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Response of Broiler Chicks to Diets Supplemented with Garlic Essential Oil as Natural Growth Promoter

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Abstract: ***This experiment was conducted to investigate the effect of feeding broiler chicks on diets supplemented with graded levels of garlic essential oil as natural growth promoter. Experimental parameters covered growth performance, carcass dressing percentage, subjective meat quality and economical appraisal. The experimental design used was the complete randomized design (CRD). One hundred and forty, 7 day-old, unsexed Ross 308 strain of broiler chicks were randomly divided into five experimental groups (A, B, C, D and E) with four replicates, each of seven chicks. Group A fed on basal diet without feed additives group B was fed on basal diet supplemented with antibiotic (Neomycin, 20gm/kg) the other groups C, D and E were fed basal diets supplemented with garlic essential oil at levels of 0.1, 0.2 and 0.3 respectively. The basal diet was formulated to meet the nutrients requirements of broiler chicks according to (NRC, 1994). Experimental diets were fed for 6 weeks. The results indicated that there were no significant (p> 0.05) differences among all treatment groups in the values of body weight gain, feed intake, feed conversion ratio, carcass dressing percentages and subjective meat quality attributes. No mortality was recorded throughout the experimental period. The economical evaluation showed that all levels of dietary garlic essential oils were economically feasible, although, the value of profitability ratio (1.27) of group E (0.3% garlic oil) was the highest of the tested groups.***

Keywords: Garlic essential oil, growth performance.

1. Introduction

The fast growing nature of broilers and their short generation interval has been associated over the years with the use of antibiotic growth promoters. (Dieumou et al., 2009).Although the use of antibiotics as growth promoters was banned, due to the negative effect on human health .Today ,the work has focused on the alternatives growth promoters to be used in poultry feed. Several compounds such as enzymes, organic acids, probiotics, prebiotics and phytogenics are used to improve the performance. Recently aromatic plants and their associated essential oils or extracts are being concerned as potentially growth promoters.

Most essential oils consist of mixtures of compounds such as phenolics and polyphenols, terpenoids, saponines, quinine, esters, flavone, flavonoids, tannins, alkaloids and non-voltiles residues; and their chemical composition and concentration of compounds is variable. These compounds have many effects as antimicrobial, stimulating animal digestive system, antioxidants, anticoccidail increase production of digestive enzymes and improve utilization of digestive products by enhancing liver functions (Ziarlarimi et al., 2011).

Garlic (Allium sativum) is widely used in all parts of world as a spice and herbal medicine for the prevention and treatment of a variety of diseases ranging from infections to heart diseases. It has long been considered that garlic has several beneficial effects for human and animals, exhibiting antimicrobial, antioxidant antiviral and antifungal properties (Konjufca et al., 1997). Garlic supplement to broiler chicks has been recognized for its strong stimulating effect on the immune system in addition to its positive effects on digestion in birds due to the very rich aromatic essential content of garlic (Demir et al., 2005). Previous researchers suggested that those functions are mainly to the bioactive compounds such as allin, daillyLsulphides and allicin . Undoubtedly, garlic essential oils which may be used as alternative to antibiotic have a wide range of potential uses.

Dieumou et al., (2009) studied the effect of ginger and garlic essential oils on growth performance of broiler chicks, results indicated no significant differences in feed intake, body weight and feed conversion ratio among the treatment groups. The treatment effects of the garlic essential oils in this experiment had a positive impact on the gut micro flora as it reduced their loads as compared to the control, contributing to some extent to heath maintenance. Therefore this study was conducted to evaluate the effects of various levels of dietary garlic essential oil as natural growth promoters on the growth performance, carcass dressing percentage and subjective meat parameters of broiler chicks.

2. Materials and Methods

This experiment was conducted during winter season (18^{th} October –29^{th} November 2012). The ambient temperature averaged 21.5ºC – 33ºC during the experimental period (6weeks). A total number of 140 one day old commercial unsexed broilers of Ross-308 strain were obtained from a commercial Company and transported to the student poultry premises, College of Agricultural Studies, Sudan University of Science and Technology, Shambat.

