RESEARCH ARTICLE

Effect of Chemically Altered Litter on Welfare Parameters of Commercial Broiler Chicken

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Abstract

The experiment was conducted to study the effect of chemically treated litter on the welfare parameters of commercial broiler chicken. A total of 144 straight-run day-old commercial broiler chicks were distributed randomly into six treatment groups, each group consisted of four replications, each of 6 chicks. The experiment was conducted in two different seasons, winter and monsoon, each of 6 weeks duration. The treatments included: T_1 (control, rice husk as litter material); T_2 (rice husk litter treated with alum @ 90 g/sq.ft.), T_3 (litter treated with boric acid, H_3BO_3, @ 24 g/sq.ft.; T_4 (litter altered with sodium bisulphate ($NaHSO_4$) @ 25 g/sq.ft.); T_5 (litter treated with commercially available probiotic product @ 1 g/ sq.ft); and T_6 (litter treated with commercially available *Yucca schidigera* liquid solution @ 1.0 mL/ sq.ft). The chemical alteration of litter (T_2 to T_6) was done on the 1st, 15th and 29th days of the experiment period. The percentage of footpad lesions with 0 score was found higher in T2 in both the seasons followed by T_3, T_4, T_6, T_5 and T_1 in winter and by T_6, T_3, T_4, T_5, and T_1 in monsoon. Similarly, the hock burn percentage was found higher in T_2 in both seasons followed by T_3, T_6, T_4, T_5, and T_1 in winter and by T_3, T_4, T_6, T_5, and T_1 in monsoon. A higher 0 score percentage indicated improved welfare parameters. In both seasons, there were no blister sores on the breast. Based on the overall result of the present experiment, it can be concluded that the broiler birds reared on rice husk litter material treated or amended with alum @ 90 g/sq.ft had decreased the footpad and hock burn lesions than the control and other treatment groups.

Key words: Broiler chicken, Commercial, Litter amendment, Welfare parameter.

Ind J Vet Sci and Biotech (2023): 10.48165/ijvsbt.19.1.07

Introduction

The Indian poultry industry has emerged as the most dynamic and fast-expanding segment of the agro-animal-based industry. Population growth, rapid urbanization, altered lifestyles, shifting food habits, and increased per capita income; all contribute to the increasing demand for poultry products. As a result, the broiler industry is one of the most successful and valuable agricultural businesses. Most broilers are raised on litter, and they spend most of their time in close contact with litter material. Hence, litter quality has a major effect on the performance and health of broilers (Nagaraj *et al.,* 2007). The poultry litter used for broiler raising is a source of released ammonia and its amelioration is a principal factor that influences the health status and performance of birds (Rashid *et al.,* 2017). The addition of various chemicals on litter material improved the bird production performance and welfare parameters because of better litter conditions and minimum levels of microorganism. Caked litter increases the ammonia level, thus negatively affecting the broiler's health, welfare, growth performance, and carcass quality (Miles *et al.,* 2004).

Broiler litter is a mixture of a substrate with the excreta of birds and may produce many detrimental bacteria that may develop, such as *Salmonella spp , Campylobacter spp., Escherichia coli, Clostridium perfringens, and Staphylococcus aureus* (Taboosha, 2017). Commercial broiler chicks are grown in an open-sided deep litter system in which the birds spend the majority of their time on the litter and their footpads, hocks, and breasts are continuously in contact with the bedding material on the floor. As a result, the type, quantity, and quality of litter material determine the extent to which hock burns, footpad dermatitis, leg deformities, breast burns, and blisters develop (Bilgili *et al.,* 2009). Many previous studies used only a few compounds to investigate the influence of litter amendment. However, no definitive conclusion could be made, particularly in the context of India. Therefore, the present study was aimed to assess the comparative effect of

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How to cite this article: Patel, J. V., Trivedi, M. M., Rajpura, R. M., & Modi, R. J. (2023). Effect of Chemically Altered Litter on Welfare Parameters of Commercial Broiler Chicken. Ind J Vet Sci and Biotech. 19(1), 27-31.

Source of support: Nil

Conflict of interest: None

Submitted: 10/10/2022 **Accepted:** 25/12/2022 **Published:** 10/01/2023

different chemical treatment of litter on welfare parameters of commercial broiler chicken.

