J. Agric. Sci. Mansoura Univ., 28 (4): 2539 - 2551, 2003

THE EFFECT OF GARLIC (*Allium sativum*) AND FENUGREEK (*Trigonella foenumgraecum L.*) ON PERFORMANCE AND SERUM LIPIDS IN TURKEYS

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ABSTRACT

This study was conducted to determine the effect of feeding garlic and fenugreek on performance and serum lipids of Bronze turkeys. A total of 192, 4 month old, Bronze turkey toms were used. The birds were divided at random, into four groups (48/group). The first group received a basal diet and served as a control. The second group was supplemented with 2% garlic paste. The third group was supplemented with 2% fenugreek. The forth group was supplemented with 1% garlic and 1% fenugreek. Every group was divided into four replicates of 12 birds each.

Turkeys received 2% garlic had significantly superior body weight gain and growth rate than other groups, during the treatment period. Four weeks after stopping the treatments, there were no significant differences between all groups.

Groups supplemented with 2% garlic, 2% fenugreek and 1% garlic plus 1% fenugreek had higher body weight than the control group throughout experimental period. However, differences were not statistically significant.

The group receiving 2% garlic had the best-feed conversion as compared to other groups.

Serum cholesterol decreased by 11.1, 5.7 and 9.7% in response to garlic, fenugreek and garlic plus fenugreek supplementation during treatment period, respectively.

Serum LDL decreased by 18.2, 20.5 and 14.7% during treatment for garlic, fenugreek and garlic plus fenugreek groups, respectively.

Serum HDL decreased by 19.9, 13.7 and 10.5 during treatment for garlic, fenugreek and garlic plus fenugreek groups, respectively.

Serum cholesterol, LDL and HDL were still lower than the control group four weeks after feed additive withdrawal.

Fenugreek group yielded the highest anti-SRBC antibody titer as compared to other groups.

Keywords: Turkey, Cholesterol, LDL, HDL, Body weight, Growth rate, Feed conversion, Garlic, fenugreek.

INTRODUCTION

Garlic is known in many countries and cultures as a therapeutic agent (Amagase *et al.*, 2001 and Chowdhury *et al.*, 2002). Experimental studies showed that garlic has potential hypolipedemic, hypotensive, hypoglycemic, hypothrombotic and hypoatherogenic properties (Bordia *et al.*, 1975; shoetan *et al.*, 1984; Qureshi *et al.*, 1993a, b) & Chowdhury *et al.* (2002).

Qureshi *et al.* (1993a) fed garlic to 5-wk-old male broilers for 2-weeks. They also exposed hepatocytes in vitro to polar fractions of garlic powder (garlic equivalent to 1, 2, 4, 6, and 8% fresh garlic paste). The results showed

a dose-dependent inhibition of hepatic- hydroxy – methylglutaryl coenzyme A (HMG-COA) reductase, cholesterol 7-hydroxylase and fatty acid synthetase.

The seeds of fenugreek (*Trigonella foenumgraecum*) are traditionally assumed to have restorative properties. Petit *et al.* (1993 & 1995) showed that fenugreek seed extract, containing steroid saponins (furostanol type) increased feed consumption and motivation to eat saponins in rats. It also induced hypercholesterolemia as well as hyperinsulinemia in human. Bordia *et al.* (1997) showed that fenugreek reduced significantly the blood lipids (total cholesterol and triglycerides) and blood sugar in humans.

Both garlic and fenugreek seeds improved primary and secondary immune response against sheep red blood cells (SRBC) of laying hens (El-Kaiaty *et al.*, 2002 a&b)

This study was conducted to determine the effect of garlic, fenugreek and garlic plus fenugreek on body weight, weight gain, growth rate, feed conversion and it's effect on serum lipid components; total cholesterol, low density lipoprotein cholesterol (LDL-chol), high density lipoprotein cholesterol (HDL-chol) of Bronze turkeys.

MATERIAL AND METHODS

This study was carried out at the poultry research, Faculty of Agriculture, Cairo University from July to November 2001. A total number of 192 Bronze turkey toms were used. At 120 days of age birds were divided at random into four groups (48 per group) allotted to different feed additives: The first group received a basal diet (Table 1) and served as a control. The second group was supplemented with 2% fresh garlic paste (Fresh garlic cloves were shopped by a blinder. The paste produced was mixed by hand with some of the feed then it was mixed in with the rest of the feed), the third group was supplemented with 2% ground fenugreek and the fourth group was supplemented with 1% garlic paste and 1% ground fenugreek. Every group was divided into four replicates of 12 bird each.

