International Journal of Science, Environment and Technology, Vol. 7, No 2, 2018, 397 – 409

ISSN 2278-3687 (O)
2277-663X (P)

EFFECT OF ORGANIC ACID TREATED CORN COB BEDDING MATERIAL ON BROILER PERFORMANCE, HOCK BURN INCIDENCE AND LITTER QUALITY

[*]Lonkar V.D.[1], Ranade A.S.[2], Kulkarni V.R.[3], Pathak C.B.[3], Yenge G.D.[4] and Daware A.G.[4]

[1]Assistant Professor and Sectional Head, Department of Poultry Science, KNP College of Veterinary Science Shirwal Dist. Satara, MS., India

[2]Associate Dean, KNPCVS, Shirwal and Professor and University Head, Department of Poultry Science, MAFSU, Nagpur, MS., India

[3]VRK & Associates, Miraj, Sangli, MS., India

[4]M.V.Sc. Scholars, Department of Poultry Science, KNP College of Veterinary Science Shirwal, Dist. Satara, MS., India

E-mail: vijulvet@rediffmail.com ([*]*Corresponding Author*)

Abstract: An experiment was conducted to compare the effects of rice husk and organic acid treated corn cob bedding material on the performance of broilers, quality of litter (moisture, pH, Ammonia and nitrogen content) and hock burn incidence in broilers. One day-old straight-run "cobb-400" commercial broiler birds (n=252) from single hatch were randomly distributed into two treatments, with six replicates per treatment, in a total of 126 birds per treatment. All broilers had a common environment except for the litter materials. The broiler birds from treatment A were reared on rice husk bedding material from 0-6 weeks of age. The broiler birds from group B were reared on bedding material corn cob from 0-6 weeks of age. The corn cob bedding material from group B was amended with 10 % organic acid. The growth parameters, quality of litter (moisture, pH, Ammonia and nitrogen content) and hock burns incidence were assessed. The results of the study indicated that, use of organic acid treated corn cob litter material was highly beneficial in significant increase in live body weights, body weight gains, feed intake and improving feed conversion ratio of broilers than untreated rice husk as bedding material. This significant improvement in the performance of broilers on organic acid treated corn cob might be due to significant decrease pH, moisture and ammonia level in the litter. Moreover, the treatment of corn cob litter material with organic acid, increased the nitrogen content of litter. The birds reared on the organic acid treated corn cob litter material showed lowered incidence of hock burns than in birds reared on untreated rice husk litter material.

Keywords: Organic acid, corn cob litter, broiler performance.

INTRODUCTION

The commercial broiler birds are reared intensively on floor in open sided deep litter poultry houses. Micro-environment, welfare and behaviour of broiler birds are the key factors to exploit their production potential. Type and quality of litter material plays major role in intensive management of commercial broilers (Karamanlis *et al.,* 2008; Skrbic *et al.,* 2012,

*Received Feb 4, 2018 * Published April 2, 2018 * www.ijset.net*

Bjedov *et al.,* 2013, Garcia *et al.,* 2010, Shepherd and Fairchild, 2010). Many researchers have been studied the effect of different bedding material like sawdust, rice, sugarcane pulp or bagasse, chopped straw, paper mill by-products, sand, wood shavings, corn cobs and dried leaves, coconut husk, wheat straw and Guinea grass on the performance of broilers as per the availability (Swain and Sundaram, 2000; Monira *et al.,* 2003; Skrbic *et al.,* 2012; Garces *et al.,* 2013). When the commercial broiler birds are reared on open sided deep litter houses they spend most of their time on the litter and their foot pads, hock and breast are in constant contact with the bedding material on the floor. Therefore, the extent of development of hock burns, foot pad dermatitis, leg abnormalities, breast burns and blisters are depends on type, quantity and quality of litter material (Bilgili *et al.,* 2009; Garcia *et al.,* 2010). Moreover, there is growing concern related to ammonia emission from poultry operations. Ammonia volatization from poultry litter commonly causes a buildup of ammonia in the atmosphere of chicken houses that has a negative impact on both farm workers and birds. The combination of ammonia and wet litter is responsible for a large number of health and density related welfare problems in poultry. The negative effects of ammonia begin at 25 ppm and become very serious at 50 ppm. Microbes in the litter convert the bird's excreta and spilled feed into ammonium (NH4+), which can bind to litter and also dissolve in water. Depending on the moisture content, temperature and acidity of litter, a portion of ammonium is being converted into NH3. Ammonia production is favored by high temperature and high pH (i.e. alkaline conditions). Litter amendments with various chemicals such as acidifiers, aluminium sulfate, sodium bisulfate (Nagaraj *et al.,* 2007), dietary manipulations (Eichner *et al.,* 2007) and a commercial ammonia binding agent (Lazarevic *et al.,* 2014) were used to reduce litter moisture, pH and ammonia emission in boiler houses. Litter amendments have positive effects on litter condition by lowering the pH and reducing ammonia emission (Iwa nczuk-Czernik *et al.,* 2007; Li *et al.,* 2008; Lee *et al.*, 2011) or litter moisture (Lazarevic *et al.,* 2014; Sahoo *et al.,* 2017.)

