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

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Received at: 22/3/2014

Accepted: 12/4/2014

ABSTRACT

The effect of feeding broiler chicks diets containing different levels of ginger powder as natural feed additive on productive performance, carcass characteristics and economical efficiency was studied. A total of two hundred one-day old, unsexed (Ross-308) broiler chicks were randomly divided into four experimental groups. Each group was further subdivided into five replicates at the rate of ten chicks per pen in complete randomized design. The birds were fed with two basal diets (starter and finisher diets). The ginger powder (*Zingiber officinale*) was added to the basal diets at level (0.0, 1, 1.5 and 2.0%) 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 then used for different parameters and economical evaluation were calculated. The results showed that, the diet with 1% ginger powder had significantly ($P<0.05$) heaviest body weight gain, higher feed intake, best feed conversion ratio, and highest dressing percentage with the highest percentage of commercial cuts (breast drumstick and thigh). The birds fed the control diet produced significantly ($P<0.05$) highest abdominal fat percentage. The mortality rate was not affected significantly by the inclusion of ginger powder in broiler diet. The highest profitability ratio (1.30) was obtained by the diet with 1% ginger powder. Inclusion of ginger powder at level 2% in broiler diet had adverse effect on growth performance.

Key words: *Ginger powder, Feed additive, Broiler chicks.*

INTRODUCTION

Feed additives are added to broiler diets to improve its productive performance by increasing growth rate, better feed conversion efficiency and greater livability in poultry birds. Spices as an additive in the diet of chickens is very common. Active principles of the plant or chemical compounds present in certain parts of the plant or the effect of therapeutic activity that companies them (Zhang *et al.*, 2009). Spices and herbs can have many benefits for the health of broilers and functions such as anti-oxidation ability (Hui, 1996), antimicrobial activity (Dorman and Deans, 2000), enhancing digestion by stimulating endogenous enzymes (Brugalli, 2003). Ginger (*Zingiber officinale*) is a perennial plant which belongs to family Zingiberaceae. Ginger is widely used in many countries as a food spice and as a herbal remedy used (Chrubasik *et al.*, 2005). The main important compounds in ginger are gingerol, gingerdiol and gingerdione which have the ability to stimulate digestive enzymes, affect the microbial activity and having anti-oxidative activity (Dieumou *et al.*, 2009). Ginger have been reported to posses useful pharmacological potent chemical substances for use in poultry (Akhtar *et al.*, 1984), this is due to its antioxidants, antibacterial, anti-inflammatory, antiseptic, anti-parasitic and immunomodulatory properties. Positive effect of ginger on blood circulation, gastric secretion, and enterokinesia were reported by Ali *et al.* (2008); Incharoen and Yamauchi (2009). In addition, ginger has been found to enhance digestive enzyme activities (Platel and Srinivasan, 1996, 2000).

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

MATERIALS and METHODS

A total of two hundred one-day old unsexed (Ross-308) broiler chicks were randomly distributed into 4 groups of 50 chicks. Each group was further subdivided into 5 replicates with 10 chicks per each. The chicks of each replicate were housed in a pen (1 square meter) in an open-sided deep litter house. Slices of dried ginger (*Zingiber officinale*) purchased from local market and ground to fine powder then

added to basal diets at the levels (0.0, 1, 1.5 and 2%) resulting in four formulae respectively to group A, B, C and D where 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). Formulation and proximate analysis and calculated analysis for the experimental basal diets are shown in Tables (1 and 2) respectively, while chemical composition of the super concentrate used in the basal diets and determined composition of ginger are shown in Table (3 and 4) respectively.

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 6^{th} 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: Formulation and proximate analysis of the experimental basal diets (percent as fed).

	Ingredients (%)	Starter diet	Finisher diet
A:	**Formulation:**		
	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	96.00	94.30
	Crude protein (N% x 6.25)	23.28	20.00
	Ether extract	5.59	6.72
	Crude fibre	6.46	5.40
	Ash	10.49	8.74
	Nitrogen free-extract	50.18	53.44

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

Item	Starter diet	Finisher diet
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	0.63	0.55
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 basal diets 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%

Table 4: Determined proximate composition of ginger [dry matter (DM) basis].