Materials and Methods

Total 144 day-old commercial straight run broiler chicks from a single hatch acquired from commercial hatcheries, Anand, Gujarat (India) were used for the experiment. Chicks were weighed individually, wing banded, and distributed randomly into six treatment groups; each of four replicates with six chicks in each replicate. The treatments included: T_1 (Control, Rice husk as litter material), T_2 (rice husk mixed with Alum @ 90 g/sq.ft., T_3 (with Boric acid (H_3BO_3) @ 24 g/sq.ft., T_4: with Sodium Bisulphate ($NaHSO_4$) @ 25 g/sq.ft.), T_5 (with commercially available probiotic product @ 1 g/sq.ft) and T_6 (with commercially available *Yucca schidigera* liquid solution @ 1.0 mL/sq.ft. The birds were raised in a deep litter type of housing system with the fresh rice husk as litter (bedding) material. The chemical treatment of litter (T_2 to T_6) was done on the 1st, 15th and 29th days of the experimental period. The feed was prepared as per the nutrient specification for the broiler recommended by Anonymous (2007) standard.

The experiment was conducted in two different seasons. Experiment-I was conducted in the winter season (WS, December-January) and experiment-II was conducted in the monsoon season (MS, August-September) for six weeks duration each. The average minimum and maximum temperatures during the winter season were 14.40 and 27.08 °C, with minimum and maximum relative humidity of 49.03 and 84.31 %, respectively. The corresponding averages for temperature in the monsoon season were 26.08 and 32.25 °C, and relative humidity 71.36 and 89.65 %, respectively. The floor space per bird given was @ 0.5 ft^2 for 1-2 weeks of age, 1.0 ft^2 for 3-4 weeks of age, and 1.5 ft^2 for 5-6 weeks of age. All six groups were raised under similar environmental and management conditions, except for the litter treatment/alteration. A digital hanging balance was used to calculate the weight of the litter, and the same amount of litter was used in each replicate. A thickness of 5 to 7 centimeters was maintained throughout the experiment. Proper spreading and timely stirring of the litter material was done to keep the thickness uniform. Vaccination was done at timely intervals to maintain healthy flocks. Biosecurity measures were strictly observed throughout the experimental period. At the entrance of the experimental shed, liquid phenyl solution was added daily as biosecurity measures.

Welfare parameters studied at the end (42nd day, 6th week) of the experiment were footpad lesions, hock lesions, and breast blisters. Footpad and hock burn lesions were scored on a five-point scale ranging from 0 to 4. A score of 0 was considered as good, while a score of 4 was considered as bad (Kaukonen *et al.,* 2016). The breast blister was graded on a scale of 0 to 2 on a three-point scale. A score of 0 was seen as excellent, while a score of 2 was regarded as poor (Nielsen, 2004).

Results and Discussion

Footpad Lesions

The findings on footpad lesions scores 0 to 4 in broilers under experiment I and II, *i.e.* winter and monsoon, are depicted in Table 1. The footpad lesions (%) with 0 scores during experiment-I (winter) were found to be highest in T_2 followed by T_3, T_4, T_6, T_5, and lowest in T_1. The footpad lesions (%) with 1 score were higher in T_5 followed by T_1, T_6, T_4, T_3, and lower in T_2. The footpad lesions with 2 scores during winter were seen only in T_1 at 4.35% (Table 1). During experiment-II (monsoon), the footpad lesions (%) with 0 scores were observed higher in T_2 followed by T_6, T_3, T_4, T_5, and T_1. The footpad lesions (%) with 1 score were found higher in T_1 followed by T_5, T_3, T_4, T_6, and lower in T_2. The footpad lesions (%) with 2 scores were found marginally different with higher values in T_1 followed by T_5, T_4, T_3, T_6, and lower in T_2. However, no lesions of scores 3 and 4 were noted in any of the seasons under any of the treatments (Table 1).