Table (1): Composition of turkey ration (Basal diet).

Ingredient	%
Corn yellow	63.3
Soybean meal (44%)	22
Concentrate (52%)	10
Soybean oil	4
Methionine	0.1
Vitamin and minerals Mixture	0.3
Salt	0.3
Total	**100**

Chemical analysis:

Crude protein 20.26
Metabolizable energy (kcal/ kg) 3200
Crude fiber (%) 3.4
Calcium (%) 1
Available phosphorus (%) 0.42

Turkeys were fed the supplemented treated diets for six weeks, then the feed additives were withheld and the turkeys fed the basal diet for the following four weeks.

1- Productive traits:

Body weight was recorded every two weeks for each bird. Weight gain was calculated every two weeks. Growth rate was calculated every two weeks. Feed conversion ratio was calculated at the end of experimental period for each replicate.

2- physiological trait:

A total number of 10 blood samples were collected randomly from the flock at the beginning of the experiment as a base line. After that, a total number of 40 blood samples were collected biweekly for 3 times during treatment and 2 times after withholding the feed additives. All blood samples were taken from the same male each time. For each sample, 3 ml blood was collected through brachial vein puncture in weatherman tubes. The blood samples were centrifuge at 3000rpm for 15 minutes. Clear serum was separated, then stored in a deep freezer at-20°C until the time of biochemical analysis. Serum cholesterol was analyzed using chemical analysis kit according to Fredrickson *et al.* (1967).

Serum High Density Lipoprotein (HDL) was determined according to the method of Warnick *et al.* (1983). Low Density Lipoprotein (LDL) was determined according to the method of Assmann *et al.* (1984).

3- Antibody production:

After five weeks from the beginning of the treatment, ten males/treatment were injected intravenously with 1 ml of SRBC suspension. Blood samples were collected 7 days postimmunization. Sera were frozen at –20°C until measuring the primary response, according to Trout *et al.* (1996). Antibody titer values were expressed as log 2 of the highest serum dilution giving total agglutination.

Statistical analysis:-

Data were analyzed using one way analysis of variance [General Linear Models (GLM) Procedure, SAS Institute, 1986]. The feed supplements considered the main effect. Mean values were compared using Duncan's Multiple Range test (Duncan, 1955), when significant differences existed.

The model used was: $Yij = \mu + Ti + Eij$

Where:

Yij = the observation of j^{th} individual under i^{th} treatment.

μ = the overall mean.

Ti = the effect of i^{th} treatment.

Eij = the uncontrolled deviation attributed to individuals.

RESULTS AND DISCUSSION

Body weight gain and growth rate:

Differences between groups, in body weight gain and growth rate, were observed only during the first four weeks of treatment (Tables, 2 & 3). By the end of the first two weeks of treatment, the garlic treated group had the highest body weight gain. This was significantly ($p < 0.05$) different from the control group. Both the fenugreek treated and garlic plus fenugreek groups had intermediate body weight gain with no significant differences from the other groups. From two to four weeks of treatment, garlic and garlic plus fenugreek treated groups had significantly superior growth rate than the control or fenugreek groups. After six weeks of treatment, no significant differences were observed between different groups in body weight gain or growth rate.

Table (2): Influence of garlic and fenugreek supplementation on body weight gain of bronze toms.

Periods (week)	Treatment			
	Control	2% garlic	2% fenugreek	1% garlic + 1% fenugreek
During treatment				
1-2	356.0 [b]** ± 49.3	476.5± 65.4	384.0 [ab] ± 45.4	403.0 [ab] ± 48.8
3-4	461.5 [b] ± 58.4	686.3 [a] ± 70.3	506.1 [b] 59.5	680.5 [a] ± 60.5
5-6	696.5 [a] ± 91.3	6082.5 [a] ± 75.6	687.3 [a] ± 80.7	696.0 [a] ± 82.1
After treatment				
1-2	641.5 [a] ± 88.3	686.0 [a] ± 80.5	623.3 [a] ± 79.3	647.0 [a] ± 86.3
3-4	523.0 [a] ± 87.8	550.0 [a] ± 75.6	650.0 [a] ± 78.9	620.0 [a] ± 85.7

*Values, with different superscript in the same row are significantly different ($P \leq 0.05$).

