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Use of Gyttja as Litter Material in Broiler Houses

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ABSTRACT
The aim of the current experiment was to evaluate the possibility of the use of gyttja as an alternative litter material to wood shavings in broiler production. In the current experiment 3150 chicks were used in two experimental groups consisting of 1575 chicks with three repetitions (3x525 chicks). The experiment last for 39 days. During the experiment chicks in two experimental groups with same diets. There were no significant differences between experimental groups in terms of live weight, feed consumption, feed conversion ratio and mortality. However, foot pad dermatitis (FPD) was found to be higher in the gyttja litter group and the difference between the groups was significant (P=0.011). In conclusion, gyttja could be used instead of wood shavings as litter in broiler houses without compromising the growth parameters. However, it should be known that there will be more FPD when using gyttja as litter in broiler production compared to using wood shavings.

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Etlik Piliç Kümeslerinde Gidya Materyalinin Altlık Olarak Kullanımı

ÖZET
Bu çalışmada etlik piliç kümeslerinde, gidya materyalinin ağaç talaşı yerine, alternatif bir altlık olarak kullanabilme imkânı araştırılmıştır. Deneme grubunda gidya materyali altlık olarak kullanılırken control grubunda altlık olarak ağaç talaşı kullanılmıştır. Mevcut denemede, üç tekrarlı (3x525 civciv) 1575 civcivden oluşan iki muamele grubunda toplam 3150 civciv kullanılmış ve deneme 39 gün sürdürülmüştür. Denemede her iki grup civcivlere aynı yemler verilmiştir. Deneme grupları arasında canlı ağırlık, yem tüketimi, yem dönüşüm oranı ve ölüm oranı açısından önemli bir fark bulunmamıştır. Ancak, kontrol grubuna göre gidya altlık grubunda daha fazla FPD (foot pad dermatitis) geliştiği görülmüş ve gruplar arasındaki fark önemli bulunmuştur (P=0,011). Sonuç olarak gidya materyali, büyüme parametrelerinden ödün vermeden broyler kümeslerinde odun talaşı yerine altlık olarak kullanılabileceği görülmüş, ancak altlık olarak gidya kullanılan grupta, ağaç talaşı kullanılan kontrol grubuna göre piliçlerin ayak tabanlarında yangıların (FPD) daha fazla olabileceği gözden kaçırılmamalıdır.

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INTRODUCTION
The use of litter is inevitable in the floor-based raising system which is the most commonly used system in the world for the broiler raising. The need for litter material increases due to the increase in broiler raising. Recently investigations have been carried out to find out alternative litters such as tree leaves (Chakma et al., 2012; Sharma et al., 2015), rice husk, sugar cane bagasse, wheat straw (Monira et al., 2003), hazelnut husk (Sarica and Cam, 2000), dried rose (Aktan and Sagdic, 2004), reversible trimmed paper products (Hector et al., 2006), factory wastes of tea plant (Atapattu and Wickramasinghe, 2007), paper industry waste (Ozlu et al., 2017), sand, zeolite, vermiculite, sepiolite, pumice stone as litter material (Bilgili et al., 1999; Eleroglu and Yalcin, 2004; Hafeez et al., 2009; Atencio et al., 2010; Miles et al., 2011; Bintas et al., 2014; Duman and Sekeroglu, 2016).

Nevertheless, wood shavings are generally accepted to be the most preferred litter material. Recently the price of wood shaving has been increased due to high use of fuel in heating during the winter (Sekeroglu et al., 2013; Ritz et al., 2016).