In view of above the experiment was designed to study the effect of organic acid treated corn cob bedding material against the commonly used rice husk as bedding material on the performance of broilers, quality of litter (moisture, $_{P}$H, Ammonia and nitrogen content) and hock burn incidence.

MATERIAL S AND METHODS

One day-old straight-run "cobb-400" commercial broiler birds (n=252) from single hatch were randomly distributed into two treatments, with six replicates per treatment, in a

total of 126 birds per treatment. All broilers had a common environment except for the litter materials. The broiler birds from treatment A were reared bedding material rice husk from 0-6 weeks of age. The broiler birds from group B were reared on bedding material corn cob from 0-6 weeks of age. The corn cob bedding material from group B was amended with 10 % organic acid. Organic acid was mixed in a mixer for 60 minutes at 10 rpm along with corn cob. The broiler pre-starter, starter and finisher diets I and II were fed *ad libitum* to the birds from 0-10, 11-21, 22-35, 36-42 days of age. All the chicks were provided with uniform floor, feeder and drinker space and were reared under standard management conditions throughout the experimental period of six weeks. The birds were vaccinated against ranikhet disease at 7^{th} and 28^{th} day of age and against gumboro disease at 9^{th} and 18^{th} day of age. The following parameters were studied during the course of the experiment.

Growth performance

The body weight, weight gain, feed intake and feed efficiency were recorded for period of 0-3 and 0-6 week.

Percent litter moisture and nitrogen

Litter samples were collected at weekly interval from five randomly chosen locations within each pen (Four from corners and one from centre) and thoroughly mixed to obtain material representative of the entire pen. Each litter material was analyzed for moisture content. Litter samples were dried at 100 °C for 18 hours to determine moisture content which is expressed on a fresh matter basis. The nitrogen content of the litter material was estimated as per the AOAC (1999).

Litter pH

For determining the pH, 5 g litter samples from five areas of each pen were taken and immersed in 50 ml of distilled water. A weighted sample was then stirred for 15 min; thereafter, the sample was filtered through filter paper. After completion of filtration, the pH of the filtered liquid was measured using a pH meter (Metler toledio, WTW, Germany). The litter pH was estimated for weekly interval period.

Litter ammonia level:

Litter ammonia was measured by using the digital ammonia measuring equipment (Drager Pac 7000) supplied by the Alltech India Pvt. Ltd. The ammonia was measured at the 6^{th} weeks of age. The digital ammonia measuring equipment was placed on the four corners and central place on the litter material of each pen and the readings were taken in ppm unit.

Hock burn score:

The hock burn were scored in six birds per replicate at six weeks of age using a 3 point scoring system (0= no burns; 1 = mild burns and 2= severe burns). The hock burns were assigned to one of three score. The mean score of hock was calculated as the cumulative total of the lesion scores divided by the total number of birds examined. (Thomas *et al.,* 2004)

Statistical analysis

The data collected on various parameters were subjected to statistical analysis as per the methods suggested by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Growth Parameters

The statistical analysis of data on effect of different bedding material on live body weights, body weight gains, feed intake and feed conversion ratio is depicted in table 1.

