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Response of Broiler Chicks to Diets Containing Different Mixture Levels of Garlic and Ginger Powder as Natural Feed Additives

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Subject: Agricultural

Abstract

The effects of feeding different mixture levels of garlic and ginger powder as natural feed additives on productive performance, carcass characteristic and economic efficiency were studied. A total of one hundred and sixty 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 eight chicks per pen in complete randomized design. The birds were fed on two basal diets (starter and finisher diets). The garlic (*Allium sativum*) and ginger (*Zingiber officinale*) powder were added in different mixture levels to the basal diets resulting in four experimental groups. The first group (A) fed on basal diets without feed additives (control diet). The other groups (B), (C) and (D) were fed on basal diets supplemented with different mixture powder levels of 1% (0.75% garlic + 0.25% ginger), 1.25% (1% garlic + 0.25% ginger) and 1.75% (1.50% garlic + 0.25% ginger) respectively. The experimental diets were fed for 6-weeks duration. Healths 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 evaluations were calculated. The results showed that, the diet with 1.75% mixture powder (1.5% garlic + 0.25% ginger) had significantly ($P<0.05$) heaviest body weight gain, best feed conversion ratio, highest dressing percentage with the highest commercial cuts percentages (breast, drumstick and thigh). The birds fed with the control diet recorded significantly ($P<0.05$) highest abdominal fat, liver and gizzard percentages. The morality rate was not significantly affected by the inclusion of mixture of garlic and ginger powder in broiler diet. The highest profitability ratio was obtained by the diet with 1.75% mixture powder. It was concluded that using a mixture of garlic and ginger as feed additives at level 1.75% enhanced the overall performance and carcass quality of broiler chicks.

Keywords: *Garlic, Ginger, Mixture, Performance carcass characteristics, Broiler, feed additives*

Introduction

Recently, herbs, spices have received an increasing attention as possible growth promoters additives references. There is an evidence suggests that some of these components have different active substances (Al-Kassie and Witwit, 2010). Additionally, they can have many benefits for the health of broilers and function such as anti-oxidation ability (Hui, 1996), antimicrobial activity (Dorman and Deans, 2000), enhancing digestion by stimulating endogenous enzymes (Brugalli, 2003), increase production of digestive enzymes and improve utilization of digestive products by enhancing liver function (Ziarlarimi *et al*., 2011). Garlic (*Allium sativum*) 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 supplements to broiler chicks has been recognized for its strong stimulating effect on the immune system . Additionally, 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, diallyl sulphide and allicin (Amagase and Milner, 1993), which posses antimicrobial activity (Tsao and Yin, 2001) that could be responsible for the growth promoting effect of garlic.

Ginger (*Zingiber officinale*) is a perennial plant which belongs to family Zingiberaceae. It 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 enzyme, 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 immuno-modulatory 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 to, ginger has been found to enhance digestive enzyme activities (Platel and Srinivasan, 1996, 2000). Many researchers that proved an increase in body weight and best feed conversion ratio when using herbal plants in broiler diets (Great, 2003; Iqbal *et al*., 2011) On the other hand, reseach on the use of herbal mixtures in bird's diets has produced inconsistent results.

The objective of this study was intended to gain more information about the effect of using different mixture levels of garlic and ginger powder on performance and carcass quality of broiler chicks.

Materials and Methods

A total of 160 one-day old unsexed (Ross-308) broiler chicks were randomly divided into 4 experimental groups of 40 chicks. Each group was further subdivided into 5 replicates at the rate 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*) and slices of ginger (*Zingiber officinale*) were purchased from local market, were sundried, ground separately to a fine powder and then added in different mixture levels to basal diets resulting in four experimental groups. The first group (A) fed on basal diets without feed additives (control diet) the other groups (B), (C) and (D) were fed on basal diets supplemented with different mixture powder levels 1% (0.75% garlic + 0.25% ginger), 1.25% (1% garlic + 0.25% ginger) and 1.75% (1.50% garlic + 0.25% ginger) respectively. 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 on 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 dies is shown in Table (3).