Parameter	Ginger
Dry matter	91.0
Crude protein (N% x 6.25)	10.1
Ether extract	3.2
Crude fibre	18.3
Ash	4.9
Nitrogen free-extract	54.5

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).

RESULTS

The effect of feeding different levels of ginger powder on broiler's performance is shown in Table (5). Final body weight, body weight gain, total feed intake and feed conversion ratio were affected significantly ($P<0.05$) with the addition of ginger powder to broiler diets. The final body weight and body weight gain were significantly ($P<0.05$) increased by the addition of ginger powder in the broiler diet as compared to control group except the diet with 2% ginger powder which produced significantly the lowest of these values. The feed intake decreased significantly ($P<0.05$) with the increasing level of ginger powder in the diet. The diet with 2% ginger powder showed significantly ($P<0.05$) the lowest of these values. The feed conversion ratio was improved significantly ($P<0.05$) by the supplementation of ginger powder in the diet. The best feed conversion ratio was produced significantly ($P<0.05$) by the diet that supplemented by 1% ginger powder.

All chicks were apparently healthy and the mortality was not significantly affected by the experimental treatments.

Table 5: The effect of feeding different level of ginger powder on performance of broiler chicks (1-42 days).

Parameter	A	B	C	D	SEM
Initial live weight (g/chick)	45.20	45.52	45.20	45.33	-
Final live weight (g/chick)	1833.00^{b}	1980.50^{a}	1936.75^{a}	1796.30^{c}	45.31
Body weigh gain (g/chick)	1787.80^{b}	1934.98^{a}	1891.55^{a}	1750.97^{c}	42.81
Total feed intake (g/chick)	3754.38^{a}	3715.16^{a}	3669.60^{b}	3466.92^{c}	53.85
Feed conversion ratio	2.1^{a}	1.92^{D}	1.94^{C}	1.98^{b}	0.03
Mortality %	0.00	0.25	0.30	0.25	0.24^{NS}

A: Control (without ginger powder)
B: 1.0% ginger powder
C: 1.5% ginger powder
D: 2.0% ginger powder
SEM: Standard error of the means
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 (6) shows the effect of feeding different levels of ginger powder on carcass characteristics of broilers. All the measured parameters were significantly (P<0.05) improved with the inclusion of ginger powder in broiler diets except the diet with 2% ginger powder. The diets with 1% and 1.5% ginger powder recorded significantly (P<0.05) the highest hot and cold dressing percentages and highest breast, drumstick and thigh percentages while the lowest percentages of these values were recorded by the diet with 2% ginger powder.

Table 6: Mean values for the dressing carcass percentages and commercial cut of broiler carcasses.

Parameters	A	B	C	D	SEM
Hot dressing percentages	68.25^{b}	70.02^{a}	69.81^{a}	67.62^{c}	0.15
Cold dressing percentage	68.01^{b}	69.03^{a}	68.82^{a}	67.06^{c}	0.11
Breast as % of cold carcass	25.53^{b}	26.01^{a}	25.91^{a}	24.03^{c}	1.26
Drumstick as % of cold carcass	15.00^{b}	16.03^{a}	15.91^{a}	14.82^{c}	0.22
Thigh as % of cold carcass	15.75^{b}	16.53^{a}	16.26^{a}	15.09^{c}	0.20

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

Table (7) shows the effect of feeding different levels of ginger powder on the non-carcass components as the percentage of body weight. All the measured parameters were significantly affected (P<0.05) by the addition of ginger powder to the experimental diets except the heart percentage. The adding of ginger powder to broiler diets significantly (P<0.05) decrease the percentage of abdominal fat, liver and gizzard. The control diet showed significantly (P<0.05) the highest abdominal fat, liver and gizzard percentages while the diets supplemented with ginger powder significantly (P<0.05) produced the lowest values.