The results on cumulative live body weights of broilers from group B did not differed significantly ($P<0.05$) from 0-3 weeks of age. However, the overall live body weights of broilers in group B for 0-6 weeks period found to be significantly ($P<0.01$) higher than live body weights of broilers from group A. This indicated that, rearing of broiler birds on corn cob bedding material amended with 10% organic acid found to be beneficial for significant improvement in live body weight. Younis *et al.* (2016) reported that the topping of fresh wood shavings with acidifier amendment significantly increased final body weights compared to chickens in the untreated litter group.

Similar results were found with body weight gain of broilers. When the data on body weight gain from 0-6 weeks was analyzed, significant ($P<0.05$) increase in gain in weights of broiler birds were observed from B than group A. The results of the present findings indicated that, treatment of corn cob with 10% organic acid improved the weight gain in broiler birds. The efficiency of utilization of feed was significantly better in the organic acid treated corn cob material than the untreated rice husk bedding material.

The feed conversion ratio of broilers was statistically analyzed for 0-3 weeks and 0-6 week period. The feed conversion ratio of broiler birds from 0-3 weeks of age was numerically improved in group B than group A. The feed conversion ratio of broiler birds from 0-6 weeks of age was found to be significantly ($P<0.05$) improved in group B than group A. No differences in live body weight, feed conversion, and mortality across all bedding types were observed by Bilgili *et al.* (2009). However, litter amendment demonstrated improved weight gain and feed conversion for broilers raised over the alum-

treated litter as compared to the untreated litter group (Guo and Song, 2009) corroborated with present findings.

The overall results of the study indicated that the body weight, weight gain, feed intake and feed conversion ratio of broiler birds reared on organic acid treated corn cob bedding material were significantly improved than the birds reared on non treated rice husk bedding material.

Percent Litter Nitrogen

The statistical analysis of the data on percent nitrogen content of litter material (table 2) from group B was significantly higher at the end of 3rd, 4th and 5th weeks of age while it was numerically higher at 1st, 2nd and 6th weeks of age than group A. Previous researchers demonstrated that the amendment of litter material increases the nitrogen content of litter material. Sahoo *et al.* (2017) reported that, the nitrogen content of the litter from organic acid treated group was higher than that of control group. The acidic nature of the litter did not allow the free ammonium ion to convert to ammonia resulting in more nitrogen retention. Choi and Moore, (2008) also observed the improved nitrogen percentage due to litter amendment. Similarly, Burgess *et al.* (1998) reported that regardless of litter source, the treatment of litter samples with Al2(SO4)3 by the small batch method resulted in significantly higher nitrogen values. Higher N content might resuls in a more balanced fertilizer because the N/P ratio of the litter will be closer to the requirements of most crops. Overall, amendment of corn cob litter material with organic acid increased its nitrogen content.

Litter $_{p}$H

The statistical analysis of the data on $_{P}$H of litter material (table 3) indicated that the pH of litter material of group B was significantly lowered than group A except at first weeks of age. The $_{P}$H of the litter from group A was ranged from 6.608 to 7.519 and group B was ranged from 5.435 to 6.821. This indicated that the litter material from group B tended towards acidic than group A. The $_{P}$H of litter material from group B was significantly reduced by one at 2nd and 6th weeks of age while it was reduced by less than one in other weeks than group A. Similar type findings were reported by Mc Ward and Taylor, (2000) while using alum and sodium bisulphate as litter amendment.

As reported by Elliott and Collins (1982), ammonia release from litter is related to litter pH and moisture. Ammonia emissions have been positively correlated with litter pH (Carr *et al.,* 1990) and negatively correlated with litter moisture content (Ferguson *et al.,* 1998). Litter treatment with aluminium sulfate, sodium bisulfate (Nagaraj *et al.,* 2007),

dietary manipulations (Eichner *et al.,* 2007), zeolite (Li *et al.,* 2008) and a commercial ammonia binding agent (Lazarevic *et al.,* 2014) were used to reduce pH.