Table (3): Influence of garlic and fenugreek supplementation on growth rate of bronze toms.

Periods (week)	Treatment			
	Control	2% garlic	2% fenugreek	1% garlic + 1% fenugreek
During treatment				
1-2	8.2 [b]** ± 1.1	10.9 [a] ± 0.9.	8.6 [b] ± 1.3	9.1 [ab] ± 1.2
3-4	9.7 [b] ± 1.3	13.8 [a] ± 1.1	10.3 [b] ± 1.4	13.8 [a] ± 1.1
5-6	13.0 [a] ± 1.1	15.4 [a] ± 1.3	12.5 [a] ± 1.1	12.4 [a] ± 1.0
After treatment				
1-2	9.1 [a] ± 0.9	12.0 [a] ± 1.2	10.1 [a] ± 1.0	10.3 [a] ± 1.1
3-4	9.5 [a] ± 1.0	7.9 [a] ± 1.2	9.6 [a] ± 1.0	8.9 [a] ± 0.9

* Growth rate= (w2-w1)/((0.5*(w1+w2))*100.

**Values with different superscript in the same row are significantly different ($P \leq 0.05$).

Heath *et al,* (1983); Sklan *et al,* (1992); and Abdo (1998) did not find a clear effect of garlic on weight gain of broiler chicks. On the other hand, Galal *et al,* (1997) observed a reduction in body weight when using garlic at 3%

level in a broiler diet. Petit *et al.* (1993) showed that fenugreek seed contained saponins that increased feed consumption which in turn, increased body weight gain in rats. El-Kaiaty *et al.* (2002 a) did not find any effect of fenugreek on body weight of layers.

Body weight:

Results showed that all supplemented groups had higher body weight than the control group throughout the experimental period. However, these differences were not significant (Table 4). The results of El-Nawawy, (1991) showed that, diet supplemented with garlic improved body weight of broiler chicks. Dey and Samanto (1993) conclude that garlic can be used as a growth promoter in broiler stocks. Alm El-Din, (1999) and El-Kaiaty *et al,* (2002 b) observed that adding garlic to layer diets improved body weight.

Table (4): **Influence of garlic and fenugreek supplementation on body weight of bronze toms.**

Periods (week)	Treatment			
	Control	2% garlic	2% fenugreek	1% garlic + 1% fenugreek
Before treatment				
	4156 ± 151	4145± 161	4274±155	4200± 161
During treatment				
1-2	4512± 182	4622± 165	4658± 168	4603± 169
3-4	4974± 192	5308± 221	5164± 218	5284± 223
5-6	5670± 283	5988± 301	5851± 278	5976± 298
After treatment				
1-2	6511± 335	6674± 310	6474± 307	6627± 328
3-4	6834± 341	7224± 318	7124± 337	7247± 344

*** No significant differences were observed between the body weight of the different treatments within period.**

Feed conversion:

As shown in Figure (1), the garlic treated group had significantly ($P \leq 0.05$) better feed conversion ratio, throughout experimental period, as compared to other groups. This may be due to growth promotion and antibacterial properties of garlic (Kendeler, 1987 and Lau, 1989). The garlic plus fenugreek treated group had the second best feed conversion ratio, followed by the fenugreek treated group. The control group had the worst feed conversion ratio.

These finding agree with Abdo (1998) who found that garlic improved feed conversion of broiler chicks. On the other hand some researches showed that garlic and fenugreek supplementation had little effect on feed conversion (Heath *et al.*, 1982; El-Nawawy, 1991; Sklan *et al.*, 1992; El-Kaiaty *et al.*, 2002 b).

