

EFFECT OF USING GARLIC POWDER AS NATURAL FEED ADDITIVE ON PERFORMANCE AND CARCASS QUALITY OF BROILER CHICKS

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ABSTRACT

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The effect of feeding broiler chicks on diets containing different levels of garlic powder as natural feed additive on productive performance, carcass characteristics and economical efficiency were studied. A total of one hundred and sixty one-day old, unsexed (Habbard) broiler chicks were randomly divided into four experimental groups. Each group was further subdivided into five replicates eight chicks per pen in complete randomized design. The birds were fed on two basal diets (starter and finisher). The garlic powder (*Allium sativum*) was added to the basal diets at (0.0, 2.0, 3.0 and 4.0%) levels resulting in four formulae respectively to groups A, B, C and D with group A serving as control group. The experimental diets were fed for 6-weeks duration. Health of the stock and performance parameters were recorded. At the end of the experiment, the birds were slaughtered, dressed for estimating the different parameters economical evaluation was also calculated. The results showed that, the diet with 3% garlic powder had significantly ($P<0.05$) heaviest body weight gain, highest feed intake, best feed conversion ratio with highest dressing and breast percentages. The birds fed on control group produced significantly ($P<0.05$) highest abdominal fat percentage. The mortality rate was not affected significantly by the addition of garlic powder in broiler diet. The highest profitability ratio (1.30) was recorded by the diet with 3% garlic powder as compared to other experimental diets.

Key words: *Garlic powder, Feed additive, Carcass quality.*

INTRODUCTION

The fast growing nature of broilers and their short generation intervals has been associated over the years with the use of antibiotic growth promoter at sub-therapeutic doses in animal feed, in order to improve performance through controlling the zoonotic pathogens in the gut (Dieumou *et al.*, 2009). Although birds raised with these feed additive achieved good performance, their potential side effects became a real public health problem worldwide (Bager, 1998; Donoghue, 2003) and led to the ban of these products by the European Union in January 2006. This decision has therefore stimulated a search for alternatives. Recently medicinal herbs and their associated essential oils or extract are being concerned as potentially growth promoters. They consist of mixtures of compounds which have many effects as antimicrobial, stimulating animal digestive system, antioxidants, anticoccidial, increase production of digestive enzymes and improve

utilization of digestive products by enhancing liver functions (Ziarlarimi *et al.*, 2011). Garlic (*Allium sativum*) which is a perennial herb with a bulb divided into segments (cloves) (Singh and Panda, 2005) and belongs to the family Amaryllidaceae and genus *Allium* (Wikipedia, the free encyclopedia (2013), 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 infection to heart diseases. Garlic has several beneficial effects on both humans and animal having antimicrobial, antioxidant properties (Konjufca *et al.*, 1997); antiviral (Weber *et al.*, 1992); and antifungal (Ankri and Mirelman, 1999). 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 it (Demir *et al.*, 2005). These functions were attributed to the bioactive compounds present in garlic such as alliin, daillyl sulphide and allicin (Amagase and Milner,

1993), which possess antimicrobial activity (Tsao and Yin, 2001) that could be responsible for the growth promoting effect of garlic.

The objective of this study was intended to gain more information about the effect of using garlic powder as natural feed additive on performance and carcass quality of broiler chicks.

MATERIALS and METHODS

A total of 160 one-day old unsexed (Habbard) broiler chicks were randomly distributed into 4 groups of 40 chicks per group. Each group was further subdivided into 5 replicates with 8 chicks per each. The chicks of each replicate were housed in a pen (1 square meter) in an open-sided deep litter house. The garlic bulbs (*Allium sativum*) which were purchased from local market desegmented into cloves then cut into chips. The chips were sun dried, grounded to fine powder and then added to the basal diets at the levels (0.0, 2, 3 and 4%) resulting in four formulae respectively to group A, B, C and D with group A serving as control group. All the experimental diets were formulated to meet the nutrient requirements of broiler chicks according to NRC (1994) which was formulated from the local feed ingredients commonly used for poultry feeding in the Sudan. The experimental diets were fed for 6-weeks duration where two phases of feeding program involved in supplying starter (1-21 days of

