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Effects of Feed Particle Size on the Performance and Carcass Characteristics of Broilers

R. Ebrahimi, M. Bojar Pour and S. Mokhtar Zadeh
Department of Animal Science, Ramin University of Agriculture and Natural Resources, Ahwaz, Iran

Abstract: This study was conducted to evaluate the effects of three various physically form diets (whole pellet, whole crumble and mix crumble and pellet) on broilers performance. It was performed using 150 broilers (male and female mix) from commercial Arbor acres breed in a completely randomized design with 3 diets by 2 replication (25 chickens per each replication). Daily gain, feed intake and FCR measured in whole period, furthermore carcass mean, breast, femur, abdominal fat, liver and gizzard measured and analyzed in end of the experiment. Body weight had not significant different. Feed intake was highest in the pellet groups. FCR in the crumble groups was higher than the other groups.

Key words: Particle size, performance, broiler, pellet groups, feed intake, crumble diet

INTRODUCTION

Cereal grains are the primary energy source in poultry diets. Therefore, not only must producers be concerned about the composition of the grain but also how it is processed so the animal may fully utilize the nutrients. Researches show that the physical form of diets and feed particle size have a great effect on poultry yield (Behnke and Beyer, 2004).

The effects of particle size on feed quality and quality of poultry has been researched in a number of settings (Behnke, 1994). Particle size increases the surface area of the grain, thus allowing for greater interaction with digestive enzymes. It also improves the ease of handling and the mixing characteristics. In poultry diets, the effects of feed particle size appear to be confounded with complexity of the diet as well as further processing such as pelleting or crumblizing.

Cabrera (1994) found no effect of feed particle size (1,000-400 microns) on growth performance of broiler chicks fed a complex (added tallow, meat and bone meal and feather meal) diet fed in a crumblized form. In a second trial, feed efficiency was improved 3% by reducing particle size from 1,000-500 microns in simple diets fed as a meal form but not in crumblized diets.

Therefore, the response to reduced particle (600-500 microns) size in broiler chicks appears to be greatest when fed simple (grain-soybean meal) diets in a meal form. Feeding a complex diet in a crumblized form did not appear to require particle size <1,000 microns. Studies with laying hens suggest no advantages in reducing particle size <800 microns. In analyzing results of several experiments evaluating the effects of dietary particle size on pig performance, it is clear that the greatest effect of particle size is on feed efficiency.

Most researchers would agree that reducing mean particle size of cereal grains to ≤600 μm results in marked improvements in nutrient digestibility and efficiency of growth. Decreasing the particle size of ingredients results in a greater surface area to volume ratio. Smaller particles will have a greater number of contact points within a pellet matrix as compared to larger particles (Behnke, 1994).

Some reports suggest that the effects of feed particle size on performance may be maintained even after pelleting. There appears to be a general consensus that particle sizes of broiler diets based on maize or sorghum, optimum particle size should be between 600 and 900 μm. Available data clearly show that grain particle size is more critical in mash diets than in pelleted or crumble diets. Although, it has been postulated that finer grinding increases substrate availability for enzymatic digestion, there is evidence that coarser grinding to a more uniform particle size improves the performance of birds maintained on mash diets.

This counter-intuitive effect may result from the positive effect of feed particle size on gizzard development. A more developed gizzard is associated with increased grinding activity, resulting in increased gut

Corresponding Author: R. Ebrahimi, Department of Animal Science, Ramin University of Agriculture and Natural Resources, Ahwaz, Iran

motility and greater digestion of nutrients. Although, grinding to fine particle size is thought to improve pellet quality, it will markedly increase energy consumption during milling. Systematic investigations on the relationships of feed particle size and diet uniformity with bird performance, gut health and pellet quality are warranted if efficiency is to be optimised in respect of the energy expenditure of grinding (Amerah *et al*., 2007). In this research we investigated the effects of feed particle size on the performance and carcass characteristics of broilers.

MATERIALS AND METHODS

Birds and diets: Experiments were performed using 150 broilers (male and female) from a commercial Arbor acres breed. Starter and grower diets were prepared and manufactured from a local factory. All diets (Table 1) were corn-soybean-based and were formulated to meet or exceed NRC (1994) recommendations. All diets and water were provided for *ad libitum* consumption.

