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ORIGINAL ARTICLE

RESPONSE OF BROILER CHICKS TO DIETS CONTAINING GUM ARABIC AS A NATURAL PREBIOTIC

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ABSTRACT: The experiment was conducted to investigate the effect of different levels of feed added Gum Arabic powder on the performance, carcass characteristics and serum chemistry of broiler chicks. Five experimental diet's were designated as A, B, C, D and E. Diet A as a control, B was supplemented with antibiotic growth powder (Neomycin), diets C, D and E were supplemented with 2, 4 and 6% of Gum Arabic respectively. 140 broiler chicks, 7 days old were randomly distributed into five treatments, each treatment with four replicates and each replicate with seven chicks. Average weight gain, feed consumption, feed conversion ratio, mortality rate, dressing percentage, weight of different commercial cut's (breast, drumstick, thigh), giblets (liver, gizzard) abdominal fat, meat chemical composition and serum chemistry were used as a criteria of response. Economics for each group was calculated at the end of the experimental period. Results obtained showed no significant difference between treatment groups in performance parameters, dressing percentage, yield of commercial cuts, non carcass components, physical and chemical composition of meat values. The supplementation of control diet with Gum Arabic significantly (P> 0.05) decreased total cholesterol, uric acid and calcium crystals and at the same time increased the level of total protein in the blood serum compared to control group and that fed on diet supplemented with antibiotic. Supplementation of Gum Arabic apparently improved the general performance of broiler chicks, significantly decreased total cholesterol and uric acid of blood serum. Economically Gum Arabic can be safely included in broiler diets up to 6% without any adverse effect.
KEYWORDS: Gum Arabic Powder, Neomycin, Total Cholesterol.

INTRODUCTION

Due to the potentially undesirable effects of antibiotics as growth promoters in poultry production, researchers are looking for viable alternative to limit or replace their use. Today they used natural sources as growth promoters, like probiotics, prebiotics; they are altering the intestinal microbiota and immune system to reduce colonization by pathogens in certain conditions (Patterson and Burkholder, 2003). Probiotics are feed additive that contain live microorganism and promote beneficial effects to the host by favoring the balance of the intestinal macrobiota (Fuller 1989; Huang *et al.*, 2004), probiotics improve live weight gain and feed conversation ratio (Jin *et al.*, 2000; Zulkifili *et al.*, 2000; Huang *et al.*, 2004), and prevent poultry pathogens and diseases (Jin *et al.*, 1998; Kabir *et al.*, 2004; Mountzaouris *et al.*, 2007; Awad *et al.*, 2009). Prebiotics are non-digestible food ingredient (Gibson and Roberforid, 1995). The use of prebiotics in broiler's diets does not have a long history. Several authors have observed the positive effects of prebiotics fractions included in the broiler's diet had higher body weight gain and increased growth performance, dressing percentage, breast and thigh muscle weight (Rebole *et al.*, 2010; Park and Park, 2011), improving digestion, enhancing mineral absorption (Coxam, 2007). Gum Arabic is the dried exudates obtained from the stems and branches of either acacia seyal or acacia sengal. It has ability to increase number of probiotics bacteria and enhancing immune system. It contains soluble dietary fibers with more than 85% of its weight as soluble fermentable fractions. It promotes beneficial physiological effects including laxation and/or attenuation each of blood cholesterol and glucose and it also improves mineral availability (Phillips, 1998; Nasir *et al.*, 2004). Sabahelkhier *et al.*, (2009) reported increased feed intake and egg shell thickness by supplementation of graded levels of gum Arabic in the basal laying hen diet. Abd-Razig *et al.*, (2010) and El-khier *et al.*, (2010) found a significant decrease in serum cholesterol, trig lyceride, but with no difference in high density protein, and that increase in the

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ratio of the G A in the basal layers diet significantly reduced serum cholesterol in a graduated manner and consequently in egg where lower yolk cholesterol was observed.

The objective of this study is to investigate the usage of different levels of Gum Arabic as a natural prebiotic on the performance, serum chemistry, dressing percentage, weight of commercial cuts, weight of internal organs compared to classical Growth promoter as antibiotic.