The chicks were fed over 7 days before start of the experiment on commercial pre-starter. At the end of adaptation period, all chicks were weighed , then assigned randomly into five dietary treatment groups (A, B, C, D and E) in completely randomized design (CRD), each group was divided into five replicates, each of 7 chicks. Chicks were bought vaccinated against Marek's disease, with on farm

vaccinated against Gumboro disease at 11 days of age through drinking water and Newcastle disease at 22 days of age using Lasota strain. Soluble multi-vitamin compounds (Pantominovit-pantex Holland B.V. 5525 ZG Duizel-Holland) given to the chicks before and after 3 days of vaccinations in order to guard stress.

An open wire mesh-side poultry house was used; the house was cleaned and well disinfected before the commencement of the experiment. 20 pens, $1m^2$ each, inside the house, were prepared using wire mesh partitioning. Each pen was equipped with one feeder and drinker to allow *ad Libitum* consumption of feed and water. Light was provided approximately 24 hours in a form of natural light during the day and artificial light during the night.

Garlic oil used in this experiment was purchased from the local market. The chicks were fed on 5 dietary treatments. The first group A fed on basal diet (negative control) without growth promoters. The second group B fed on basal diet containing an antibiotic (Neomycin 20mg/kg) as chemical growth promoter (positive control). The other groups C, D and E were fed on the basal diet supplemented with garlic oil as natural growth promoter, at levels 0.1, 0.2 and 0.3% respectively. The basal diet was formulated to meet the nutrients requirements of broiler chicks according to the (NRC, 1994).

The ingredients percent composition and the calculated chemical analysis of the experimental diets were presented in Table (1). Average body weight, weight gain and feed intake (gm) for each group were determined weekly throughout the experimental period. Health of the experimental stock and mortalities were closely observed and recoded daily.

Table 1: The ingredients percent composition of experimental diets

Ingredient%	*Diets*				
	A	*B*	*C*	*D*	*E*
Sorghum (Fetarita)	65.00	65.00	65.00	65.00	65.00
Groundnut cake	14.15	14.15	14.15	14.15	14.15
Sesame cake	15.00	15.00	15.00	15.00	15.00
Concentrate*	05.00	05.00	05.00	05.00	05.00
D.C.P	00.60	00.60	00.60	00.60	06.00
Salt	00.25	00.25	00.25	00.25	00.25
Total	100.00	100.00	100.00	100.00	100.00
Antibiotic (Neomycin, mg/kg)	-	20	-	-	-
Garlic oil%	-	-	0.1	0.2	0.3

Calculated chemical analysis of experimental diets

Dry matter	94.85	94.85	94.85	94.85	94.85
Crude protein	22.70	22.70	22.70	22.70	22.70
Crude Fiber	04.35	04.35	04.35	04.35	04.35
Ether Extract	03.35	03.35	03.35	03.35	03.35
Ash	04.65	04.65	04.65	04.65	04.65
Nitrogen.Free Extract	59.80	59.80	59.80	59.80	59.80
Calcium	01.06	01.06	01.06	01.06	01.06
Total phosphorous	00.79	00.79	00.79	00.79	00.79
Available phosphorous	00.50	00.50	00.50	00.50	00.50
ME. Kcal/Kg**	3117	3117	3117	3117	3117

*crude protein 40% ; crude fat 3.90% ; crude fiber 1.44% ; calcium 10% ; available phosphorus 6.40% ; energy 1950 K cal/Kg ; Methionine 3% ; Methio + cystin 3.3% ; lysine 10 – 12 % ; crude minerals 39.30% ; sodium 2.77% ; linoleic acid 0.24% ; Nacl 6% ; Vitamins: vit. A 200.000 I.U/Kg ; D3 70.000 I.U/Kg ; Experiment 400 mg/Kg ; K3 30mg/Kg ; B1 50 mg/Kg ; B2 150 mg/Kg ; B6 50mg/Kg ; B12 180 mcg/Kg.D Pantothenic acid 155 mg/Kg ; Niacine 440 mg/Kg ; folic acid 8 mg/Kg ; choline chloride 5.800 mg/Kg ; Antioxydant (BHT) 1000 mg/Kg .Trace Elements; Manganise 1600 mg/Kg ; zinc 1600 mg/Kg ; Iron 580 mg/Kg ; copper 450 mg/Kg ; Iodine 55 mg/Kg ; selenium 8 mg/Kg ; Cobalt 9 mg/Kg ; Molbden 20 mg/Kg.

