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EFFECT OF FEED PARTICLE SIZE ON PERFORMANCE OF BROILER CHICKEN

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ABSTRACT

An experiment was conducted to study the effects of feed particle size on performance of broiler chicken with one hundred and fifty, day-old commercial broiler chicks (Vencobb-400) allotted to three dietary treatments ground using hammer mill screen openings of 3mm (T_1), 5mm (T_2) and 7mm (T_3) with five replications per treatment and 10 birds per replicate in a completely randomized design. An iso-caloric and iso nitrogenous maize – soya based broiler starter and finisher feed (BIS 2007) ground in hammer mill using 3mm, 5mm and 7mm screens were used for the study. Broiler starter ration was fed from 0 to 3 weeks of age and thereafter broiler finisher ration from 4 to 6 weeks of age. Six samples of each experimental ration after the homogenous mixing were taken for the measurement of particle size distributions using laboratory sieves of 4.76, 2.00, 1.00 and 0.50 mm screens. Screen size significantly affected the particle size distribution, modulus of fineness, electricity consumption, time consumption in grinding and performance of birds. The mean body weight and weight gain (0-6weeks) was significantly ($P< 0.05$) higher for birds belonging to T_1 and T_2 compared to T_3. Birds belonging to T_3 recorded a significantly ($P< 0.05$) higher feed consumption as compared to T_1 and T_2 at six week of age. Feed efficiency improved with decrease in particle size. Birds belonging to T_1 projected a significantly ($P<0.05$) lower cumulative FCR than T_2 and T_3 at six week of age. Overall mean livability per cent was same in all treatments. The cost benefit analysis revealed that the net profit / Kg live weight (Rs) at six week of age was highest in T_1 (Rs. 28.01) followed by T_2 (Rs. 25.40) and lowest being in the group T_3 (Rs. 26.39).

INTRODUCTION

Greater emphasis has been given during the past two decades to identify the new feedstuffs to widen the feed resource base and to use growth promoters in feed so as to improve the efficiency and economic viability of broiler production. In such situation improving the nutritive value of availabe feed ingredients is of great importance. Optimization of feed particle size is one important strategy for improving nutritive value of feed. A smaller particle size is associated with a larger surface area of the grain, possibly resulting in higher digestibility in poultry due to a greater interaction with digestive enzymes in the gastrointestinal tract (Goodband *et al.,* 2002 and Jurgens 1993). But feed particle size reduction is the second largest energy cost after that of pelleting in the manufacture of broiler feeds (Reece *et al.,* 1985). Because decreasing feed particles to a finer size requires greater energy use, any reduction in energy consumption used for grinding will significantly lower the cost of feed manufacture. Reece *et al.,* (1986b) and Lott *et al.*, (1992) reported improved broiler performance when corn particle size decreased from 1,289 to 987 µm and from 1,173 to 710 µm, respectively. So a sound knowledge of particle size in broiler mash ration which would optimize the growth performance and economic viability is of great significance especially in the context of soaring feed ingredient prices. Hence the present study will evaluate the effect of feed particle size on the growth performance, digestive tract development and profitability of broiler chicken.

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MATERIALS AND METHODS

One hundred and fifty, day-old commercial broiler chicks (Vencobb-400) were used for the study. All the chicks were wing banded and weighed individually before housing. Chicks were allotted to three dietary treatments T_1, T_2 and T_3 with five replications per treatment and 10 birds per replicate in a completely randomized design. The three treatments were as follows:

Broiler ration ground using hammer mill with 3 mm screen openings
Broiler ration ground using hammer mill with 5 mm screen openings
Broiler ration ground using hammer mill with 7 mm screen openings

The broiler chicks were reared under deep litter system of management. Standard manage mental practices were followed during the entire period of experiment. The chicks were brooded using incandescent bulb till they attained 3 weeks of age. Thereafter, light was provided only during night hours. The birds were provided with feed and clean drinking water *ad libitum* throughout the experimental period. Chicks were immunized against Ranikhet and Infectious Bursal disease. The performance of birds was recorded for a period of six weeks.

The experimental rations were formulated as per BIS (2007) specifications of nutrients for broiler chicken. All ration were iso-caloric and iso-nitrogenous. Broiler starter ration was fed from 0 to 3 weeks of age and thereafter broiler finisher ration from 4 to 6 weeks of age. The Per cent particle size distributions of broiler experimental rations are given below.

Laboratory Sieve Size (mm)	Broiler Starter Ration			Broiler Finisher Ration		
	(HMSO-3mm)	(HMSO-5mm)	(HMSO-7mm)	(HMSO-3mm)	(HMSO-5mm)	(HMSO-7mm)
>4.75	0.00	0.28	2.94	0.00	2.33	5.11
2.00 - 4.75	11.51	13.65	23.10	13.33	20.56	25.22
1.00 - 2.00	42.50	43.51	41.60	46.67	45.56	41.22
0.50 - 1.00	32.17	28.02	22.37	32.78	25.67	23.22
<0.50	13.82	14.54	9.99	6.44	5.89	5.22

RESULTS AND DISCUSSION

Results of the experiment are depicted in Table 1.