Litter moisture

During the entire experimental period, the moisture content (table 4) of group A was always on higher side than group B. The statistical analysis of the data on litter moisture at different weeks of rearing period indicated that, the moisture content of litter material from group B was significantly lowered at the end of 1st, 4th, 5th and 6th weeks of age than group A. The moisture content of the litter at the end of 2nd and 3rd weeks of age in group B numerically lowered than in group B. The formation of litter cakes in the group A was more frequent than the litter material from group B.

In the present study the moisture content of litter material from group A reached upto 54.174 % and in the organic acid treated litter material it was 47.312 % at the end of 6th week. Lynn and Spechter (1987) showed that when litter moisture content exceeds 46%, the litter surface becomes wet and unfriable. Wet litter can cause growth depression, disease susceptibility and induce severe discomfort in the form of contact dermatitis in broiler chickens (Dawkins *et al.*, 2004).

This indicated that corn cob as litter material for rearing of broilers is beneficial for reducing the moisture content of litter which helps to keep litter material dry. Keeping litter dry is a critical part of overall management of poultry farm. Litter conditions influences bird performance, which in turn affects profit of producers and integrators. Dry litter helps control the ammonia level, providing a healthy flock environment, and reduces condemnations due to hock, footpad burns and breast blisters. Similar to the present findings, Sahoo *et al.* (2017) reported that moisture content of litter of control group was higher than that of both sodium bisulphate and alum treated groups. Many other workers used, aluminium sulfate, sodium bisulfate (Nagaraj *et al.,* 2007), dietary manipulations (Eichner *et al.,* 2007), zeolite (Li *et al.,* 2008) and a commercial ammonia binding agent (Lazarevic *et al.,* 2014) were used to reduce litter moisture.

Litter Ammonia Level

The ammonia content of the litter material (table 5) was at the level of 0 ppm during the initial period of the experiment. The level of ammonia at 6th weeks of age differed significantly ($P<0.01$) between treatments. The ammonia level measured in group A was significantly ($P<0.01$) higher (30.167 ppm) than group B (18.889ppm) at the end of 6th week of age. Ammonia emissions from broiler litter have several disadvantages. It causes

environmental problems, negative effect on the health, welfare, and performance of birds (Miles *et al.,* 2004). Ammonia formation is directly controlled by factors such as pH, temperature, and the moisture level in the litter (Elliott and Collins, 1982; Carr *et al.,* 1990). Ammonia in the litter may contribute to further development of contact dermatitis (Bilgili *et al.,* 2009), although it does not seem to directly cause it (Martins *et al.,* 2013). The bacteria-generated ammonia dissolves at a high moisture level (Mayne *et al.,* 2007; Meluzzi *et al.,* 2008; Allain *et al.,* 2009) and forms an alkaline solution that acts as an irritant to the footpads and hocks. Application of alum [Al2(SO4)314H2O], which decreases either water-soluble phosphorus or ammonia volatilization individually or both. Alum is used as a cost-effective means to reduce ammonia volatilization from poultry litter in poultry houses (Moore *et al.,* 2004; Gilmour *et al.,* 2004). Litter treatments with chemical or microbiological products have positive effects on litter condition by reducing ammonia emission (Iwa´nczuk-Czernik *et al.,* 2007; Li *et al.,* 2008; Lee *et al.*, 2011). In the present study the treatment of corn cob litter material with organic acid significantly reduced the ammonia level and thereby increased the performance of broiler birds than birds reared on rice husk litter material.

Hock Burn Score

Out of total assessed birds, 98.39% and 67.59 % of birds from group B showed 0 score for hock burns while 73.81 and 41.96 % of birds from group A showed 0 score for hock burns at the end of 4^{th} and 6^{th} weeks of age (table 6) respectively. This indicated that, the percentage of 0 score for hock burns was highest in group B as compared to group A at the end of 4^{th} and 6^{th} weeks of age. At the end of 4^{th} weeks of age only 1.64 % of birds showed 1 score in group B as against 35.48 % birds in group A. Similarly, at the end of 6^{th} weeks of age 32.41 % of birds showed 1 score in group B while it was observed in 53.57 % of birds in group A. The 2 score for hock burn incidence was not observed in both the groups at the end of 4^{th} weeks of age. However, 4.46 % of birds from group A showed 2 score of hock burn incidence and there was no incidence of hock burns in group B at the end of 6^{th} weeks of age. The breast blister score was nil among the treatment as well as the control group. There was overall better hygiene of the broiler chicks due to less moisture, cake formation of litter in the litter-treated groups B than that of group A.

