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RESEARCH PAPER

The Effect of Different Litter Materials and Season on litter pH, Atmospheric Ammonia and Foot Burn

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Abstract

In the poultry sector, the live weight per unit area has increased compared to previous years. Due to this live weight increase, foot problems are also increasing. For this reason, it becomes even more important to make the climatic environment suitable for the litter and poultry house. In unsuitable environmental conditions, animal productivity decreases, feed conversion rates decrease, and disease and death rates increase. The aim of this study was to determine the effects of different litter materials (wood shavings, rice hulls) and season (winter, spring, summer, autumn) on litter pH, atmospheric ammonia and foot burn (%) in broiler houses connected to an integration in Turkey. The research was carried out in 4 broiler house located in Eşme district of Uşak province. Each of the poultry house in the same region and in the east-west direction has a capacity of 10000 units. Their heating and ventilation systems are similar. In summary rice hulls were effective alternatives to wood shavings as bedding material for reducing the atmospheric ammonia and foot burn (%).

Introduction

Achieving the expected performance of broilers depends on suitable environmental factors, one of which is the type of litter and the management of the litter (Butcher and Miles, 2012). A quality litter material should be absorbent, lightweight, inexpensive, with high moisture absorption and release qualities to minimize litter caking. An ideal badding material should be nontoxic (Ritz *et al*., 2009). Straw, wood shavings and sawdust are commonly used as litter material. In addition, materials such as wheat, barley, rye, oats, sunflower, rice, hazelnut, maize, soy, peanut, cotton, sugarcane are used as purely or mixed as a litters material (Gencoglan and Gencoglan, 2017). Wood shaving are considered the best litter and are widely used (Sekeroğlu *et al.,* 2013). The most common air pollutant in poultry houses is ammonia emission. Many management aspects in the poultry industry can affect odor generation and ammonia emissions. The most common air pollutant in poultry houses is ammonia emission. Many management aspects in the poultry industry can affect odor generation and ammonia emissions. Factors such as litter management, litter depth, type and management of water and feed resources, ventilation and temperature control systems, bird density, animal health and ration quality are at the top (Hayes *et al.,* 2006). Emission rates should be evaluated very well, as the ammonia emission levels vary widely according to the countries, husbandry and seasons. The pH of the litter used in broiler production is between 8 and 10, and the pH is approximately 7 in a dry litter (Lavergne *et al.,* 2006). Most bacteria, including those responsible for ammonia volatilization, are ineffective at low pH (Ritz *et al*., 2009). In animal welfare inspections in Europe, footpad dermatitis, hock and breast burn are often used as an indicator of housing conditions and the general welfare of broilers (Haslam *et al*., 2007). The problem of foot dermatitis is a concern for the broiler industry, both for product safety and animal welfare (Shepherd, 2010). Leg health, foot, ankle and foot burn in broiler chickens is an important indicator of well-being. Foot burn in broiler is usually superficial in nature, but can cause pain and discomfort when deeper. In terms of the etiology of footpad dermatitis in broiler production, the most important characteristics of the litter may be the ability of the litter to absorb moisture and release it rapidly (Bilgili *et al*., 2009). The most important characteristics of poultry house is to regulate the ambient temperature to reduce seasonal effects on animals. The heating and cooling systems maintain approximate constant temperatures within the house; however, climatic factors outside the house may affect house environmental conditions. The moisture and temperature of the litter affected by outdoor conditions (Roberts *et al.*, 2013).

Material and Methods

The research was carried out in 4 broiler house located in Eşme district of Uşak province. Each of the poultry house in the same region and in the east-west direction has a capacity of 10000 units. Wood shavings litter were used in two of these four houses, and rices hulls litter were used in the other two. The research was carried out in 4 seasons (Winter, Spring, Summer, Autumn). The same standard ratios produced by the integrated company were used in all poultry houses for broilers. Feed and water were available ad libitum during the investigation. The stocking density is adjusted to 14-18 broilers per m² at slaughter age. During the experiment, ammonia gas was measured weekly in the 18 broilers per m² at slaughter age. During the experiment, ammonia gas was measured weekly in the house. pH levels were determined in litter. At the end of the experiment, foot burns (%) of the broilers sent to the slaughterhouse were determined. Analysis of variance of obtained data was computed using the general linear model (GLM) using SPSS 20 version package program. Significant differences among means were evaluated using Duncan's multiple range test.