age) and finisher (22-42 days of age). Calculated analysis of the experimental basal diets was done according to feedstuff analysis outlined by Ellis (1981), while determined chemical analysis was conducted by the method of AOAC (1995). Ingredients, proximate analysis and calculated analysis for the experimental basal diets are shown in Tables (1 & 2), respectively, while chemical composition of the super concentrate used in the basal diets is shown in Table (3). Feed and water were offered ad-libitum. The light was continuous throughout the experimental period. The performance of the experimental birds in term of feed intake, live weight gain and feed conversion ratio were recorded weekly. Health of the experimental stock and mortality rate were closely observed and recorded daily. At the end of 6th week the experimental birds were individually weighed after overnight fast (except for water) then slaughtered without stunning. They were then scalded, manually plucked, washed and allowed to drain on wooden tables. Evisceration was performed by a ventral cut and visceral as well as thoracic organs were removed. After evisceration internal organs (heart, liver and gizzard) were removed, weighed individually and expressed as percentage of slaughtered weight. Eviscerated carcasses were weighed and then chilled in a refrigerator for 24 hours at 4°C. Cold carcasses were recorded.

Table 1: Ingredients and proximate analysis of the experimental basal diets (percent as fed)

Item	Starter (0-3weeks)	Finisher (4-7 weeks)
A: Ingredients%:		
Grain sorghum	53.00	65.00
Wheat bran	7.00	5.00
Groundnut meal	12.00	11.00
Sesame meal	18.00	9.00
Super concentrate	5.00	5.00
Oyster shell	2.75	2.75
Common salt	0.25	0.25
Vegetable oil (corn)	2.00	2.00
Total	100	100
B: Determined analysis,%		
Dry matter	97.00	95.00
Crude protein (N% x 6.25)	23.28	20.00
Ether extract	5.59	6.78
Crude fibre	6.46	5.40
Ash	10.49	8.74
Nitrogen free-extract	51.18	54.06

Table 2: Calculated analysis of the experimental diets on dry matter basis (DM).

Item	Starter (0-3 weeks)	Finisher (4-7 weeks)
Metabolizable energy (Kcal/kg)	2940	3027
Crude fat,%	7.91	6.57
Crude protein,%	23.12	20.09
Lysine,%	1.13	1.03
Methionine,%	0.53	0.44
Cystine,%	0.36	0.29
Methionine + cystine,%	0.89	0.73
Calcium,%	1.14	0.97
Available phosphorus,%	0.73	0.65
Caloric-protein ratio	127	151
ME Kcal/kg: protein %		

Metabolizable energy: calculated according to Ellis (1981)

Table 3: Chemical composition of the super concentrate used in the experimental diet formulation (Hendrix broiler concentrate)

Metabolizable energy	1900 (Kcal/kg)
Crude protein	32.00%
Lysine	11.00%
Methionine	2.80%
Methionine + cystine	2.25%
Calcium	8.00%
Available phosphorus	5.00%

RESULTS

All the slaughtered birds were used for dissection. The breast, thigh and drumstick of the left side of each carcass were dislocated, weighed and expressed as percentage of cold carcass weight. Taste panel was done for broiler's breast and thigh meat after wrapped individually in aluminum foil, and roasted in an electric oven at 175°C for 90 minutes. Ten taste panelists were used to score colour, flavour, tenderness and juiciness of the meat, according to the guidelines of Cross *et al.* (1978). Statistical analyses were made by analysis of variance for a completely randomized design, according to Steel and Torrie (1986).