** *Calculated according to Ellis (1981).*

At the end of the experiment five chicks were selected randomly from each group, weighed individually after an overnight fasting with only water allowed, then they were slaughtered. After bleeding they were scalded in hot water, hand-plucked and washed, and eviscerated.

The hot carcasses were weighed for calculation the dressing percentage. The legs were separated from each carcass, cutted into commercial cuts, weighed, then they were deboned and the meat was frozen and stored for sensory evaluation. Frozen deboned legs cuts were thawed at 5-7 ºC before cooking for sensory evaluation. The meat was trapped in aluminum foil, placed in roast pan and cooked at 176.7 ºC in conventional preheated electrical oven to about 80 ºC internal muscle temperature. The cooked meat was allowed to cool to room temperature for about 10 minutes. The samples were kept warm until served. Trained panelists were instructed to eat crackers drink water between samples testing to clear the plate and pause for 20 seconds between all samples evaluated; flowing recommended procedure (Hawrysh *et al*., 1980). The sensory panel evaluated the chops for tenderness, flavor, colour and juiciness using an eight-point scale.

The collected data were tabulated and subjected to One-way Analysis of variance (ANOVA) by using the SAS computer program (SAS, 1994). The significant differences (LSD) were used for treatment means separation as outline by Steel and Torrie (1986). All values were presented as means and standard error. The level significantly set up $P < 0.05$.

3. Results

The effect of feeding different levels of dietary garlic oils is shown in Table 2 and Figure 1. All groups started in similar body weight (100 gm). The results showed the Treatment effect on weight gain and feed intake were not significant ($p>0.05$). However chicks in groups (B, C, D and E) gain more weight and consumed more than that obtained by group (A)). Feed conversion ratio (FCR) was not affected significantly by the dietary treatment and the mean values were closely similar in all experimental groups.

No mortality was detected in all treatment groups a throughout the experimental period. The results indicated no significant differences ($p>0.05$) between all treatment groups in carcass dressing percentage. The mean average subjective meat quality score values of color, tenderness, juiciness and flavor of leg cuts (thigh and drumstick) did not differ significantly ($p>0.05$) among the dietary treatments and scores given for all attributes are above moderate acceptability level (Table 3) . The results of economical evaluation indicated that the dietary groups C, D and E

gained more net profit than that of groups A and B. the value Profitability ratio (1.27) of group E was the highest of the tested groups.

Table 2: The effect of different dietary amount of garlic oil and the antibiotic on the performance of broiler chicks for 6 weeks

Items	*Groups*					*$Lsd_{0.05}$*	*SE±*
	A	B	C	D	E		
Initial weight g/bird	100	103.55	104.39	102	100	-	-
Final Weight g/bird	1578	1660	1643.00	1654.00	1662.00	-	-
Weight Gain g/bird	1478	1556.45	1538.00	1552.00	1562.00	190.50^{ns}	61.84
Feed Intake g/bird	2950.00	3135.00	3100.00	3102.00	3130.00	386.70ns	125.50
F C R	1.87	0.187	1.88	1.87	1.87	0.09744^{ns}	0.03162
Dressing%	69.63	69.65	69.64	69.65	69.67	6.088^{ns}	1.867
Mortality	00.00	00.00	00.00	00.00	00.00	00.00	00.00

Means in a raw do not different significantly (p>0.05)
Lsd = least significant difference, **SE ±** = standard error, **n.s** = not significantly difference (p>0.05)
A = negative controlled group, **B** = positive controlled group, C = 0.1% garlic essential oil
D = 0.2% garlic essential oil**, E** = 0.3% garlic essential oil, **F C R= Feed Conversion Ratio**