MATERIALS AND METHODS

This study was conducted at the poultry department of Animal Production College of Agricultures Studies, Sudan University of Science and Technology, during the period from 14/4 to 26/5/242 in which the ambient temperature ranged between 39 to 41.

A total of one hundred of forty 7 day old unsexed broiler chicks strain Hubber Purchased from a local commercial hatchery (Ommat company) were randomly divided into five treatment diets (A, B, C, D and E). Each treatment group was sub divided into four replicates of 7 birds per each. The chicks were adapted of fed over 7 days on broiler pre-starter before the start of experiment.

Chicks were vaccinated against Gambaro disease at 11 days of age and Newcastle disease in drinking water at 22 days age. Soluble multivitamin compound (Univet) given to chicks before vaccination to guard against stress.

The chicks were fed a commercial broiler pre-starter for week. The ingredients composition of the control diet was presented in table (1).

The Gum Arabic (GA) Hashab was purchased from the GA Company (Savan). The experimental diets were designed as a control diets B is control supplemented with antibiotic as growth promoter (Neomycin 25% water soluble powder), diets C, D, E were supplemented with 2, 4 and 6% GA respectively. The experimental diet was analyzed for the crude protein, moisture content, crude fat and crud ash percentage according to the methods of AOAC, (1984). The diet was formulated to meet the requirement established by NRC, (1994). The feed of drinking water were provided *ad libitium.* Strict sanitation practices were maintained in the house before and during the experiment. Chicks were kept in an open wire mesh-side poultry house the house was constructed on concrete floor. The roof was made of metal sheets the sides were permanently covered with sacks to reduce hot current wind. Stand fans of air coolers were used to keep the temperatures in house cool. Twenty pens (cm) inside the house were prepared us wire mesh partitioning the pens were cleared washed of disinfected with formalin of phenol solution before for the start of the experiment. A layer of wood shavers used as a litter material. Each pen was supplied with client disinfected 2.5 gallon drinker of 5 kg feeder- light was provided 24hours in a farm of natural light during the day of artificial during night.

Body weights was recorded weekly by group weighting of the birds of each group and feed consumption also record at the time of weight. Body weight again and FCR were calculated weekly and mortality was record daily through the experimented period.

After end of the experiment chicks were fasted over night except from water on bird from each replicate was randomly selected weighted individually, slaughtered and blood samples were collected in heparinized test tube and analysis to determine total plasma cholesterol spectrometerically using commercial kit. The internal organs were expressed as a percentage of live body weight.

The carcasses were eviscerated, weighed, chilled over night in a refrigerator (4^{o}C) to measure cold carcass weight. The chilled carcasses were weighted (cold weight) after 24 hours, then they were weighed after 24 hours then they were sawed into two halves. The left side then divided into the commercial cuts (breast, drumstick, and thigh). Each cut was weighed individually then deponent to determine the weight of meat. The meat was stored frozen for analysis and panel taste the right side for carcasses stored at 4^{o}C.

Stored meat samples were cut into small pieces minced twice and double samples were analyzed for Protein, Fat, Ash, and moisture content according to AOAC, (1975) diets were analyzed, the separated serum from the collected blood samples also analyzed. The stored right side of carcasses was slightly seasoned wrapped individually in aluminum foil and roasted at 190^{o}C for 70 minutes with average internal temperature of 88^{o}C and served warm. Well trained panel test were used to score color, flavor, tenderness and juiciness of meat according to (Cross *et al.*, 1978) method. The roasted samples were served randomly to each judge at room temperature. Water was provided to the panelist to rinse their mouth after tasting each sample.

The hot and cold carcasses were expressed as a percentage of live weight. The commercial cuts were expressed as percentage of hot carcasses Non carcasses components (heart, liver, and gizzard) were expressed as a percentage of live weight. Meat and bone of each cut were

expressed as a percentage of the weight of its cut. The data obtained were statistically analyzed with the standard procedures of analyses of variance (ANOVA) using completely randomized design. Significant differences between treatment means were separated using the Duncan's multiple range tests with 5% probability (Duncan, 1995).