The effect of feeding different levels of garlic powder on broiler's performance is shown in Table (4). Final body weight, body weight gain, total feed intake and feed conversion ratio were significantly ($P < 0.05$) affected by different levels of garlic powder. Generally the inclusion of garlic powder in the experimental diets improved significantly ($P < 0.05$) the broiler's performance. The diet with 3% level of garlic powder showed significantly ($P < 0.05$) heaviest final body weight and body weight gain, highest total feed intake with the best feed conversion ratio as compared to the other experimental diets. The experimental treatments had no significant ($P > 0.05$) effect on the mortality rate. Only one bird from each treatment was died, which cannot be related in any way to the experimental treatment.

Table 4: The effect of feeding different levels of garlic powder on performance of broiler chicks (1-42 days).

Parameter	A	B	C	D	SEM
Initial live weight (g/chick)	45.52	45.02	45.18	45.39	-
Final live weight (g/chick)	1857.63 ^c	2026.13 ^b	2145.19 ^a	1976.50 ^b	9.83
Body weigh gain (g/chick)	1812.11 ^c	1981.11 ^b	2100.01 ^a	1931.10 ^b	9.72
Total feed intake (g/chick)	3624.22 ^c	3843.35 ^b	4032.01 ^a	3784.95 ^b	9.77
Feed conversion ratio	2.00 ^a	1.94 ^b	1.92 ^c	1.96 ^b	0.006
Mortality %	1.00	1.00	1.00	1.00	0.001 ^{NS}

A: Control (without garlic powder)

B: 2% garlic powder

C: 3% garlic powder

D: 4% garlic powder

SEM: Standard error of the mean

N.S. Not statistically significant (P>0.05)

Means on the same raw with the same superscripts are not significantly different (P>0.05).

Table (5) shows the effect of feeding different levels of garlic powder on carcass characteristic of the broilers. All the measured parameters were significantly (P<0.05) affected by the different levels of garlic powder. The inclusion of garlic powder in the broiler diets significantly (P<0.05) improved the hot and cold dressing percentages and breast percentage compared to the control diet. Birds fed on 3% level of garlic powder gave significantly (P<0.05) highest hot and cold dressing percentages and highest breast percentage compared to other experimental groups. On the other hand, the highest percentages of the drumstick and thigh meat significantly (P<0.05) were recorded by the control group.

Table 5: Means values for the dressing carcass percentages and commercial cut of broiler carcasses.

Parameter	A	B	C	D	SEM
Hot dressing percentages	68.82 ^c	69.01 ^b	70.02 ^a	68.99 ^b	0.15
Cold dressing percentage	68.00 ^c	68.80 ^b	69.82 ^a	68.62 ^b	0.12
Breast as % of cold carcass	24.92 ^c	25.80 ^b	26.50 ^a	25.50 ^b	1.32
Drumstick as % of cold carcass	15.90 ^a	15.11 ^b	15.01 ^b	15.00 ^b	0.25
Thigh as % of cold carcass	16.80 ^a	15.20 ^b	15.02 ^b	15.00 ^b	0.24

A: Control (without garlic powder)

B: 2% garlic powder

C: 3% garlic powder

D: 4% garlic powder

SEM: Standard error of the means

Means on the same raw with the same superscripts are not significantly different (P>0.05).

Table (6) shows the effect of feeding different levels of garlic powder on the giblets as the percentage of body weight. The dietary treatment significantly (P<0.05) influenced the development of organs of the broilers except the heart percentage. Generally, the inclusion of garlic powder in the diets lowering the percentages of these organs (abdominal fat, liver and gizzard). Birds fed the garlic powder diets produced significantly (P<0.05) the lowest percentage of abdominal fat, liver and gizzard, while those fed the control diet produced the highest percentages of these organs.

