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Araştırma Makalesi

Applicability of Cotton Gin Waste as Litter Material in Broiler Production¥

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Abstract

This study examined the applicability of gin waste for litter use in broiler production. 630 day-old Ross 308 hybrid birds were used in three treatment groups with three replications kept on commonly used wood shavings (L1), on gin waste (L2) and on a combination of 50% wood shavings and 50% gin waste (L3). During the 42-day experiment, changes in live weight, feed intake, feed conversion rate, vitality, carcass characteristics (weight, yield, gizzard, liver and heart weight), moisture content and enumeration of *Eschericia coli* in the bedding materials were examined. The study revealed that the effect of litter materials was significant on live weight and carcass weight (P<0.05). The best results regarding live weight and carcass weight (2177.93 g and 1643.10 g) were gained in L2, followed by L1 (2173.27 g and 1622.70 g), and L3 (2086.23 g and 1544.70 g). No statistically significant differences were found for liver, heart and gizzard. The differences in feed consumption and feed conversion ratio were statistically not significant. No statistically significant differences were found for vitality. At study end, moisture content was statistically different in L2. In L1 and L3, *E coli* colonization was determined, while it was not observed in L2. As a result, it can be concluded that gin waste is an alternative litter material to be used in broiler breeding.

Key words: Litter material, gin waste, broiler, performance characteristics

Etlik Piliç Üretiminde Altlık Materyali Olarak Pamuk Çırçır Atığının Uygulanabilirliği

Özet

Bu çalışmada, pamuk çırçır atığının etlik piliçlerde altlık materyali olarak uygulanabilirliği araştırılmıştır. Bu çalışmada günlük 630 adet Ross 308 broyler civcivi kullanılmış, %100 talaş (L1), %100 çırçır atığı (L2) ve %50 talaş + %50 çırçır atığı kombinasyonu (L3) olmak üzere toplam üç muamele grubu ve her muamele grubunda 3'er adet tekerrür yer almıştır. Toplam 42 günlük deneme sürecinde broylerlerin canlı ağırlık değişimi, yem tüketimi, yemden yararlanma oranı, yaşama gücü, karkas parametreleri (ağırlık, randıman, taşlık, karaciğer ve kalp ağırlıkları), altlık nemi ve *Escherichia coli* sayımı araştırılmıştır. Muamelelerin; canlı ağırlık ve karkas ağırlığı üzerine etkisi istatistiki olarak önemli bulunmuştur (P<0.05). Deneme sonu canlı ağırlığı ve karkas ağırlığı bakımından en iyi sonuç, L2 grubunda (2177.93 g ve 1643.10 g sırasıyla) gözlemlenmiş, bunu L1 grubu (2173.27 g ve 1622.70 g sırasıyla) ve L3 grubu (2086.23 g, 1544.70 g sırasıyla) takip etmiştir. Karaciğer, kalp ve taşlık ağırlıkları bakımından gruplar arasındaki farklılıklar istatistiki açıdan önemli bulunmamıştır. Yem tüketimi ve yemden yararlanma oranı bakımından gruplar arası fark istatistiksel olarak önemli bulunmamıştır. Yaşama gücü bakımından da gruplar arası fark istatistiksel olarak fark görülmemiştir. Çalışma sonunda altlık nemi oranı L2 grubunda istatistiksel olarak farklı tespit edilmiştir. Yine *E. Coli* bakımından altlık materyali olarak L1 ve L3 gruplarında koloni gelişimi gözlenirken, L2 grubunda koloni gelişimine rastlanmamıştır. İncelenen özellikler bakımından etlik piliç yetiştiriciliğinde altlık olarak çırçır makinesi atığının talaşa alternatif olarak kullanılabileceği sonucuna varılmıştır.

Anahtar Kelimeler: Altlık Materyali, Çırçır makinesi atığı, Etlik piliç, Performans özellikleri

Introduction

The poultry sector is the fastest developing and biggest sector in the agricultural industry. The fact that poultry meat contains low cholesterol levels, production is economical and there are no restrictions in poultry meat consumption have

contributed to this development (Bolan et al, 2010).