Table 1: The ingredients and calculated composition of the control diet

ingredients	Percent
Dura	65.00
Ground cake	11.00
Sesame cake	18.00
Conc.	5.00
shell	0.39
Nacl	0.25
Lysine	0.05
Meth	0.11
Vit.	0.20
Total	100.00
Calculated Analysis of Experimental diet	
ME	3135.85
CP	22.88
Lysine	1.20
Meth	0.60
Ca	1.01
P	0.66
EE	5.80
Ash	4.70

Conc. = Broiler concentrate, shell =Oyster shell, Meth=methionine, Vit. =vitamin
ME=metabolizable energy, **CP=**crude protein**,** **Ca**=calcium, **P**=phosphorus, **EE**=ether extract

RESULTS

The result of chemical analysis of Gum Arabic (Table 2) showed that it contain 0.72% (w/w) reducing sugars, 0.25% (w/w) calcium, 3.1% (w/w) potassium, 13% (w/w) insoluble fiber, and total ash 3-2% (w/w). Results obtained showed no significant (P> 0.05) difference in the performance (Final body weight, body weight gain and feeding) of broiler chicks fed on diets supplemented with antibiotic (Neomycin) on these diet's supplemented with graded levels of Gum Arabic powder (Table 3). Data obtained for body weight showed that chicks fed on diet containing 4% gum Arabic (GA) showed numerically higher body weight followed by group fed on 6%, while control group showed numerically the lowest value in body weight. Similar results were obtained for body weight gain (BWG).

Results also revealed that chicks fed on diet supplemented with antibiotic consumed numerically more feed followed by groups fed on 6%, 2% and 4% GA while chicks on control diet consumed the lowest value of feed. However the higher feed consumption for the antibiotic group did not cause proportionate increase in the body weight gain, there for result in lower efficiency of feed utilization.

The data concerning FCR of experimental chicks when subjected to analysis of variance revealed that chicks group fed on diet supplemented with antibiotic record significantly (P<0.05) the lowest value compared to all tested group's while chicks fed on diets supplemented with GA recorder no significant (P<0.05) difference compared to the control group.

Average values of hot carcasses weights, yield of commercial cuts and non carcasses component's were illustrated in (Table 4) the results record no significant (P>0.05) differences among the tested groups. Values of non carcasses component's of (liver, gizzard and heart) and dressing percentage of experimental chicks showed no significant (P> 0.05) differences.

Average chemical composition (objective analysis) and subjective values of commercial cut's meat were in (Table 5) the data subjected to analysis of variance showed no significant (P>0.05) differences among the tested groups, although there was a decrease in total protein present with the GA supplementation compared to both control and diet containing antibiotic. The subjective panel test meat attributes of tested groups showed no significant difference (P>0.05) between groups, scores given for all attributes were above moderate acceptability level. The effected feeding on diet's containing GA and antibiotic on blood serum were shown in (Table 6) there was no significant differences (P>0.05) between control and chicks fed on diet supplemented with antibiotic in all parameters. But there were a significant (P< 0.05) between them and chicks fed on diet's containing GA.

The addition of GA to control diet significantly (P<0.05) decreased the total cholesterol, uric acid and calcium content serum and at the same time increased the level of total protein.

Chicks fed on diet containing 4% GA record the highest profit followed by chicks fed on diet contain 6% GA compared to all tested group, chicks fed on control diet recorded the lowest profit. Based on the results obtained it may be concluded that GA can be supplemented in the broiler diet up to 6% without any adverse effects. Supplementation of GA to broiler diet significantly the total cholesterol, uric acid and calcium crystals and same time increased the level of total protein in the blood serum. GA supplementation apparently improved the general performance of broiler chicks. Economically GA is included in broiler diets up to 6% without any adverse effect.

