

Behaviour of the Broiler Chicken as Affected by the Form of Diet

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Abstract

Poultry feeds are produced mainly in three physical forms; mash, crumbles and pellets. Even though the merits and demerits of these physical forms in relation to poultry production, processing cost and environment are well documented, form of the diet on the behaviour of broilers is less studied. Behaviour is an important aspect in animal welfare and, both directly and indirectly affects the production parameters. A completely randomized experiment was conducted to investigate the effect of two forms of the diet (mash or crumble) on the behavior of broiler chicken reared on deep litter. Observers were assigned to monitor the behavior of birds for a total of 6 hours on two consecutive days. Time spent on 5 major activities (feeding, drinking, walking, standing and lying) and four combined activities (feather brushing, inter-bird interaction, wing flapping and litter eating) were recorded. The total time spent on combined activities was around 14 % of the total time (6 hrs). Birds fed on crumble diets spent significantly ($P < 0.05$) more time on litter eating than those fed on mash form diet ($7.96 \% \pm 0.94$ Vs $6.45 \% \pm 2.10$). Since litter is an important source of vitamin B, significance of increased litter eating behavior needs to be further studied. Major activities consumed almost 84 % of the time. The time spent on feeding and drinking were significantly ($P < 0.05$) higher for mash form diet fed birds ($11.21\% \pm 2.94$ and $5.04 \% \pm 0.57$, respectively) compared to crumble diets fed birds ($5.97\% \pm 0.94$ and $4.51 \% \pm 1.50$, respectively). The time spent on walking and standing was also numerically higher when mash form diets were fed. Birds fed on crumble diets spent significantly longer time on lying than when mash form diets were fed. Irrespective of the form of diet, lying was the most prominent behavioral activity taking 62% and 70 % of the total time for mash and crumble diets, respectively. Increased time on activities such as feeding, drinking, walking and standing in mash-form-diet fed birds may reduce the net energy available to the birds and increase the heat stress. Therefore the behavior of birds fed on crumble diets seems to have some indirect benefits on the energy value of the diet. Reduced heat production may be beneficial, particularly in hot climates. However, restriction of the activities due to crumble diet needs to be studied in relation to poultry welfare.

Key words: Feed form, Broiler behavior

Introduction

The last century experienced the greatest ever productivity boom of the livestock industry, including poultry. However, Rollin (1995) argues that the actual productivity of the livestock industry could have been substantially low had the environmental and welfare costs of the industry are also considered in the estimations of productivity. Under present management conditions, broilers are forced to adapt to housing and feeding management systems, which are quite different to what their ancestors used to live with. Due to intense public pressure, now poultry industry has been required to consider animal welfare seriously. Since behaviour is an indicator of welfare, any management system must take poultry behaviour into serious consideration. Poultry feeds are produced mainly in three physical forms; mash, crumbles and pellets. Merits and demerits of these physical forms in relation to poultry production, processing cost and environment are well documented. It can be assumed that the form of diets may effect the behavior as well. Apart from the direct effects of such behavioral differences on animal welfare, any changes in behavior may have both direct and indirect implications on production parameters. The objective of the study was to investigate the effects of two physical forms (mash and crumble) of the diets on the behaviour of broiler chicken reared on deep litter.

Materials and Methods

150 broiler chickens were reared in 6 pens. Each pen had 25 birds with 1.5 ft² /bird. Birds in three pens were fed on a commercial broiler finisher diet while the birds in other three pens were fed on an on-farm prepared diet from day 22. Commercial diet was in crumble form (diameter 3.5 mm and length 5 mm) and the other diet was in mash form. Bulk density of the commercial and on-farm prepared diets was 0.569 g/ cm³ and 0.379 g/ cm³ , respectively. The on-farm prepared diet was based on maize, soybean meal and rice bran. The actual ingredient composition of the crumbled diet was not known. The nutrient composition of the diets were similar for major classes of nutrients (Table 1)

Table 1. Nutrient composition of crumble form and on-farm prepared mash form diets

Nutrient	Crumble diet1	On-farm prepared diet2
Protein (%)	20.0	20.0
Metabolizable energy	3050 kcal/kg	3100 kcal/kg
Calcium (%)	0.9	0.9
Available Phosphorus (%)	0.4	0.35
Bulk density	0.569g/cm ³	0.379g/ cm ³
Length and diameter	3.5mm and 5 mm	Not applicable

1. As given by the feed manufacturer
2. Calculated nutrient composition

On day 28 three birds per pen were randomly selected and painted yellow, green and red on the top of the head. Therefore a total of 9 birds in 3 cages were studied per treatment and thus the experiment was considered as completely randomized design with 9 replicates pre treatment. Three days were allowed for the painted birds to settle and their pen-mates to familiarize with painted birds On the day of the observation (32nd day) three observers were assigned to each pen. Each of the observers was instructed to study the behavior of a particular bird. Nine activities were observed. They were; (1) feeding (2) drinking (3) standing (4) walking (5) lying (6) wing flapping (7) inter-bird interaction (8) feather brushing and (9) litter eating. Since the last four activities (wing flapping, inter-bird interaction, feather brushing and litter eating) were often associated with the activities such as standing, walking and lying the latter set of activities were termed as combined activities. A feeder and drinker were provided for each pen and the birds were fed adlib. At a given starting point, observers were asked to monitor the behavior of birds assigned to him/her. The observers were asked to note down the activities the bird engaged with; starting time of a particular activity and the time of the end of that activity. No observer was used more than one-hour duration. Whenever a new observer started the observations, the data of the first 15 minutes of his/her observation were omitted from the analysis so the he or she can familiarize with the birds behaviour. Birds were observed for 6 hours on two consecutive days (13.30 to 16.30 hrs in the first day and 13.30 to 15.30 hrs in the second day. The mean temperature of the study period was 30.5 oC. 9 birds within a treatment were considered as replicates and the times engaged in each activity in seconds were subjected to analysis of variance using the GLM procedure on software SAS (1986).