Table 7: Body weight and organ proportions of broiler chickens.

Parameters	A	B	C	D	SEM
Final body weight (g/chick)	1833.00^{b}	1980.50^{a}	1936.75^{a}	1796.30^{c}	45.31
Abdominal fat as % of body weight	2.35^{a}	1.92^{b}	1.91^{b}	1.90^{b}	0.017
Liver as % of body weight	2.9^{a}	2.20^{b}	2.18^{b}	2.15^{b}	0.10
Heart as % of body weight	0.55	0.52	0.54	0.53	0.011^{Ns}
Gizzard as % of body weight	2.92^{a}	2.29^{b}	2.25^{b}	2.10^{b}	0.01

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

Table (8) 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 8: Subjective scores for the breast and thigh of broiler meat.

Parameters	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}

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

Table (9) shows calculation of total cost, revenues and net profit for the experimental groups. The results obtained from the economic study indicated that, treatment (B) with 1% ginger powder showed the highest profitability ratio (1.3) while the lowest ratio was produced by treatment (D) with 2% ginger powder (0.89) as compared to control group.

Table 9: 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	6.00	6.00	6.00	6.00
	Management	4.00	4.00	4.00	4.00
	Feed	11.70	11.72	11.79	11.82
	Total cost	21.70	21.72	21.79	21.82
Revenues					
	Average eviscerated carcass weight (kg)	1.25	1.39	1.35	1.21
	Price (SDG/kg)	23	23	23	23
	Total revenues	28.75	31.97	31.05	27.94
Net profit					
	Total revenues	28.75	31.97	31.05	27.94
	Total cost	21.70	21.72	21.79	21.82
	Net profit/bird	7.05	10.25	9.26	6.12
	Net profit/kg meat	5.64	7.37	6.86	5.06
	Profitability ratio/kg meat	1.00	1.30	1.22	0.89

DISCUSSION

The effect of feeding graded levels of ginger powder on productive performance of broiler is shown in Table (5). Treatment effect on final body weight, body weight gain, total feed intake and feed conversion ratio was significant (P<0.05). The inclusion of ginger powder in diet of broiler significantly (P<0.05) enhanced the body weight and the bodyweight gain as compared to the control group with the exception for the diet with 2% ginger powder which showed significantly (P<0.05) adverse effect. The treatments with (1 and 1.5%) ginger powder showed the highest weight gain as compared to control group. The improvement in body weight gain in the levels (1 and 1.5%) ginger powder could be attributed to the fact that herbal plant may provide some compounds that enhance digestion and absorption of some nutrients in these diets which leading to improve the growth of birds. This result was in line with the finding of Igbal *et al.* (2011); Demir *et al.* (2003) who reported that there is an increase in body weight by using ginger in broiler diets. Some experts reported that red ginger has characteristics as stimulant for feed digestion and conversion which increase body weight gain. On the other hand, the depression on body weight in the diet with 2% ginger powder could be explained by the fact that some scientifics evidence demonstrated that many of herbal plants have medical properties that alleviate symptom and may prevent diseases and also high use of them may cause poisoning due to its strong bitter taste and reduce feed intake which could be leading to reduction in body weight (Hosseini,

2011; Ficker *et al.* 2003). The result coincided with the finding of Herati and Marjuki (2011) who mentioned that, increase ginger in the ration up to 2% showed lower total weight gain. This was contrary to the findings of Garcia *et al.* (2007); Ghazaiah *et al.* (2007) and Tollba *et al.* (2007) who observed no difference in bodyweight gain in broilers fed with ginger and pepper extract for a period of six weeks. In addition Onimisi *et al.* (2005) and Ademola *et al.* (2009) observed that ginger increased body weight when included up to 2% level in the diet. Similarly, Al-Homidan (2005) found increased in weight gain of broilers when fed 2% and 6% ginger.