Table 2: Chemical analysis of Gum Arabic (GA)

Ingredient	**Percent**

Moisture	7.45 % (w/w)
Total ash	3.2 % (w/w)
Reducing sugars	0.72 % (w/w)
Calcium	0.25 % (w/w)
Potassium	3.1 % (w/w)
Sodium	0.006 % (w/w)
Dietary fiber (in soluble)	13 % (w/w)
Dietary fiber (soluble)	76.2 % (w/w)

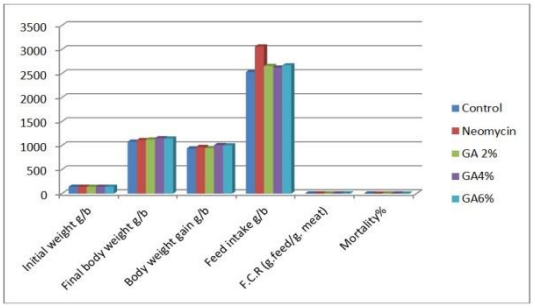

Figure 1: The performance of broiler chicks feed on diets containing Gum Arabic.

Table 3: The performance of broiler chicks feed on diets containing Gum Arabic

Parameters	Control	Neomycin	GA 2%	GA4%	GA6%	SE+
Initial weight g/b	142.5	142.5	142.5	142.6	142.6	2.69
Final body weight g/b	1081.75	1115.25	1125.5	1153.5	1145.8	24.89
Body weight gain g/b	941.64	969.5	948.0	1009.5	1002.59	26.44
Feed intake g/b	2530.89	3062.57	2657.03	2623.22	2668.93	169.55
F.C.R (g.feed/g. meat)	2.32	2.76	2.37	2.333	2.328	0.114
Mortality%	2.86	0.71	2.14	1.43	0.0	-

F.C.R =Feed conversion ratio

Table 4: Average Values weight of hot carcass weight, yield of commercial cuts and non carcass components of broiler chicks fed diets containing Gum Arabic

Parameters	A	B	C	D	E	SE+
Hot eviscerated weight(g)	635	866.67	825	61167	726.67	-
Breast *	42.29	42.17	42.19	42.54	41.82	0.91
Drumstick*	27.69	28.63	27.95	28.54	27.32	0.49
Thigh*	24.52	23.33	23.09	24.07	23.23	0.49
Wing*	19.97	19.69	20.3	20.33	20.23	0.49
Gizzard	2.72	2.41	3.26	2.89	3.22	0.45
Heart	2.36	2.18	2.16	2.34	2.14	0.1
Liver	3.35	3.36	3.31	3.3	3.29	0.18

A= Control, B= Neomycin , C=GA2% D=GA4% E=GA6%

***** as% of hot carcass

Table 5: Chemical composition and subjective meat a tributes of broiler chicks fed diets containing Gum Arabic

Treatment	A Control	B Neomycin	C GA 2%	D GA4%	E GA6%
Moisture%	76.91	77.5	77.2	77.1	77
Protein%	20.7	20.6	20.3	19.9	20.2
Fat%	1.9	2.0	1.9	2.0	1.98
Ash %	1.5	1.0	1.4	1.7	1.7
Color	6.6	5.7	6.5	6.0	5.5
Flavor	6.0	5.0	5.7	5.7	6.1
Tenderness	6.5	5.2	5.2	5.7	5.3
Juiciness	6.0	5.6	5.0	6.0	5.0

Table 6: Effect of feeding broiler chicks on diets containing GA on blood serum analysis

Treatment	Cholesterol Mg/dL	Total protein	Albumin	Uric acid	Ca^{++}	P
Control (A)	114	3.9	2.46	3.8	8.55	3.36
Neomycin (B)	119.7	4.16	2.53	3.46	7.83	3.6
GA 2 %(C **)**	109.66	4.13	2.5	3.0	7.56	3.41
GA 4%(D)	107	3.93	2.8	3.14	7.5	3.93
GA 6 %(E)	105	4.45	2.9	3.15	6.99	4.6

DISCUSSION

Results of this study showed no significant differences in the performance (Body weight, body weight gain and feed intake) of broiler chicks fed on diet, supplemented with antibiotic (Neomycin) and diets supplemented with graded levels of Gum Arabic powder. Although, chicks fed on diets supplemented with high levels of GA (4% and 6%) recorded the highest values of body weight (BW) and body weight gain (BWG) compared to those fed on control diet and diet with Neomycin, while the latest group consumed more feed compared to other tested groups. These result were in line with findings of Sims and Seflon, (1999) who reported no difference in BW, BWG and F1 for

probiotics and Waldroup *et al.,* (2003) and Midilli *et al.,* (2008) who found that dietary probiotic and/ or probiotic supplementation did not significantly affect BW, BWG, FI, Carcass weight and carcass yield.

