

Inclusion of dust bathing materials in housing systems for layers can affect performance and functionality

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Abstract

Effect of access to wood shavings and processed paper in the litter bath of modified cages on performance, gizzard activity and plumage condition was studied for hens fed a wheat-based diet. Egg production was similar for all treatments, but birds with access to paper showed higher ($P<0.05$) feed consumption than the control birds and birds with access to wood shavings. This resulted in a corresponding difference ($P<0.05$) in feed utilisation. A weak tendency for better ($P=0.15$) plumage condition was observed for birds with access to wood shavings at the last part of the laying period. Weights of empty gizzard and gizzard contents were considerably higher ($P<0.05$) for birds with access to wood shavings. The amount of large particles in duodenum decreased ($P<0.05$) with access to wood shavings. In contrast, birds with access to paper showed a higher portion of large particles in the duodenum.

Introduction

Advances in genetics, nutrition and husbandry management during the past half century have resulted in a phenomenal improvement in productivity. Today's diet consists of highly concentrated feedstuffs providing the flow of nutrients for efficient digestion and utilisation. However, cereals and legumes, the bulk of modern commercial poultry diets, contain a significant amount of fibre. In addition to the fibre from the feed, poultry housed in floor systems are able to ingest litter materials from the floor. Similarly, layers in modified cages will be able to pick up fibrous materials from the litter bath. Their effects on digestibility, gut functions and bird behaviour are largely unknown.

Indeed, insoluble fibre itself has shown beneficial effects on nutrient digestion and gizzard activities (Hetland & Svihus; Hetland et al., 2003; Rogel et al., 1987). Recent research has shown that digesta passing through the gizzard has a remarkably consistent particle size distribution with the majority of particles being smaller than 40 μm in size regardless of the original feed structure (Hetland et al., 2002). Thus, the aim of these studies was to investigate the response of birds to coarse wood shavings and processed paper on gizzard functions and plumage condition. Furthermore, we examined the effect of fibre with and without gizzard stimulating properties on the voluntary intake of fibre in birds fed low- and high-fibre diets.

Materials and Methods

The experiment used non-beak-trimmed Lohmann Selected Leghorn (LSL) reared at a commercial pullet farm until 16 weeks of age. At this age, 420 birds were moved to the experimental facility with commercial modified cages (Victorson) with perches and litter bath placed on top of the nest box at the end of each cage unit with 7 birds each. A wheat-based diet composed of 53% wheat, 14% maize and 13% soybean meal was used in the experiment. Other components of the diet included fish meal, limestone, maize gluten meal, fat, amino acids, shell meal, monocalcium phosphate, minerals, vitamins and sodium bicarbonate. Wood shavings and coarsely cutted hard paper (cellulose) were used as litter in the litter bath in one third of the cages each from 25 weeks of age. In the last third of the cages, no litter was included in the litter bath. Litter consumption was measured thrice before 35 weeks of age. At 35 weeks, 28 birds per treatment were selected for scoring of plumage condition, following the procedure of Tauson et al. (1984). Afterwards, the same birds were dissected, and gizzard and gizzard contents were weighed. Duodenal contents were collected for determination of

particle size distribution. From this age the treatment with processed paper was excluded from the experiment. At 62 weeks of age, plumage condition was scored for all birds with or without access to litter in the litter bath. At the same age, all birds in 5 cages per treatment were killed and dissected for weighing of gizzard and gizzard contents. Contents of duodenum were taken out for particle size analysis.

Results and Discussion

Wood shavings and paper in the litter bath did not affect egg production (Table 1). However, birds with access to paper showed higher ($P<0.05$) feed consumption than control birds and those with access to wood shavings. Thus, a corresponding poorer feed utilisation was observed. Appetite for paper was 2-3 times higher than for wood shavings. Birds with access to wood shavings showed approximately 70% higher ($P<0.05$) weight of empty gizzard and almost 3 times higher ($p<0.05$) weight of gizzard contents. It is believed that a functioning gizzard should be large and muscular, and able to retain feed components. This, in turn, results in better regulation of digestive processes, leading to improved digestibility of nutrients. This appears to be confirmed in the current study with wood shavings, but no such effect was found for birds consuming paper, probably due to the soft texture, which do not stimulate gizzard function.