The use of litter accounts for 2-3% of the total cost in broiler production (Sekeroglu et al., 2013). Therefore the litter material should be cost-effective, easy to obtain, dust-free, mildew-free and free from solid bodies. At the same time, it should be environmentally friendly, non-toxic to human and animal health, comfortable bed for animals, high water holding capacity and can be used for other purposes (fertilizer, fuel, etc.) after it's as litter use (Munir et al., 2019). The litter materials should also be promptly managed in order to control its moisture, ammonia and prevent the disease factors and dust production (Sorbara et al., 2000; Toghyani et al., 2010). Litter material affects broiler's behavior, physiological features (Munir et al., 2019), some welfare parameters and immunity systems along with their performances (Shao et al., 2015). Depending on the type of litter material that is used, lessions appear in breast, feet joints, foot pad and toes, by that, development and carcass characteristics are adversely affected. This situation, sometimes results with decrease in meat quality as well as economic loss (Bilgili et al., 1999; Meluzzi et al., 2008). High levels of litter moisture cause FDP (Takase et al., 2011).

Also one of the major problems regard to large broiler production stems from the accumulation of litter material that is mixed with the animal feces. This type of waste's use as a source of organic matter in plant production is deemed to be a practical method (Singh et al., 2010). However, its large extent accumulation harms environment and causes environmental pollution (Sharpley et al., 2007; Bolan et al., 2010). Broiler houses' waste texture varies depending on several factors, and it consists average of 62% feces, 31% broiler house litter material, 3% shed feed, 2% feather and 2% other waste. (Adiyaman, 2009).

Gyttja is a waste material with organic contents that is found on the upper lignite layer, and it has semi-formed lignite features. But, its low energy levels do not allow for it to be used as a fuel resource (Demirkiran and Cengiz, 2011). Thus, after being dug from the lignite's upper layer it is used as a filling material for where it's dug from. (Saltali and Yildirim, 2016). It features an organomineral structure formed by the mixture of organic and mineral substances lay on the beds of Lake Floor, with its color ranging from light grey to brownish black and containing fossilised lake creatures. Gyttja has characteristics as such as containing nutrient elements beneficial for plants and humic acid and having a high organic matter rate. It can also be used as soil conditioner since it is compatible with the regulations on organic fertilizer (Gulser et al., 2014). The reserves of gyttja which can be used for agricultural purposes is approximately 1.8 billion tons in Afsin-Elbistan coal basin and it is reported that this figure is 4.8 billion tons with areas to be opened for new production (Kadioglu et al., 2015). Yakupoglu et al. (2013) reported the gyttja features as follows; C / N ratio; 12.6, EC (dSm^{-1}) 0.77, $CaCO_3$; specific gravity of 39.1%; 2.25 g/cm^3, water holding capacity; 206%, total N; 1.76%, P; 19.4 mg kg^{-1}, K; 183 mg kg^{-1}, Ca; 122628 mg kg^{-1}, Mg; 2348 mg kg^{-1} Na; 183.8 mg kg^{-1} Fe; 53.4 mg kg^{-1} Cu; 6.62 mg kg^{-1}, Zn; 5.86 mg kg^{-1} and Mn; 28.7 mg kg^{-1}.

In this study, it was aimed to determine whether it is possible to use gyttja which is cost effective and abundant, as an alternative litter material in broiler production.

MATRIALS AND METHODS

This study was carried out in University of Kahramanmaras Sutcu Imam, Animal Production, Application and Research Center; by the license numbered 2017/03-01 issued by the KSU Agricultural Faculty's Local Board of Animal Experiments. In the current experiment two identical poultry houses with a same ventilation rate and lighting program were used to prevent the treatment contamination such as moisture odor and ammonia etc. The diameters of each house feature 7 m of width, 19 m of length and 3 m of height, in an enclosed setting with full environment control. The trial was carried out in three replications in each of the pine wood shaving and gyttja groups. The gyttja used as the litter material in the experimental house was supplied from lignite deposit of Thermal Power Plant in Afsin-Elbistan. The gyttja material used in the study was directly obtained from the mine having diameter spectrum in respect of its particles ranging from powder-size to orange-watermelon sizes, and featuring a near-black color. Large pieces were shrunken by crushing, and the pieces ranging in sizes from chickpea-bean to powder were laid on the experimental house floor by a spread of 6 kg/m^2. Along with that, in control house, pine wood shavings were used as a litter material by a spread of 3 kg/m^2. Each repetition is divided into 3 sections (44.27 m^2) with a 2.3 m wide, 19 m long and 60 cm high wire fence which prevents chicks from passing. As animal material, day-old Ross 308 produced from 54 weeks old parent stocks were used. The study was conducted with 3150 chicks placed to the control house and experimental groups, each house hosting three replications, as each replication consisted of 525 number of one day old chicks (11.86 chicks/m^2) belonged to mixed sex groups. The houses were heated with infra-red electric heaters. In each house, 3 thermostat controlled heaters were used, and the temperature values were kept similar during the experiment. The composition of diets used in the experiment are given in Table 1.