Results and Discussion

Table 2 shows the time spent on each main and combined activity (as a percentage of the total time; 6 hours) as affected by the form of the diet. Out of the total 6 hour period, the total time spent on combined activity was around 14 %. Though not significant, birds fed on crumbled form of diet was more active with combined activities than the birds fed on mash form of diet (14.21% vs 14.99 %). Litter eating behavior was the most obvious activity among the combined activities. Interestingly, birds fed on crumbled diets spent significantly more time ($P<0.05$) on litter eating. As discussed later, birds on crumble form of diet spent significantly less time on feeding and drinking and, numerically lower time on standing and walking. Therefore birds on crumbled diets had much time for other activities such as litter eating. Poultry litter has been found to be rich in vitamin B and thus it is a source of vitamin B for birds reared on deep litter. Therefore significantly increased time spent on litter eating when crumbled form of diet was given, may be beneficial for the birds vitamin nutrition.

Table 2. Time budget (as a percentage of the total time; 6 hours) of the broilers as affected by the form of feed.

Major activities	Mash form Feed	Crumble form Feed	Probability Level
Feeding	11.21% ± 2.94	5.97% ± 0.94	0.0001
Drinking	5.04 % ± 0.57	4.51 % ± 1.50	0.0001
Standing	11.91 % ± 0.29	10.88 % ± 1.84	0.4324
Walking	8.85 % ± 1.53	7.22 % ± 3.64	0.9396
Lying	62.22 % ± 4.50	70.16 % ± 4.85	0.0001
<i>Combined activities</i>			
Wing flapping	1.55 % ± 0.54	1.50 % ± 0.46	0.4163
Inter-bird interactions	0.0051 % ± 0.48	0.0092 % ± 0.72	0.9647
Feather brushing	6.21 % ± 2.10	5.53 % ± 1.74	0.6243
Litter eating	6.45 % ± 2.10	7.96 % ± 0.94	0.0001

Time spent on inter-birds interaction was the least prominent combined activity and was not significantly affected by the treatments. The division of behavior into main and combined activities was an arbitrary one. Times spent on combined activities such as feather brushing and litter eating were higher than the time spent on drinking which was defined as a main activity of the six activities defined as main activities, lying on the litter was the most prominent one. Siegal *et al.* (1997) and Boa

et al. (1991) also found that fast growing broilers spent more time on lying and less time on other activities. Our findings suggest that under local conditions broilers reared on deep litter spent less time on activities such as feeding, drinking and standing and utilized the spare time for lying when diets were in crumble form. Though lying brings about some benefits as discussed later, longer lying time may increase the inhalation of NH₃ and risk of developing breast blisters. The production of heat is low when birds are lying than when they are walking and standing since the latter kind of activities necessitate energy production within the body. Interestingly birds spent significantly less time ($P < 0.05$) on feeding and drinking when they were fed on crumbled diets than when fed on mash form diets. Intake of feed was not determined for the selected birds, but the intakes of the groups of the birds including the intake of selected birds were determined. The feed intakes of the birds given mash and crumble form of diets on day 28 were 117g/bird and 110 g/day, respectively and were not statistically different ($p = 0.60$). The nutrient composition of the two diets were similar for major classes of nutrients; energy, protein, Ca and P. (Table 1).

Feed intake regulatory nerve endings of the birds have been found to be located in the crop (Forbes, 1983). The weight of the digesta in the crop rather than the volume seems to be the satiety signal in birds. We suggest that the ingestion of feed is ceased through a negative feedback mechanism when the weight of the contents in the crop reach a threshold weight. The bulk density of the crumble and mash form diets was 0.569g/cm³ and 0.370g/cm³, respectively. When a diet is in crumble form, birds may require fewer bouts to meet the threshold weight of the digesta in the crop than when it is in mash form. Therefore birds need to spend more time to ingest the same weight of feed when it is in mash form than in crumble form. The time cost of feeding may have some practical applications in broiler management. The net energy amount of a feed is the actual level of energy available to the bird for the production and maintenance. Increased energy cost of feeding and digestion reduce the net energy value of a feed. For example in ruminants the energy cost of eating was estimated to be 3 – 6 % of the metabolizable energy intake (McDonald *et al* 1995). Therefore increased time spent on feeding may negatively affect the net energy value of the mash form feeds in broilers. The time spent on drinking was also reduced when crumbled diets were given. Hill *et al* (1979) found that drinking of water by poultry was followed by meals. Therefore increased feeding time and number of feeding times might be the reason for increased time budget on drinking activity. Behaviors of broiler chicken fed on crumble form of diets were found to be beneficial when production aspects are concerned. Reduced energy cost of feeding, and other activities positively affect the net energy value of the feed. Furthermore, longer lying time and reduced active time may be helpful in hot climate by reducing the heat stress. However, it must be noted that behaviors of the ancestors of modern broiler were quite complex and varied. Therefore the restriction of behavior by altering the feed form may have animal welfare and ethical complication.

Conclusion

The form of the diets affected the behaviour of the broiler. Behaviour of the broilers fed on crumble form of diet seems to increase the net energy value of the feeds while producing less heat. However, these behavioural changes may adversely affect the welfare of the birds.

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