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RESEARCH ARTICLE

Effect of *Yucca schidigera* Spraying in Different Litter Materials on Some Litter Traits and Breast Burn of Broilers at the Fifth Week of Production [1]

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Summary

This study was carried out to determine the effects of different levels of *Yucca schidigera* spraying in different litter materials on some litter traits (moisture, pH, ammonia, total colony count, number of Enterobacteriaceae and number of yeast and mold) and breast burn of broilers at the 5th week of production. A total of four hundred thirty two 1-d-old male broiler chicks (ROSS-308) were used. In this study 12 chicks were put in each pen having 170x94x90 cm (depth x length x height). Half of the litter was wood shavings, the other was rice hull. *Yucca schidigera* extract was pulverized weekly at the level of 0, 4% and 8% to each pen from the second week of the study. Litter materials and *Yucca schidigera* spraying at different level did not affect the examined litter traits and breast burns of broilers (P>0.05) at the 5th week of production.

Keywords: *Broiler, Yucca schidigera, Litter traits, Breast burn*

Farklı Altlık Materyallerine Püskürtülen *Yucca schidigera*'nın Üretimin 5. Haftasında Bazı Altlık Özellikleri ile Etçi Piliçlerin Göğüs Yanıkları Üzerine Etkisi

Özet

Bu çalışma farklı altlık materyallerine değişik dozlarda ilave edilen *Yucca schidigera*'nın üretimin 5. haftasında bazı altlık özellikleri (nem, pH, amonyak, toplam koloni sayısı, Enterobakteri ve maya-küf düzeyleri) ile etçi piliçlerde göğüs yanıkları üzerine etkisini belirlemek amacıyla yapılmıştır. Bu çalışmada toplam 432 adet bir günlük yaşta erkek civciv (ROSS 308) kullanılmıştır. Çalışmada civcivler 170x94x90 cm (genişlik x uzunluk x yükseklik) boyutlarındaki bölmelerin her birinde 12 adet olacak şekilde yerleştirilmiştir. Altlık materyali olarak bölmelerin yarısında talaş diğer yarısında pirinç kavuzu kullanılmıştır. Her altlık grubu denemenin 2. haftasından itibaren her hafta altlığa 0, %4 ve %8 *Yucca schidigera* püskürtülecek şekilde 3 eşit alt gruba ayrılmıştır. Kullanılan altlık malzemelerinin ve altlığa değişik düzeylerde *Yucca schidigera* ilavesinin üretimin 5. haftasında incelenen altlık özellikleri ile etçi piliçlerde göğüs yanıklarını etkilemediği görülmüştür (P>0.05).

Anahtar sözcükler: *Etçi piliç, Yucca schidigera, Altlık özellikleri, Göğüs yanıkları*

INTRODUCTION

Broilers are reared on the litter and they spend most of their lifetime in close contact with this. Therefore litter quality has a major effect on health and performance of broilers [1]. Many products have been used as litter. In many broiler producing areas, availability of new litter is limited by supply and price. Each litter has got advantages and disadvantages from the others. Locally available materials are usually preferred as litter for poultry [2,3]. Wood shavings

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and rice hulls have commonly been used as bedding materials [4]. There are many factors, which must be taken into account for successful litter management. These include the type of litter used, depth of the litter, floor space per bird, feeding and watering devices used, kind of flooring, ventilation system, litter amendments, and the incidence of disease that can affect litter and its fertilizer value [5].

Incorrect litter interfered directly in the appearance of breast lesions and foot-pad dermatitis. These are important sources of economic loss through downgrading and carcass condemnations as well as welfare considerations linked to the potential for associated pain and discomfort [6,7]. Litter amendment improved bird welfare and production due to better litter conditions and microorganism levels in broiler houses. Many litter additives have been used to reduce litter pH, reduce ammonia volatilization [1]. However, before this management practice can be put into widespread usage, questions concerning the environmental impact of different types of chemical amendments and their safety in broilers on commercial farms must be addressed [8]. One of the most known additives for fixing ammonia is derived from the cactus *Yucca schidigera*, and it acts by binding or converting NH_4 [9]. Yucca is currently used as dietary supplement for poultry, primarily for ammonia binding, but also to improve performances safety [10,11]. Therefore the aim of this study was to determine the effects of *Yucca schidigera* spraying in different litter materials on moisture, pH, ammonia, total colony count, number of *Enterobacteriaceae* and number of yeast and mold of litters and breast burn of broilers at the 5th week of production.