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Table 1. The composition of diets used in the experiment

Nutrient Contents	Starter 1	Grower 1	Grower 2	Finisher
Feed form	Granular	Granular	Pellets	Pellets
Days	0-10	11-21	22-31	32-39
Dry matter (%)	88	88	88	88
Crude protein%	24	23	21	19
Crude cellulose %	6.0	6.0	6.0	6.0
Crude ash %	8.0	8.0	8.0	8.0
Insoluble ash in HCl %	1.0	1.0	1.0	1.0
Calcium%	1.0-1.5	1.0-1.5	0.9-1.5	0.8-1.2
Phosphorus %	0.70	0.70	0.65	0.60
Sodium %	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30
NaCl (Salt) %	0.35	0.35	0.35	0.35
Lysine %	1.30	1.20	1.10	0.90
Methionine %	0.60	0.50	0.50	0.35
Cystine %	0.32	0.40	0.30	0.30
Metabolic Energy (Kcal kg^{-1})	3200	3200	3200	3200

The experiment last for 39 days. At the end of the experiment, broilers in the experimental groups were individually weighed. Broilers in both groups were given no feed during 12 hours prior to body weight measuring.

Foot pad dermatitis (FPD) was evaluated at the end of the trial (39 days) from the both foot of each chicken. In case where FPD did not develop equally in both feet, the most affected foot was considered. FPD scores were recorded as follows: 0: no lesions;1: small point lesions, 2: lesions covering more than 25% of the foot; 3: lesions covering more than 50% of the foot; 4: lesions covering the entire sole of the foot (Figure 1; Hocking et al., 2008; Sarica et al., 2014). FPD score value of each repetition is calculated by the following formula (Kyvsgaard et al., 2013). Repetition score = 0x(num. of foot with the score 0)+1x(num. of foot with the score 1)+2x(num. of foot with the score 2)+3x(num. of foot with the score 3)+4x(num. of foot with the score 4). The result found was divided by the number of broilers to obtain a coefficient.

Score 0 Score 1 Score 2 Score 3 Score 4

Figure 1. Foot pad dermatitis scores

Litter's moisture measurement was carried out at the end of the experiment by taking 10 samples from different areas from the each house. The samples were weighed separately and placed in the oven, dried at 105 °C for 12 hours; then the average values were obtained by weighing the samples again and determining their moisture contents.

Statistical analysis were made by using t-test SPSS V22.0 statistical package program (SPSS, 2013).

RESULTS AND DISCUSSION

The initial chick weight, live weights, feed consumption, FCR mortality and FPD scores in this study are given in Table 2.