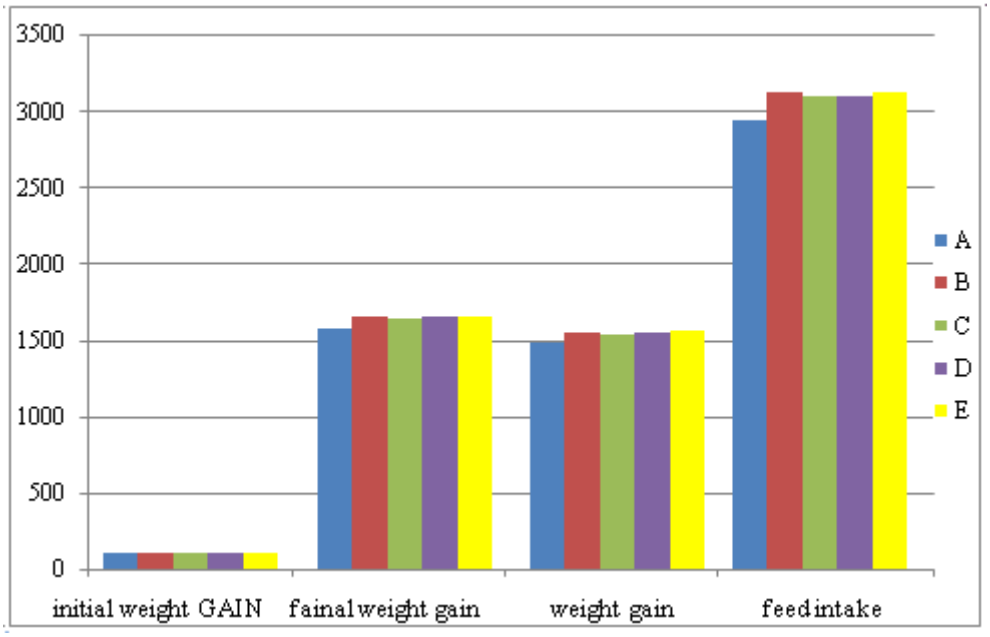

Figure 1: The effect of different dietary amount of garlic oil and the antibiotic on the initial weight gain, final weight gain and feed intake of broiler chicks for 6 weeks

Table 3: The effect of different dietary amount of garlic oil and the antibiotic on percentage of subjective values of broiler chicks (6 weeks)

Items	*Groups*						
	A	*B*	*C*	*D*	*E*	$Lsd_{0.05}$	*SE*±
Tenderness	5.87	5.89	5.88	5.90	5.91	5.9243^{ns}	0.2824
Flavor	5.53	5.54	5.55	5.57	5.57	5.7194^{ns}	0.2206
Colour	5.85	5.87	5.86	5.87	5.88	1.017^{ns}	0.312
Juiciness	5.51	5.52	5.52	5.54	5.55	5.151^{ns}	0.3531
Total Revenue	20.77	21.27	21.97	22.23	23.00	-	-
Total cost of production	14.4	14.9	14.8	14.9	14.9	-	-
Total Profit	6.37	6.37	7.17	7.33	8.1	-	--
Profitability Ratio	1	1	1.12	1.15	1.27	-	-

Lsd = least significant difference, **SE ±** = standard error, **n.s** = not significantly difference (p>0.05), **A** = negative controlled group, B = positive controlled group, C = 0.1% garlic essential oil, **D** = 0.2% garlic essential oil, E = 0.3% garlic essential oil

4. Discussion

In this study the apparent health of experimental stock was good throughout the experimental period. The general behavior of the stock also was good. The ambient temperature during the experimental period fell within the thermo neutral zone has extracted no heat on the experimental birds. No mortalities were recorded among the different treatment groups throughout the experimental period; this may be due to the hygienic situation of the experiment. Similar results were obtained by Fayed *et al.,* (2012). However, Tollba and Hassan (2003) reported that garlic as natural feed additive in broiler diets decreases the mortality rate due to its active ingredients which are acts as anti-microbial agents.