MATERIAL and METHODS

This study was approved by Ankara University Animal Care and Use Committee (2010/100/366). A total of 432 1-d-old male broiler chicks (ROSS-308) obtained from a commercial hatchery (Beypiliç, Bolu, Turkey). The trial design with 2 litter and 3 *Yucca schidigera* treatments with 6 replication pens (n=12 chicks). Half of the pens contained the wood shavings (8 kg/pen) and the other half of the pens contained rice hulls (8 kg/pen) as a litter material. Each litter material groups were divided into 3 *Yucca schidigera* groups; control (no treatment of *Yucca schidigera*), 100 ml of 4% *Yucca schidigera* and 100 ml of 8% *Yucca schidigera*. Liquid *Yucca schidigera* extract used in this experiment was DK Sarsaponin liquid (Ekol Gıda, İstanbul, Turkey). DK Sarsaponin liquid is a pure, natural extract of the Mahave Yucca plant. It contains 50% total soluble Yucca and 12% saponins. In this trial 4% (4 ml *Yucca schidigera* with 96 ml water) and 8% (8 ml Yucca schidigera with 92 ml water) solutions were prepared using DK Sarsaponin liquid. 100 mililitres of these prepared solutions were applied by spraying onto the litter surface of each pen (1.6 m^2) litter groups using a small hand pump weekly (once a week) from the second week to the fifth week in *Yucca schidigera* groups. Therefore every week 0.4 and 0.8 g saponin and totally from the second to the fifth week 1.6 g and 3.2 g were added to each pen of 4% and 8% *Yucca schidigera* groups.

During the first week each pen was equipped with one chick drinker and one chick feeder and the other weeks each pen was equipped with two nipples and one hanging suspended feeder. Feed as mash form and water were provided *ad libitum* during the experiment. Birds were fed with a starter diet (222.8 g/kg crude protein and 3136 kcal/kg ME) from 1 to 21 day of age and a grower diet (220.2 g/kg crude protein and 3200 kcal/kg ME) from 22 to 35 d of age.

A litter sample was collected from five sites (4 corner and 1 central samples), then mixed and 100 g sub sample from mixed sample was taken in a plastic bag at 35 day of age from pen to determine the pH, moisture, ammonia and microbiological analyses. To determine litter pH, 20 g of litter sample was mixed with 30 ml of sterile distilled water. Then pH was measured [12] with pH meter (Selecta, pH-2004, Barcelona, Spain). 2 g litter sample of each pen were dried in an oven at 105°C for 8 h to determine moisture content of samples [13]. Litter ammonia-N of each pen was determined using the spectrophotometer [14]. Analyses were made in three parallel. For microbiological analyses, initial suspensions were prepared with 10 g sample and 90 ml Peptone Salt Diluent (Merck, Darmstadt, Germany) using stomacher (Masticator, IUL, Barcelona, Spain). Additional tenfold dilutions were made by Peptone Salt Diluent [15]. 1 ml of initial suspension and dilutions were transferred in two sterile plates and 10 ml melted Plate Count Agar (Merck) was then added per plate. The plates were incubated at 37°C for 48 h. After incubation colonies on plates were counted and total aerobic counts were calculated as cfu/g [16]. 1 ml of initial suspension and dilutions were transferred in two sterile plates and 10 ml melted Violet Red Bile Glucose Agar (Merck) was poured into each plate. After solidification of the mixture additional 15 ml Violet Red Bile Glucose Agar was added per plate to achieve semi-aerobic condition. The plates were incubated at 37°C for 24 h. After incubation, presumptive pink-red colonies were subcultured on Nutrient Agar (Merck) and confirmed by means of tests for fermentation of glucose and presence of oxidase. The numbers of *Enterobacteriaceae* as cfu/g of the samples were calculated from the number of confirmed typical colonies per plate [17]. 0.1 ml of initial suspension and dilutions were surface plated on two Dichloran Rose Bengal Chloramphenicol Agar (Merck) plates. After incubation at 25°C for 5 days colonies on plates were counted and yeast and mould counts were calculated as cfu/g [18].

All broilers of each pen were examined for breast burn at 35 days of age. The breast burn scoring system was a 2-point visual ranking system, where a score of 0 indicated

breast with no lesions present and a score of 1 indicated breast with lesions [19].

Data were tested for distribution normality and homogeneity of variance. Data set showed normality and a two-way ANOVA was used to determine the differences between litter and *Yucca schidigera* groups as well as their interactions with respect to moisture, ammonia, pH, total colony count, number of *Enterobacteriaceae* and number of yeast-mold. Comparisons among means were made by Duncan's multiple range test. Multiple logistic regression analysis was used to explore the effect of litter and *Yucca schidigera* groups in breast burn of broilers. Odds ratios (AOR) and 95% confidence intervals (CI) were estimated. A value of $P<0.05$ was considered statistically significant [20].