Feed and water were offered ad-libitum. The light was continuous throughout of the experimental period. The performance of the experimental birds in term of feed intake, live weight gain and fed conversion ratio were recorded weekly. Health of the experimental stock and morality 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^{o}C. Cold carcasses were recorded. 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. Statistical analyses were made by analysis of variance for a completely randomized design, according to Steel and Torrie (1986).

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	94.00
	Crude protein (N% x 6.25)	22.28	20.00
	Ether extract	5.59	6.72
	Crude fibre	6.46	5.40
	Ash	10.49	8.74
	Nitrogen free-extract	50.18	53.71

Table (2): Calculated analysis of the experimental diets (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%	0.73	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 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%

Results

The effect of feeding different mixture levels of garlic and ginger powder on broiler's performance is shown in Table (4). All the measured parameters were significant (P<0.05) with exception of total feed intake which was insignificant. The final body weight, bodyweight gain and feed conversion ratio were improved significantly (P<0.05) with the increasing different mixture levels of garlic and ginger powder in broiler diet in comparison with control diet. The diet with 1.75% mixture level (1.50% garlic + 0.25% ginger) showed significantly (P<0.05) heaviest final body weight and body weight gain with the best feed conversion ratio in comparison with other experimental diets. All chicks were apparently healthy and the morality was not significantly affected by the experimental treatments.

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

Parameter	A	B	C	D	SEM
Initial live weight (g/chick)	45.62	45.41	45.13	45.25	-
Final live weight (g/chick)	1862.11^{d}	1975.31^{c}	2029.15^{b}	2153.16^{a}	9.82
Body weigh gain (g/chick)	1816.49^{d}	1929.90^{c}	1984.02^{b}	2107.91^{a}	9.62
Total feed intake (g/chick)	3889.30	3849.50	3848.99	3830.18	9.79^{NS}
Feed conversion ratio	2.14^{c}	1.99^{b}	1.93^{b}	1.82^{a}	0.005
Mortality %	0.001	0.00	0.001	0.000	0.00^{NS}

A: Control (without feed additives)
B: 1.00% mixture powder level (0.75% garlic + 0.25% ginger)
C: 1.25% mixture powder level (1.00% garlic + 0.25% ginger)
D: 1.75% mixture powder level (1.5% garlic + 0.25% ginger)
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 mixture levels of garlic and ginger powder on carcass characteristics of broilers. All the measured parameters were significantly (P<0.05) affected by experimental treatments. The diets with 1.75% mixture powder level showed significantly (P<0.05) highest hot and cold dressing percentages and highest commercial cuts percentages (breast, drumstick and thigh) compared to the other experimental diets. Although, the differences between diets 1% and 1.25% mixture powder levels were insignificant (P>0.05) for all these values

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

Parameters	A	B	C	D	SEM
Hot dressing percentages	68.13^{c}	69.51^{b}	69.76^{b}	70.01^{a}	0.14
Cold dressing percentage	67.93^{c}	68.25^{b}	68.80^{b}	69.83^{a}	0.13
Breast as % of cold carcass	24.61^{c}	25.31^{b}	25.73^{b}	26.05^{a}	1.29
Drumstick as % of cold carcass	14.01^{c}	15.00^{b}	15.09^{b}	16.36^{a}	0.21
Thigh as % of cold carcass	15.00^{c}	15.41^{b}	15.62^{b}	16.30^{a}	0.20

A: Control (without feed additives)
B: 1.00% mixture powder level (0.75% garlic + 0.25% ginger)
C: 1.25% mixture powder level (1.00% garlic + 0.25% ginger)
D: 1.75% mixture powder level (1.5% garlic + 0.25% ginger)
SEM: Standard error of the mean
Means on the same raw with the same superscripts are not significantly different (P>0.05).