The achievement of expected performance in poultry depends on environmental factors and one of these is the management and selection of bedding materials (Butcher and Miles, 2012). In world poultry production litter is used as floor system, and the material it consists of is important. Given some variation depending on litter material, litter contributes to costs in poultry production at an amount of 3% (Coleman, 1987; Koçak et al., 1991). In Turkey, materials like straw, wood shavings and rice husks are used. In regions where poultry production is carried out, waste materials emerging from agricultural production that are inexpensively available and have low moisture content are most commonly used. There is a body of research about the effect on bedding materials depending on absorption characteristics and pH levels on broiler performance, carcass characteristics, and inner-environmental conditions of broiler houses (Mutaf et al., 1977; Poyraz et al., 1990; Lien et al., 1998; Toledo et al., 2019). Litter quality has a significant effect on broiler growth and quality of carcass. The material that is used as bedding material must not include hard particles, must be of a particle size that cannot be swallowed by animals, must not contain dust or mould or be toxic, must have a high capacity of moisture absorption, and it needs to be available inexpensively (Koçak et al., 1991; Türkoğlu et al., 1997). Also, the material should have a moisture content between 20% and 30%, must not be formed into a ball when pressed in the hand, and it should be spread easily. Very dry bedding materials can retard the process of fledging, and, when the amount of dust is increased, lead to infections of the upper respiratory tract (Atasoy, 2012). A layer too thick causes problems in feet and legs, oedema in the breast, aspergillosis and coccidiosis, and accelerates the emission of ammoniac from the manure (Petek et al., 2010). An increase of ammoniac in the inner atmosphere of the broiler house diminishes feed consumption and live weight gain, causes conjunctivitis and infections in the respiratory tract, deteriorates the carcass quality and increases the number of bacteria in the air (Şenköylü, 2001).

The kind of litter material has an impact on the animals' performance, well-being, health, behaviour and product quality (Garcia et al., 2012). In broiler production, materials like resin-free wood shavings, hazelnut husks, crushed corn stems, paper shavings, rice husks, volcanic ash and perlite are used as litter materials. The most frequently material used is wood shavings. However, since wood shavings are strongly demanded in regions with intensive broiler production and are used as fuel in winter, there are difficulties in availability, and therefore the costs for purchase increase. For that reason, it is advantageous to develop and provide alternative litter materials in terms of availability and reducing costs. In particular, it appears to be reasonable to examine the applicability of waste products such as paper waste (Özlü et al., 2017) for litter purposes in poultry production.

Turkey was the seventh biggest cotton producer in the world in 2015/2016, and it is expected that the increase in cotton production will continue (Basal et al., 2020). The exploitation of waste products emerging in cotton ginning in intensive production in some regions of Turkey is an issue that has been evaluated by researchers in Turkey and in other countries for years. The main concern of these researchers is to recycle gin waste and to contribute to the country's economy. To gain 1 kg of cotton fibre from 5 kg seed cotton raw material, cotton is cleaned and ginned (Güngör et al., 2009). That way fibre can be extracted from the seed cotton, and the remaining parts of seeds and waste are separated in the ginning machines. It has been calculated that for every 224 kg cotton bale produced in the ginning process, approximately 34 kg waste emerge (Holt et al., 2006), and that a yearly production of 60.000-700.000 t cotton fibre production leads to an amount of 90.000-100.000 t gin waste (Alkaya, 2010).

The aim of this study was to examine the applicability of gin waste as an alternative litter material to conventionally used bedding materials and to analyse effects on performance.

Materials and Methods

A total of 630 day-old male broiler chicks (Ross 308) were used in this study. During the experiment, animal care, feeding and treatment were realised in the broiler houses belonging to the Animal Application and Research Units at Kahramanmaraş Sütçü İmam University. The examination of the carcass after slaughtering was done in the laboratories of the Faculty of Agriculture, Department of Animal Production, at KSÜ.