The feed intake significantly ($P<0.05$) tended to decease with increasing the level of ginger powder in the diets of broiler as compared to control diet. The lowest feed intake was significantly ($P<0.05$) found by the birds fed with 2% level of ginger powder. These results are in agreement with those reported by Zomrawi *et al.* (2013); Herawati (2006) who mentioned that, birds fed diet with 1.5-2.0% ginger consumed less amount of feed. Similar result was obtained by Herawati (2010) who reported that, broiler fed 2% dried supplementary red ginger meal had significantly lower feed intake than those fed on the control diet. The results coincided with the finding of Herati and Marjuki (2011) who mentioned that increase ginger in the ration up to 2% showed lower feed intake. This was contrary to the finding of Doley *et al.* (2009) who observed no difference in feed intake by broilers fed with ginger extract for a period of six weeks.

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 for the birds fed diets supplemented with ginger powder. The best feed conversion ratio was significantly ($P<0.05$) obtained by the diet with 1% ginger powder. The better feed conversion ratio can be attributed to the anti-bacterial properties of the ginger 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 Herawati (2006); Tollba (2003); Herawati (2010); Moorthy *et al.* (2009) and Onimisi *et al.* (2005) they illustrated that birds fed with diets containing ginger up to 2% recorded better feed conversion ratio than un-supplemented ones. The positive effect of ginger powder in broiler diets on the final body weight and body weight gain and feed conversion ratio can be explained by the fact that, ginger have medical and chemical properties responsible for taste, the most noteworthy being ginerol and shagaol. It has antibacterial and anti-inflammatory actions (Zomrawi, 2012). Due to the active ingredients that found in ginger formation of more stable intestinal flora and improved feed conversion efficiency in consequence of better digestion (Tekeli, 2007). Treatment effect on mortality rate was not significant. The birds died in the experiment were not related to experimental treatments.

As shown in Table (6) the hot and cold dressing percentages were significantly ($P<0.05$) affected by the addition of ginger powder to the diets of broiler. The diets with 1 and 1.5% ginger powder produced significantly ($P<0.05$) the highest percentages of hot and cold dressing carcasses while the lowest percentages were significantly ($P<0.05$) produced by diet 2% ginger powder as compared to control diet. The higher dressing percentages of birds fed with 1% and 1.5% ginger powder diets and those obtained lower percentage for group fed with 2% ginger powder may be attributed to the coincided effect of these levels in feed intake and weight gain. These results are in line with the finding of Zomrawi (2013) who found higher dressing percentage of birds received 1% ginger root powder diet lower percentage for group fed 2% ginger root powder diet. In contrast, Zomrawi *et al.* (2012) found, no significant differences ($P>0.05$) were observed in dressing percentage among the birds that fed with different levels of ginger root powder (0.0%, 0.5%, 1% and 1.5%). The percentages of commercial cuts (breast, drumstick and thigh) showed significant ($P<0.05$) improvement with the inclusion of ginger powder in the broiler diets with exception of the diet with the 2% ginger powder. These results are in line with the findings of Alcicek *et al.* (2004); Tollba *et al.* (2007), Ademola *et al.* (2009) and Javed *et al.* (2009) who stated that, carcass characteristics improved in broilers fed different levels of powder aqueous extract of ginger from 1-42 days of age. In contrast, El-Deck *et al.* (2002) and Moorthy *et al.* (2009) observed no significant effect on carcass characteristics of broilers fed with different levels ginger power and extract of ginger up to six weeks of age.

As shown in Table (7), the inclusion of ginger powder in the broiler diets significantly ($P<0.05$) affected the percentages of non-carcass components (abdominal fat, liver and gizzard) except the heart percentage. Generally, it seems that, the higher percentage of ginger powder in the diets, the lower percentages of the abdominal fat, liver and gizzard compared to control group. The reduction in the percentage of abdominal fat for the diets supplemented with ginger powder may be attributed to the action of ginger which have been reported to posses lipid lowering effects (Sharma *et al.*, 1996). Similarly, several studies showed that, the addition of ginger and its essential oils to broiler diet as growth promoters reduced significantly the abdominal fat of the chickens (Rafiee *et al.*, 2013; Valiollahi *et al.*, 2014). In addition Ademola *et al.* (2009) stated that, ginger could be used as antilipidemic agents in broiler diets to lower abdominal fat pad.