Similar to present findings Bjedov *et al.* (2013) recorded a lower incidence of footpad lesions (%) in chopped straw with the addition of microbial preparation (16.67) than in unchopped straw (36.02), chopped straw (20.09), and unchopped straw with the addition of microbial products (33.00) with respective score 3. Furthermore, Purswell *et al.* (2013) found significantly ($p<0.05$) higher incidence of footpad lesions in the negative control litter compared to one treated with sodium bisulfate on different days. However, Sahoo *et al.* (2017) noted only one bird with a footpad scored 3 in the control group compared to the alum and sodium bisulphate treated groups. Toppel *et al.* (2018) discovered a reduced incidence of footpad lesions with different concentrations of sodium bisulfate complex (SBS) (150 and 250 g/m^2) compared to untreated litter. Rashid *et al.* (2017) observed higher erosion of skin on birds' feet, ulcers, scabs, and swollen footpads in the control group, while mild lesions were found in litter treated with calcium carbonate @ 50 g/kg or no lesions were found in litter treated with alum @ 25 g/kg and litter treated with @ 25 g alum and @ 50 g calcium carbonate/kg. Unlike present observations Oliveira *et al.* (2015) reported non-significant variation in footpad lesions (%) among the aluminium sulfate, gypsum, dolomitic limestone, and charcoal treated groups, as well as the control group. Similar to current findings Mohammed (2019) also reported significantly ($p<0.01$) higher (100%) incidence of footpad lesion score 3 in litter treated with alum (UT-2.50) compared to litter without alum.

Hock Burn Lesions

The hock burn lesions (%) with 0 scores during experiment-I (winter) were found to be higher in T_2 followed by T_3, T_6, T_4, T_5, and lower in T_1. Furthermore, the hock burn lesions (%) with 1 score were found higher in T_1 followed by T_5, T_4, T_6, T_3, and lower in T_2. The hock burn lesions (%) with 2 score

was found only in T_1 (4.35), and no hock burn scores 3 and 4 were observed in any of the groups (Table 2). During experiment-II (monsoon), the hock burn lesions (%) with 0 scores were found to be the highest in T_2 followed by T_3, T_4, T_6, T_5, and T_1. The corresponding hock burn lesions (%) with 1 score were higher in T_2, T_3 followed by T_6, T_4, T_5, and T_1. During monsoon, the hock burn lesions (%) with 2 scores were found to be higher in T_1 and T_5 followed by T_6, T_3, T_4, and lower in T_2. The corresponding hock burn lesions (%) with 3 scores were also found to be higher in T_1 followed by T_5, T_6, T_4, T_3, and no lesion was seen in T_2. The hock burn lesion with 4 scores was found only in control T_1 (8.70 %). Thus during monsoon season, the hock burn lesions scores 2, 3 and 4 were found higher in T_1 than in other treatment groups (Table 2). It was noticeable that 0 score footpad lesions and hock burn lesions were lower in monsoon as compared to winter but score 1 lesions were higher in monsoon as compared to winter.

Table 1. Footpad lesions of broilers in different litter treatments at the end of the experiment in winter and monsoon seasons

Footpad score	T_1	T_2	T_3	T_4	T_5	T_6
Experiment-I (Winter): Number of birds assessed (% of score)						
0	13 (56.52)	20 (83.33)	17 (73.91)	17 (70.83)	14 (58.33)	16(69.56)
1	9 (39.13)	4 (16.67)	6 (26.09)	7 (29.17)	10 (41.67)	7 (30.44)
2	1 (4.35)	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
Total	**23 (100.00)**	**24 (100.00)**	**23 (100.00)**	**24 (100.00)**	**24 (100.00)**	**23 (100.00)**
Experiment-II (Monsoon): Number of birds assessed (% of score)						
Footpad score	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**
0	4 (17.39)	14 (58.33)	11 (45.83)	10 (41.67)	9 (39.13)	11 (45.83)
1	14 (60.87)	9 (37.50)	11 (45.83)	11 (45.83)	11 (47.83)	11 (45.83)
2	5 (21.74)	1 (4.17)	2 (8.33)	3 (12.50)	3 (13.04)	2 (8.33)
3	0	0	0	0	0	0
4	0	0	0	0	0	0
Total	**23 (100.00)**	**24 (100.00)**	**24 (100.00)**	**24 (100.00)**	**23 (100.00)**	**24 (100.00)**

Figures in parentheses indicate the percentage of welfare score.