Results and Discussion

The data on average atmospheric ammonia (ppm) are presented in Table 1. There were no treatment effects on atmospheric ammonia (ppm) ($p>0.05$) in the first week. But the overall average atmospheric ammonia (ppm) at weeks 2, 3, 4, 5 and 6 of experiment was significantly ($p<0.05$) higher wood shavings compared to with rice hulls (Table 1). In this study, the summer season had significantly ($p<0.05$) lower atmospheric ammonia (ppm) than all other seasons at weeks 4, 5, and 6. But, the autumn season had significantly lower atmospheric ammonia (ppm) ($p<0.01$) than all other seasons at week 2 and the atmospheric ammonia (ppm) were not differing significantly ($p>0.05$) among the groups at weeks 1 and 3. Exhaust ammonia concentration varied according to the season. This finding is agreement with the results reported by Wheeler *et al*., 2006. There were generally higher values during cold weather periods corresponding to relatively low ventilation rates in their investigation. Mean total NH_3 emissions from wheat straw was 19% higher in litter around waterers than wood shavings (Tasistro *et al*., 2007). There were no interactions between litter type and season (Table 1).

Table 1. The Effect of Different Litter Materials and Season on Atmospheric Ammonia (ppm)

Parameters	1. Week $\bar{x} \pm S\bar{x}$	2. Week $\bar{x} \pm S\bar{x}$	3. Week $\bar{x} \pm S\bar{x}$	4. Week $\bar{x} \pm S\bar{x}$	5. Week $\bar{x} \pm S\bar{x}$	6. Week $\bar{x} \pm S\bar{x}$
Litter						
Rice Hulls	6.6±0.09	12.5±0.20b	28.5±0.36b	35.9±0.29b	45.0±0.61b	54.0±0.56b
Wood Shavings	6.8±0.10	12.9±0.18a	29.8±0.29a	37.2±0.68a	46.8±0.63a	56.3±0.72a
P	0.11	0.04	0.04	0.03	0.01	0.03
Season						
Spring	6.9±0.09	13.0±0.19a	29.5±0.44	36.8±0.42ab	47.9±0.81a	57.2±1.06a
Summer	6.7±0.09	13.3±0.16a	28.5±0.34	34.9±0.43b	44.0±0.71b	53.5±0.85c
Autumn	6.7±0.23	12.1±0.19b	29.3±0.87	37.4±1.02a	45.6±0.80ab	54.1±0.64bc
Winter	6.6±0.14	12.6±0.19ab	29.3±0.51	37.1±0.67ab	46.3±0.57ab	56.0±0.65ab
P	0.49	0.01	0.56	0.03	0.01	0.01
Litter X Season						
Rice Hulls X Spring	6.8±0.14	12.7±0.07	28.9±0.85	36.2±0.57	46.6±0.92	55.6±1.70
Rice Hulls X Summer	6.7±0.28	13.3±0.21	27.9±0.42	35.3±0.57	42.9±0.99	52.5±1.20
Rice Hulls X Autumn	6.4±0.35	12.0±0.50	28.4±1.84	36.1±1.77	44.8±1.91	53.2±0.85
Rice Hulls X Winter	6.6±0.21	12.3±0.14	28.8±1.34	36.0±0.35	46.0±0.21	54.9±0.35
Wood Shavings X Spring	7.0±0.21	13.3±0.14	30.1±0.49	37.5±0.49	49.2±0.14	58.9±0.35
Wood Shavings X Summer	6.8±0.07	13.3±0.49	29.0±0.14	34.5±1.06	45.1±0.42	54.5±1.77
Wood Shavings X Autumn	7.1±0.21	12.3±0.28	30.2±1.63	38.7±1.56	46.5±0.99	55.0±1.06
Wood Shavings X Winter	6.6±0.42	12.9±0.35	29.9±0.35	38.3±0.21	46.6±1.84	57.1±0.35
SEM	0.07	0.14	0.28	0.4	0.48	0.53
P	0.31	0.51	0.96	0.13	0.64	0.78

a, b, c: Means within columns with no common superscript differ significantly ($p<0,05$).

pH levels in groups of litter material and seasons were not statistically different in Table 2. These results are similar to and confirm those of earlier studies (Benabdeljelil and Ayachi, 1996; Meluzzi *et al.,* 2008). The straw litter had higher litter pH than both the shredded paper litter and wood shavings litter in the study by Terčič *et al*. (2015). Litter material and season significantly affected foot burn (%). The condition of foot burn (%) deteriorated as the wood shaving litter and spring season.