RESULTS

In this study moisture content of litter was 32.9% in wood shavings group and 30.9% in rice hull group and ammonia-N content of litter was 5.7 g/kg in wood shavings group and 5.7 g/kg in rice hull group at the 5th week of production ($P>0.05$). Moisture contents of litter were 32.0%, 32.3% and 31.4%, and ammonia-N contents of litter were 6.1 g/kg, 5.7 g/kg and 5.4 g/kg in the groups of 0, 4 and 8% *Yucca schidigera* spraying in litters, respectively and these differences among them were not statistically significant ($P>0.05$).

pH and microorganism levels in groups of *Yucca schidigera* spraying in the different litter materials were not statistically different in *Table 1*. Percentage of breast burn as a 2 point scale was 4.3% and 3.8% of broilers reared on wood shavings and rice hull and they were 3.6, 3.6 and 5.0% of broilers reared on 0, 4 and 8% spraying in litters, respectively *(Table 2)*. There were no statistically significant differences in breast burn of broilers among examined group.

DISCUSSION

In this study wood shavings or rice hull as a litter material had no statistically significant influence on moisture of litter at the 5th week of production. Similarly, Sarıca and Cam [21] reported that wood shavings and rice hull groups gave similar results in terms of litter moisture at the 5th week of production. In their study moisture content of litter was 33.5% in wood shavings group and 36.9% in rice hull group. However, Oğan [22] found moisture level at 42 days of age 28.9% and 39.07% in wood shavings and rice hull groups. Meluzzi et al.[23] reported that litter moisture was changed by season and moisture content of litter as rice hull was found to be 38.7% and 25.3% in winter and summer, respectively. Villagra et al.[4] showed that moisture content of wood shavings was 18% at 35 days of age. The reported moisture contents of same litters vary widely because of attributing to the several factors such as stocking density, feeding and watering devices used, kind of flooring, ventilation system, slaughter age and season [5,23].

Table 1. *Effect of Yucca schidigera (YS) spraying in different litter materials on litter characteristics at the 5th week of production*
Tablo 1. *Farklı altlık materyallerine püskürtülen Yucca schidigera'nın (YS) üretimin 5. haftasında altlık özelliklerine etkisi*

Litter Material	Level of YS	Moisture (%)	Ammonia-N (g/kg)	pH	TCC (log_{10} cfu/g litter)	NE (log_{10} cfu/g litter)	NYM (log_{10} cfu/g litter)
Wood shavings	0	32.7	6.1	7.5	7.3	6.5	6.3
	4	33.2	5.8	7.3	7.2	6.1	5.9
	8	32.8	5.2	7.0	7.4	6.4	6.2
Rice hull	0	31.4	6.0	7.4	7.3	6.4	6.0
	4	31.4	5.5	8.1	7.1	6.6	6.5
	8	29.9	5.7	7.9	7.2	6.5	6.0
Main effect							
Wood shavings		32.9	5.7	7.2	7.3	6.4	6.1
Rice hull		30.9	5.7	7.8	7.2	6.5	6.1
0% spraying of YS		32.0	6.1	7.4	7.3	6.4	6.1
4% spraying of YS		32.3	5.7	7.7	7.2	6.4	6.2
8% spraying of YS		31.4	5.4	7.4	7.3	6.5	6.1
Pool SEM		0.626	0.228	0.157	0.055	0.083	0.078
P							
Litter		NS	NS	NS	NS	NS	NS
Level of YS		NS	NS	NS	NS	NS	NS
Litter X Level of YS		NS	NS	NS	NS	NS	NS

TCC: *Total colony count,* ***NE:*** *Number of Enterobacteriaceae,* ***NYM:*** *Number of yeast and mold,* ***NS:*** *Non significant, n=6*

Table 2. *Effect of Yucca schidigera (YS) spraying in different litter materials on breast burn of broilers at the 5th week of production*

Tablo 2. *Farklı altlık materyallerine püskürtülen Yucca schidigera'nın (YS) üretimin 5. haftasında etçi piliçlerde göğüs yanıklarına etkisi*

Group	Breast Burn (%)	Odds Ratio	95% C.I		P
			Lower	Upper	
Wood shavings	4.3	1			
Rice hull	3.8	0.888	0.336	2.350	NS
0% spraying of YS	3.6	1			
4% spraying of YS	3.6	0.992	0.281	3.507	NS
8% spraying of YS	5.0	1.400	0.433	4.523	NS

NS: *Non significant, n=72*

Ammonia is an abundant pollutant in broiler houses and it may have a great impact on poultry welfare [24]. Ammonia is formed during the decomposition of uric acid and the efficiency of this conversion is directly related to the level of litter moisture [25]. Due to the similar moisture between the litter materials; there were no statistically significant in ammonia-N levels of wood shavings and rice hull at the 5th week of production.