The particle size influenced 21-day body eight with 3mm HMSO had significantly (P< 0.05) higher body weight than 5mm and 7mm . This could be due to better digestibility as higher surface area to volume ratio of finer particles facilitates better enzyme action. The result was in agreement with findings of Lott *et al*. (1992) who concluded that corn ground through a hammer mill screen opening of 3.18 mm significantly increased 21-day body weight compared with corn ground through screen opening of 9.59 mm. The particle size also influenced 42 day body weight with 5mm HMSO having higher body weight but no significant (P< 0.05) difference was observed between birds of 3mm and 7mm. Increase in body weight of birds towards the sixth week of age in 7mm HMSO could be due to compensatory growth and increased feed intake resulted due to larger particle size of feed. Cumulative weight gain up to three weeks and six weeks of age were significantly different (P< 0.05) among particle size. This result was in agreement with the findings of Santos *et al*. (2008) who reported that feeding finely ground corn-soya diets resulted in greater body weight gain than feeding

Table 1. The mean performance parameters of broiler chicken at 42 days of age as influenced by feed particle size

Parameter	HMSO-3mm	HMSO-5mm	HMSO-7mm
Body weight (g)			
0-3 weeks	974.43 ^{a} ±11.43	926.05 ^{b} ±13.25	925.08 ^{b} ±11.34
0-6 weeks	2612.92 ^{a} ±45.43	2441.46 ^{b} ±24.38	2595.08 ^{a} ± 60.11
Body weight gain (g)			
0-3 weeks	926.39 ^{a} ±11.27	878.41 ^{b} ±13.55	876.23 ^{b} ±10.73
0-6 weeks	2564.88 ^{a} ±45.67	2393.82 ^{b} ±24.77	2546.23 ^{a} ±59.97
Feed intake (g)			
0-3 weeks	1234.35±10.31	1249.86±13.19	1256.69±13.25
0-6 weeks	4168.50^{ab} ±31.32	4071.85 ^{b} ±34.29	4294.97 ^{a} ±64.80
Feed conversion ratio			
0-3 weeks	1.33 ^{b} ±0.02	1.42 ^{a} ±0.01	1.43 ^{a} ±0.02
0-6 weeks	1.63 ^{b} ±0.02	1.70 ^{a} ±0.00	1.69 ^{a} ±0.02
Livability (0-6 weeks)	96.00	96.00	96.00
Net profit/kg body weight, ₹	28.01	25.40	26.39

Note: Mean values bearing different subscript (a,b) within the row differ significantly (P<0.05)
HMSO- Hammer Mill Screening Opening

The particle size reduction of experimental ration was achieved by using a hammer mill (Precision Products, Ahmadabad, Gujarat, India) with screens of 3mm, 5mm and 7mm openings. Six samples of each experimental ration after the homogenous mixing were taken for the measurement of particle size distributions. The particle size were determined by passing 100 g of each sample through a series of laboratory sieves (4.76, 2.00, 1.00 and 0.50 mm screens) and quantifying the amount of samples collected on each screen and a pan under the 0.5 mm screen. Data collected on various parameters were analyzed statistically as per methods described by Snedecor and Cochran (1994) and significant differences were spotted by applying Duncan's Multiple Range Test (Duncan, 1955). All the tests of difference between means were conducted at five percent probability level.

coarsely ground diets. The higher body weight gain in 3mm HMSO could be due to enhanced consumption of smaller diets by chicks and better digestibility as higher surface area to volume ratio of finer particles facilitates better enzyme action. Whereas increase in body weight gain towards later stage in 7mm HMSO could be due to compensatory growth and increased feed intake helped by larger particle size of feed. Feed particle size influenced feed consumption with birds consuming more of larger particles towards sixth week of age. The result was in agreement with the findings of Parsons *et al*. (2006) who reported that the feed intake increased as dietary corn particle size increased for a period from 22 to 42 days in broilers when fed corn ground using hammer mill screens of 3.18, 4.76, 6.35 and 7.94 mm. However, Bendetti *et al*. (2011) and Zang *et al*. (2009) also reported no significant difference

in feed consumption with increase in particle size feeding corn ased diets obtained by using hammer mill with sieves of 3 to 10mm in broiler chicken for a period of 42 days. Feed particle size also influenced FCR of broiler chicken with HMSO-3mm grinding significantly improving the cumulative FCR compared to HMSO-5mm and HMSO-7mm ground diets. This could be due to better digestibility as higher surface area to volume ratio of finer particles which facilitated better enzyme action. On the other hand, a higher FCR in T_2 and T_3 could be due to greater requirement for gizzard action to decrease size of feed and poor digestibility or could be due to imbalance in energy and protein intake by birds due to difficulty in consuming larger corn particle especially during first few weeks of age. The result was in close agreement with the findings of Parsons *et al*. (2006) who reported a feed efficiency (gain/feed) decreased as dietary corn particle size increased in broiler chicken from 22 to 42 days of age when fed with corn ground using hammer mill screens of 3.18, 4.76, 6.35 and 7.94 mm. However, Hamilton and Proud foot (1995), Santos *et al*. (2008), Zang *et al*. (2009), Jacobs *et al*. (2010) and Bendetti *et al*. (2011) concluded that corn-based diets ground through hammer mill screen openings of 1.59mm to 9.52 mm had no significant influence on feed conversion ratio in broiler chicken from 0 to 42 days of age.

Feed particle size have influence on cost of production of broiler chicken and it is more economical to feed broilers on diets ground in HMSO-3mm as feed cost to produce a kg body weight is lower compared to HMSO-5mm and 7mm. This was in agreement with Oppong –sekyere *et al.* (2005) who concluded that it is more economical to feed broilers on finer diets as cost of feed to produce a kg body weight was higher for birds fed on diets with larger grain particle sizes. Based on the results obtained in the present study, it could be concluded that HMSO-3mm resulted in higher body weight gain, feed efficiency and net return than HMSO-5mm and 7mm. So a hammer mill screen size of 3mm can be recommended for grinding feed for broiler chicken production up to 42 days of age.

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