Table 2: Hock burn score of broilers in different litter treatments at the end of the experiment in winter and monsoon seasons

Hock burn score	T_1	T_2	T_3	T_4	T_5	T_6
Experiment-I (Winter): Number of birds assessed (% of score)						
0	11 (47.83)	21(87.50)	17 (73.91)	16 (66.67)	14 (58.33)	16 (69.57)
1	11 (47.83)	3 (12.50)	6 (26.09)	8 (33.33)	10 (41.67)	7 (30.43)
2	1 (4.35)	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
Total	**23 (100.00)**	**24 (100.00)**	**23 (100.00)**	**24 (100.00)**	**24 (100.00)**	**23 (100.00)**
Experiment-II (Monsoon): Number of birds assessed (% of score)						
0	6 (26.09)	12 (50.00)	10 (41.67)	10 (41.67)	8 (34.78)	9 (37.50)
1	7 (30.43)	11 (45.83)	11 (45.83)	10 (41.67)	8 (34.78)	10 (41.67)
2	4 (17.39)	1 (4.17)	2 (8.33)	2 (8.33)	4 (17.39)	3 (12.50)
3	4 (17.39)	0	1 (4.16)	2 (8.33)	3 (13.04)	2 (8.33)
4	2 (8.70)	0	0	0	0	0
Total	**23 (100.00)**	**24 (100.00)**	**24 (100.00)**	**24 (100.00)**	**23 (100.00)**	**24 (100.00)**

Figures in parentheses indicate the percentage of welfare score.

In the present experiment, moisture was lower in the alum and boric acid supplement groups, so the incidence of welfare parameters was less in these groups. In our experiment, the moisture percentages ranged from 11-34% and 13-43% during winter and monsoon season, respectively. Therefore, a higher incidence of footpad and hock burn lesions with 2 and 4 scores was found in monsoon with higher moisture (21.74 & 17.39% respectively) as compared to winter season (4.35 & 4.35%, respectively). The present findings suggest that litter wetness is the most critical determinant in the development of footpad and hock burn lesions in broiler chicks, this is also supported by many previous studies (Meluzzi *et al.,* 2008; Shepherd and Fairchild, 2010; De Jong *et al.,* 2014). Similar to our observations, lower incidence of hock burn lesions recorded in acid treated group (Lonkar *et al*., 2018) and 150 and 250 g/m^2 of sodium bisulfate complex group (Toppel et al., 2018) compared to untreated litter. The current findings however differ from those of Oliveira *et al.* (2015), wherein the hock burn lesions percentages were non-significant amongst the aluminum sulfate, gypsum, dolomitic limestone, and charcoal treated groups, as well as the control group. In general, in the present study, the incidence of footpad and hock burn scores were lower in the alum and sodium bisulpate groups compared to other treatment groups, but the control group had a greater incidence of welfare parameters.

Breast Blisters

There were no blister sores on the breast in any experiment. The present results were in accordance with the findings of Sahoo *et al.* (2017), who also noted absence of breast blisters in the alum, sodium bisulphate treated groups as well as in the control group, while Onbasilar *et al.* (2013) found non-significant difference in breast blister (%) with 4 and 8% of the *Yucca schidigera* groups and the untreated group. Furthermore, Avcilar *et al.* (2018) revealed that the feather score and skin injury were non-significant in all sepiolite amended litter groups.

Conclusions

The present experiment concluded that the welfare parameters such as hock burns and footpad lesions were significantly lower in the broilers reared on the rice husk litter treated with alum @ 90 g/sq.ft area as compared to the control group and the litter treated with boric acid @ 24 g/ sq.ft.; sodium bisulphate @ 25 g/ sq.ft.; commercially available probiotic product @ 1 g/ sq.ft; or with commercially available *Yucca schidigera* liquid solution @ 1.0 ml/ sq.ft. Furthermore, no adverse effect was observed in any of the groups in the breast blister parameter.

Acknowledgement

The authors wish to thank the principal, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand, for providing facilities to conduct this study.

References

Anonymous. (2007). Bureau of Indian Standards (IS 1374: 2007). *Poultry Feeds – Specification.* Fifth Revision, New Delhi India.