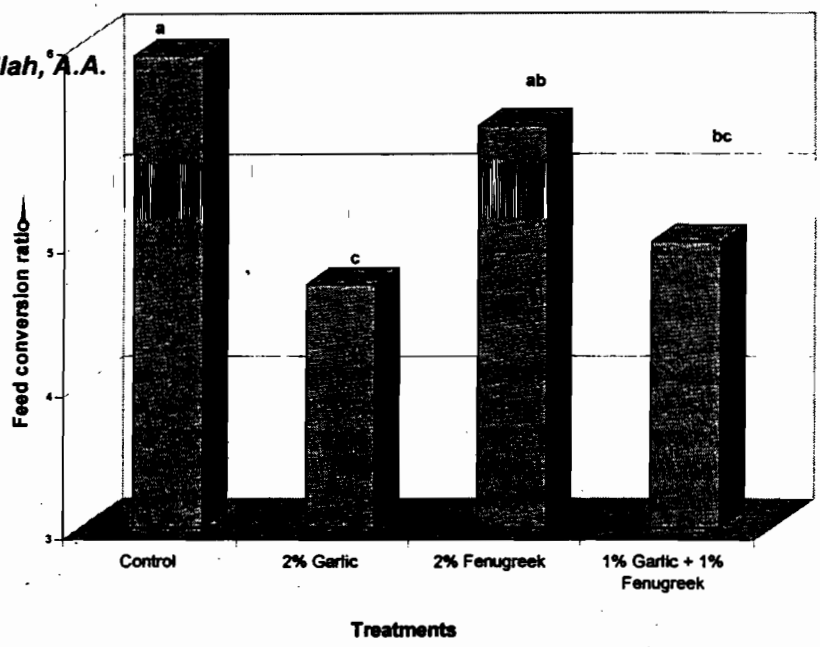

Figure 1: Influence of garlic and fenugreek on feed conversion of Bronze turkey toms during the experimental period.

Serum cholesterol:

Results showed that dietry garlic, fenugreek and garlic plus fenugreek significantly reduced the serum cholesterol level throughout the experimental period. The lowest serum cholesterol levels of Bronze toms were observed in the garlic treated group after 6 weeks of feeding the garlic (Table 5). The same pattern was still present after 2 and 4 weeks of garlic withdrawal. After four weeks of treatment. The lowest serum cholesterol levels were observed in birds fed diet supplemented with 1% garlic plus 1% fenugreek. During this period no significant differences were observed in serum cholesterol levels between birds fed diets supplemented with garlic or those supplemented with fenugreek.

Table (5): Influence of garlic and fenugreek supplementation on serum cholesterol (mg/100ml) of bronze toms.

Periods (week)	Treatment			
	Control	2% garlic	2% fenugreek	1% garlic + 1% fenugreek
Before Treatment				
	138.65± 2.30	138 65± 2.30	138.65 ± 2.30	138.65 ± 2.30
During treatment				
1-2	$140.5 \pm 2.4^{a*}$	127.5 ± 2.6^{c}	135.0 ± 2.2^{b}	133.2 ± 2.3^{b}
3-4	142.3 ± 2.3^{a}	132.4 ± 2.6^{b}	132.0 ± 2.1^{b}	128.1 ± 2.4^{c}
5-6	145.2 ± 1.9^{a}	121.0 ± 2.2^{d}	136.1 ± 2.0^{b}	125.1 ± 2.1^{c}
Average	142.7 ± 3.4^{a}	126.8 ± 2.9^{c}	134.4 ± 3.3^{b}	128.8 ± 3.1^{c}
After treatment				
1-2	150.3 ± 1.9^{a}	134.0 ± 1.6^{d}	145.0 ± 1.7^{b}	140.2 ± 2.0^{c}
3-4	153.5 ± 1.4^{a}	140.0 ± 1.1^{d}	150.2 ± 1.0^{b}	145.3 ± 1.3^{c}
Average	151.9 ± 1.4^{a}	137.0 ± 1.7^{d}	147.6 ± 1.3^{b}	142.7 ± 1.6^{c}

*Values with different superscript in the same row are significantly different ($P \leq 0.05$).

Four and six weeks, after treatment, birds fed the diet supplemented with garlic plus fenugreek had significantly lower serum cholesterol levels than that fed diet with fenugreek only. Serum cholesterol was reduced during treatment with garlic, fenugreek and garlic plus fenugreek in an average of 11.1, 5.7 and 9.7%, respectively. Four weeks after stopping the treatments, the corresponding cholesterol levels were still reduced by about 9.8, 2.8 and 6.0%.

