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EFFECT OF FEED FORM AND METABOLIZABLE ENERGY LEVEL ON THE PERFORMANCE AND CARCASS QUALITY OF BROILER CHICKS

(With 6 Tables)

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SUMMARY

The effect of feed form and metabolizable energy level on the performance and carcass quality of broiler chicks were studied. Two feed forms, ground or whole sorghum grains (G.S.G. or W.S.G.), with three levels of metabolizable energy (2977, 3088 and 3199 Kcal/kg) which replicate 4 times were used in 2 x 3 factorial design. A total of 120 one-day-old unsexed broiler chicks of commercial strain (Hybro-type) were randomly distributed into 24 pens, each containing equal weight at the rate of five chicks per pen for 7-weeks duration. Health of the stock and performance parameters were recorded. At the end of the experiment, the birds were slaughtered and dressing percentages for different treatments were recorded. The results indicated that, the energy level had a significant ($P<0.05$) effect on performance of broiler chicks. Birds fed the highest energy diet (3199 Kcal/kg) showed better results in body weight gain and feed efficiency with the lowest feed intake as compared to the other two diets (2977 and 3088 Kcal/kg). Birds fed the whole sorghum grain diet produced significantly ($P<0.05$) higher relative weight of gizzard percentage as compared to those fed ground sorghum grain diets.

Key words: *Feed, metabolizable energy, carcass quality, broiler chicks.*

INTRODUCTION

Feed is the most expensive portion in broiler production. In an attempt to reduce this cost, optimal feed intake is required in order to support optimal and efficient growth. Feed form has a significant impact on optimizing feed intake and consequently results in significant profit

opportunities. Whole sorghum grain can be used to reduce the cost of grinding, in addition to more nutritious than ground, since oxidation occurs after grind, reducing nutritional content; and the longer the ground grain sits around, the greater the loss. Recent research has showed that significant increased level of fines resulted in reduced live weight and increased feed conversion ratio (Quentin *et al.,* 2004). Accordingly, to maximize performance, the accumulation of fine particles in the feed should be minimized.

On the other hand, the energy level in broiler feed constitutes the major entity, as it is required in larger quantities than other nutrients and it also influenced voluntary feed intake. In addition to, energy constitutes, the major cost item in formulation of adequate least-cost diet for broilers. So in order to formulate balanced broiler diets with the lowest-cost to achieve optimum production, more studies should be conducted. The objective of the present research was to investigate the effect of feed form and energy level and their dietary interaction on the performance and carcass quality of the broiler chicks.

MATERIALS and METHODS

One-hundred and twenty one-day old unsexed chicks of commercial strain (Hybro-type) were randomly distributed into 6 groups each of 20 chicks. Each group was further subdivided into 4 replicates with 5 chicks per each. The chicks of each replicate were housed in a pen (1 square meter) in an open-sided deep litter house. A 2 x 3 factorial arrangement was used during the experimental period. Two feed forms, ground or whole sorghum grains (G.S.G. or W.S.G.), were replicated 4 times with each of the three levels of metabolizable energy (2977, 3088 and 3199 Kcal/kg). All the diets were formulated to be iso-nitrogenous 23% NRC (1994), matching broiler chick requirements. Calculated analysis of the experimental diets was done according to feedstuff analysis outline by Ellis (1981), while determined chemical analysis was conducted by the methods of AOAC (1990). Formulation, proximate analysis and calculated analysis of the experimental diets are shown in Tables (1 & 2), respectively. An imported super concentrate (Hendrex broiler concentrate) which was incorporated in all the experimental diet at the rate of 5% to upgrade protein quality and ensure the supply of essential critical amino acids is shown in Table (3). Feed and water were offered ad-libitum.