In most studies, litter moisture is cited as the most important factor for the occurrence of footpad dermatitis and hock burns (Clark *et al.,* 2002; Meluzzi *et al.,* 2008; Shepherd and Fairchild, 2010; De Jong *et al.,* 2014) found a strong positive correlation (0.89) between the moisture content of the litter and the occurrence of footpad dermatitis. Dawkins *et al.* (2004)

reported that the broiler birds had more hock lesions with wetter litter (score 2, r = 0.27). The significant decrease in the moisture content of litter material from group B may caused the lowered incidences of hock burns in group B than in group A.

Conclusions

The use of organic acid treated corn cob litter material was highly beneficial in significant increase in live body weights, body weight gains, feed intake and improving feed conversion ratio of broilers than untreated rice husk as bedding material. This significant improvement in the performance of broilers on organic acid treated corn cob might be due to significant decrease pH, moisture, and ammonia level in the litter. Moreover, the treatment of corn cob litter material with organic acid increased the nitrogen content of litter. The birds reared on the organic acid treated corn cob litter material showed low incidence of hock burns than in birds reared on untreated rice husk litter material.

References

[1] Allain, V., Mirabito, L., Arnould, C., Colas, M., Le Bouquin, S., Lupo, C. and Michel V. 2009. Skin lesions in broiler chickens measured at the slaughterhouse: relationships between lesions and between their prevalence and rearing factors. *Brit. Poult. Sci.* **50:** 407-417.

[2] AOAC. 1999. Official Methods of analysis, 16th edition. Association of Official Analytical Chemists, Washington, DC.

[3] Bilgili, S., J. Hess, J. Blake, K. Macklin, B. Saenmahayak, and Sibley J. 2009. Influence of bedding material on footpad dermatitis in broiler chickens. *J. Appl. Poult. Res.* **18:**583-589.

[4] Bjedov, S., Zikic, D., Peric, L., Dukic Stojcic, M. and Milosevic, N. 2013. Effect of different litter treatments on production performance of broiler chickens. *Biotechnol. in Anim. Husbandry*. **29**:625-630.

[5] Burgess, R. P., Carey, J.B., Shafer, D.J. 1998. The impact of pH on nitrogen retention in laboratory analysis of broiler litter. *Poult. Sci.* **77:**1620–1622.

[6] Carr, L.E., Wheaton, F.W., Douglass, L.W. 1990. Empirical models to determine ammonia concentrations from broiler chicken litter. *Trans. ASAE*. **33**:1337–1342.

[7] Clark, S., Hansen, G., McLean, P., Bond Jr., P., Wakeman, W., Meadows, R. and Buda, S. 2002. Pododermatitis in turkeys—Case report. *Avian Dis.* **46**:1038–1044.

[8] Choi, I.H., Moore, Jr. P.A. 2008. Effects of liquid aluminum chloride additions to poultry litter on broiler performance, ammonia emissions, soluble phosphorus, total volatile fatty acids, and nitrogen contents of litter. *Poult. Sci.* **87**:1955–1963.

[9] Dawkins, M., Christ, S., Donnelly, A. and Tracey A. Jones. 2004. Chicken welfare is influenced more by housing conditions than by stocking density. *Nature*. **427**: 342-344

[10] De Jong, I.C., Gunnink, H., Van Harn, J. 2014. Wet litter not only induces footpad dermatitis but also reduces overall welfare, technical performance, and carcass yield in broiler chickens. *J. Appl. Poult. Res.* **1**: 51–58.