Avcilar, O.V., Kocakaya, A., Onbasilar, E.E., & Pirpanahi, M. (2018). Influence of sepiolite additions to different litter materials on performance and some welfare parameters of broilers and litter characteristics. *Poultry Science*, *97*(9), 3085-3091.

Bilgili, S., Hess, J.B., Macklin, K.S., Saenmahayak, B., & Sibley, J.L. (2009). Influence of bedding material on footpad dermatitis in broiler chickens. *Journal of Applied Poultry Research, 18*(3), 583-589.

Bjedov, S., Zikic, D., Peric, L., Dukic S., & Milosevic, N. (2013). Effect of different litter treatments on the production performance of broiler chickens. *Biotechnology in Animal Husbandry*, *29*(4), 625-630.

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. *The Journal of Applied Poultry Research, 1,* 51-58.

Kaukonen, E., Norring, M., & Valros, A. (2016). Effect of litter quality on footpad dermatitis, hock burns, and breast blisters in broiler breeders during the production period. *Avian Pathology, 45*(6), 667- 673.

Lonkar, V.D., Ranade, A.S., Kulkarni, V.R., Pathak, C.B., Yenge, G.D., & Daware, A.G. (2018). Effect of organic acid-treated corn cob bedding material on broiler performance, hock burn Incidence, and litter quality. *International Journal of Science, Environment and Technology, 7*(2), 397-409.

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 carcass injuries. *British Poultry Science, 49,* 257-264.

Miles, D.M., Branton, S.L., & Lott, B.D. (2004). Atmospheric ammonia is detrimental to the performance of modern commercial broilers. *Poultry Science, 83*(10), 1650-1654.

Mohammed, A. (2019). Possibility of broiler production on reused litter. *Egyptian Poultry Science Journal, 39*(2), 405-421.

Nagaraj, M., Wilson, C.A.P, Saenmahayak, B., Hess, J.B., & Bilgili, S.F. (2007). Efficacy of a litter amendment to reduce pododermatitis in broiler chickens. *Journal of Applied Poultry Research, 16*(2), 255-261.

Nielsen, B.L. (2004). Breast blisters in groups of slow-growing broilers in relation to strain and the availability and use of perches. *British Poultry Science, 45*(3), 306-315.

Oliveira, M.C., Goncalves, B.N., Padua, G.T., Silva, V.G., Silva, D.V. & Freitas, A.M. (2015). Treatment of poultry litter does not improve performance or carcass lesions in broilers. *The Revista Colombiana de Ciencias Pecuarias, 28*(4), 331-338.

Onbaşilar, E.E., Erdem, E, Unal, N., Kocakaya, A., & Torlak, E. (2013). Effect of *Yucca schidigera* spraying in different litter materials on some litter traits and breast burn of broilers at the fifth week of production. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi, 19*(5), 749-753.

Purswell, J.L., Davis, J.D., Kiess, A.S., & Coufal, C.D. (2013). Effects of frequency of multiple applications of litter amendment on litter ammonia and live performance in a shared airspace. *Journal of Applied Poultry Research*, *22*(3), 469-473.

Rashid, A., Banday. M.T., Adil. S., Khan, A.A., Saim Qureshi, S., Madeeha Untoo, M., & Ashraf, P. (2017). Effect of chemically treated litter on ammonia emission, performance and carcass

characteristics of broiler chicken. *Journal of World Poultry Research, 7*(2), 88-93.

Sahoo, S.P., Kaur, D., Sethi, A.P.S., Sharma, A., Chandra, M., & Chandrahas, (2017). Effect of chemically amended litter on litter quality and broiler performance in winter. *Journal of Applied Animal Research*, *45*(1), 533-537.

Shepherd, E.M. & Fairchild, B.D. (2010). Footpad dermatitis in poultry. *Poultry Science, 89,* 2043-2051.

Taboosha, M.F. (2017). Effect of reusing litter on productive performance, carcass characteristics and behavior of broiler chickens. *International Journal of Environment, 6*(2), 61-69.

Toppel, K., Kaufmann, F., Schon, H., Gauly, M., & Andersson, R. (2018). Effect of pH-lowering litter amendment on animal-based welfare indicators and litter quality in European commercial broiler husbandry. *Poultry Science, 98*(3), 1181-1189.