In the study, the animals were given a starter diet from day 0 to 15 (3100 kcal/kg ME and 23% protein), a developer feed from day 16-34 (3150 kcal/kg ME and 22% protein) and a finisher feed until day 40 (3200 kcal/kg ME and 19% protein) *ad libitum.*

Experimental Design and Applications

In order to examine the applicability of gin waste as litter material, 3 types of bedding materials were used, and the broiler chicks were distributed in three groups accordingly: Group L1 was kept on wood shavings, group L2 on gin waste, and group L3 was kept on a 0homogenously mixed composition of 50% wood shavings and 50% gin waste. There were 3 replications for each group. The bedding materials were spread in the broiler house at a layer thickness of 10 cm (+/- 1 cm). In each of the 9 pens (6 m^2 each), 70 broilers were randomly placed. Throughout the 42-day treatment, the broilers were exposed to 23 h daily lightning provided by day light and fluorescent lamps.

The feed given to the treatment groups were documented on a daily basis and the feed remaining at the end of a week was weighed in order to calculate feed consumption. Vitality was recorded daily. Live weight was individually determined until the end of week 6. Based on the collected data, feed conversion and live weight gain were calculated. After slaughtering, weight of cold carcass, gizzard, heart and liver of samples were determined.

Microbiological Analysis

At study begin and then every two weeks, litter samples were taken from 3 different places in each pen, mixed and the moisture content of the litter materials was analysed. For the microbiological analysis, a total of 5 samples from each replication area, 4 from the corners and 1 near the waterer were taken and mixed. In the laboratory, the most-probable number (MPN) method was used to count *E. Coli* and mould. In this method, the samples taken from the litter materials are diluted in physiological salt water at a ratio of 1:9, and after inoculating three broths, the proliferation was checked and the colonies were counted (Thatcher and Clarke, 1978). After the experiment, all data were analysed with one-way analysis of variance (ANOVA) using SPSS programme. The means of the results being statistically significant according to the analysis of variance were tested with Duncan's multiple range test (Bek and Efe, 1989).

Results and Discussion

Live Weight

In the experiment, the live weights of the birds on three different types of litter materials were examined every week, and at study beginning, there was no statistically significant difference between the groups (Table 1). At the end of week 6, the highest live weights were observed in L2 and L1 (2177,93±36,56 and 2173,27±42,92g), the lowest in L3 (2086,23±37,72). While the analysis of variance showed that the difference between the groups L1 and L2 was not statistically significant (P>0.05), the difference between these groups and L3 was statistically significant (P<0.05) (Table 1).

Table 1. Weekly live weight means of broilers kept on different litter materials ($\bar{X} \pm S$).

	L1	L2	L3
Study beginning	42.20^{a}±3.00	42.20^{a}±2.99	43.10^{a}±2.68
Week 1	160.84^{a}±1.02	139.37^{c}±1.02	145.67^{b}±1.28
Week 2	371.23^{a}±1.15	346.33^{b}±3.97	354.03^{b}±4.70
Week 3	807.67^{a}±12.85	788.50^{ab}±8.77	772.80^{b}±12.94
Week 4	1190.97^{a}±17.09	1227.37^{a}±15.13	1139.63^{b}±16.78
Week 5	1811.87^{ab}±20.88	1822.77^{a}±22.83	1764.97^{b}±24.67
Week 6	2173.27^{a}±42.92	2177.93^{a}±36.56	2086.23^{b}±37.72

*P<0.05; different letters in the same row indicate statistically significant differences.

The selection of the most suitable litter materials has been a research issue in broiler production and it continues to be one in our days. Similar to the current study, Sarıca and Çam (1998) examined the effect of different litter materials such as wood shavings, rice husk-hazelnut husks, hazelnut husks, wheat stalks and rice hulls, and found that the live weights were 2499,36±18,74 g, 2490,06±18,75 g, 2453,08±18,89 g, 2480,68±19,05 g, and 2473,87±18,94 g. According to the statistical analysis, the differences were not statistically significant. Willis et al (1997) used wood shavings, wood shavings with leaves and solely leaves and after the treatment differences in live weight were found to be statistically not significant. In a similar vein, Lien et al. (1998) used peanut hulls and wood shavings showing live weight 2011 g and 2019 g in the groups. Demirulus et al. (2000) found out in their study on different litter materials that live weight was 2003,8±20,3 g, 1953,8±29,4 g, 1947,3±24,1 g for animals kept on straw, straw, wood shavings, and straw and wood shavings and no significant difference was found. Sarıca and Biçer (2004), in their study with hazelnut husks and hazelnut husks with wood shavings found out that live weights were 2924,2 g, 2870,6 g and 2831,0 g,

and there was no statistically significant difference. Atapattu and Wickramasinghe (2007) used nut hulls and waste coming from tea factories. In their study the live weights were 2058±116 g and 2012±76 g, and the differences were not statistically significant. Özlü et al. (2017) showed statistically significant differences in live weight between broilers kept on paper waste and rice hulls in the 6th week.