Qureshi *et al.* (1983 a) observed that diets supplemented with 1, 2, 4, 6, and 8% garlic paste reduced serum cholesterol by 18, 21, 21, 24 and 25%, respectively, in male broiler chickens. The results of Chowdhury *et al.* (2002) showed that diet supplemented with 2, 4, 6, or 8% garlic paste reduced laying hens serum cholesterol level, on the average, by 15, 28, 33, and 43% respectively. Similar results were observed by El-Kaiaty *et al.* (2002 a and b) in laying hens. In addition, they showed that, using 2% fenugreek reduce serum cholesterol level. Also, Konjufca *et al.* (1997) observed a reductions of plasma, liver and breast muscle cholesterol in garlic supplemented birds. They also reported that Hepatic 3-Hydroxy-3-methylglutaryl-CoA (HMG-CoA) reductase activity was reduced due to dietary garlic. It was also shown that both garlic or fenugreek not only reduced serum cholesterol levels of animals but also in human (Bordia *et al.,* 1997 and Sowmya and Rajyalakshmi, 1999). Serum cholesterol was reduced when Turkeys, as well as other species, are fed garlic supplemented diets. Garlic may decrease the incorporation of acetate with cholesterol (Kritchevsky *et el.*, 1980; Chang and Johonson, 1980) and increase fecal bile acids and nutral sterol excretion (Chi *et al.*, 1982). Both actions are consistent with the lowering serum cholesterol.

Serum Low Density lipoprotein (LDL):

In general, all feed supplementation significantly reduced serum LDL during and after treatment as compared to the control group (Table 6). However, no significant differences were observed between serum LDL of garlic, fenugreek and garlic plus fenugreek group through experimental period.

Serum LDL was reduced by an average of 18.2, 20.5 and 14.7% during treatment (as compared to the control average), and by 11.7, 7.5 and 8.6% after the treatment was stopped for the 2% paste garlic, 2% ground fenugreek and 1%paste garlic+1%ground fenugreek, respectively. Qureshi *et al.* (1983) found that the suppressive action of garlic is at the cholesterol biosynthesis level. They also stated that the suppression of HMG-CoA reductase is manifested in the decreased serum concentration of LDL-cholesterol and total cholesterol.

Table (6): Influence of garlic and fenugreek supplementation on serum low-density lipoprotein (mg/100ml) of bronze toms.

Periods (week)	Treatment			
	Control	2% garlic	2% fenugreek	1% garlic + 1% fenugreek
Before Treatment				
	52.5 ± 3.4	52.5 ± 3.4	52.5 ± 3.4	52.5 ± 3.4
During treatment				
1-2	53.2 ± 2. 9^{a}	46.05 ± 3.2^{b}	46.2 ± 2.8^{b}	48.5 ± 3.0^{b}
3-4	55.4 ± 3.2^{a}	44.01 ± 3.0^{b}	43.7 ± 2.9^{b}	46.3 ± 3.1^{b}
5-6	56.5 ± 3.1^{a}	45.01 ± 2.9^{b}	41.1 ± 3.2^{b}	45.8 ± 2.8^{b}
Average	55.0 ± 3.3^{a}	45.0 ± 3.1^{b}	43.7 ± 3.0^{b}	46.9 ± 3.0^{b}
After treatment				
1-2	55.6 ± 2.1^{a}	48.4±2.3^{b}	50.2 ± 1.9^{b}	49.6 ± 2.0^{b}
3-4	58.4 ± 2.0^{a}	52.3±2.2^{b}	55.3 ± 2.1^{b}	54.7 ± 1.9^{b}
Average	57.1 ± 2.1^{a}	50.4 ± 2.3^{b}	52.8 ± 2.0^{b}	52.2 ± 1.9^{b}

*Values with different superscript in the same row are significantly different (P≤ 0.05).

Serum High Density Lipoprotein (HDL):

The control group had the highest serum HDL level throughout the experimental period as compared to other groups (Table 7). On the other hand, the garlic group had the lowest serum HDL comparing to the garlic plus fenugreek group after four and six weeks of treatment and after stopping the treatment.

Table (7): Influence of garlic and fenugreek supplementation on serum high-density lipoprotein (mg/100ml) of bronze toms.

