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Influence of varying dietary energy levels supplemented with ginger or probiotics on performance of broiler chickens under a semi-arid environment

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Target Audience: Poultry farmers, Nutritionist, Researchers

Abstract

This study evaluated the effects of varying dietary energy levels supplemented with ginger or probiotics on performance and carcass characteristics of broiler chickens in a semi-arid environment. A total of one hundred and forty four (144) Arbor acre day-old broiler chicks were randomly allotted to six (6) dietary treatments with four replicates of six chicks each. Three metabolizable energy levels (3100, 2900, and 2700 ME/kcal/kg) were supplemented with either ginger (5g/kg) or probiotic (0.505g/kg) to give six experimental diets for the starter and finisher phases respectively. The experimental diets were fed ad libitum throughout the eight week experimental period. Feed intake increased (P<0.001) with decreasing dietary energy from 3100 to 2700Kcal/kg. The medium energy diet gave greater (P<0.05) live weight, weight gain, feed conversion ratio (FCR) and lower mortality. The medium energy diet had better (P<0.001) dressing percentage compared to the other levels. Ginger sustained higher (P<0.001) dressing percentage than probiotic. While the interactive effects of energy levels with either ginger or probiotics showed that the low dietary energy combination with probiotics gave the lowest (P<0.001) dressing percentage. It was concluded that feeding broiler chickens a medium energy (2900Kcal/kg) diet with ginger as an additive improves growth performance and carcass yield of broilers under a semi-arid environment.

Keywords: Broiler chickens, energy, ginger, probiotic

Description of Problem

Feed plays an important role in the physiology of chickens as previous researchers have established that chickens feed to satisfy their energy requirements (1). Cells also require energy to carry out all activities from membrane contraction to DNA replication (2, 3). According to (4) there are inconsistent responses of broiler chicks to varying contents of metabolizable energy (ME) in their diets with the main reasons for this discrepancy being the nutrient composition and/or digestibility of diet, the physical form of diet, type and level of added fat, dietary ME level, strain, gender and age of bird, ambient temperature, and the interactive effects of dietary ME and amino acid density and certain additives.

Herbs, spices and their extracts can stimulate feed intake, endogenous secretions and many have antioxidant activities that can improve the oxidative stability of poultry meat and eggs thus increasing their shelf life (5). Ginger *(Zingiber officinale)* is a tropical herbal plant found in abundance in Africa and Asia. It belongs to the family of *Zingiberaceae*. It is used worldwide as a spice and exibits antioxidative, androgenic (6; 7) and humoral

immunity activity (8) in animals. The major active ingredients of ginger, such as gingerols, geraniol, zingerone, gingerdiol, shogaols, zingibrene etc have antioxidant activity (9). It has also been reported that ginger oil has dominative protective effect on DNA damage induced by hydrogen peroxide (H_2O_2) and might act as a scavenger of oxygen radical and might be used as an antioxidant (10 as cited in 6).

Probiotic is a culture of living microorganisms that are used as functional ingredients to manipulate and maintain good health by controlling gut microflora and increasing digestive enzyme activity (11). Probiotics were defined by (12) as live microbial food supplements which beneficially affect the host either directly or indirectly by improving its intestinal microbial balance. Many beneficial effects of probiotics were suggested, such as improved immune system, modification of gut microbiota, reduced inflammatory reactions, decreased ammonia and urea excretion, lower serum cholesterol, and improved mineral adsorption; on the other hand probiotics may have an indirect positive impact on performance parameters and production profitability (11).

The objective of this study was to evaluate the effects of varying dietary energy levels supplemented with ginger or probiotics on performance and carcass characteristics of broiler chickens in a semi-arid environment.

Materials and Methods

The research was conducted at the Animal Science Livestock Teaching and Research Farm, University of Maiduguri. Maiduguri, the Borno state capital is located on longitude 30.05^o East and latitude 11.05^o North. The mean relative humidity ranges between 30% to 50% and the highest in August up to 90% (13). The annual rainfall ranges between 300mm to 700mm and fall mostly between the periods of June to September. The ambient temperature is usually high up to 30^{o}c and 40^{o}c during the harmattan period (November – February) (14).

A total of one hundred and forty four (144) Arbor acre day-old broiler chicks were purchase from a reputable hatchery. They were individually weighed and randomly allotted to six (6) dietary treatments with four replicates of six chicks each. Three metabolizable energy levels (3100, 2900, and 2700 ME/kcal/kg) were supplemented with either ginger (5g/kg) or probiotic (0.505g/kg) thus six experimental diets were formulated for the starter and finisher phases (Table 1).

The air dried ginger used for the experiment was purchased from a reputable market in Maiduguri. It was milled and stored in airtight containers until used. A probiotic 'BIOVET-YC' manufactured by Pharmanza India Ltd containing *saccharomyces ceravisiae* and *saccharomyces bourladii* was purchased and added to the feed according to manufacturer's instruction.

