemical bases of the sulfo-phosphovanillin reaction for estimating serum total lipids. Clin. Chem., 18(3): 723.

Matsuura M., (2001). Saponins in garlic as modi?ers of the risk of cardiovascular disease. Journal of Nutrition 131, 1000S–1005S.

Mazur, W.M.; Duke, J.A.; Wahala, K.; Rasku, S.; and Adlercreutz , H., (1998). Isoflavonoids and lignins in legumes : Nutritional and health aspects in human , J. Nutr Biochemistry, 9: 193-200.

Muralidhara, Narsimhamurthy K., Viswanatha S. and Ramesh B.S., (1999). Acute and subchronic toxicity assessment of debitterized fenugreek powder in the mouse and rat. Food Chem Toxicol 1999;37:831–8.

Nasra B. A., Eid Y. Z., and Abd El-Ghany F. A., (2010). Effect of dietary supplementation with phytoestrogens sources before sexual maturity on productive performance of mandarah hens. Egypt. Poult. Sci. 30 (3): 829-846.

National Research Council, NRC, (1998). Nutrient Requirements of Poultry, 10th ed. Washington, DC, National Academy Press.

Oakenfull D.G., (1986). Aggregation of bile acids and saponins in aqueous solution. Australian Journal of Chemistry 39, 1671–1683.

Oakenfull D.G. and Sidhu G.S., (1990). Could saponins be a useful treatment for hypercholesterolemia? European Journal of Clinical Nutrition 44, 79–88.

Oda K., Matsuda H., Murakami T., Katayama S., Ohgitani T. and Yoshikawa M., (2000). Adjuvant and haemolytic activities of 47 saponins derived from medicinal and food plants. Biological Chemistry 381, 67–74.

Oleszek W., Nowacka J., Gee J.M., Wortley G. & Johnson I.T., (1994). Effects of some purified alfalfa (Medicago sativa) saponins on transmural potential difference in mammalian small intestine. Journal of the Science of Food and Agriculture 65, 35–39.

Petit P.R., Sauviaire Y.D., Hillaire-Buys D.M., Leconte O.M. and Baissac Y.G., (1995). Steroid saponins from fenugreek seeds: extraction, purification and pharmacological investigation on feeding behavior and plasma cholestrol. Steroids. 10: 674–680.

Potter S.M., Jimenez-Flores R., Pollack J., Lone T.A. and Berber-Jimenez M.D., (1993). Protein saponin interaction and its influence on blood lipids. Journal of Agricultural and Food Chemistry 41, 1287–1291.

Rabia J. A., (2010). Effect of using fenugreek, parsley and sweet basil seeds as feed additives on the performance of broiler chickens. International Journal of Poultry Science 9 (3): 278-282.

Radwan, N.L., (2003). Effect of using some medicinal plants on performance and immunity of broiler chicks. Ph. D . Thesis, Fac. Of Agric .,Cairo Univ., Egypt.

Rihab G. M. A., (2011). The effect of some feed supplements on activity of kidneys of broiler chicken. http://www.uobabylon.edu.iq/uobcoleges/service_showarticle.aspx?fid=12&pubid=416

Safaa H. M., (2007). Effect of dietary garlic or fenugreek on cholesterol metabolism in laying hens. Egypt Poult. Sci. 27: 1207-1221.

SAS, (1996). SAS User's Guide, statistics (6.2th Ed.) Cary NC: SAS Institute Inc.

Sauvaire, Y., Petit, P., Broca, C., Manteghetti, M., Baissac, Y.,Fernandez-Alvarez, J., Gross, R., Roye, M., Leconte, A.,Gomis, R. and Ribes, G., (1998). 4Hydroxyisoleucine.Anoval amino acid potentiator of insulin secretion. Diabetes, 47: 206-210.

Schryver, T., (2002). Fenugreek. Total Health, 24:42-44.

Shimoyamada M., Ikedo S., Ootsubo R. and Watanabe K. (1998). Effects of soybean saponins on chymotryptic hydrolyse of soybean proteins. Journal of Agricultural and Food Chemistry 46, 4793–4797.

Sim J.S., Kitts W.D. and Bragg D.B., (1984). Effect of dietary saponin on egg cholesterol level and laying hen performance. Canadian Journal of Animal Science 64, 977–984.

Southon S., Johnson I.T., Gee J.M. and Price K.R. (1988). The effect of Gypsophylla saponins in the diet on mineral status and plasma cholesterol concentration in the rat. British Journal of Nutrition 59, 49–55.

Stark A. and Madar Z., (1993). The effect of an ethanol extract derived from fenugreek (Trigonella foenum-graecum) on bile acid absorption and cholesterol level in rats. British Journal of Nutrition 69, 277–287.

Terapunduwat S. & Tasaki I., (1986). Effect of dietary saponin on the performance and plasma cholesterol level of chicks and the alleviation of saponin toxicity by cholesterol supplementation. Japanese Journal of Zootechnical Science 57, 524–533.

Van der Zijpp, A. J. and Leenstra F. R., (1980). Genetic analysis of the humoral immune response of White Leghorn chickens. Poult. Sci., 59: 1363-1369.

بعض التغيرات الفسيولوجية المصاحبة لاضافة بذور الحلبة لعليقة بدارى التسمين

عبدالله حسن حسين على و زينهم شيخون حسن

قسم الانتاج الحيوانى والدواجن – كلية الزراعة – جامعة جنوب الوادى

استخدم فى هذه التجربة 120 كتكوت غير مجنس عمر يوم من سلالة الروس وقسمت الكتاكيت عشوائيا الى 5 معاملات تحت كل معاملة 3 مكررات وبكل مكررة 8 كتاكيت. غذيت الكتاكيت على عليقة بادئة (من 0 – 3 اسابيع من العمر) وعليقة نامى (من 4 – 6 اسابيع من العمر). احتوت العليقة الاساسية على 24 و 22% بروتين خام و 3009 و3135 كيلو كالورى طاقة ممثلة/ كجم عليقة لعليقتى البادئ والنامى على الترتيب. احتوت التجربة على 5 معاملات، المعاملة الاولى غذيت الكتاكيت على العليقة الاساسية بدون اى اضافات (المقارنة). بينما اضيف للعليقة الاساسية للكتاكيت فى المعاملات 2 و 3 و 4 و 5 حلبة مطحونة بنسب 0.5 و1.0 و1.5 و 2.0% على الترتيب. تم قياس وزن الجسم ومعدل النمو اليومى والغذاء المستهلك ومعدل التحويل الغذائى والاستجابة المناعية وبعض مكونات السيرم لبدارى التسمين.

كان لاضافة الحلبة على عليقة بدارى التسمين تاثير سلبى ($P<0.05$) على وزن الجسم ومعدل النمو اليومى ومعدل التحويل الغذائى خلال فترة البادئ. وعلى النقيض فان اضافة الحلبة قللت ($P<0.05$) تركيز الكولسترول فى السيرم كما زادت عدد الاجسام المضادة خلال الاسبوع السابع من العمر. بينما لم يكن هناك اى تاثير معنوى لاضافة الحلبة للعليقة الاساسية على الغذاء المستهلك ومواصفات الذبيحة وباقى القياسات الفسيولوجية الاخرى (البروتين الكلى والالبيومين والجلوبيولين والالبيومين/الجلوبيولين والجلوكوز والليبيدات الكلية وانزيمات الكبد و الفوسفاتيز القلوى).