Table 1. Performance, plumage condition and peck damages¹

	Control	Paper	Wood shavings	RSD
Laying percentage	97.1	97.1	97.4	1.27
Egg weight, g	59.2	59.4	59.4	1.73
Egg prod, g/hen/day	57.5	57.7	57.8	1.84
Feed consumption, g/hen/day	108 ^b	110 ^a	107 ^b	3.79
Feed/egg	1.87 ^b	1.92 ^a	1.85 ^b	0.078
Plumage condition, 34 wk of age	3.1	3.1	3.0	0.05
Plumage condition, 62 wk of age	2.2	-	2.4	0.329
Weight of empty gizzard, g/kg lwt, 35 wk of age	6.33 ^c	7.80 ^b	10.80 ^a	0.68
Weight of gizzard contents, g/kg lwt, 35 wk of age	1.75 ^c	3.45 ^b	4.71 ^a	0.79
Weight of empty gizzard, g/kg lwt, 62 wk of age	5.89 ^b	-	9.27 ^a	0.47
Weight of gizzard contents, g/kg lwt, 62 wk of age	2.10 ^b	-	3.92 ^a	0.47
Consumption of litter, g/hen/day, 30 wk of age	-	7.3	4.1	-
Consumption of litter, g/hen/day, 35 wk of age	-	11.0	4.0	-
Consumption of litter, g/hen/day, 62 wk of age	-	-	4.3	-
Weighted mean particle size, μm	111 ^b	237 ^a	68 ^b	75.4
Limit for smallest 10 percentages, μm	5.1	5.5	4.7	0.9
Median particle size, μm	52	134	32	56.2
Limit for largest 10 percentages, μm	316 ^b	640 ^a	192 ^b	186.5

¹Means within row with different letter indicate significant ($P<0.05$) differences. RSD is square root of MSE in the Analysis of Variance.

In layers and broilers, access to wood shavings and oat hulls has resulted in improved starch digestibility (Hetland et al., 2003). Since paper easily breaks down to small particles, it does not stimulate gizzard function. Instead it will pass through the gut undigested, contributing primarily to the indigestible part of the digesta. Because of the birds' relative high appetite for paper, the indigestible part will increase by approximately 25%, which may play a role for the digestive capacity as well as energy expenditure related to moving the bulk digesta through

the gut. In contrast, hard wood shavings need to be ground before leaving the gizzard, serving a function as a gizzard stimulating.

Hetland et al. (2002; 2003) illustrate that broilers have a remarkable ability to grind all feed components in the gizzard down to a relatively narrow range of particle sizes. The particle size distribution data of the current experiment illustrates that the gizzard of layers can grind feed components even more extensively than that of broilers. However, the data also indicate that the grinding capacity or grinding functionality may be dependant on litter source. Hard fibre structures such as wood shavings need to be ground before entering the small intestine, and the gizzard activity, as indicated by the gizzard size, is strongly stimulated by such components in the feed or environment. In contrast, the measurement of gizzard size suggests that paper does not stimulate gizzard activity, even though the consumption of paper was twice the amount of wood shavings.

Another area of interest in relation to the effect of structural components of feed on chickens is the ability of hard, insoluble fibre sources to alleviate welfare problems such as feather pecking, vent pecking and cannibalism (Aerni et al., 2000; El-Lethey et al., 2000; Hartini et al., 2002). The current study seems to lend support to this as we have shown numerical improvement in plumage conditions in birds with access to wood shavings in the litter bath.

In conclusion, the data from the current study illustrate that consumption of wood shavings from the litter bath do not reduce performance. Wood shavings consumed at appetite increase gizzard size by 70%. This causes a remarkable reduction in the amount of large particles passing through the gizzard. An improved plumage condition can be expected with access to wood shavings in the litter bath.

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