Table 6: Body weight and organ proportions of broiler chickens

Parameters	A	B	C	D	SEM
Final body weight (g/chick)	1857.63	2026.13	2145.19	1976.50	9.83
Abdominal fat as % of body weight	2.20 ^a	1.93 ^b	1.92 ^b	1.90 ^b	0.015
Liver as % of body weight	2.25 ^a	2.16 ^b	2.10 ^b	2.01 ^b	0.02
Heart as % of body weight	0.53	0.55	0.56	0.53	0.012 ^{NS}
Gizzard as % of body weight	2.56 ^a	2.09 ^b	2.05 ^b	2.01 ^b	0.03

A: Control (without garlic powder)

B: 2% garlic powder

C: 3% garlic powder

D: 4% garlic powder

SEM: Standard error of the means

NS: Not statistically significant (P>0.05)

Means on the same raw with the same superscripts are not significantly different (P>0.05).

Table (7) shows the effect of dietary treatment on subjective scores for breast and thigh of broiler meat. The values of tenderness, juiciness, flavour and colour did not differ significantly (P>0.05) among the dietary treatments and the score given for all attributes are above moderate acceptability level.

Table 7: Subjective scores for the breast and thigh of broiler meat.

Parameter	A	B	C	D	SEM
Tenderness					
Thigh	5.62	5.35	5.48	5.22	0.04 ^{NS}
Breast	5.34	5.20	5.21	5.01	0.03 ^{NS}
Juiciness					
Thigh	5.52	5.70	5.55	5.46	0.03 ^{NS}
Breast	5.43	5.61	5.43	5.31	0.02 ^{NS}
Flavour					
Thigh	5.51	5.36	5.29	5.58	0.03 ^{NS}
Breast	5.62	5.75	5.60	5.42	0.03 ^{NS}
Colour					
Thigh	5.29	5.51	5.60	5.42	0.04 ^{NS}
Breast	5.35	5.40	5.22	5.35	0.03 ^{NS}

A: Control (without garlic powder)

B: 2% garlic powder

C: 3% garlic powder

D: 4% garlic powder

SEM: Standard error of the means

NS: Not statistically significant (P>0.05)

Table (8) shows the calculation of total cost, revenues and net profit for the experimental groups. The results obtained from the economic study indicated that, treatment (c) with 3% garlic powder showed the highest profitability ratio (1.30) as compared to the control group.

Table 8: Total cost, revenues and net profit of broiler chicks fed on different levels of garlic powder.

Item	A	B	C	D
Cost (SDG)				
Chick purchase	6.0	6.0	6.0	6.0
Management	4.0	4.0	4.0	4.0
Feed	11.4	12.0	12.3	12.5
Total cost	21.4	22.0	22.3	22.5
Revenues				
Average eviscerated carcass weight (kg)	1.278	1.398	1.502	1.363
Price (SDG/kg)	23	23	23	23
Total revenues	29.39	32.15	34.55	31.36
Net profit				
Total revenues	29.39	32.15	34.55	31.36
Total cost	21.40	22.00	22.30	22.50
Net profit/bird	7.99	10.15	12.25	8.86
Net profit/kg meat	6.25	7.26	8.15	6.51
Profitability ratio/kg meat	1.00	1.16	1.30	1.04

Total cost calculated according to 2014 a current (2014) price of meat 23 (SDG)/kg

DISCUSSION

The effect of feeding different levels of garlic powder on productive performance of broilers is shown in Table (4). Treatment effect on the final body weight, body weight gain, total feed intake and feed conversion ratio was significant ($P < 0.05$). The inclusion of garlic powder in diet of broiler significantly ($P < 0.05$) enhanced the body weight and the weight gain as compared to the control group. The improved weight gain of bird fed on garlic powder could be attributed to allicin active ingredients in garlic which promotes the performance of intestinal flora, thereby improving digestion and enhance the utilization of energy, which improve the growth of birds. This result was in line with the finding of EL-Gamry *et al.* (2002); Tollba and Hassan (2003); Al-Homidan (2005) and Fayed *et al.* (2011) who found that the dietary garlic powder improved significantly the weight gain of broiler chicks. The birds fed on 3%