Carcass Performance

In order to examine effects of different litter materials on carcass performance, the broilers mean slaughter, cold carcass, heart, liver and gizzard weights were determined. Examining the data belonging to slaughter and carcass yield, there were no statistically significant differences (P>0.05) between the groups observed except for carcass and gizzard weight (Table 2).

Table 2. Mean slaughter, carcass, liver, heart and gizzard weights and standard deviation for broilers kept on different litter materials.

	Slaughter Weight $\bar{X} \pm S$	**Carcass Weight** $\bar{X} \pm S$	**Liver** $\bar{X} \pm S$	**Heart** $\bar{X} \pm S$	**Gizzard** $\bar{X} \pm S$
L1	2173.27^{a}±42.92	1622.70^{a}±34.08	42.37^{a}±1.38	10.97^{a}±0.32	39.17^{a}±0.96
L2	2177.93^{a}±36.56	1643.10^{a}±29.18	40.63^{a}±1.20	11.60^{a}±0.36	38.80^{a}±0.76
L3	2086.23^{b}±37.72	1544.70^{b}±31.94	40.57^{a}±1.04	10.83^{a}±0.37	38.27^{a}±0.89

*P<0.05; ^{a,b}: Different letters in the same row indicate statistically significant differences.

While the highest slaughter and carcass weight was observed in L2, this was followed by group 1. The lowest slaughter and carcass weight was seen in group 3. The differences were statistically significant. Regarding gizzard weight, the highest value belonged to the group kept on wood shavings, the lowest in group L3. This can be explained with lack of homogenous mix of gin waste and wood shavings and, therefore, emergence of pelletisation and holes in the material layer. However, İpek et al. (2002) in their study on the effect of several litter materials like wood shavings, straw, rice, wood shavings with zeolite, straw with zeolite and rice with zeolite report that there was no statistically significant difference between the groups in carcass weight.

Feed Consumption and Feed Conversion

The 6-week experimental study showed that the best feed conversion was in group L2 (1.90) followed by L1 (1.91) and L3 (2.01) (Table 3).

Table 3. Mean feed consumption and feed conversion rates for broilers kept on different litter materials.

	Feed Consumption, g	**Feed Conversion Rates**
L1	4157.4^{a} ±45.38	1.91^{a} ±0.12
L2	4138.6^{a} ±55.78	1.90^{a} ±0.18
L3	4192.8^{a} ±67.53	2.01^{a} ±0.20

*P<0.05; a,b; different letters in the same row indicate statistically significant differences.

At the end of the experiment in which animals in groups were kept on different litter materials, the mean feed values and the calculated feed conversion rates were tested with paired comparison test, and the group differences were found to be statistically not significant (P>0.05) Willis et al (1997) used wood shavings, wood shavings with leaves and solely leaves and after the treatment differences in feed conversion were found to be statistically not significant. In a similar vein, it is known that in a study with hazelnut husks and hazelnut husks with wood shavings, there were no statistically significant differences in feed conversion (Sarıca and Biçer, 2004). In the same way, Atapattu and Wickramasinghe (2007) used nut hulls and waste coming from tea factories in their study. They found an effect of different litter materials on feed conversion of 1.80±0.12 and 1.78±0.01, and these differences were not statistically significant.

Parallel to these studies, there was no statistically significant difference in feed conversion between the used groups L1, L2 and L3 in the current study. However, İpek et al. (2002) in their study on the effect of several litter materials like wood shavings, straw, rice, wood shavings with zeolite, straw with zeolite and rice with zeolite found feed conversion rates of 1.851±0.019, 1.755±0.012 and 2.039±0.024. They reported, in terms of feed conversion, statistically significant differences in all periods and over the whole experiment between all groups. In the current

study, there was no statistically significant difference between the groups. For that reason, the results in this study are not in line with the results of İpek et al. (2002). This can be explained with the difference in litter material used.

