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Full Length Research Paper

Effects of alum treatment of two litter materials on growth performance of broiler chicken

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The objective of this study was to evaluate the effects of aluminum sulfate (alum) amendment to 2 litter materials on broiler growth performances. 645 newly born broiler chicks were randomly allocated into 4 litter groups (control straw, control sawdust, alum treated straw and alum treated sawdust). Feed and water were provided ad libitum throughout the 42 day **experimental period. Chicks were placed in floor pens at a final stocking density of 12 bird/m^2. At the end of the experiment, live weights of control straw, control sawdust, alum treated straw and alum treated sawdust groups in females were 2173.46, 2183.43, 2365.74, 2383.27 g respectively and in males were 2566.69, 2503.43, 2578.68, 2675.46 g respectively. Alum provided benefits broiler weight gain when compared to the untreated control. FCR of control straw, control sawdust, alum treated straw and alum treated sawdust groups were 1.76, 1.72, 1.86 and 1.77 respectively. Livability of control straw, control sawdust, alum treated straw and alum treated sawdust groups in females were 88.59, 90.55, 83.97 and 88.13% respectively and in males 91.73, 96.51, 90.64 and 90.79% respectively. Livability (%) was not different (P > 0.05) among treatments. The weight of breast (g), neck (g), gizzard (g), heart (g), back (g) and fat (g) did not differ among groups. There were significantly different in live weight and weight of carcass (g) among groups. Thigh (g), wing (g), liver (g) were significantly different among groups and sexes (P < 0.05).**

Key words: Litter, aluminum sulfate, broiler, performances.

INTRODUCTION

Litter quality significantly influences broiler performances (Ritz et al., 2005). Poultry litter is composed of a mixture of litter material, manure, spilled food and feathers. An ideal bedding material must be absorbent, lightweight, cheap and free of toxic. Furthermore, spent litters could be used to as a fertiliser or as a livestock feed. Sawdust are currently the most popular bedding materials. Regionally, straw can be favoured by poultry producers for litter when sawdust and pine shavings are becoming shortage and expensive.

One of the major problems currently facing the poultry production, which was appeared in order to reduced ventilation during winter, is ammonia gas (NH_3) volatilization in poultry houses. Ammonia levels increase as high as 40 - 70 PPM in the atmosphere of poultry houses because of the deficient ventilation (Valentine, 1964; Xin et al., 1995). Ammonia levels reaching as high as 100 ppm in commercial poultry houses have also been reported (Anderson et al., 1964). The production of high concentrations of ammonia in poultry house adversely affects farm workers (Donham, 2000). High concentrations of ammonia in poultry house reduce bird body weights (Quarles and Kling, 1974; Reece et al., 1979; Kleven and Glisson, 1997; Moore et al., 1999). Gain to feed ratio depress at high NH3 ammonia volatilization in poultry house (Caveny and Quarles, 1978; Caveny et al., 1981; Beker et al., 2004). Deaton et al. (1984) demonstrated that egg production decrease in high levels of NH3. Many studies have demonstrated that high levels of NH3 on farms damage the respiratory tract (Anderson et al., 1964; Brugh, 1987) and increase mortality (Kristensen and Wathes, 2000; Elliot and Collins, 1982). Carlile (1984) suggested that atmospheric NH3 should not exceed 25 ppm in poultry houses. Chemical amendments such as aluminum, calcium and iron have been shown to greatly reduce NH_3

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Table 1. Protein and energy components of diets.

Component	Starter diet	Grower 1 diet	Grower 2 diet	Finisher diet
%CP	23	22.25	21.20	21
Energy (Kcal/Kg)	3023	3200	3325	3375

Table 2. Effect of alum amendment in the litter on broiler performance.

Parameters	Sex	Straw $\bar{x} \pm S\bar{x}$	Sawdust $\bar{x} \pm S\bar{x}$	Alum-straw $\bar{x} \pm S\bar{x}$	Alum-sawdust $\bar{x} \pm S\bar{x}$
Body weight (g)	Female	2173.46 ± 40.45^{b}	2183.43 ± 31.96^{b}	2365.74 ± 28.56^{a}	2383.27± 35.40^{a}
	Male	2566.69 ± 36.03^{b}	2503.43 ± 36.68^{b}	2578.68 ± 40.14^{b}	2675.46 ± 52.11^{a}
Live ability (%)	Female	88.59 ± 1.42	90.55 ± 0.76	83.97 ± 1.22	88.13 ± 3.76
	Male	91.73 ± 3.50	96.51± 3.49	90.64 ± 6.92	90.79 ± 6.18
Feed conversion ratio	Female + male	1.76 ± 0.01^{xy}	1.72 ± 0.01^{y}	1.86 ± 0.02 ^{x}	1.77 ± 0.03 ^{xy}

^{a,b,c} : Means followed by the same letter within a row are not significantly different (P < 0.01)
^{x,y,} : Means followed by the same letter within a row are not significantly different (P < 0.05).

volatilization from poultry litter (Moore and Miller, 1994: Moore et al., 1995, 2000; Shreve et al., 1995; Burgess et al., 1998).