level of garlic powder produced significantly ($P < 0.05$) the highest body weight gain as compared to the other experimental groups. Similar results were obtained by Soliman (2000) who mentioned that addition of dried garlic to diet at level 3% improved significantly the productive performance of broiler chicks. The results coincided with the finding of Ahmed (2005) who found higher weight gain of broiler chicks fed on ration supplemented with garlic as natural growth promoter. In addition to, Ziton (2009) stated that, the supplementation of basal diet with dried garlic at levels 2, 3 and 4%, respectively had significantly better weight gain than the control group.

The feed intake significantly ($P < 0.05$) tended to be higher in the birds that fed on garlic powder diets compared to the control group. The highest feed intake was significantly ($P < 0.05$) produced by the birds fed on 3% level of garlic powder. These results

are in agreement with those reported by Racesi *et al.* (2010) who indicated that, the diet supplemented with garlic powder at level 1-3% had significantly better feed intake compared to the control diet.

The feed conversion ratio was affected significantly ($P<0.05$) by the experimental diets. There was a significant ($P<0.05$) improvement in the feed conversion ratio of the birds fed on diets which supplemented with garlic powder compared to the control diet. The best feed conversion ratio was significantly ($P<0.05$) obtained by the diet with 3% level of garlic powder. The better feed conversion ratio can be attributed to the anti-bacterial properties of the garlic powder which resulted in better absorption of the nutrients in the gut and finally leading to improvement in feed conversion ratio. These results are consistent with the finding of Soliman (2000); El-Gamry *et al.* (2002); Tollba and Hassan (2003) and Ziton (2009) who mentioned that, addition of garlic powder in broilers diet improved significantly the feed conversion ratio of the broilers. Treatment effect on mortality rate was not significant. Birds were kept in clean disinfected environment following all hygiene regulation programs, only one bird from each treatment was died, which cannot be related in any way to the experimental treatment. The results are in agreement with those reported by Fayed *et al.* (2011) who found that supplementation of garlic powder in broiler diets with 1 kg/ton and 0.5 kg/ton had no significant differences in mortality rate.

As shown in Table (5), the hot and cold dressing percentages were significantly ($P<0.05$) increased for birds fed on garlic powder based diets as compared to the control group. Birds fed on diet with 3% garlic powder produced significantly ($P<0.05$) the highest hot and cold dressing percentages, while birds fed on the control diet produced the lowest percentage values. These results are in line with the finding of Dieumou *et al.* (2012) who reported that, carcass dressing percentage of broiler chicks fed on diets supplemented with garlic essential oil were better significantly ($P<0.05$) than values obtained from those fed on the control diet. In contrast, Ziton (2009) reported that, addition of garlic powder in broilers diet had no significant effect on dressing percentage. The percentages of commercial cuts (breast, drumstick and thigh) showed significant ($P<0.05$) variation between the dietary treatment groups. The addition of garlic powder in broiler diets significantly ($P<0.05$) increased the breast percentage and decreased the thigh and drumstick percentages. The diet with 3% level garlic powder produced significantly ($P<0.05$) the highest breast percentage, while the highest drumstick and thigh percentages were produced by the group fed the control diet. Similar results were reported by Miller (1965) who indicating that, a decrease of breast percentage is counteracted by a corresponding increase in the other

body proportions of broiler carcasses. As shown in Table (6), the inclusion of garlic powder in the broiler diets significantly ($P<0.05$) affected the percentages of giblets (abdominal fat, liver and gizzard) except the heart percentage. Generally, it seems that, the higher percentages of garlic in the diets, the lower percentages of the abdominal fat, liver and gizzard as compared to the control diet. The reduction in the percentage of abdominal fat for the diets that supplemented with garlic powder may be attributed to the action of garlic which have been reported to possess lipid lowering effects (Agarwal, 1996). Similar results were obtained by several studies which showed that, the addition of garlic and its essential oils to broiler diet as growth promoters reduced significantly the serum level of cholesterol and triglyceride (Pesti, 1997; Meraj, 1998; Ademola *et al.*, 2009; Onibi *et al.*, 2009 and Rahimi *et al.*, 2011).