[11] Eichner, G., Vieira, S.L., Torres, C.A., Coneglian, J.L.B., Freitas, D.M., and Oyarzabal, O. A. 2007. Litter moisture and foot pad dermatitis as affected by diets formulated on an all-vegetable basis or having the inclusion of poultry by-product. *J. Appl. Poult. Res.* **16**: 344–350.

[12] Elliott, H.A., Collins, N.E. 1982. Factors affecting ammonia release in broiler houses. *Trans Am Soc Agric Eng*. **25**:0413–0418.

[13] Ferguson, N.S., Gates, R.S., Taraba, J.L., Cantor, A.H., Pescatore, A.J., Straw, M.L, Forz, M.J., Burnham, D.J. 1998. The effect of dietary protein and phosphorus on ammonia concentration and litter composition in broilers. *Poult. Sci.* **77**:1085–1093.

[14] Garcês, A.; Afonso, S.M.S.; Chilundo, A. and Jairoce, C.T.S. 2013. Evaluation of different litter materials for broiler production in a hot and humid environment: 1. Litter characteristics and quality. *J. Appl. Poult. Res.* **22**:168-176.

[15] Garcia, R., Almeida, P.I., Caldara, F.R., Näas, I.A., Pereira, D.F., Freitas, L.W. and Graciano, J. 2010. Effect of the litter material on drinking water quality in broiler production. *Revista Brasileira de Ciencia Avicola* **12**:165-169.

[16] Gilmour, J.T., Koehler, M.A., Cabrera, M.L, Szajdak, L., Moore, P.A. 2004. Alum treatment of poultry litter: Decomposition and nitrogen dynamics. *J Environ Qual.* **33**:402–05.

[17] Guo, M., Song, W. 2009. Nutrient value of alum-treated poultry litter for land application. *Poult. Sci.* **88**:1782–1792.

[18] Haslam, S.M., Brown, S.N., Wilkins, L.J., Kestin, S.C., Warriss, P.D. & Nicol, C.J. 2006. Preliminary study to examine the utility of using foot burn or hock burn to assess aspects of housing conditions for broiler chickens. *British Poult Sci*, **47**. 13-18.

[19] Iwa nczuk-Czernik, K., Witkowska, D., Sowinska, J., Wojcik, A., and Mituniewicz, T. 2007. The effect of a microbiological and a disinfecting preparation on the physical an chemical properties of litter and the results of broiler chicken breedin, *Polish J. Natural Sci.* **22**: 395–406.

[20] Lazarevic, M., Resanovic, R., Vucicevic, I., Kocher, A., and Moran, C.A. 2014. Effect of feeding a commercial ammonia binding product De-Odorase™ on broiler chicken performance, *J. Appl. Anim. Nutr.* **2**: 6.

[21] Karamanlis, X., Fortomaris, P., Arsenos, G., Dosis, I., Papaioannou, D., Batzios, C. and Kamarianos, A. 2008. The effect of a natural zeolite (Clinoptilolite) on the performance of broiler chickens and the quality of their litter. *Asian-Austral J. Anim. Sci.* **21**:1642-1650.

[22] Lee, K.W., Lillehoj, H.S., Lee, S.H., Jang, S.I., Ritter, G.D., Bautista, D.A. and Lillehoj, E.P. 2011. Impact of fresh or used litter on the posthatch immune system of commercial broilers. *Avian Dis.* **55**:539-544.

[23] Li, H., Xin, H. Burns, R.T., and Liang, Y. 2008 Reduction of ammonia emissions from stored laying hen manure through topical application of zeolite, AlCClear, Ferix-3, or poultry litter treatment. *J. Appl. Poultry Res.* **17**: 421–431, 2008.

[24] Lynn, N.J., and H.H. Spechter. 1987. The effect of drinker design on broiler performance, water usage, litter moisture and atmospheric ammonia. FAC report No. 488, Gleadthorpe EHF, Meden Vale, Mansfield, Notts, UK.

[25] Martins, R.S., Hötzel, M.J., and Poletto, R. 2013. Influence of in-house composting of reused litter on litter quality, ammonia volatilisation and incidence of broiler foot pad dermatitis. *Brit. Poult. Sci.* **54**: 669-676.