The purpose of this study was to evaluate the effects of amending different litters (Straw and sawdust) with alum ($Al_2(SO_4)_3$ 14 H_2O) on broiler performance and carcass parameters.

MATERIALS AND METHODS

The study was carried out at the poultry research unit, department of animal science, Yuzuncu Yil University, Turkey. The poultry house was divided into 2 parts as control and treatment groups. Each part was separated by floor to ceiling partitions and had separate air exhaust/heating systems. 645 1-d-old broiler chicks (Ross 308) obtained from a commercial hatchery were allotted to 4 treatments (straw, sawdust, alum treated straw, alum treated sawdust. Each litter type had 8 replicate pens. All chicks were wing-banded for individual identification (sex, weight gain, ect.). The height of the litter was 8 - 10 cm. Alum was added to the straw and sawdust litter at 0.091 kg/bird (Miles et al., 2003).

The birds were exposed to a 24 h photo-period and feed and water were provided ad libitum. The experiment occurred during December and January. The birds were fed starter diet 0 - 11 days, grower 1 diet 12 - 20 days, grower 2 diet 21 - 35 days and finisher diet 36 - 42 days. Diet components are given in Table 1.

Broilers in each pens were weighed weekly as a group. Mortality was recorded daily and feed conversion was adjusted accordingly.

On day 42, 5 male and 5 female were randomly selected from each groups, individually weighed at the rearing facility and transported in coops to the processing plant. Feed was withdrawn 11 h prior to processing of the birds. The birds were slaughtered and hand-eviscerated on a small, partially automated poultry processing line. The processed carcasses were chilled by immersion in crushed ice and water for 2 h and weighed. From the refrigerated carcasses, breast, thigh, neck, wings, edible viscera (heart, liver, gizzard) and fat (perivisceral, perineal and abdominal) were removed Descriptive statistics were expressed as mean ± standard error. 3-ways repeated ANOVA (3 factors experiment with repeated measurements on 1 factor levels) and 2-ways factorial ANOVA were used to compare means of sex and group. And then Turkey multiple comparison test was used for determination of different group. 1 and 5% were considered as statistical significant level. All of statistical analyses were executed by using SPPS (ver: 13) statistical packet programs.

RESULTS AND DISCUSSION

Comparisons of broiler body weight (g), liveability (%) and feed conversion ratio are given in Table 2 for litter treatments.

Performance (average weight) was significantly improved for female birds raised on alum treated litters relative to the control groups. Although male birds raised over the alum straw were not significantly affected, male birds raise over the alum sawdust sigificantly improved relative to the control. Male birds raised over the alum straw was slightly higher than the straw in our study. The results of our study are consistent with those reported in the past investigations (McWard and Taylor, 2000; Moore ve et al., 1997, 1999). The authors determined that weight gain for broilers raised over the alum were significantly better than the control group. In our study there were no statistical differences between the bedding materials (straw and sawdust) in live weight. Our findings were in agreement with the findings of Brake ve et al., (1992).

No statistical effects of the alum and bedding materials on feed conversion efficiency or chicken liveability were detected. These results are somewhat consistent with those of Tasistro et al., (2007), who indicated that there were no statistical differences in feed conversion efficiency and mortality between the sawdust litter and wood shavings litter. However, McWard and Taylor (2000) showed that aluminum sulfate applications to poultry litter

Table 3. Effect of alum amendment in the litter on slaughter characteristics of broiler.

