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Effect of Gum Arabic (*Acacia senegal, L. Willd*) on lipid profile and performance of Laying Hens

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ABSTRACT:
Objective: This experiment studied effect of Gum Arabic as a supplementary diet and its effect on lipid profile (serum, egg yolk and meat) and performance of Laying Hen. Methodology and results: One hundred and fifty commercial laying hens (29 weeks age/ white lohmann) were used.
The 150 laying hens are divided into five groups randomly G_1, G_2, G_3, G_4 and G_5, where each group contained 30 laying hens kept in separated battery house. G_1(Control) was fed basal layers diet while G_2, G_3, G_4 and G_5 were fed basal diet supplemented with Gum Arabic concentration at 1, 3, 5 and 7% respectively.
The study revealed that in serum, there was a significant decrease in cholesterol, triglyceride, but no significant difference in High Density protein (HDP) - cholesterol at P≤ 0.05, in egg yolk. There was a significant decrease in cholesterol for G_5 compared with G_1, also there was a significant decrease Triglyceride in G_4 and G_5 compared with G_1 indicated that there was a decrease in phospholipids in G_5 compared with G_1. Lipid profile of meat for treated groups (G_2, G_3, G_4 and G_5) showed no significant difference at P≤ 0.05 compared with non- treated group (G_1). The performance (body weight, egg weight and daily egg production) of laying hens showed significant increase at P≤ 0.05, but there was an increase in body and egg weight. Finally, there was no significant difference in daily egg production at P≤ 0.05. The addition of Gum Arabic as supplement of laying hens diet indicated there was no significant difference in serum cholesterol and daily egg production. Whereas, it is showed significant decrease in triglyceride, total lipid and phospholipids, but indicated significant increase in egg and body weight. Application of Gum Arabic as supplement in the diet of poultry production should be done because Gum Arabic is rich in highly soluble fiber.
Keywords: Serum, Egg yolk, Meat and Lipid Profile, Performance and Laying Hens

INTRODUCTION

The food industries are now promoting fresh and processed food with less total fat and cholesterol so that consumers may follow current nutritional advice without changing their types of food. Even more research remains to be done, to clearly delineate the relationship between food fats and health, to develop new technologies for making effective transformation in food composition, and to describe the physiological and biochemical mechanism of the effect of food fats on health welfare (Goldman, 1994). Animal production ,in particular poultry meat, represent an important part in our diet compared with some food substitutes because it is a good source of high biological

protein value and low total fat quantity. It also provides Iron and Zinc metal of high bio-availability in low quantity compared with the red meat. It has a significant amount of vitamin B such as Thiamin, Riboflavin and Niacin (Oveson. 2003).

Gum Arabic (GA) is dietary fiber that is derived from dried exudates of *Acacia senegal* (Nasir, 2008), It contains of high molecular weight (lipoprotein) and low molecular weight (heterogeneous gum polysaccharides). It is indicated that the supplementation with Gum Arabic increases fecal nitrogen excretion and lowers serum urea nitrogen concentration in chronic renal failure patients consuming a low protein diet (Bliss, et al. 1996). Increasing the ratio of the Gum Arabic (5- 15%) in the basal a layers diet significantly reduced serum cholesterol in a gradual manner and consequently in egg where lower yolk cholesterol was observed by Sabahelkhier (2008).Cholesterol, the most important sterol, is found only in food derived from animal sources such as egg yolk, liver and kidney (Johnson, and Standers, 1994). The body of human can not breakdown the sterol nucleus, but it is either excreted unchanged in bile or converted to bile acids and then excreted. Both bile acids and cholesterol undergo an entroheptic circulation (Backett, et al. 2005).

Triglycerides can be hydrolysized, re-synthesized, and utilized as source of energy or employed in the synthesis of additional lipid such as phospholipids and cholesterol (Goldman, 1994). There are four types of triglycerides which differ in their amount of protein and lipid: Chylomicron, derived from intestinal absorption of triglycerides: Very low density protein (VLDP), derived from the liver for export triglycerides: High density protein (HDP) and Low density protein (LDP) for cholesterol transport (Marray, 1999).

For good health and performance of laying hens, their diet must contain all the know nutrients (Water, protein, carbohydrates, vitamin and minerals) in the proper amount because any insufficiency of these nutrients leads to poor growth, reproduction, eggshell quality, egg size and egg production (Damron and Sloan, 2003).

The aim of this study was to investigate the effect of Gum Arabic on the lipid profile of serum, egg yolk and meat (triglycerides, phospholipids and cholesterol) and performance (body weight, egg weight and daily egg production) of the laying hens.