Period (week)	Treatment			
	Control	2% garlic	2% fenugreek	1% garlic + 1% fenugreek
Before Treatment				
	72.5 ± 3.5	72.5 ± 3.5	72.5 ± 3.5	72.5 ± 3.5
During treatment				
1-2	73.5 ± 3.0^{a}	66.1 ± 3.3^{b}	67.3 ± 3.2^{b}	70.5 ± 3.1^{b}
3-4	75.3 ± 2.8^{a}	62.3 ± 2.7^{c}	64.5 ± 2.9^{b}	67.2 ± 3.0^{b}
5-6	76.8 ±3.0^{a}	53.0 ± 2.9^{c}	63.5 ± 2.6^{b}	64.1 ± 2.7^{b}
Average	75.2 ± 2.8^{a}	60.5 ± 2.7^{c}	65.1 ± 2.9^{b}	67.3 ± 3.0^{b}
After treatment				
1-2	78.5 ± 2.8^{a}	58.5±2.9^{c}	65.1 ± 3.0^{b}	66.2 ± 3.3^{b}
3-4	79.4 ± 3.0^{a}	64.5±3.2^{c}	71.2 ± 2.9^{b}	70.2 ± 3.1^{b}
Average	79.0 ± 3.1^{a}	61.5 ± 2.8^{c}	68.2 ± 2.7^{b}	68.2 ± 2.8^{b}

*Values with different superscript in the same row are significantly different (P≤ 0.05).

No differences were observed between serum HDL levels of garlic plus fenugreek group and fenugreek group. Similar pattern was observed between the overall means of the groups.

The current results showed that 2% dietary garlic paste reduced serum HDL, on the average, by 19.9 and 22.2% 6 weeks after starting the treatment, and 4 weeks after stopping the treatment, respectively. While, dietary garlic plus Fenugreek, at 1% of each, reduced the HDL level, on the average, by 10.5 and 13.7% at the same time points, respectively. Dietary 2% Fenugreek reduced the serum HDL, on the average, by 13.4 and 13.7% at the same time points (as compared to the control average), respectively.

El-Kaiaty *et al.* (2002 a and b) showed that 2% garlic or fenugreek reduced both serum HDL by 14 and 15%, respectively. While LDL was reduced by 9 and 11%, respectively. The combination of 1% garlic and 1% fenugreek reduced HDL and LDL by 17% and 12% respectively. The reduction in serum cholesterol and LDL in response to garlic or fenugreek supplementation may be attributed to the inhibition in hepatic-hydroxy methylglutaryl Co-enzyme A (HMG–CoA) reductase, cholesterol 7-alfa hadroxylase, and fatty acid synthesis (Qureshi *et al.*, 1983 a). They also, found that the suppressive actions of garlic did not affect HDL-Cholesterol. This discrepancy may be due to differences in the nature of the diet used, the age of the birds, species or the physiological state of the birds.

Regardless of the feed additive, the HDL concentration in turkeys, in the current study, were higher (60–79 mg/100 ml serum) than those reported by El-Kaiaty *et al.* (2002 a and b). They reported 27-41 mg/100ml serum HDL in Bovans hens (commercial layers). Conversely, the LDL concentrations in turkeys were lower (41-57 mg/100ml serum) than those observed in Bovans layers (88-110 mg/100ml serum). These differences may be species specific. Bersot *et al.* (2002) found that the low HDL-cholesterol levels appear to be genetic in nature. They stated that HDL-cholesterol levels are lower by 10-15% lower in Turks than seen in the United States and Western Europe. Low level of HDL-cholesterol is a major risk factor in coronary heart disease. Coronary heart disease risk increased by 2-4% for every mg/dl decrease in HDL-cholesterol levels.

High density lipoprotein (HDL) is a good cholesterol because it is the only lipoprotein which can accept the free cholesterol from the cells. HDL consists of HDL-nascent, HDL_1, HDL_2 and HDL_3. HDL-nascent is synthesized in the liver tissues and is transferred to bloodstream to accept free cholesterol from cell membranes. When HDL-nascent bind with free cholesterol it is transformed to HDL_3. The lecithin cholesterol acyl-transferase (LCAT), which is located on HDL, esterified the free cholesterol in HDL_3 then the later is transformed into the larger LDL_2 and rarely HDL_1 particles. The cholesterol ester transfer protein (CETP) transfers cholesterol from HDL_2 to other lipoproteins for eventual removal by the liver (Richard, 1994).

Antibody titer against SRBC:

The levels of antibody titer against SRBC, seven days post immunization, are shown in (Figure 2). The results indicated that no significant differences were observed between groups. However, fenugreek group had the highest anti-SRBC antibody titer as compared to the other groups. This was followed, in descending order, by garlic, garlic plus fenugreek and control groups, respectively.

El-Kaiaty *et al.* (2002 b) studied the influence of fenugreek and garlic on humoral immune response of White Bovans hens. They found that hens feed 2% fenugreek had the highest primary and secondary antibody levels against SRBC fowled by hens fed 3% garlic and then the control group.