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

Feed form	G.S.G.	W.S.G.	G.S.G.	W.S.G.	G.S.G.	W.S.G.
Metabolizable energy (Kcal/kg)	2977	2977	3088	3088	3199	3199
A: Formulation:						
Grain sorghum	65	65	63	63	61	61
Groundnut meal	11	11	13	13	15	15
Sesame meal	16	16	14	14	12	12
Super concentrate	5	5	5	5	5	5
Oyster shell	2.75	2.75	2.75	2.75	2.75	2.75
Common salt	0.25	0.25	0.25	0.25	0.25	0.25
Vegetable oil	-	-	2	2	4	4
Total	100	100	100	100	100	100
B. Determined analysis						
Dry matter	96.43	96.43	96.92	96.92	97.81	97.81
Crude protein (W% x 6.25)	22.35	22.35	22.18	22.18	22.28	22.28
Ether extract	4.66	4.66	6.87	6.87	7.95	7.95
Crude fiber	4.83	4.83	4.85	4.85	4.96	4.96
Ash	9.33	9.33	9.20	9.20	9.94	9.94
Nitrogen free extract	54.69	54.69	54.09	54.09	54.76	54.76

G.S.G.: ground sorghum grains.
W.S.G.: whole sorghum grains.

Table 2: Calculated analysis of the experimental diet (percent as fed)

Feed form	G.S.G.	W.S.G.	G.S.G.	W.S.G.	G.S.G.	W.S.G.
Metabolizable energy (Kcal/kg)	2977	2977	3088	3088	3199	3199
Crude fat	5.60	5.60	7.34	7.34	9.00	9.00
Crude protein	22.08	22.08	22.12	22.12	22.12	22.12
Lysine	1.08	1.08	1.09	1.09	1.07	1.07
Methionine	0.49	0.49	0.47	0.47	0.48	0.48
Cystine	0.30	0.30	0.32	0.32	0.32	0.32
Methionine + cystine	0.83	0.83	0.82	0.82	0.77	0.77
Calcium	1.11	1.11	1.09	1.09	1.07	1.07
Total phosphorus	0.69	0.69	0.67	0.67	0.65	0.65
Calorie-protein ratio	135	135	140	140	146	146
(ME Kcal/kg: protein %)						

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

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

The light was continuous throughout the experimental period. The performance of the experimental birds in term of feed intake, live weight gain and feed efficiency were recorded weekly. Health of the experimental stock and mortality rate were closely observed and recorded daily. At the 7^{th} week, the birds were individually weighed after overnight fast (except for water) and 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 of internal organs were removed, weighed individually and expressed as relative percentage of slaughtered weight. Eviscerated carcasses were weighed and then chilled in a refrigerator for 24 hours at 4^{o}C and cold carcasses were recorded. Data were analyzed by two-ways of variance using the general linear model procedure of SAS (SAS, Institute) (1998), using the replicate mean of all parameters. The model included feed form and metabolizable energy, and two way interaction. Significant differences among treatment means were determined by Duncan's multiple range test with 5% level of probability.

RESULTS

The effect of feed form and metabolizable energy level on broiler chicks performance is shown in table 4. Feed form had no significant ($P>0.05$) effect on broiler performance. The differences between the mean final live weight, body weight gain, total feed intake and feed conversion ratio were not significant among the all experimental dietary treatments.

Birds fed the whole sorghum grains diets produced higher body weight gain and better feed conversion ratio with the lower feed intake as compared to those fed the ground sorghum grains diets, although the differences among these diets were insignificant. On the other hand, the energy level increased significantly ($P<0.05$) body weight gain with the decreased in feed intake as the dietary energy level was increased. The feed conversion ratio was improved significantly ($P<0.05$) with increasing the level of energy. Birds fed high energy diet (3199 Kcal/kg) gave the highest body weight gain with the lowest feed intake and best feed conversion ratio as comparison to the other two diets (2977 and 3088 Kcal/kg).

Table 4: The effect of feed form and energy level on the performance of broiler chicks.