MATERIAL AND METHODS

Materials: The current experiment was conducted in Alhaj Suleiman Project for Poultry Production in Khartoum State. The biochemical analysis was done in Department of Biochemistry, Faculty of Veterinary, and University of Khartoum. One hundred and fifty commercial laying hens (White lohmann) were divided into five groups namely: G_1 without Gum Arabic as control, G_2 received 1% Gum Arabic, G_3 received 3% Gum Arabic, G_4 received 5% Gum Arabic and G_5 received 7% Gum Arabic. Each group contained 30 hens (29 weeks of age). Before start of the experiment all the hens were fed the basal diet without Gum Arabic for two weeks for adaptation as shown in Table (1). The water was distributed to the hens by pipe with nipple drinkers to each cage. Period of experiment three months.

Table 1: Basal diet formulation.

Ingredients	Sorghum	Groundnut cake	Wheat bran	Concentrates	Limestone	Total
Kg\ton	600	165	90	50	95	1000

Egg samples: 10 eggs from each group were collected manually and randomly every ten days for biochemical analysis. **Blood samples:** 10 blood samples were collected randomly from each group every ten days. Bloods were collected from the hen's wing by using sterilizing syringes and needle. Two ml of blood was taken from each hen and put in plain container and allowed to clot. Then

the sample was centrifuged at 3000 rpm for ten minutes to separate serum from blood cell. The serum was kept in test tubes – 20 °C and then used to estimate cholesterol, triglycerides and HDP cholesterol.**Meat samples:** Two meat samples were collected randomly from each group every ten days. Laying hens were slaughtered and immediately the muscle of the thigh was put in container and kept in a freezer for estimation of total lipid, Cholesterol, Phospholipids and triglycerides.

Performance (body weight, egg weight and daily egg production) of laying hens: It was determined every ten days.

Methods:

Serum cholesterol: It was determined according to method described by Meiattini, et al. (1978) and Allain, et al. (1974).**Serum triglycerides:** It was determined according to method described by Friedman and Young (1997) and, Fassati and Prencips (1982).

Serum high density protein (HDP): It was determined according to method described by Burstein, et al. (1980) and Grove (1979).

Extraction of lipid from egg yolk and meat (chloroform: methanol, 2:1 v/v): It was extracted from egg yolk according to methods modified by Overturp dryer (1969) and Folich, et al. (1952).

Statistical analysis: The experiment was conducted under the completely randomized design. Statistical analysis was performed by using one-way ANOVA for Statistical Package for Social Science (SPSS) software. Differences were considered significant at P≤ 0.05.

RESULTS AND DISCUSSION

Table 2: Effect of Gum Arabic on lipid profile (Total lipid, Cholesterol, Triglyceride, phospholipids and HDP) of serum, egg yolk and meat of laying hens

	Serum				**Egg yolk**				**Meat**			
Groups	**TL mg/dl**	**Ch mg/dl**	**Tg mg/dl**	**HDP mg/dl**	**TL mg/dl**	**Ch mg/dl**	**Tg mg/dl**	**Pl mg/dl**	**TL mg/dl**	**Ch mg/dl**	**Tg mg/dl**	**Pl mg/dl**
G_1 0%)	ND	108±2	448±9	21±1	179±6	18±0.7	63±3	[a]44±2	23±5	6±0.8	10±3	6±1
G_2 1%)	ND	104±3	447±8	21±1	178±5	16±0.6	63±3	42±3	23±3	7±0.5	9±1	7±1
G_3(3%	ND	104±3	436±9	21±1	178±3	16±0.6	57±2	40±1	26±3	9±1.0	9±1	8±1
G_4(5)	ND	104±2	436±8	21±1	178±4	16±0.6	55±2	[a] 39±2	28±2	9±0.8	9±3	8±1
G_5 7%)	ND	102±2	421±8	21±1	174±3	16±0.4	50±2	[a] 39±2	30±3	9±0.6	9±2	8±1

ND = Not Determine, TL =Total Lipid, Ch = Cholesterol, TG= Triglyceride, HDP = High Density Protein, PL= Phospholipids

Mean values with same letters within column are significant difference at P ≤ 0.05

Lipid profile of laying hen: Table 2 indicates the total cholesterol of serum for G_1, G_2, G_3, G_4 and G_5 at 108, 106, 105, 104 and 102 mg /dl, respectively. These findings indicate that a significant difference in the reduction of total cholesterol of the serum comparing with G_1 (control) at P ≤ 0.05, but it showed no significances in the diet supplemented with Gum Arabic at concentration of 1, 3, 5 and 7 mg /dl. Total triglycerides of serum for G_1, G_2, G_3, G_4 and G_5 are 448, 447, 436, 436 and 421 mg /dl, respectively. These results illustrate that there is no significant difference in the diet supplemented with Gum Arabic except for G_5 which showed a significant difference at P ≤ 0.05. These finding are inline with results that obtained by McNaughton (1978).The high density protein of serum is the same (21mg\dl) as for control and treated groups. These findings are supported by the results given by Davidson (1990). Total lipids of egg yolk for G_1, G_2, G_3, G_4 and G_5 are 179, 178, 178, 178 and 174