As shown in the Table (8) 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 the scores being at above moderate values.

As shown in Table (9), the economical evaluation of the experimental diets indicated that the diet with 1% level of ginger powder showed the highest profitability ratio (1.3) while the diet with 2% level of ginger powder showed the lowest ration (0.89). This might be due to the highest and lowest returns of the weight gains recorded by these groups of chicks respectively.

It could be concluded that the incorporation of ginger in broiler diet as feed additive at 1% level significantly enhanced growth and productive performance of broiler chicks.

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اثر استخدام مسحوق الزنجبيل كاضافة علفية طبيعية على الأداء وخصائص الذبيح فى الدجاج اللاحم

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أجريت هذه التجربة لدراسة أثر تغذية الدجاج اللاحم على علائق تحتوي على مستويات مختلفة من مسحوق الزنجبيل (Zingiber officinale) كإضافة علفية طبيعية على الأداء الإنتاجي وخصائص الذبيحة بالإضافة إلى العائد الاقتصادي. تم استخدام النظام العشوائي الكامل في تصميم هذه التجربة، حيث استخدم عدد ٢٠٠ كتكوت لاحم غير مجنس من سلالة الروس ٣٠٨، قسمت عشوائياً إلى عدد ٤ مجموعات تجريبية متساوية تقريباً في الوزن الابتدائي. كل مجموعة ضمت ٥ مكررات بكل مكرر عدد ١٠ كتاكيت. تمت تغذية الكتاكيت على عليقتين أساسيتين (عليقة بادية وعليقة ناهية) مضافاً إليها مسحوق الزنجبيل بالمستويات (٠.٠ ، ١.٠ ، ١.٥ و٢.٠) على التوالي لتكوين أربعة مجموعات C, B, A وD واعتبرت المجموعة A كمجموعة قياسية. تم تكوين العليقتين الأساسيتين وفقاً للاحتياجات الغذائية للدجاج اللاحم الصادرة من (NRC, 1994). تمت التغذية على العلائق التجريبية لمدة ٦ أسابيع. تمت المراقبة اللصيقة لصحة القطيع وتسجيل قياسات الأداء الإنتاجي ثم الذبح بنهاية فترة الإعلاف وتسجيل قيم الذبيحة ومن ثم التقييم الاقتصادي. أثبتت النتائج المتحصل عليها، أن المجموعة التي تم تغذيتها على ١% مسحوق الزنجبيل قد تحصلت معنوياً ($P < 0.05$) على أفضل المعدلات بالنسبة لقيم الوزن المكتسب، استهلاك العلف، معدل الكفاءة التحويلية للغذاء، نسبة التصافي ونسب القطع التجارية (الصدر، الفخذ والساق). أشارت النتائج بأن المجموعة القياسية A قد تحصلت معنوياً ($P < 0.05$) على أعلى معدل لقيمة دهن الأحشاء. أوضحت النتائج أن إضافة مستويات مختلفة من مسحوق الزنجبيل إلى علائق الدجاج اللاحم لم يظهر أي تأثير معنوي ($P > 0.05$) على معدل النفوق. أظهر التقييم الاقتصادي ربحية نسبية (١.٣٠) لمجموعة ١% مسحوق الزنجبيل، حيث كانت الأعلى بين المجموعات المختبرة. كما أكدت النتائج المتحصل عليها أن إضافة مسحوق الزنجبيل بالمستوى ٢% إلى علائق الدجاج اللاحم له تأثير سالب على الأداء الإنتاجي. وقد خلصت نتائج هذه التجربة إلى انه يمكن استخدام مسحوق الزنجبيل بنسبه (١%) كمحفز للنمو الطبيعي في علائق الدجاج اللاحم بدون اى اثر ضار على الأداء الانتاجى وخصائص الذبيح.