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The effects of different sizes of insoluble grit on growth performance and carcass traits in broiler chickens

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ABSTRACT

The present study was conducted to investigate the effects of different sizes of insoluble grit on growth performance and carcass traits in broiler chickens. A total of 200 broilers (Ross 308), 10 days old, were randomly allotted to five experimental equal groups with four replicates of 10 chickens (five male and five female) and fed with basal diet + ground wheat (without grit); basal diet + whole wheat (without grit) and basal diet contain 1.5% grit of diet with sizes of 2, 3 and 4 mm. Growth performance (evaluated through weight gain, feed intake and feed conversion ratio) was determined on day 24 and 42. Also, carcass traits (relative weights of carcass, breast, thigh, liver, heart, gizzard and intestine) and intestine length were assessed on day 42. Weight gains and feed conversion ratio were significantly improved in broilers added with grit 2 mm compared to the control group ($p<0.05$), whereas; carcass traits were not significantly altered. These data suggest that grit with size of 2 mm improve growth performance in broiler chickens.

Key words: Broiler, carcass, grit, performance

Introduction

Grit is considered as a kind of angular and hard crushed rock preferentially derived from granite, is used by the avian in place of "teeth". Also, it plays an important role in enhances the mechanical digestion by gizzard (Garipoglu et al., 2006). Grits can be classified into insoluble and soluble grits. The insoluble grits include mica, silica and sand. They are not digestible and retained in the gizzard whereas; soluble grit include oyster shell and limestone, which serve as source of calcium and they also are easily dissolved in the gizzard (Adeniji and Oyeleke, 2008).

In addition, the previous studies showed that grit can improve the efficiency of feed utilization by the poultry and enhance average feed intake (Atteh, 2003; Waugh et al., 2006). In other study, Adeniji (2009) stated that, the cost of feed reduced in broilers treated by grit. Through previous studies stated that the feeding insoluble grit in birds are not essential for good performance and feed efficiency whereas; growth and gizzard development was faster for broilers fed with grit (Garipoglu et al., 2006).

In the study of Jones and Taylor (1999) and Silva-Junior et al. (2003), it was reported that growth performance was not significantly modified in broilers treated insoluble granite-grit whereas; granite-grit increased proventriculus and gizzard weight. It was hypothesized in the present that insoluble grit that increase the grinding activity of the gizzard will change gut motility, improve peptic digestion in the gizzard and consequently to greater performance in broiler chickens. On the other hand, little research has been conducted on the use of different sizes of insoluble grit in broiler diets. Thus, the objectives of this study were to investigate the effects of different sizes of insoluble grit on growth performance and carcass traits in broiler chickens.

Materials and Methods

Birds, experimental design and management

A total of 200 broilers (Ross 308), 10 days old, were randomly assigned to five dietary treatments in a complete randomized design, each of which was replicated four times with 10 birds per replicate (five male and five female).

RESEARCH ARTICLE

Control groups were fed a basal diet + ground wheat (without grit), basal diet + whole wheat (without grit) and others were fed a basal diet contain 1.5% grit of diet with sizes of 2, 3 and 4 mm. The diets were formulated to meet the requirements of broiler as recommended by the catalogue of Ross 308 broilers (Table 1). Birds had access to feed and water ad libitum. All the procedures were approved by the institutional animal care and use committee of the Shabestar branch, Islamic Azad University. Chickens were housed in an environmentally controlled room. Room temperature was maintained at 32°C during the first week and gradually reduced to 21°C by the end of the third week. Twenty-three hours of fluorescent lighting was provided per day throughout the experimental period as recommended by the catalogue of Ross 308 broilers.

In each cage, total chicken body weight, chicken numbers and the weight of unconsumed and added feed were recorded on days 10, 24 and 42. Body weight gain, feed consumption and feed conversion ratio was calculated for each cage (replicate) between 11 and 24, 25 and 42 and 1 and 42 days. For each time period, body weight gain was calculated and expressed as grams per bird. Feed intake (g of feed intake/bird) over the entire grow-out period was calculated by totalling feed consumption in each time interval between each bird sampling. Feed conversion ratio (g of feed intake /g of body weight gain) was calculated by dividing total feed intake by total weight gain in each cage.

Carcass characteristics

On day 42, eight birds per experimental groups were randomly selected for organ weights. Birds were weighted and slaughtered by cervical dislocation then the abdominal cavity was opened. The weight of carcass, breast, thigh, heart, gizzard, liver and intestine were recorded and the corresponding percentages (% of live body weight) were calculated. At the final, intestine length was measured.