[26] Mayne, R.K., Else, R.W. and Hocking, P.M. 2007. High litter moisture alone is sufficient to cause footpad dermatitis in growing turkeys. *Brit. Poult. Sci.* **48:** 538-545.

[27] McWard, G.W., Taylor, D.R. 2000. Acidified clay litter amendment. *J Appl. Poult. Res.* **9**:518–529.

[28] Meluzzi A, Fabbri C., Folegatti E, Sirri F. (2008). Survey of chicken rearing conditions in Italy: effects of litter quality and stocking density on productivity, foot dermatitis and carcase injuries. *Brit. Poult. Sci.* **49**: 257–264.

[29] Miles, D.M., Branton S.L., Lott, B.D. 2004. Atmospheric ammonia is detrimental to the performance of modern commercial broilers. *Poult. Sci.* **83**:1650– 1654.

[30] Monira, K.N., Islam, M.A., Alam, M. J. and Wahid, M. A. 2003. Effect of litter material on broiler performance and evaluation of manurial value of used litter in late autumn. *Asian-Austral. J. Anim. Sci.* **16**:555-557.

[31] Moore, P.A. Jr, Watkins, S., Carmen, D.C., DeLaune, B. 2004. Treating poultry litter with alum. University of Arkansas Cooperative Extension Fact Sheet (FSA8003-PD-1-04N).

[32] Nagaraj, M., Wilson, C.A.P., Saenmahayak, B., Hess, J.B., and Bilgili, S.F. 2007. Efficacy of a litter amendment to reduce pododermatitis in broiler chickens. *J. Appl. Poult. Res.* **16**: 255–261, 2007.

[33] Shepherd, E.M. and Fairchild, B.D. (2010). Footpad dermatitis in poultry. *Poult. Sci.* **89**:2043–2051.

[34] Skrbic, Z., Pavlovski, Z., Lukic, M.; Petricevic, V. and Milic, D. 2012. The effect of lighting program and type of litter on production and carcass performance of two broiler genotypes. *Biotechol. in Anim. Husbandry.* **28**:807-816.

[35] Swain, B. K. and Sundaram, R. N. S. 2000. Effect of different types of litter material for rearing broilers. *Brit. Poult. Sci.* **41**:261-262.

[36] Thomas, D.G., Ravindran, V., Thomas, D.V., Camden, B.J., Cottam, Y.H., Morel, P.C.H., Cook, C.J. 2004. Influence of stocking density on the performance, carcass characteristics and selected welfare indicators of broiler chickens. *New Zeal. Vet. J.* **52**: 76–81.

[37] Sahoo, S.P, Daljeet Kaur, A.P.S., Sethi, A. Sharma, M. Chandra and Chandrahas. 2017. Effect of chemically amended litter on litter quality and broiler performance in winter. *J. Applied Anim. Res.* **45**:1: 533-537

[38] Snedecor GW, Cochran WG. 1989. Statistical methods. 8th ed. New Delhi: Affiliated east-west press

[39] Younis, M.E.M., K.A.B. Eman, H.A. Ahmed and Elbestawy A.R. 2016. Broiler performance, carcass characters and litter composition after management of fresh litter with two types of acidifier amendment. *Int. J. Agri. Inno. Res.* **4**(6): 2319-1473.

Table: 1. Cumulative body weight, weight gain, feed intake and Feed Conversion Ratio (FCR) of broilers from 0-3 and 0-6 weeks period reared on different bedding material

Groups	Body weight		Weight gain		Feed Intake		FCR	
	0-3 weeks	0-6 weeks	0-3 weeks	0-6 weeks	0-3 weeks	0-6 weeks	0-3 weeks	0-6 weeks
Group A	777.675 ±11.076	2330.910^{b} ±39.208	731.045 ±11.052	2284.280^{b} ±39.144	981.648 ±20.776	3590.075^{a} ±49.293	1.262 ±0.016	1.541^{a} ±0.011
Group B	810.902 ±16.367	2494. 348^{a} ±26.532	764.643 ±16.172	2448.090^{a} ±26.476	1028.150 ±17.305	3740.683^{b} ±26.590	1.269 ±0.021	1.500^{b} ±0.012
CV	4.309	3.399	4.537	3.437	4.660	2.647	3.621	1.884
CD	NS	150.024**	NS	149.680**	NS	124.784*	NS	0.037*