Table (6) shows the effect of feeding different mixture levels of garlic and ginger powder on abdominal fat and giblets (liver, heart and gizzard) as percentage of body weight. All the measured parameters were significantly (P<0.05) except the heart percentage. The addition of different mixture levels of garlic and ginger powder to broiler diets significantly (P<0.05) decreased the percentages of abdominal fat, liver and gizzard in comparison with the control diet.

Table (6): Body weight and organ proportions of broiler chickens

Parameters	A	B	C	D	SEM
Final body weight (g/chick)	1862.11[d]	1975.31[c]	2029.15[b]	2153.16[a]	9.820
Abdominal fat as % of body weight	2.36[a]	1.93[b]	1.92[b]	1.90[b]	0.016
Liver as % of body weight	2.98[a]	2.09[b]	2.06[b]	2.03[b]	0.110
Heart as % of body weight	0.55	0.54	0.53	0.55	0.011[NS]
Gizzard as % of body weight	2.92[a]	2.29[b]	2.20[b]	2.11[b]	0.02

A: Control (without feed additives)
B: 1.00% mixture powder level (0.75% garlic + 0.25% ginger)
C: 1.25% mixture powder level (1.00% garlic + 0.25% ginger)
D: 1.75% mixture powder level (1.5% garlic + 0.25% ginger)
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 (7) shows calculation of total cost, revenues and net profit for the experimental groups. The results obtained from the economic study indicated that, treatment (D) with 1.75% mixture powder level (1.50% garlic + 0.25% ginger) showed the highest profitability ration (1.34) in comparison with the control group.

Table (7): Total cost, revenues and net profit of broiler chicks fed on different mixture levels of garlic and ginger 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	12.1	12.5	13.0
Total cost (SDG)	21.70	22.10	22.5	23.0
Revenues				
Average eviscerated carcass weight (kg)	1.26	1.37	1.41	1.50
Price (SDG/kg)	23	23	23	23
Total revenues	28.98	31.51	32.43	34.50
Net profit				
Total revenues	28.98	31.51	32.43	34.50
Total cost (SDG)	21.70	22.10	22.50	23.00
Net profit/bird	7.20	9.41	9.93	11.50
Net profit/kg meat	5.71	6.86	7.04	7.66
Profitability ratio/kg meat	1.00	1.20	1.23	1.34

Total cost calculated according to 2014 acurrent (2014) price of meat 23 (SDG/kg).

Discussion

The effect of feeding different mixture levels of garlic and ginger powder on productive performance of broiler is shown in Tale (4). Treatment effect on final body weight, body weight gain and feed conversion ratio was significant (P<0.05) with the exception of total feed intake which was insignificant. The inclusion of different mixture levels of garlic and ginger powder in broiler diets significantly (P<0.05) enhanced the body weight and the body weight

gain in comparison with the control diet. The diet with 1.75% mixture powder level showed significantly (P<0.05) the highest body weight and body weight gain in comparison with other experimental diets. This improvement may be due 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. Additionally, the improvement in body weight gain may be 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). These results were in line with the finding of Ademola *et al*. (2009) reported a numerical increase in final body weight and weight gain of broilers fed a mixture of garlic and ginger. Similarly, Onu (2010) stated there was a numerical increase in weight of birds fed garlic and ginger mixture (combination of 0.25% garlic and ginger) in comparison with control group. The improvement may be due to improve gut environment and microflora achieved with garlic and ginger supplementation. This effect is attributed to the fact that the susceptibility of pathogenic gram positive bacteria to the antibacterial components of garlic and ginger are higher than that of the physiological desirable intestinal bacteria (Reeds *et al*., 1993; Javandel *et al*., 2008). In contrast, Horton *et al*. (1991); Ademola *et al*. (2004); Omage *et al*. (2007) reported that the inclusion of ginger and garlic in diets did nto improve the weight gain of broilers.