Statistical analysis

All the data were subjected to ANOVA procedures for completely randomized designs using the general linear model (GLM) procedure of the SAS program (SAS Institute, 2003). When data were percentages they were transformed by arc sin square root. Differences between treatments were compared by the Duncan's multiple range tests following ANOVA, and values were considered statistically different at $p < 0.05$.

Results

Overall, there were no significant treatment effects on feed intake through the whole experimental period. Body weight gain ($p<0.05$) and feed conversion ratio ($p< 0.05$) were significantly improved in chickens treated by grit 2 mm compared to the other groups whereas; body weight gains and feed conversion ratio in chickens treated by grit 3 and 4 mm were not significantly altered through the whole experimental period (Table 2, 3 and 4). Furthermore, as shown in table 5, addition of grit in the diet of broilers chickens had not significant effect on the weight of carcass, breast, thigh, heart, gizzard, liver, intestine and intestine length. Although the differences were not statistically significant, it was also noted that the gizzard numerically increased in broilers fed with grit compared to control groups.

Discussion

Results of the present study showed that growth performance of broilers improved with grit size of 2 mm but broilers treated by sizes of 3 and 4 mm were not significantly altered. Franzina Bale-Therik et al. (2012) reported that daily feed intake, daily body weight gain and feed conversion ratio of local chicken fed with grits (zero, 0.25, 0.50 and 0.75% of body weight to basal diet) were significantly higher and better than those without fed grit.

In other side, Garipoglu et al. (2006) observed no significant effects of grit into broiler diet on final live weight and feed efficiency. Several research reports have also observed no significant effect of grit supplementation on growth performance of broilers although gizzard weight was greater in birds given grit (Silva-Junior et al., 2003; Jones and Taylor, 1999; Taylor, 1996; Kriz, 1985; Lazar et al., 1984; Kriz et al., 1981). Feeding grit had no effect on growth performance of broilers (Bennett et al., 2002a), turkey toms (Bennett et al., 2002b) or laying hens (Bennett and Classen, 2003) fed similar levels of whole barley or mash diets. Svihus et al. (1997) and Bennett et al. (1995) reported that grit supplementation has no effect on performance of broilers even though supplied with whole grains. Other experiment results with respect to feed and subsequently protein and energy intake showed that the use of grit has no beneficial effect on mechanical digestion (Garipuglu et al., 2006). Also, access to insoluble grit in broilers (Bennett et al., 2002a), and turkey toms (Bennett et al., 2002b) did not alter the response

RESEARCH ARTICLE

to feeding whole barley. By contrast, Karunajeewa and Tham (1984) reported that pullets fed with whole grain may enhance their consumption of grit when it is available free choice.

Grit consumption might be attributed to the physical development of gizzard. Thus, the bird fed with grit, the grit stimulated the secretion digestive enzyme and in addition the mixing of the enzyme with the ingest leading to an improved digestibility of ingests and consequently to greater performance in broiler chickens (Garipoglu et al., 2006). Gionfriddo and Best (1995) reported that dietary grit addition increased the digestive efficiency of ostriches that consequently promotes the nutrient assimilation and sustains performance in ostriches.

In other study, grit intake increased weight of gizzard, length of gut as a proportion of body weight and the content of insoluble grit (0.84 vs. 4.22%) in the faeces compared to the control group but had no effect on carcass weight (Garipoglu et al., 2006). Increased gizzard weight might be a result of acceleration of muscle movement as Moore (1998) postulated. In addition, Yildiz et al. (2001) stated that supplying insoluble grit to the chickens fed mash, crumble or

Table 1. *Composition of the basal diet (ingredient and nutrients) given to broiler chickens for 6 weeks*.