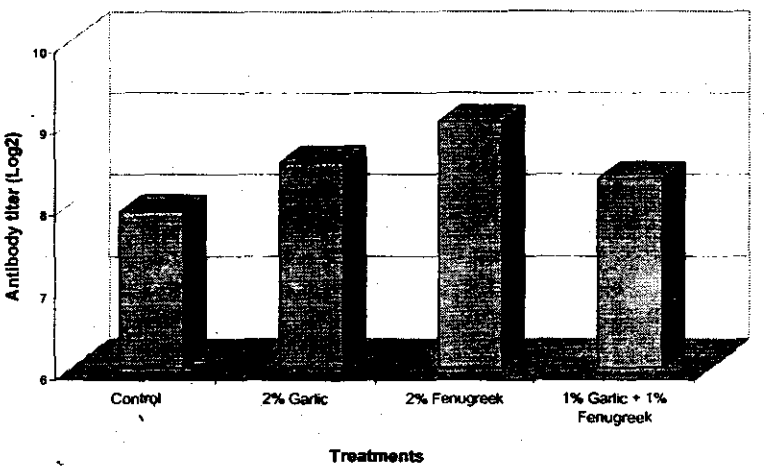

Figure 2: Influence of garlic and fenugreek on antibody titer against SRBC of Bronze toms during the experimental period.

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J. Agric. Sci. Mansoura Univ., 28(4), April, 2003

تأثير الثوم والحلبة علي الكفاءة الإنتاجية وشبيهات الدهون بالدم في الرومي

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أجريت هذه الدراسة لتقدير تأثير إضافة الثوم والحلبة إلي علائق الرومي البرونزي علي كل من الكفاءة الإنتاجية وشبيهات الدهون بالدم. أستخدم في هذه الدراسة عدد ١٩٢ ديك رومي عمر ٤ شهور قسمت هذه الطيور عشوائيا إلي ٤ مجاميع كل مجموعة بها ٤٨ ديك مقسمة لأربعة مكررات لكل مجموعة.

المجموعة الأولي أستخدمت كمجموعة للمقارنة، وغذيت علي العليقة الأساسية. المجموعة الثانية تم تغذيتها علي نفس العليقة مضافا إليها ٢% ثوم، والمجموعة الثالثة غذيت علي عليقة المقارنة مضافا إليها ٢% حلبة، والمجموعة الرابعة غذيت علي عليقة المقارنة مضافا إليها ١% ثوم+١% حلبة.

وكانت أهم النتائج المتحصل عليها كالتالي:

١- كان معدل الزيادة في الوزن والنمو أعلي في الرومي المغذي علي عليقة المقارنة المضاف إليها ٢% ثوم بصورة معنوية عن المجاميع الأخري خلال فترة المعاملة وإختفي هذا التأثير بعد ٤ أسابيع من إيقاف المعاملة.

٢- كان وزن الجسم في المجاميع التي تمت معاملتها بالثوم أو الحلبة أو الثوم+الحلبة أعلي من مجموعة المقارنة طوال فترة التجربة وكانت هذه الزيادة غير معنوية.

٣- أظهرت مجموعة الثوم تحسن في معدل الإستفادة الغذائية عن باقي المجاميع.

٤- حدث إنخفاض في مستوي الكوليستيرول الكلي بالسيرم بمعدل ١١,١%، ٥,٧%، ٩,٧% خلال فترة المعاملة كإستجابة لكل من الثوم والحلبة والثوم+الحلبة مقارنة بمجموعة المقارنة علي التوالي.

٥- لوحظ إنخفاض في الليبوبروتينات منخفضة الكثافة بمعدل ١٨,١%، ٢٠,٥%، ١٤,٧% ومرتفعة الكثافة بمعدل ١٩,٥%، ١٣,٤%، ١٠,٥% لكل من معاملات الثوم والحلبة والثوم+الحلبة مقارنة بمجموعة المقارنة خلال فترة المعاملة علي التوالي.

٦- استمر الإنخفاض في كل من كوليستيرول السيرم والليبوبروتينات المنخفضة الكثافة والعالية الكثافة عن مجموعة المقارنة طوال الأربعة أسابيع بعد إيقاف الإضافات.

٧- أظهرت مجموعة الحلبة إرتفاع في مستوي الأجسام المناعية عند حقن الطيور بكرات الدم الحمراء للغنم مقارنة بالمجاميع الأخري.