The feed intake was not significantly affected by the experimental treatment. These results are in agreement with those reported by Ademola *et al*. (2009); Onu (2010) who reported that no significant (P>0.05) difference in the feed consumption between birds fed with combination of garlic and ginger powder diets and 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 for the birds fed with diets which supplemented with mixture garlic and ginger powder in comparison with control diet. The best feed conversion ratio was significantly (P<0.05) recorded by the diet with 1.75% mixture level of garlic and ginger powder. The better feed conversion ratio can be attributed to the anti-bacterial properties of both garlic and 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 in line with the finding of Onu (2010) who reported that, birds fed supplemented diets (garlic and ginger) recorded superior (P<0.05) feed conversion ratio than the control. The improved feed efficiency observed in birds fed garlic and ginger supplemented diets suggests that the antimicrobial action of garlic and ginger may be sufficient to inhibit microbial fermentation (Ankri and Mirelman, 1999). According to Reeds *et al*. (1993), in rapidly growing young animals, the gastro intestinal tract and the skeletal musculature draw from the same limited supply of nutrients and are in effect competitors for the deposition of nutrients. As much as 6% of the net energy in animal diet can be lost due to bacterial utilization of glucose in the small intestine (Vervaeke *et al*., 1979) and these bacteria require amino acids in relatively similar proportional amount as animal (Hays, 1978). When garlic and ginger were added there may have been a nutrient sparing effect, therefore improving the 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 broiler diets improved significantly the feed conversion ratio of the broilers. Additionally, Tollba (2003); Onimisi *et al*. (2005); Herawati (2006); Moorthy *et al*. (2009) and Herawati (2010) they illustrated that birds fed with diets containing ginger up to 2% recorded better feed conversion ratio than un-supplemented one. Treatment effect on mortality rate was not significant. Birds were kept in clean disinfected environment following all hygiene regulation programs. The birds died in the experiment were not related to experimental treatments.

Table (5) showed the effect of feeding different mixture levels of garlic and ginger powder on hot and cold dressing percentages and percentages of commercial cuts (breast, thigh and drumstick) of broiler. The birds fed with highest mixture powder level (1.75%) showed significantly (P<0.05) the highest hot and cold percentages in comparison with control group. Similarly, Dieumou *et al*. (2012) 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. Additionally, Zomrawi (2013) mention that the higher dressing percentage of birds received 1% ginger root powder diet in comparison to control group. The percentages of commercial cuts (breast, thigh and drumstick) showed significant (P<0.05) improvement with the inclusion of different mixture levels of garlic and ginger powder in broiler diets in comparison with control diet. The diet with 1.75% mixture powder

recorded significantly (P<0.05) the highest percentages. Similarly, Alcicek et al. (2004);Tollba et al.(2007);Ademola et al (2009) and Javed *et al*. (2009) stated that, carcass characteristic improved in broilers fed different levels of powder or aqueous extract of ginger from 1-42 days of age.

As shown in Table (6), the inclusion of different mixture levels of garlic and ginger powder in broiler diets significantly (P<0.05) affected the percentage of abdominal fat and giblets (liver and gizzard) except the heart percentage. Generally, it seems that, the higher percentage of mixture (garlic and ginger powder) in the diet, the lower percentages of the abdominal fat, liver and gizzard in comparison with control diet. The reduction in the percentage of abdominal fat for the diets that supplemented with mixture of garlic and ginger powder may be attributed to the action of both garlic and ginger which have been reported to posses lipid lowering effects (Agarwal, 1996 and 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*., 2013). In addition to, Ademola *et al*. (2009) stated that, ginger could be used as antilipidemic agents in broiler diets to lower abdominal fat pad. Similarly, results were obtained by several studies which showed that, the addition of garlic and its essential oil to broiler diets 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), the economical evaluation of the experimental diets indicated that, the diet which is supplemented with the highest mixture level 1.75% of garlic and ginger powder showed the highest profitability ratio (1.34) in comparison with the control diet. This might be due to the highest return of the weight gains recorded by this group of chicks.

In conclusion, the supplementation of mixture of garlic and ginger powder at level 1.75% enhanced growth, productive performance and meat quality of broiler chicks.

"Cite this article"

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