Hence, litter amendments are suggested to improve litter conditions and keep NH_3 levels in check [1]. But it is important that the production cost and their safety for bird health and environment. *Yucca schidigera* contains high levels of saponin steroids that bind the ammonia. Yucca extracts are used as animal feed additives and in crop production safely [10,26]. Therefore, it does not affect negatively on broiler health and environment. We thought that it may be added to the poultry litter to bind the ammonia in litter during the production. However, in this study it is observed that moisture and ammonia levels of litter, in groups of *Yucca schidigera* spraying in litters were not statistically different. *Yucca schidigera* spraying in litters during production in examined dose (4% and 8%) did not change these properties. We did not find any study about Yucca extract spraying in poultry litter. Only, it was added to the swine manure, mariculture and shrimp farming. Panetta et al.[27] added the Yucca extract to the swine manure at 0, 7.4 and 14.9 mg/L to determine the effects of a nitrogen-binding agent on ammonia emission potential. In their study headspace ammonia-N concentration was affected by the different doses of Yucca extract. Santacruz-Reyes and Chien [28] showed that *Yucca schidigera* concentration of 18 mg/L was effective solution for ammonia reduction in seawater and mariculture.

In this study it was showed that pH, total colony count, number of *Enterobacteriaceae* and number of yeast-mold levels in groups of *Yucca schidigera* spraying in the different litters were not statistically different at the 5th week of production. pH levels in examined groups ranged from 7.0 to 8.1 in examined groups at the 5th week. It was found that total colony count, number of *Enterobacteriaceae* and number of yeast-mold ranged from 7.1 to 7.4 $\log_{10}$ cfu/g, 6.1 to 6.6 $\log_{10}$ cfu/g and 5.9 to 6.5 $\log_{10}$ cfu/g, respectively in examined groups at the 5th week. Terzich et al.[29] indicated that total bacteria counts range from a minimum of $1.72x10^7$ cfu/g to a maximum of $8.80 x10^{11}$ cfu/g in poultry litter taken from different examined region. Martin et al.[30] reported the results of total bacteria counts between $1.2x10^3$ cfu/g and $8.4x10^3$ cfu/g.

Choi and Moore [31] reported that some litter amendments resulted in the greatest reduction in NH_3 emissions and the greatest litter nitrogen contents. Choi and Moore [31] also reported that ammonia nitrogen was about 1.3-2.3 g/kg in control litter and was about 1.0-7.1 g/kg in the litters with various amendments. One of the most important factors that can affect ammonia volatilization is litter pH [31]. Reece et al.[32] suggested that very little ammonia was released from litter having pH below 7, whereas more ammonia was rapidly released from litter having pH above 8. Carr et al.[33] also reported that ammonia release from litter increased as litter pH increased. However in this present study moisture levels and pH levels of litters in all groups were less than 32.9% and 8.08, respectively. Because of these reasons in the present study ammonia nitrogen levels and microbial load in litter may not be affected in the present study.

Good litter management is vital to maintain animal welfare including the absence of contact dermatitis. However, this management is related to litter material [34]. Bray and Lynn [35] and Haslam et al.[36] concluded that breast burn is primarily affected by litter type and quality. In this study, multiple logistic regression analysis revealed similar rates of breast burn with wood shavings and rice hull as a litter and different levels of *Yucca schidigera* ("4" vs "0" and "8" vs "0"), because similar results were observed in our study in which moisture and ammonia levels of examined groups. Sarıca and Cam [21] reported that breast blister scores as a 5 point scale of broilers were reared on the wood shavings and rice hull were 1.8 and 1.4, respectively and this was not statistically different. Moisture levels above 35% in litter resulted negative effects on bird health such as pododermatitis [37], folliculitis and necrotic enteritis [38]. However in the present study moisture levels of litters in all groups were less than 32.9%.

As a conclusion, wood shavings and rice hull as a litter material and *Yucca schidigera* spraying in these litters at the level of 4 and 8% from the second week to the fifth week of production did not affect the moisture and ammonia of the litter and breast burn of broilers at the 5th of production. The effect of *Yucca schidigera* could be seen in bad litter conditions depend on stocking density. Further studies will be done in negative poultry housing conditions and also with different applications such as application time, way and dose of *Yucca schidigera* spraying in litters.

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