Means bearing different superscript within the column differ significantly, * (P<0.05), ** (P<0.01). CV-Coefficient of Variation, CD-Critical Difference, NS-Non significant

Table 2: Percent nitrogen content of different bedding material on dry matter basis (Mean±SE) at weekly interval

Groups	I WK	II WK	III WK	IV WK	V WK	VI WK
Group A	1.090 ±0.130	1.430 ±0.089	1.270^{b} ±0.048	1.418^{b} ±0.064	1.430^{b} ±0.048	1.478 ±0.039
Group B	1.137 ±0.063	1.562 ±0.058	2.095^{a} ±0.101	2.092^{a} ±0.061	1.747^{a} ±0.061	1.563 ±0.108
CV	22.483	12.296	11.521	8.712	8.511	13.111
CD	NS	NS	0.355**	0.280**	0.247**	NS

Means bearing different superscript within the column differ significantly, * (P<0.05), ** (P<0.01). CV-Coefficient of Variation, CD-Critical Difference, NS-Non significant

Table 3: pH (Mean±SE) of different bedding material at weekly interval

Groups	I WK	II WK	III WK	IV WK	V WK	VI WK
Group A	6.608^{a} ±0.073	6.791^{a} ±0.105	7.519^{a} ±0.038	7.094^{a} ±0.063	7.462^{a} ±0.074	7.408^{a} ±0.109
Group B	6.475^{b} ±0.073	5.435^{b} ±0.032	6.821^{b} ±0.126	6.663^{b} ±0.078	6.613^{b} ±0.072	6.393^{b} ±0.115
CV	4.718	5.405	5.499	4.390	4.388	6.908
CD	NS	0.300**	0.359**	0.275**	0.281**	0.433**

Means bearing different superscript within the column differ significantly, * (P<0.05), ** (P<0.01). CV-Coefficient of Variation, CD-Critical Difference, NS-Non significant

Table 4: Percent moisture (Mean±SE) content of different litter material at weekly interval

Groups	I WK	II WK	III WK	IV WK	V WK	VI WK
Group A	16.267[a] ±0.986	19.087 ±1.168	41.351 ±1.059	52.401[a] ±1.153	51.180[a] ±1.289	54.174[a] ±1.177
Group B	12.331[b] ±0.235	16.631 ±0.584	38.339 ±1.152	41.121[b] ±1.795	46.943[b] ±1.065	47.312[b] ±1.041
CV	21.264	21.940	11.782	13.688	10.225	9.199
CD	2.765**	NS	NS	5.820**	3.398*	4.286**

Means bearing different superscript within the column differ significantly, * (P<0.05), ** (P<0.01). CV-Coefficient of Variation, CD-Critical Difference, NS-Non significant

Table 5: Ammonia level (ppm) of different litter material at 6th weeks of age

Groups	Ammonia level (ppm)
Group A	30.167[a]±1.893
Group B	18.889[b]±2.464
CV	38.004
CD	8.476**

Means bearing different superscript within the column differ significantly, * (P<0.05), ** (P<0.01). CV-Coefficient of Variation, CD-Critical Difference, NS-Non significant

Table 6: Hock Burn Score of broilers reared on different litter material at 4th and 6th weeks of age

	Hock burn score	4th week		6th week	
		Group A	Group B	Group A	Group B
Number of birds assessed	0 score	93	122	47	73
	1 score	33	2	60	35
	2 score	0	00	5	00
	Total birds	**126**	**124**	**112**	**108**
% Score	% 0 score	73.81	98.39	41.96	67.59
	% 1 score	35.48	1.64	53.57	32.41
	% 2 score	0.00	0.00	4.46	00

(0= no hock burns; 1 = mild hock burns and 2= severe hock burns)