The incidence of footpad burn was higher in straw litter compared litter made of wood shaving in the study by Škrbić *et al.* (2015). Like us, Musilová *et a*l (2013) reported that the most severe damage of the feet was found in the spring followed by winter. Meluzzi et al. (2008) reported that in winter the foot pad dermatitis score was higher than in summer. There were no interactions between litter material and season on foot burn (%) (Table 3).

Table 2. The effect of different litter materials and season on litter pH

Parameters	1. Hafta $\bar{x} \pm S\bar{x}$	2. Hafta $\bar{x} \pm S\bar{x}$	3. Hafta $\bar{x} \pm S\bar{x}$	4. Hafta $\bar{x} \pm S\bar{x}$	5. Hafta $\bar{x} \pm S\bar{x}$	6. Hafta $\bar{x} \pm S\bar{x}$
Litter						
Rice Hulls	6.7±0.07	7.2±0.04	8.1±0.05	8.8±0.09	9.5±0.10	10.4±0.07
Wood Shavings	6.8±0.06	7.3±0.04	8.2±0.03	8.8±0.05	9.4±0.07	10.3±0.07
P	0.25	0.06	0.07	0.63	0.38	0.33
Season						
Spring	6.7±0.05	7.2±0.06	8.2±0.06	8.9±0.08	9.6±0.15	10.5±0.13
Summer	6.8±0.15	7.2±0.08	8.2±0.08	8.7±0.07	9.4±0.03	10.4±0.05
Autumn	6.8±0.11	7.3±0.07	8.1±0.09	8.7±0.12	9.3±0.13	10.3±0.14
Winter	6.6±0.05	7.2±0.06	8.2±0.05	8.9±0.05	9.5±0.09	10.4±0.05
P	0.57	0.9	0.94	0.09	0.15	0.63
Litter X Season						
Rice Hulls X Spring	6.8±0.04	7.1±0.04	8.2±0.11	9.1±0.08	9.9±0.08	10.7±0.04
Rice Hulls X Summer	6.6±0.40	7.1±0.13	8.0±0.15	8.6±0.17	9.4±0.06	10.4±0.16
Rice Hulls X Autumn	6.6±0.16	7.2±0.13	8.0±0.16	8.7±0.31	9.3±0.26	10.2±0.11
Rice Hulls X Winter	6.6±0.17	7.3±0.11	8.1±0.13	8.9±0.11	9.5±0.23	10.4±0.11
Wood Shavings X Spring	6.6±0.06	7.3±0.11	8.1±0.13	8.8±0.13	9.4±0.13	10.2±0.06
Wood Shavings X Summer	6.9±0.10	7.3±0.17	8.3±0.08	8.7±0.09	9.5±0.09	10.3±0.05
Wood Shavings X Autumn	6.9±0.08	7.4±0.06	8.3±002	8.9±0.15	9.3±0.38	10.3±0.47
Wood Shavings X Winter	6.6±0.06	7.2±0.14	8.2±0.08	9.0±0.11	9.6±0.23	10.4±0.13
SEM	0.05	0.03	0.03	0.05	0.06	0.05
P	0.19	0.36	0.17	0.29	0.25	0.26

Table 3. The effect of different litter materials and season on foot burn (%)

Parameters	6.Week $\bar{x} \pm S\bar{x}$
Litter	
Rice Hulls	37.9±1.38b
Wood Shavings	43.5±1.74a
P	0.01
Season	
Spring	46.3±2.29a
Summer	37.0±1.29c
Autumn	36.8±1.60c
Winter	42.8±1.65b
P	0.01
Litter X Season	
Rice Hulls X Spring	42.5±2.12
Rice Hulls X Summer	35.0±1.41
Rice Hulls X Autumn	34.0±0
Rice Hulls X Winter	40.0±1.41
Wood Shavings X Spring	50.0±1.41
Wood Shavings X Summer	39.0±1.41
Wood Shavings X Autumn	39.5±0.71
Wood Shavings X Winter	45.5±0.71
SEM	1.3
P	0.36

a, b, c: Means within columns with no common superscript differ significantly (p<0,01).

Conclusion

Spring season and wood shavings were associated with increased atmospheric ammonia. Litter material and seasons had no significant effect ($P > 0.05$) on litter pH levels. The study showed that foot burn (%) is a severe problem by the spring season and wood saving litter. There were no interactions between litter material and season on the parameters discussed in the study.

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