On the other hand, these results disagreed with Piray *et al.,* (2007) demonstrated significant increases in BWG in broilers recovering diets supplemented with prebiotics, Abd-Razing *et al.,* (2010) who reported significant increasing in body weight of hen from addition of graded kevels of Gum Arabic in laying hens.

Also results revealed that chicks fed diet supplemented with antibiotic (Neomycin) recorded significantly ($p \geq 0.05$) lowest value for FCR compared to other tested groups. This lowest might be due to higher feed intake of this group which did not cause proportionate increase in the body weight gain, therefore, resulted in lower efficiency of feed utilization. Sabahelkhier *et al.,* (2009) found that supplementation of 15% GA in layer based diet increased feed intake and Midilli *et al.,* (2008) who found that FCR was significantly improved for chicks fed diet supplemented with probiotic.

Data obtained showed no significant ($p \geq 0.05$) difference in average values of hot carcass, yield of commercial cuts (breast, thigh, and drumstick), non-carcass components (liver, heart and gizzard) and dressing percentage. These results were in line with findings of Midilli *et al.,* (2008).

Also results showed no significant difference in average chemical composition (objective) values of meat, although there was a decrease in total protein percentage with GA supplementation compared to control and antibiotic groups. It is indicated that the supplementation with GA increases fecal nitrogen secretion and lowers serum urea nitrogen excretion and lowers serum urea nitrogen concentration. These results were in line with that of Bliss *et al.,* (1996).

The subjective meat attributes of tested groups showed no significant difference, secures given for all attributes was above moderate acceptability level.

Also results showed no significant difference on blood serum between control and antibiotic groups, but there was a significant difference ($p \geq 0.05$) between them and chicks fed on diet supplemented with grappled level. The addition of GA to control diet significantly ($p \geq 0.05$) decreased the total cholestrol, uric acid serum, calcium content and at the same time increased the level of total protein. Therefore, albumin and phosphorus probiotics absorb bile acid turn it into wastes to prevent re-absorption of cholesterol in blood as well as lowering LDL-cholesterol (bad cholesterol). These results confirmed by Abd-Razig *et al.,* (2010), El-khier *et al.,* (2010) who found that addition of GA at 15% in layer diet significantly reduced serum cholesterol, also Ross *et al.,* (1983) who reported that administration of GA to men for 3 weeks result in modest fall in serum cholesterol and he reported that the mechanism of the decrease in cholesterol with Gum Arabic is not by absorption of cholesterol metabolites as the fecal bile acids and neutral sterols did not increase. The findings in the present study are also consistent with those reported by Kelley and Tsai, (1978), they noticed that GA reduces serum cholesterol in rats, suggesting that GA inter with dietary cholesterol absorption. The soluble fraction of various dietary fiber sources, seem to have the potential for lowering plasma total cholesterol level. GA (soluble dietary fiber) was observed to be effective in lowering the total plasma cholesterol level (Al-Othman *et al.,* 1998).

On the other hand, these results disagreed with Topping *et al.,* (1985) who showed that plasma cholesterol concentration was unaffected by feeding GA and Annison *et al.,* (1995) who recorded that GA to rats has no significant affect on plasma cholesterol. It is also not agreement with the work of Tageldin *et al.,* (2006) who reported increase on cholesterol level in rabbits fed GA and that GA associated with an increase in total cholesterol biosynthesis.

The mortality rate decreased with the addition of GA compared to control group which recorded the highest rate of mortality. This might be due that natural probiotic (GA) creates suitable environment for probiotics to grow and help eliminate toxins, fats and balance out bad bacteria thus, enhance the immune system, which will secure body to be less prone to sickness and severe as energy booster. This result was in agreed with report of Gibson and Roberfroid, (1995); Marinho *et al.,* (2007) and Rayes *et al.,* (2009).

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