Vitality

One of the most important criteria to evaluate the applicability of litter materials is vitality (Sarıca and Selçuk, 1993). In this study, as a result of the chi-square test, differences in vitality rate between the treatment groups were not found statistically significant (P>0.05). The vitality rate of the treatment groups L1, L2 and L3 kept on different litter materials were 94.77%, 94.29% and 94.77%. At study end, the differences in vitality rate between the groups were statistically not significant. Sarıca and Biçer (2004), in their study with hazelnut husks and hazelnut husks with wood shavings, report that there was no statistically significant difference in vitality between the groups. Also Atapattu and Wickramasinghe (2007), using nut hulls and waste coming from tea factories showed that differences in vitality between the treatment groups were not statistically significant. In the current it was shown that differences in vitality rates were not statistically significant between the treatment groups, and for this reason, these studies' results are similar to the results of the current study. However Sarıca and Çam (1998), who used different litter materials such as wood shavings, rice husk-hazelnut husks, hazelnut husks, wheat stalks and rice hulls, showed that the effect of different litter materials on vitality was statistically significant. Willis et al. (1997), who used wood shavings, wood shavings with leaves and solely leaves, showed that the effect of different litter materials on vitality was statistically significant. In the same way, İpek et al. (2002) in their study on the effect of several litter materials like wood shavings, straw, rice, wood shavings with zeolite, straw with zeolite and rice with zeolite report that there was no statistically significant difference between the groups in vitality.

Moisture Content of Litter Materials

The mean values for moisture content in the different litter materials at study beginning and end are given in Table 4. The lowest moisture content at study beginning was identified in L2 at 8.25%, and the highest in L1 at 9.70%. During the experiment the moisture content changed in different litter materials, and the lowest moisture content was determined in L2 at 25.80%. This was followed by treatment group L3 with a value of 29.61% and the highest moisture content was in L1 with a value of 34.79%.

Table 4. Moisture content at experiment beginning and end in different litter materials.

	Study beginning	**Study end**
L1	9,70[a]	34,79[a]
L2	8,25[a]	25,80[b]
L3	8,58[a]	29,61[a]

*P<0.05; different letters in the same row indicate statistically significant differences.

At study end, the difference between group L2 and group L1 appeared to be statistically significant. Atasoy (2012) reports that the most appropriate moisture content is between 20% and 30%. The moisture content rates for L2 and L3 were in the optimum range at study end. It can be concluded that gin waste displays a different moisture holding capacity compared to wood shavings due to its texture, and this capacity is conducive for litter purposes.

E.coli Numbers in Litter Materials

In week 6, the pathogenic microorganisms *E. coli* colonies were counted, and the numbers are given in Table 5.

Table 5. *E. coli* colony numbers (cfu / g litter) in litter materials in week 6.

	10^{-4}	**10^{-5}**	**10^{-6}**
L1	7.10	0.77	0.40
L2	n. g.	n. g.	n. g.
L3	6.30	0.80	0.13

*n. g.: no growth.

While *E. coli* growth was observed in L1 and L3 at study end, there was no growth in the samples belonging to L2.

In the study, the applicability of gin waste as litter material in broiler production was examined. It was compared with wood shavings, which are commonly used as litter material, in terms of applicability and effects on some performance traits of broilers. As a result of the statistical

analysis, the effects are statistically not significant with some exceptions.

In regions where broiler production is run intensively, the acquisition of litter materials is potentially difficult. The fact that supplying wood shavings, which are commonly used in broiler production as litter materials, is difficult and cost-intensive leads to a problematic situation for producers. For that reason, it can be said that the availability of gin waste in regions with cotton production and the relatively cost-efficient acquisition is advantageous. It is the aim of the fast-growing broiler sector to reach profitability. Even though the increase in per capita profit of animals bred on gin waste appears to be modest compared to the birds in the treatment group, the design of the groups with a restricted number of broilers in the current study should be considered. When broilers are bred in large-scale production, the profit gained from litter material selection can be enhanced. The results of this study suggest that the application of gin waste as litter material in broiler production is a reasonable and profitable decision. Moreover, exploiting gin waste as litter material in broiler production contributes to the country's economic welfare because a waste product is further exploited.

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