Feed intake was determined by subtracting the leftover every morning from the quantity fed the previous day. Birds were weighed at the beginning of the experiment and the final weight at the end of the experiment. Feed conversion ratio was calculated by dividing the quantity of feed consumed by the weight gained during the duration of the experiment. At the end of the experiment, four birds were randomly selected from each treatment for carcass measurements. The birds were starved of feed overnight and slaughtered the next morning by severing the jugular vein using a sharp knife. The birds were allowed to bleed completely before been defeathered and then eviscerated. The carcass weight and that of cut- up parts were recorded after which they were expressed as percentage of the live weight of each bird.

Data were analysed as a completely randomized design with a factorial arrangement of treatments (three energy levels

by two feed additives) using the General Linear Model (GLM) procedure of SPSS 20.0, means were compared using the Duncan multiple range test (DMRT) of the same software.

Results and Discussion

Table 2 shows the effects of treatment on growth performance of broiler chickens under a semi-arid environment. Feed intake increased ($P<0.001$) with decreasing dietary energy from 3100 to 2700Kcal/kg. Feeding the medium energy diet sustained greater ($P<0.05$) live weight, weight gain and FCR, while lowering ($P<0.05$) mortality. The main effects of ginger and probiotics had no influence on growth parameters. The interaction effect of dietary energy with the feed additives (ginger and probiotics) however, revealed that feed intake was higher ($P<0.05$) when birds were fed 2700Kcal with either of the additives. Live weight, weight gain and FCR were consistently better when medium energy diet (2900Kcal/kg) was supplemented with any of the additives. A combination of high energy (3100Kcal/kg) with ginger also sustained similar FCR values to those of birds fed the medium energy diet.

The results of feed intake obtained in this study are in agreement with the observations of (15) that feed intake reduced with higher dietary energy. On the contrary, (4) reported no difference in feed intake when broilers were fed diets varying in energy level with addition of either probiotics (Avian plus: at 150 g/ton diet) or an enzyme (Sicozyme: at 500 g/ton diet). They however observed no individual influence of either the probiotic or enzyme on feed intake which supports the results in this study. Similar to our findings on the main effects of ginger and probiotics, (16) also reported no difference between the control and groups fed differently processed ginger. Similarly, (17) observed no difference in feed intake of broiler chickens between the control and groups fed a probiotic. Observations by (18) also showed non-significant difference in the feed consumption of broiler finisher birds fed 0.25% ginger. The better performance (live weight, weight gain and FCR) observed for birds in the medium energy group are at variance with the report of (4). There are conflicting reports about the effects of energy level in the diet on weight gain, feed intake and feed efficiency of the modern broiler chicken (15; 19). Infante‐Rodríguez *et al*. (20) reported a better feed efficiency when moderate energy is fed to broilers while (21) observed that an increase in energy level improved weight gain and feed conversion.

Although the main effects of ginger and probiotics on body weight and gain, FCR and mortality were not significant, the combination of these additives with different energy levels had effects on these parameters. However, (4) and (22) reported no interaction between energy levels in the diet and probiotic on performance of broilers. It was observed by (23) and (24) that broilers response to feed additives may be influenced by factors such as species, age and stage of production, nutrition, environment, management practices, additive type and dosage. This may account for the significant difference in this study.

The effects of varying dietary energy levels supplemented with ginger or probiotic on carcass characteristics of broiler chickens are shown on Table 3. The medium energy diet had better ($P<0.001$) dressing percentage compared to the other levels. On the contrary, (20) concluded that dietary energy level did not influence processed carcass weight, breast, drumstick plus thighs, wings and back fat weight or carcass yields. Ginger sustained higher ($P<0.001$) dressing percentage than probiotic. While the interactive effects of energy levels with either ginger or probiotics showed that the low dietary energy combination with probiotics gave the lowest ($P<0.001$) dressing percentage. This confirms

the report of (25) who demonstrated that diet supplementation with ginger powder and a protoxin probiotic increased chick's total carcass weight. It was also observed by (26) that birds fed 1% ginger root powder achieved higher dressing percentage (73.7%) than control (71.1%) group.

Abdominal fat percentage decreased ($P<0.01$) with decreased level of dietary energy and inclusion of ginger in the diet. The interaction of ginger with energy at all levels consistently gave lower abdominal fat percentage in comparison to probiotic and energy interactions. Interactions of energy with ginger or probiotics had no influence on total edible parts. In tandem to observations in this work, (27) reported that broiler chickens fed increased energy and amino acids levels, showed increased abdominal fat, while weight of the carcass cuts were not affected. Similarly, (28) also noted that increased dietary energy density increased abdominal fat in broiler chickens.