mg/dl, respectively. These findings showed no significant difference for the groups except G_5 which showed significant difference at $P \leq 0.05$. These results are inline with results reported by Jensen, et al. (1993). Total triglycerides of egg yolk for G_1, G_2 and G_3 are the same (63 mg/dl) while total triglycerides of egg yolk for G3, G4 and G_5 are 57, 55 and 50 mg\ dl, respectively. These results have confirmed that diet supplemented with Gum Arabic indicated a reduction in the total triglyceride for egg yolk in all groups compared with G_1, but the reduction is not significantly different for other groups except G_1 and G_5 that showed a high significant difference at $P \leq 0.05$. These findings are supported by results given by McNaughton (1978).

Phospholipids of egg yolk for G_1, G_2 and G_3 are 44, 42 and 40 mg/ dl, respectively. While Phospholipids of egg yolk for G_4, G_5 are the same (39 mg/dl). These results reveal that there is reduction in phospholipids, but not significant difference at $P \leq 0.05$ but G1 comparing with G_4 and G_5 is a significant difference at $P \leq 0.05$. Awad et al., (1997) reported that the major egg yolk phospholipids are phosphatidylcholine and phosphatidylethanolamine which are lower cholesterol reduced liquid egg yolk than control. This is probably due to their partial absorption and precipitation with β- cyclodextrin during the cholesterol reduction process. Total lipids of egg yolk for G_1, G_2, G_3, G_4 and G_5 are 23, 23, 26, 28, and 30 mg/dl, respectively. These findings indicate there is an increase in total lipid for treated groups comparing with the control group. These results are supported by he results given by Tageldin, et al, (2006).

Cholesterol of meat for $G_1$and G_2 is 6 and 7 mg/dl, respectively while cholesterol for G_3, G_4 and G_5 is same (9 mg/dl). These findings indicate there is no effect of supplemented Gum Arabic on cholesterol for the meat. Triglyceride of meat for G_1 is 10 mg/dl while Triglyceride of meat for G_2, G_3, G_4 and G_5 is same (9 mg/dl). These results are indicated there is no effect of diet supplemented with Gum Arabic on the triglyceride for the meat. Phospholipids of meat for G_1 and G_2 are 6 and 7mg/dl, respectively while Phospholipids of meat for G_3, G_4 and G_5 are same (8 mg/dl). These results are reveal that no effect of diet supplemented with Gum Arabic on phospholipids of meat

Table 3: Effect of Gum Arabic on Performance laying hens

Groups	Hen's weight (g)	Egg's weight(g)	Egg production / group /day
G_2 (0%)	1375±10	54±0.6	70±1.2
G_2 (1%)	1425±11	56±0.7	70±1.3
G_3(3%	1438±11	56±0.6	70±1.1
G_4 (5 %)	1440±10	56±0.7	70±1.3
G_5 (7%)	1485±12	56±0.5	70±1.2

Performance of laying hens: Table 3 shows the body weights for G_1, G_2, G_3, G_4 and G_5 which are 1375, 1425, 1438, 1440 and 1485 g, respectively. These results indicate that the diet supplemented with Gum Arabic resulted in an increase in the body weight of laying hen and is significantly different at $P \leq 0.05$. These findings are confirmed the results that obtained by Tageldin, et al, (2006). The weight of egg G_1 is 54 mg while weight of egg for G_2, G_3, G_4 and G_5 is same (56g). These results are indicated there is increase in weight of egg for treated groups but the increase is not significantly different at $P \leq 0.05$. These findings are supported the results that given by Kelley and Tsai (1978). The daily production of eggs is same (70 eggs). These findings are illustrated there is not change in eggs production for diet supplemented with Gum Arabic compared with control in three months. These results are inline with the findings reported by McNaughton (1978).

CONCLUSION AND APPLICATION:

It is concluded that feeding laying hens diets supplemented with 1, 3, 5 and 7% Gum Arabic showed no significant differences in serum cholesterol, high density protein, but reduced serum triglycerides concentration significantly in group that received 1% Gum Arabic. Addition of Gum Arabic as 1, 3, 5 and 7% to laying hens diets decreased egg yolk and total lipid concentration. 7% Gum Arabic decreased egg yolk cholesterol, but 5 and 7% Gum Arabic decreased egg yolk triglyceride and 7% Gum Arabic decreased phospholipids significantly. Meat lipid showed no significant differences due to feeding 1, 3, 5 and 7% Gum Arabic. There was a clear and significant increasing in egg and body weight of hen resulted from addition 1, 3, 5 and 7% Gum Arabic in laying hens. Finally, there were no significant differences in daily egg production. Further studies must be conducted to investigate the effect of the Gum Arabic on lipid and performance of both Broilers and layers hens.

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