Ingredient (%)	**Starter 1 to 10 d**	**Grower 11 to 24 d**		**Finisher 25 to 42 d**	
Corn grain	56.59	51.37	49.78	55.49	54.11
Soybean meal (44% CP)	36.74	34.60	32.70	30.68	28.44
Wheat	-	6.00	6.00	6.00	6.00
Corn gluten	-	-	1.50	-	1.70
Soybean oil	0.95	3.34	3.79	3.36	3.72
Di-calcium Phosphate	1.89	1.65	1.67	1.53	1.56
Oyster shell	1.35	1.11	1.11	1.08	1.08
Salt	0.23	0.23	0.23	0.23	0.23
Sodium bicarbonate	0.26	0.26	0.26	0.25	0.26
Vitamin premix [a]	0.25	0.25	0.25	0.25	0.25
Mineral premix [b]	0.25	0.25	0.25	0.25	0.25
L-Threonine	0.64	0.50	0.48	0.44	0.42
DL-Methionine	0.42	0.26	0.25	0.26	0.25
L-Lysine	0.38	0.12	0.18	0.13	0.19
Salinomycin	0.05	0.05	0.05	0.05	0.05
Grit	-	-	1.50	-	1.50
Nutrients (Calculated)					
ME, kcal/kg	2850	3000	3000	3050	3050
ME. MJ/kg	11.93	12.56	12.56	12.76	12.76
CP, %	22.14	20.95	20.95	19.54	19.54
Ca, %	1.05	0.90	0.90	0.85	0.85
Available phosphorous, %	0.50	0.45	0.45	0.42	0.42
Na, %	0.18	0.18	0.18	0.18	0.18
K, %	0.98	0.87	0.83	0.80	0.76
Cl,%	0.17	0.17	0.17	0.17	0.17
Lys, %	1.43	1.18	1.18	1.09	1.09
Met + Cys, %	1.07	0.90	0.90	0.86	0.86
Trp, %	0.30	0.29	0.28	0.26	0.25
Thr,%	0.94	0.80	0.80	0.74	0.74
EE, %	-	5.58	5.97	5.72	6.04
Linoleic acid, %	1.87	1.72	1.65	1.74	1.67

a - Vitamins mixture provide per 2.5 kilogram of diet: vitamin A, 12000000 IU; vitamin B1, 4000 mg; vitamin B2, 6000 mg; vitamin B3, 18000 mg; vitamin B6, 3000 mg; vitamin B12, 15 mg; vitamin D3, 5000000 IU; vitamin E, 50000 IU; vitamin K3, 3000 mg; vitamin B9, 1500 mg; vitamin B5, 70000 mg; vitamin H2, 100 mg; choline chloride, 400000 mg.

RESEARCH ARTICLE

Table 5. *Effects of different sizes of insoluble grit on weight of carcass, breast, thigh, heart, gizzard, liver, intestine and intestine length of male broiler chickens when they were 42 days old (based on percentage of live body weight).*

Diet	Carcass (%)	Breast (%)	Thigh (%)	Heart (%)	Liver (%)	Gizzard (%)	Intestine (%)	intestine length (Cm)
Wheat ground + without grit	67.95	23.10	20.19	0.71	1.96	1.81	4.83	189.25
Whole wheat + without grit	67.85	24.00	19.81	0.59	1.97	1.70	4.60	195.00
Whole wheat + grit 2 mm	69.74	25.95	21.41	0.57	2.00	1.95	5.04	187.50
Whole wheat + grit 3 mm	68.36	24.25	20.04	0.61	2.26	2.09	5.30	174.50
Whole wheat + grit 4 mm	67.17	25.14	20.54	0.73	2.10	2.00	5.36	193.50
SEM	1.11	0.88	0.59	0.07	0.18	0.13	0.39	7.05
P-Value	0.5871	0.2390	0.3897	0.4617	0.7648	0.2911	0.6480	0.3069

Table 6. *Effects of different sizes of insoluble grit on weight of carcass, breast, thigh, heart, gizzard, liver, intestine and intestine length of female broiler chickens when they were 42 days old (based on percentage of live body weight).*

Diet	Carcass (%)	Breast (%)	Thigh (%)	Heart (%)	Liver (%)	Gizzard (%)	Intestine (%)	intestine length (Cm)
Wheat ground + without grit	65.78	23.38	18.46	0.79	2.12	1.90	6.06	162.25
Whole wheat + without grit	66.23	23.11	18.28	0.75	2.10	1.91	5.63	158.75
Whole wheat + grit 2 mm	67.18	24.77	19.81	0.62	2.15	2.12	6.12	180.00
Whole wheat + grit 3 mm	66.79	24.68	18.16	0.67	2.10	1.94	5.24	165.25
Whole wheat + grit 4 mm	66.53	22.20	18.44	0.68	2.15	2.02	4.80	170.50
SEM	0.49	1.34	0.70	0.05	0.13	0.10	0.44	5.99
P-Value	0.3710	0.6313	0.4672	0.2200	0.9971	0.6078	0.2373	0.1652

pellet diets increased the thickness of gizzard muscles. Also, birds may have either a behavioral or a nutritional need for the ingestion of insoluble grit. It is a behavioral need due to the fact that they were not forced to eat grit and it is a nutritional need because broilers had a lower protein and energy intake due to its help to grind the ingredients although experimental feeds were in mash form (Garipuglu et al., 2006). Thus, these results do support the idea that the grit is necessary when an all-mash system is used. (Garipuglu et al., 2006). Salt and stone eating is a natural behavior in broilers, generally associated with animal welfare. For this reason, free choice grit might be regarded as a method, which can be used to alleviate stress conditions and to improve the animal welfare (Garipuglu et al., 2006).