Although birds which received garlic essential oil and antibiotic diets had greater weight gain than those fed negative control diet; the weight gain did not show significant differences between dietary treatment groups. These results are in accordance with the reports of Amouzmehr *et al*., (2013). Who found no significant differences in weight gain of chick fed with garlic essential oil compared to the control group. Also Botsoglu, (2004) reported non-significant effect of garlic powder supplementation on weight gain of broiler chicks. These result did not agreed with those of Dieumou *et al.,* (2012) who found the broiler chicks fed on either garlic extract or streptomycin sulphate diets gained significantly more weights than those fed control diets. Similarly, AL-Homidan, (2005); Tollba and Hassan (2003); and Fayed *et al.,* (2012) found that the dietary garlic powder improved significantly the weight gain of broiler chicks. These authors attributed the improvement in weight gain obtained by dietary garlic and its extracts groups to allicin active ingredients in garlic which promotes the performance of intestinal flora, thereby improving digestion and enhancing the utilization of energy, leading to improve the growth of birds.

The feed intake in this study tended to be higher in the chicks fed on garlic essential oil or antibiotic diets compared with negative control group, but the differences were not statistically significant. This result is equally in harmony with the findings of Dieumou *et al.,* (2009); Amouzmehr *et al*., (2013) who showing no significant effect of garlic essential oils on the feed intake of broiler chicks. In contrast, Dieumou *et al*., (2012) found that addition of garlic essential oil and streptomycin sulphate to the diet improved the feed intake of broiler chicks.

The feed conversion ratio in the present study was not affected significantly by the experimental diets. This result is consistent with the findings of Rahimi *et al*., (2011); Dieumou *et al*., (2009), who reported chicks fed with garlic essential oils diet had the same feed conversion ratio with control group, whereas Dieumou *et al.,* (2012) reported that use of garlic essential oil improved significantly the feed conversion ratio in broiler chicks. They attributed the better feed conversion ratio to the anti-bacterial properties of the garlic and its extracts, which resulted in better absorption of the nutrients in the gut and finally leading to improvement in feed conversion ratio.

Treatments effect in this study was not significant on carcass dressing percentage. These results are in line with the findings of Amouzmehr *et al.,* (2013) and Dieumou *et al.,* (2012) who reported that garlic essential oil did not have any significant effect on carcass dressing percentage of broiler chicks. In contrast, Dieumou *et al*., (2012) reported that carcass dressing percentage of broiler chicks fed on diets supplemented with either garlic essential oil or streptomycin sulphate were better significantly than values obtained from those fed on control diet. No significant differences were observed between all treatment groups in subjective meat quality attributes (colour, Flavor, juiciness and tenderness) and all score being at above moderate values. However, Eugèiuszr and Edyta, (2007) inform that 5gm/kg diet of dried garlic contributed to the increase sensory assessment of chicken meat.

The results in this study showed that application of garlic essential oils and antibiotic, had no significant effect on performance, carcass dressing percentage and meat quality parameters. Although, this experiment was performed in disinfected condition that may have resulted in a decreased the efficiency of these growth promoters. However, the results cited in literature are highly variable about the degree of improvement in growth performance and carcass characteristics of broiler obtained by dietary garlic extract as growth promoters. This may be due to the variation in the efficiency of the garlic extract additive which depend on many factors including, birds materials, dose used, management, genetic variation of garlic, age of plant and environmental factors such as climate and soil (Pourali et al., 2010).

The results of economical evaluation of experimental diets showed that the addition of garlic essential oil at various inclusion levels in the diet of broiler was economically profitable, but the values of profitability ratio (1.27) of the test group E (0.3%, garlic oil) was the highest of the test groups. , Mukhtar,(2011)Mukhtar *etal.*,(2012 ,2013a,2013b) found that addition of Clove oil ,Black cumin, Lemon grass, Spearmint essential oils and Amal *etal.,* (2013) who used Halfa bar essential oil to the broiler diet economically was feasible.

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