As shown in Table (7) no significant differences were observed between all treatment groups in subjective meat quality attributes (colour, flavour, juiciness and tenderness) of the breast and thigh meat. All score being at above moderate values. However, Eugeiuszr and Edyta (2007) inform that 5 mg/kg diet of dried garlic contributed to the increase sensory assessment of chicken meat as compared to control diet.

As shown in Table (8), the economical evaluation of the experimental diets indicated that, the diet with 3% level garlic powder showed the highest profitability ratio (1.3) as compared to the control group. This might be due to the highest return of the weight gains recorded by this group of chicks.

It could be concluded that the incorporation of garlic in broiler diet as feed additive at 3% level significantly enhanced growth and productive performance of broiler chicks.

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أثر استخدام مسحوق الثوم كإضافة علفية طبيعية على الأداء وخصائص الذبيح في الدجاج اللحم

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أجريت هذه التجربة لدراسة أثر تغذية الدجاج اللحم على مستويات مختلفة من مسحوق الثوم (*Allium Sativum*) كإضافة علفية طبيعية على الأداء الإنتاجي وخصائص الذبيحة بالإضافة إلى المردود الاقتصادي. استخدم النظام العشوائي الكامل في تصميم هذه التجربة، حيث استخدم ١٦٠ كتكوت لحم غير مجنس من سلالة الروس ٣٠٨ في عمر يوم، قسمت عشوائياً إلى ٤ مجاميع تجريبية متساوية تقريباً في الوزن الابتدائي. كل مجموعة ضمت ٥ مكررات، بكل مكرر ٨ كتاكيت. تمت تغذية الكناكيت على عليقتين أساسيتين (عليقة بادية وعليقة ناهية) مضافاً إليها مسحوق الثوم بالمستويات (0.0 ، 2.0 ، 3.0 ، و 4.0%) على التوالي لتكوين أربعة مجموعات A ، B ، C و D حيث استخدمت المجموعة A كمجموعة قياسية. تم تكوين العليقتين الأساسيتين وفقاً للاحتياجات الغذائية للدجاج اللحم الصادرة من (NRC 1994). تمت التغذية على العلائق التجريبية لمدة ٦ أسابيع. تمت المراقبة للصيقة لصحة القطيع وتسجيل قياسات الأداء الإنتاجي ثم الذبح بنهاية فترة الإغلاف وتسجيل قيم الذبيحة ومن ثم التقييم الاقتصادي. أثبتت النتائج المتحصل عليها أن إضافة مسحوق الثوم بمستوى ٣% أدى معنوياً ($P < 0.05$) إلى أفضل المعدلات بالنسبة لقيم الوزن المكتسب، استهلاك العلف، معدل الكفاءة التحويلية للغذاء نسبة التصافي بالإضافة إلى نسبة القطعة التجارية (الصدر) بالمقارنة مع المجموعات التجريبية الأخرى. أشارت النتائج بأن المجموعة القياسية (A) قد تحسنت معنوياً ($P < 0.05$) على أعلى معدل بالنسبة لقيمة دهن الأحشاء. كما أوضحت النتائج بأن إضافة مستويات مختلفة من مسحوق الثوم إلى علائق الدجاج اللحم لم يظهر أي تأثير معنوي ($P > 0.05$) على معدل النفوق. أشارت الدراسة الاقتصادية للتجربة أن مجموعة مسحوق الثوم (٣%) قد تحسنت على أعلى ربحية نسبية (١.٣٠) بالمقارنة مع بقية المجموعات التجريبية الأخرى.