Parameters	Sex	Straw $\bar{x} \pm S\bar{x}$	Sawdust $\bar{x} \pm S\bar{x}$	Alum-straw $\bar{x} \pm S\bar{x}$	Alum-sawdust $\bar{x} \pm S\bar{x}$
Live weight (g)	Female	2322.27± 57.03 [ab]	2237.00 ± 60.22 [b]	2386.67 ± 64.39 [ab]	2515.00 ± 60.35 [a]
	Male	2554.44 ± 103.12 [b]	2723.50 ± 57.16 [ab]	2788.64 ± 110.62 [a]	2805.00 ± 77.69 a
Carcass weight (g)	Female	1747.27 ±44.62 [ab]	1671.50 ± 48.37 [b]	1833.78 ± 50.02 [ab]	1888.45 ± 44.64 a
	Male	1961.56± 56.84 [b]	1959.80 ± 66.15 [b]	2062.45 ±90.19 [ab]	2165.00 ± 51.19 [a]
Thigh (g)	Female	450.73± 5.93 [b]	454.30 ± 17.20 [b]	487.67 ± 17.98 [ab]	514.36 ± 12.60 [a]
	Male	553.78 ± 9.36 [a]	561.00 ± 15.46 [a]	563.09 ± 28.28 [a]	600.00 ± 13.59 [a]
Wings (g)	Female	194.09 ± 4.37 [b]	179.90 ± 3.37 [b]	203.89 ± 6.73 [ab]	239.18 ± 30.15 [a]
	Male	216.89 ± 6.53 [a]	216.90 ± 7.84 [a]	216.91± 12.55 [a]	226.56 ± 5.27 [a]
Breast (g)	Female	597.45 ±23.67 [a]	569.30 ± 21.43 [a]	615.11± 18.76 [a]	623.00 ± 18.02 [a]
	Male	643.89 ± 20.97 [a]	674.90 ± 16.50 [a]	711.27 ± 36.26 [a]	723.78 ± 24.45 [a]
Back (g)	Female	341.91 ± 14.99 [a]	343.00 ± 13.77 [a]	379.56 ± 15.83 [a]	385.45 ± 10.40 [a]
	Male	404.78 ± 17.15 [a]	425.60 ± 18.82 [a]	428.55 ± 23.15 [a]	444.22 ± 14.52 [a]
Neck (g)	Female	117.27 ± 5.81 [a]	112.70 ± 5.81 [a]	111.44 ± 6.76 [a]	126.91± 7.12 [a]
	Male	131.33 ± 8.91 [a]	131.00 ± 4.82 [a]	127.82 ± 6.10 [a]	148.11 ± 8.84 [a]
Heart (g)	Female	14.09 ± 0.68 [a]	13.80 ± 0.80 [a]	14.56 ± 0.56 [a]	15.18 ± 0.92 [a]
	Male	16.78 ± 1.08 [a]	16.30 ± 0.92 [a]	18.91 ± 1.12 [a]	17.22 ± 0.57 [a]
Liver (g)	Female	49.27 ± 1.99 [a]	42.30 ± 2.64 [bc]	52.33 ± 2.40 [c]	54.73 ± 2.72 [a]
	Male	50.44 ± 2.40 [a]	48.30 ± 1.40 [a]	59.00 ± 2.55 [a]	55.89 ± 2.96 [ab]
Gizzard (g)	Female	36.00 ± 1.82 [a]	34.80 ± 1.25 [a]	33.11 ± 1.01 [a]	35.09 ± 1.24 [a]
	Male	37.44 ± 1.37 [a]	39.30 ± 2.92 [a]	36.45 ± 1.86 [a]	36.44 ± 2.05 [a]
Fat (g)	Female	35.18 ± 5.45 [a]	28.20 ± 4.96 [a]	39.33 ± 4.69 [a]	40.64 ± 5.10 [a]
	Male	29.11 ± 3.04 [a]	22.60 ± 3.92 [a]	19.00 ± 2.37 [a]	30.67 ± 4.80 [a]

[a,b,c] : Means followed by the same letter within a row are not significantly different ($P < 0.05$).

resulted in improved feed conversion. Moore et al. (2000) showed that aluminum sulfate applications to poultry litter lowered litter pH, which resulted in less NH3 volatilization and lower atmospheric NH3. Moore et al. (1999) reported higher body weights than controls (1.73 vs 1.66 kg), lower mortality (3.9 vs 4.2%) and better feed conversion (1.98 vs 2.04) for broilers on alum treated litter. Do et al. (2005) reported that alum and aluminum chloride were the effective compounds evaluated on the commercial farms with respect to reducing ammonia contents.

Comparisons of slaughter characteristics are given in Table 3 for litter treatments. Female broilers raised over the alum sawdust showed significantly higher live weight and carcass weight than sawdust litter. Male broilers raised over the alum sawdust showed significantly higher carcass weight than sawdust litter. Female broilers raised over the alum sawdust showed significantly higher thigh and wings than sawdust litter. Female broilers raised over the alum sawdust showed significantly higher liver than sawdust litter. No significant differences were present in thigh, breast, back, neck, heart, gizzard and fat among the litter treatments. Bilgili et al. (1999) found that there were no effects of the bedding materials (sand and pine shavings) on carcass quality.

Conclusıon

In conclusion, alum applications exhibited significantly better weight gain in comparison to birds raised over untreated litter. Ammonia volatilization can be reduced by the application of alum. Due to reducing NH3 levels in winter, requirement for ventilation rates in poultry house increase. So, energy use also increases. But alum applications can decrease energy use. These benefits results in economic returns to both integrators and growers.

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