As a conclusion, addition of grit in the diet of broiler chickens significantly improve weight gains and feed conversion ratio in broilers fed whit grit 2 mm compared to other groups whereas, carcass traits were not significantly altered.

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References

Adeniji AA, Oyeleke MM. 2008. Effects of dietary grit fed on the utilizatyion of rumen content by pullet chicks. J. Appl. Sci. Res., 4(10): 1257-1260.

Adeniji AA. 2009. Effects of dietary grit inclusion on the utilization of palm kernel cake by pullet chicks. Anim. Nutr. Feed Technol., 9: 29-36.

Atteh JO. 2003. Principle and practices of livestock feed manufacturing (3rd ed). Published by Adeleke Ilorin. Nigeria.

Bennett CD, Classen HL. 2003. Performance of two strains of laying hens fed ground and whole barley with and without access to insoluble grit. Poult. Sci., 82: 147-149.

Bennett CD, Classen HL, Riddell C. 1995. Live performance and

RESEARCH ARTICLE

health of broiler chickens fed diluted with whole or crumble wheat. Can. J. Anim. Sci., 75: 611-614.

Bennett CD, Classen HL, Riddell C. 2002a. Feeding broiler chickens wheat and barley diets containing whole, ground and pelleted grain. Poult. Sci., 81: 995-1003.

Bennett CD, Classen HL, Schwean K, Riddell C. 2002b. Influence of whole barley and grit on live performance and health of turkey toms. Poult. Sci., 81: 1850-1855.

Franzina Bale-Therik J, Sabuna C. Jusoff K. 2012. Influence of Grit on Performance of Local Chicken under Intensive Management System. Global Veterinaria, 9 (2): 248-251.

Garipoglu AV, Erener G. Ocak N. 2006. Voluntary Intake of Insoluble Granite-grit Offered in Free Choice by Broilers: Its Effect on Their Digestive Tract Traits and Performances. Asian-Aust. J. Anim. Sci., 4: 549-553.

Gionfriddo JP, Best LB. 1995. Grit use by house sparrows. Effect of diets and grit size. The Cooper Ornithological Society.

Jones GPD, Taylor RD. 1999. Performance and gut characteristics of grit-fed broilers Proceedings Australian Poultry Science Symposium Volume No 11, University of Sydney, NSW, pp. 57-60.

Karunajeewa H, Tham SH. 1984. Choice feeding of the replacement pullet on whole grains and subsequent performance on laying diets. Br. Poult. Sci., 25: 99-109.

Kriz L. 1985. Effect of silica grit on efficiency and slaughter characteristics of caged broiler chickens. Acta Univ. Agric. Br. Facult. Agric., 33: 211-216.

Kriz L, Treblik P, Mika O, Spacek F, Rehacek J. 1981. Effect of silica grit on yields and carcass value of broiler chickens. Acta Univ. Agric. Br. Facult. Agric., 29: 275-282.

Lazar V, Kacirkova J, Klecker D. 1984. Verifying the applicability and time of silica grit feeding to broiler chickens. Acta Univ. Agric. Br. Facult. Agric., 32: 105-109.

Moore SJ. 1998. Use of an artificial gizzard to investigate the effect of grit on the breakdown of grass. J. Zool., 246: 119-124.

SAS Institute: 2003. SAS Proprietary Software. Release 9.1. SAS Inst. Inc., Cary, NC.

Silva-Junior VL, Cotta JTB Oliveira AIJ. 2003. Effect of the forms of presentation of corn and the use of grit in the rations on performance in broiler. Ciencia e Agr., 27: 1165-1171.

Svihus B, Herstad O, Newman CW, Newman RK. 1997. Comparison of performance and intestinal characteristics of broiler chickens fed on diets containing whole, rolled or ground barley. Br. Poult. Sci., 38: 524-529.

Taylor EJ. 1996. An evaluation of the importance of insoluble versus soluble grit in the diet of canaries. J. Avi. Med. Surg., 10: 248-251.

Waugh EE, Aganga AA, Seabo D, Omphile UJ Sopito CMT. 2006. Growth rate and feed conversion rate of ostriches feed ration with or without grit in Botswana. Department of Animal Science and Production. Botswana College of Agriculture. Botswana.

Yildiz B, Yildiz H, Bahadir A. 2001. Yemin fiziksel yapisi ile yemleme eklinin broylerlerde muskuler mide uzerindeki etkisi (The effects of physical texture of feed and feeding regime on the gizzards of broilers) Turk J. Vet. Anim. Sci., 25: 295-300.