Diet	Treatments		Parameters					
	Feed form	Metabolizable energy (Kcal/kg)	Initial Live weight (g/chick)	Final live weight (g/chick)	Body weight gain (g/chick)	Total feed intake (g/chick)	Feed conversion ratio	Mortality (%)
A	G.S.G.	2977	45.20	1879.05[a]	1833.80[a]	4250.3[a]	2.31[a]	2[a]
B	G.S.G.	3088	45.22	1974.61[a]	1929.30[a]	4198.0[a]	2.17[a]	2[a]
C	G.S.G	3199	45.13	2072.00[a]	2026.80[a]	4048.0[a]	1.99[a]	2[a]
D	W.S.G.	2977	45.15	1885.13[a]	1839.90[a]	4217.8[a]	2.29[a]	1[a]
E	W.S.G.	3088	45.12	1979.72[a]	1934.60[a]	4148.1[a]	2.14[a]	1[a]
F	W.S.G.	3199	45.21	2079.51[a]	2034.0[a]	4033.4[a]	1.98[a]	1[a]
SEM (±)			-	81.32	79.70	133.73	0.041	0.020
Main effect								
Feed form								
G.S.G.			45.18	1975.22[a]	1929.96[a]	4165.43[a]	2.15[a]	2[a]
W.S.G.			45.16	1981.45[a]	1936.16[a]	4133.10[a]	2.13[a]	1[a]
SEM (±)			-	58.17	55.31	100.32	0.029	0.01
Metablizalbe energy (Kcal/kg)								
2977			45.17	1882.09[b]	1836.8[b]	4234.0[a]	2.30[a]	1[a]
3088			45.17	1976.94[b]	1931.9[b]	4173.0[a]	2.20[a]	1[a]
3199			45.17	2075.75[a]	2030.4[a]	4040.7[b]	1.99[b]	1[a]
SEM (±)			-	58.17	55.31	100.32	0.029	0.01

A, b: Means within columns with no common superscripts are different significantly (P<0.05)
SEM (±): Standard error of means.

The interaction between the feed form and the energy level was not statistically significant (P>0.05) on weight gain, feed intake and feed conversion ratio of the broilers. The treatments had no significant (P>0.05) effect on the mortality rate. Birds fed whole sorghum grain diets showed lower mortality than those fed ground grain diets, although these improvement was not statistically significant. The effects of feed form and energy level on hot and cold dressing percentages were showed in table 5. The feed forms had no significant (P>0.05) effect on both hot and cold dressing percentages of the broiler. In addition the different levels of energy had no significant (P>0.05) effect on both hot and cold dressing percentages.

Table 5: The effect of feed form and metabolizable energy level on the dressing percentages of broiler.

Diet	Treatments		Parameters	
	Feed form	Metabolizable energy (Kcal/kg)	Hot dressing (%)	Cold dressing (%)
A	G.S.G	2977	70.28[a]	69.87[a]
B	G.S.G.	3088	70.28[a]	69.89[a]
C	G.S.G.	3199	70.28[a]	69.89[a]
D	W.S.G.	2977	70.29[a]	69.88[a]
E	W.S.G.	3088	70.29[a]	69.88[a]
F	W.S.G.	3199	70.29[a]	69.87[a]
SEM (±)			0.0261	0.0241
Main effects				
Feed form	G.S.G.		70.28[a]	69.88[a]
	W.S.G.		70.29[a]	69.87[a]
SEM (±)			0.0191	0.0170
Metablizable energy level (Kcal/kg)		2977	70.29[a]	69.87[a]
		3088	70.28[a]	69.88[a]
		3199	70.28[a]	69.88[a]
SEM (±)			0.0191	0.0170

SEM (±): Standard error of means

Table 6 shows the effect of feed form and energy level on the abdominal fat and relative weight percentages of some organs (liver, heart and gizzard). The feed form had no significant ($P>0.05$) effect on the percentage of abdominal fat, liver and heart except the gizzard which was significantly ($P<0.05$) increased with diets contained whole sorghum grains as compared to ground sorghum grains. On the other hand, the energy level had no significant ($P>0.05$) effect on all the parameters measured.

The interaction between the feed form and energy level was not statistically ($P>0.05$) significant on the percentages of abdominal fat, and relative weight of liver, heart and gizzard (Table 6).

Table 6: The effect of feed form and metabolizable energy level on the non-carcass components as a percentage of body weight.