Statistical analysis: The birds allocated in a completely randomized design with 3 diets by 2 replication (25 chicken/each replication). The chicken was grown till 42 days. The diets that were used are shown in Table 1. The data collected were analyzed by using the GLM procedures of SAS Institute (2002). The DMI, average daily gain and FCR were measured. At the end of the experimental period 4 broilers were killed from each treatment group to allow carcass, femur, chest, abdominal fat, gizzard and liver weight to be measured.

Table 1: Ingredient of diets formulated to NRC (1994) specifications (kg tone^{-1}). All diets were adjusted in nutrient density for the percentage of added moisture or commercial pellet binder

Nutrient contents	Starter	Grower
Corn	462.00	512.00
Soybean meal	276.00	226.00
Wheat	120.00	120.00
Shell	10.00	9.15
Sodium bicarbonate	1.50	-
Salt	1.00	1.00
Fish meal	50.00	50.00
Canola meal	50.00	50.00
Phosphate	9.00	12.00
Met	1.80	1.80
Vitamin-Mineral premix	6.00	6.00
Oil	5.00	5.00
Ca (%)	1.04	1.04
P (%)	0.55	0.54
Met	0.83	0.78
Lys	1.90	1.80
Supplied nutrition		
Energy (kcal kg^{-1})	2883.00	2925.00
Protein (%)	22.40	20.60

RESULTS AND DISCUSSION

Effects of feed particle size on weight gain: As shown in Table 2, the average daily gain of chickens fed with pelleted diet was greater than those fed with the crumbled and mixture of crumble and pellet diets. The effects of the pelleted diet seemed to be through enhancing feed intake and improving FCR (Table 2). These results are support by the research of Salari *et al*. (2006), Van biljon (2005) and Galobart and Moran (2005). Blobasy which showed that the form of the diet hadn't significant effect on weight gain, DMI and FCR.

Effects of feed particle size on feed intake: According to the average of daily feed intake (Table 2), we can understand that the daily feed intake in birds that used pellet was higher than other diets. Wahlstrom *et al*. (1999) reported that crumble diets as compared with mashed diets had most effects on feed intakes of hybrid layers. Increasing feed intake in pelleted diets is due to increased of digestibility, gelatinization of diet elements and increased palatability. On the basis of these results the effect of processing on improving performance of broiler is clear making it important growers pay attention to the particle size of chicken food stocks because of its influence on FCR and weight gain.

Effects of feed particle size on FCR: As shown in Table 2 in the whole period, FCR were low for pellet diet. These results are supported by Salari *et al*. (2006) and Galobart and Moran (2005). Van biljon (2005) showed that the feed particle size did not significantly effect on feed efficiency however caused to improve the FCR.

Effects of feed particle size on carcass characteristics: As show in Table 3, the shape of the diet has a significant effects on abdominal fats ($p>0.05$); however weight of

Table 2: Effects of feed particle size on average daily gain, feed intake and FCR

Items	Whole pellet	Whole crumble	Crumble and pellet mixture
Daily weight gain (g)	60.84±2.31	55.49±2.44	58.78±3.80
Feed intake (g/chicken/day)	106.83±6.43	101.87±7.45	102.78±6.43
FCR	1.73±0.27	1.84±0.18	1.80±0.00

Table 3: Effects of feed particle size on carcass characteristics (g)

Items	Whole pellet	Whole crumble	Crumble and pellet mixture
Carcass	1242.6±22.5	1509.7±30	1612.5±15
Chest	551.24±27.5	486±5	524±40
Femur	459.75±35	468±7	496.7±41
Abdominal fats	50±0^{a}	38.2±4^{b}	32.2±5.5^{b}
Liver	70.75±1	63.1±6.2	72.7±2.15
Gizzard	50.45±0	51.5±2	42.03±5.65

carcass, chest, femur, liver, gizzard and heart did not differ by feed particle size. Salari *et al*. (2006) has shown that pellet diets had significant effect on an increasing abdominal fats and decreasing femur percent of broiler compared to other diets.

CONCLUSION

The results indicate that the physical form of the diet had a significant effect on abdominal fat which was highest in broilers that fed with whole crumble diet.

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