Conclusion and Applications

Feeding broiler chickens energy level of 2900Kcal/kg diet with ginger (5g/kg) as an additive in a semi-arid environment:

1. Improves feed intake, body weight gain and feed conversion ratio
2. Yields higher edible portion of carcass and reduces abdominal fat.

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Table 1: Ingredients and percentage composition of different energy diets fed to broiler chickens

Ingredients	**Energy Levels**					
	Starter			Finisher		
	High	Medium	Low	High	Medium	Low
Maize	40.34	39.78	41.41	51.32	49.22	52.12
Wheat bran	10.00	10.00	10.00	11.67	15.00	15.00
GNC	40.11	40.11	39.21	28.67	27.43	28.53
Sesame	5.00	5.00	4.82	5.00	5.00	1.00
Bone meal	2.50	2.50	2.50	1.50	1.50	1.50
Limestone	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.35	0.35	0.35	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis						
CP (%)	24.00	24.00	24.00	20.00	20.00	20.00
ME (Kcal/kg)	3100	2900	2700	3100	2900	2700
Lysine (%)	0.90	0.90	0.88	0.74	0.74	0.75
Methionine (%)	0.32	0.32	0.32	0.29	0.29	0.27
Calcium (%)	0.15	0.15	0.15	0.13	0.14	0.10
Phosphorus (%)	0.51	0.51	0.51	0.60	0.52	0.51

Table 2: Effect of varying dietary energy levels supplemented with ginger or probiotic on performance of broiler chickens

	Total Feed intake (g/bird)	Initial weight (g/bird)	Final weight (g/bird)	Weight gain (g/bird)	FCR	Mortality (%)
Metabolizable energy levels (Kcal/kg)						
3100 (High)	4689.3^{b}	417	1345^{b}	1227^{b}	3.91^{ab}	8.33^{ab}
2900 (Medium)	4610.9^{b}	417	1821^{a}	1404^{a}	3.31^{b}	6.25^{b}
2700 (Low)	5053.2^{a}	417	1580^{b}	1163^{b}	4.63^{a}	12.5^{a}
±SEM	94.3	6.42	72.73	72.98	0.31	2.59
Significance	**	NS	*	*	*	*
Feed additive						
Ginger (G)	4739.8	417	1693	1276	3.85	8.33
Probiotic (P)	4829.1	417	1670	1254	3.93	9.72
±SEM	77.0	0.34	59.38	59.59	0.25	2.12
Significance	NS	NS	NS	NS	NS	NS
Energy/feed additive interactions						
High*G	4467.8^{b}	417	1704^{abc}	1286^{abc}	3.48^{bc}	6.25^{b}
Medium*G	4605.8^{b}	417	1882^{a}	1464^{a}	3.17^{c}	4.17^{b}
Low*G	5145.8^{a}	417	1494^{c}	1077^{c}	4.91^{a}	14.58^{a}
High*P	4910.8^{a}	416	1586^{bc}	1169^{bc}	4.34^{ab}	10.92^{ab}
Medium*P	4616.0^{b}	418	1761^{ab}	1343^{ab}	3.44^{bc}	8.34^{ab}
Low*P	4960.6^{a}	417	1666^{abc}	1249^{abc}	4.02^{abc}	10.42^{ab}
±SEM	3.37	0.59	102.86	103.22	0.44	3.67
Significance	*	NS	*	*	*	*

Table 3: Effect of varying dietary energy levels supplemented with ginger or probiotic on carcass characteristics of broiler chickens

	Live weight (g)	Dressing (%)	Total edible part (%)	Abdominal fat (%)
Metabolizable energy levels (Kcal/kg)				
3100 (High)	1996^{b}	67.09^{b}	64.97	2.46^{a}
2900 (Medium)	2073^{ab}	72.88^{a}	66.81	2.13^{b}
2700 (Low)	2196^{a}	56.48^{c}	66.84	1.84^{c}
±SEM	94.3	2.21	2.31	0.09
Significance	**	**	NS	***
Feed additive				
Ginger (G)	2114	68.67^{a}	65.15	1.76^{b}
Probiotic (P)	2063	62.30^{b}	67.26	2.52^{a}
±SEM	55.94	1.80	1.89	0.07
Significance	NS	**	NS	***
Energy/feed additive interactions				
High*G	1850^{c}	64.15^{b}	63.70	2.31^{b}
Medium*G	1975^{bc}	70.67^{ab}	64.52	1.65^{c}
Low*G	2516^{a}	71.20^{a}	67.23	1.33^{d}
High*P	2142^{b}	70.67^{ab}	66.24	2.61^{a}
Medium*P	2172^{b}	75.08^{a}	69.10	2.61^{a}
Low*P	1877^{c}	41.76^{c}	66.45	2.35^{b}
±SEM	96.89	3.13	3.27	0.12
Significance	*	***	NS	***