	Treatments		Parameters			
Diets	Feed form	Metabolizable energy (Kcal/kg)	Abdominal fat as (%) of body weight	Liver as (%) of body weight	Heart as (%) body weight	Gizzard as (%) of body weight
A	G.S.G.	2977	2.10[a]	2.01[a]	0.51[a]	2.1[a]
B	G.S.G.	3088	2.10[a]	2.02[a]	0.53[a]	2.10[a]
C	G.S.G	3199	2.12[a]	2.00[a]	0.52[a]	2.1[a]
D	W.S.G.	2977	2.10[a]	2.01[a]	0.52[a]	2.3[a]
E	W.S.G.	3088	2.11[a]	2.02[a]	0.51[a]	2.3[a]
F	W.S.G.	3199	2.12[a]	2.01[a]	0.53[a]	2.3[a]
SEM (±)			0.0201	0.01	0.230	0.26
Main effect						
Feed form						
G.S.G.			2.11[a]	2.01[a]	0.52[a]	2.1[b]
W.S.G.			2.11[a]	2.01[a]	0.52[a]	2.3[a]
SEM (±)			0.0190	0.0191	0.012	0.018
Metablizalbe energy (Kcal/kg)						
2977			2.10[a]	2.01[a]	0.5[a]	2.2[a]
3088			2.10[a]	2.02[a]	0.5[a]	2.2[a]
3199			2.12[a]	2.00[a]	0.5[a]	2.2[a]
SEM (±)			0.0190	0.0191	0.012	0.018

A, b: Means within columns with no common superscripts are different significantly (P<0.05)
SEM (±): Standard error of means.

DISCUSSION

The results indicated that, the body weight gain, feed intake and feed conversion ratio were significantly (P<0.05) affected by the level of dietary energy. The birds fed diet contained 3199 Kcal/kg metabolizable energy produced significantly (P<0.05) the heaviest body weight gain with lowest feed intake and best feed conversion ratio as compared to other two diets (2977 and 3088 Kcal/kg). These results were in line with other findings (El-Tazi, 2001 and El-Husseini *et al*., 2002) which showed an increased in feed intake as the dietary energy level was reduced. The result coincided with the finding of Proudfoot and Hulan (1987) who mentioned that, the highest dietary energy (3100 Kcal/kg) gave the highest growth rate, highest profit and most efficient feed conversion as compared to the lowest energy diet (2900 Kcal/kg). Similar results have been obtained by Bertechini *et al*. (1991) who reported that, there was a linear increased in weight gain and a decreased in feed intake as the metabolizable energy intake was increased.

No significant differences in hot and cold dressing percentages were observed between the different levels of energy. These results disagreed with El Tizai (2001) who found that the hot and cold dressing percentages of broiler chicks were increased with increasing the level of energy.

The feed form had no significant effect ($P>0.05$) on the productive performance of broiler chicks. The use of whole sorghum grain diets gave similar body weight gain, feed intake and feed conversion ratio as ground sorghum grain diets. These results coincided with the finding of Rose *et al*. (1995) who mentioned that broiler chickens offered diet in which most of the wheat was fed as whole grain had the same body weight and feed conversion as birds fed diets in which all of the wheat was crumbled. These results support with the findings of Safaa *et al.* (2009) who mentioned that, neither type of cereal nor geometric mean diameter affected productive performance or egg quality of young brown hens, except for feed intake that increased with the coarser particle size. In addition, Jones and Taylor (2001) reported that the use of whole triticale in the pelleted food produced similar body weight and enhanced the feed conversion efficiency as compared to ground triticale.

No significant differences in hot and cold dressing percentages were observed between the birds fed the whole sorghum grain diets and those fed the ground sorghum grain diets. These results were agreed with the finding of El Tazi *et al*. (1990) who recorded that, the dressing percentage of broilers was found to be not significantly affected by feeding different feed forms to broilers.

Birds fed the whole sorghum grain diets produced significantly ($P<0.05$) highest relative weight of gizzard as compared to those fed the ground sorghum grain diets. Similar results were obtained by Hetland and Choct (2003) who reported that, the gizzard exposed to whole wheat is better developed than that fed ground wheat.

With regard to mortality rate, birds fed whole sorghum grain diets had lower mortality than those fed on ground sorghum grain diets, although the improvements had not be statistically significant. The reduction in morality rate that occur with whole sorghum grain feeding may be due to drier litter on whole grain feeding which is a source of improved bird health. These results were supported by the findings of Cumming (1992) who mentioned that, the gizzard action of grinding whole wheat will also grind coccidia eggs and reduce coccidia challenge. These results were in line with Jones and Taylor (2001) who mentioned

that the mortality rate was reduced by feeding pelleted diets containing whole grain, which was possibly related to the early development of the gastro-intestinal tract relative to total body development.

The interaction between the feed form and dietary energy level was not statistically significant in the performance and carcass quality of the broiler chicks. The absence of an interaction between the two main factors indicated that the effect of fed form was not counteracted by varying of the dietary metabolizable energy level.

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