Table 2. The effect of litter type on the live weight, feed consumption, feed conversion ratio mortality and foot pad dermatitis (n=3*)

Parameters	**Wood shavings litter**	**Gyttja litter**	**P-value**
Initial chick weight (g)	48.20±0.208	48.20± 0.173	1.00
Live weight (g)	2519.70±15.407	2513.33±9.514	0.74
Feed consumption (g)	4114.00±11.846	4128.33±3.844	0.31
Feed conversion ratio	1.633±0.010	1.643±0.005	0.44
Mortality (%)	2.99±0.127	2.86±0.290	0.72
FPD Scores	0.99±0.098*	1.44±0.022*	0.011

Values are given as means ± SE, in the same row. * Each repetition is the average of 525 chicks

There were no significant differences between experimental groups in terms of live weight, feed consumption, feed conversion ratio and mortality. It is interesting that some researchers also found no significant differences between the treatment groups (Aktan and Sagdic, 2004; El-Wahab et al., 2013; Bintas et al., 2014; Sharma et al., 2015; Yamak et al., 2016; Lima et al., 2018). However other researchers found significant differences between the treatment groups (Atencio et al., 2010; El-Deek et al., 2011; Chakma et al., 2012; Ritz et al., 2016).

Compared to the control group using wood shavings as litter, in the gyttja group FPD score was found significant ($P<0.05$). Contrary to this study, Benabdeljelil & Ayachi, (1996) observed no significant differences in FPD scores in all groups using six types of different litter materials. But in some studies it was reported that the use of litter material (Yamak et al., 2016; Zikic et al., 2017) and the moisture content of the litter materials (Ekstrand et al., 1997; Takase et al., 2011) have an effect on the FPD. It is also reported that there is a significant difference in terms of FPD scores when the litter was used for the second time (Yamak et al., 2016).

At the beginning of the experiment, the litter moisture content of experimental groups were 11.55% and 18.07%. At the end of the experiment these values was 67.0% and 56.50% respectively (Table 3).

Table 3. Moisture content of the litter materials used in the trial at the beginning and end of the study

Used litters in experiment	Initial moisture (%)	Post-experiment moisture (%)
Wood shavings litter	11.55	67.00
Gyttja litter	18.07	56.50

At the end of the 39-day trial, when the water holding capacity was examined among the materials used as litter, the wood shavings were observed to hold more water than the gyttja. However, at the end of the trial, the gyttja litter also suffered from FPD formation even though it had less moisture content. This is because the gyttja litter material contains chickpea-bean sized particles that are thought to physically trigger the formation of FPD on the footpad of the broilers.

This result is in agreement with findings of other studies in which wood shavings used as litter in control group was determined to have a similar initial moisture content (Sarica and Cam, 2000; Ipek et al., 2002; Eleroglu and Yalcin, 2004; Atapattu and Wickramasinghe, 2007; Hafeez et al., 2009; El-Deek et al., 2011; Bintas et al., 2014).

The wood shavings and rice hulls litter mixed with poultry house is not recommended as a fertilizer for plant production due to slow degradation of wood shavings and rice hulls in soil. It is very interesting to notice that the wood shavings and gyttja litters mixed with broiler feces obtained from experimental groups were used as a fertilizer in vetch and triticale production in another experiment carried by Iric (2019) who suggested that fertilization with gyttja litter mixed with broiler feces improved the triticale hay yield and quality. The N and organic matter content of gyttja litter is likely increased when it is mixed with broiler feces, thereby resulting in improved in the hay yield and quality as in the experiment carried by Iric (2019). Gyttja mixed with broiler feces not only can be utilized as a soil conditioner but also fertilizer for plant production when the results obtained in the current experiment and that by Irıc (2019) were taken into consideration.

CONCLUSION

There are no significant differences between treatment groups in terms of liveweigth, feed consumption, feed conversion ratio and mortality In conclusion, gyttja could be used instead of wood shavings as litter in broiler houses without compromising the growth parameters. However, it should be known that there will be more FPD when using gyttja as litter in broiler production compared to using wood shavings. New studies can be done by changing the gyttja material to smaller particle form, to eliminate the FPD problem.

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Author Contribution Rates:

The authors hereby declare that BY contributed 80%, GF contributed 20% to the article.

Statement on conflict of interest

There is no conflict of interest between the authors.

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