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Effect of Chemical Treatment of Litter on its Quality and Footpad Lesions of Broiler Chicken

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ABSTRACT

A study was conducted to determine the effect of two chemicals (alum and calcium carbonate) on litter quality and footpad lesions of broiler chicken. 208, one-week old commercial broiler chicks were used and randomly distributed into 4 treatments of 4 replicates with 13 chicks each. The treatments were T1: control in which no chemical was added to litter; T2: Litter treated with alum @ 25g/kg; T3: Litter treated with calcium carbonate @ 50g/kg and T4: Litter treated with 25g alum and 50g calcium carbonate/kg. Litter condition (moisture, pH, nitrogen and total viable count) and foot pad lesions were evaluated. The results revealed a significant ($p<0.05$) reduction in the moisture content and pHof litter material in alum treated groups compared to T3 and control. Total nitrogen content of litter showed a significant ($p<0.05$) increase in in alum treated groups compared to T3 and control. A significant ($p<0.05$) reduction in total viable count was observed in all the treatment groups with best results in alum treated groups (T2 and T4). In control group birds had severe lesions like erosion of skin on their feet, ulcers and scabs, signs of hemorrhages and swollen footpads but only mild (T3) or no lesions (T2 and T4). It may be concluded that litter amendment in broiler chicken especially with alum is highly useful in improving the litter quality and welfare of birds in terms of reducing the incidence of footpad dermatitis.

1. Introduction

In India, most of the poultry production is done in deep litter system wherein an absorbent litter material is used on floor for rearing of birds. Commonly used litter materials in various parts of the world are sawdust, wood shavings, chopped straws, seeds and hulls, cardboard peat, sand etc.

(Lopes *et al.,* 2013). Quality of litter plays a vital role as it has influence on the health, performance and carcass quality parameters and welfare of broilers (Đukić Stojčić *et al.,* 2016). Wet litter results in high ammonia production that has negative effect on performance of birds, so it must be kept dry (Ritz *et al.,* 2006). Wu and Hocking, 2011 reported that litter moisture more than 30% leads to impaired foot pad condition. Litter condition has been considered to be the most important factor leading to foot pad lesions in broiler chicken (Mayne *et al.,* 2007). The footpad condition is an important aspect of poultry welfare that in severe cases can cause pain, unsteady walk, reduced feed intake and weight gain due to pain-induced decreases in feed intake (Hester *et al.,* 1997; Berg, 2004).

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Foot pad dermatitis is a type of contact dermatitis which is a condition wherein skin areas are affected which are in contact with unsuitable or irritating material (Greene *et al.,* 1985). Various litter amendments with chemical and microbiological products are often used to improve litter condition and reducing the occurrence of footpad dermatitis (Shepherd *et al.,* 2010). In view of the correlation between litter condition and bird welfare in terms of footpad dermatitis, the present study was undertaken with the objective to assess the effect of two chemicals (alum and calcium carbonate) on litter quality anffootpad lesions of broiler chicken.

2. Materials and Methods

The experimental protocol was approved by the Institutional Animal Ethics Committee. The experiment was conducted at the Research Farm of the Division of Livestock Production and Management, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shuhama, Srinagar, India. A total of 208 day old Cobb broiler chicks were procured from a reputed source and reared together in battery cages until 7 days of age. On 8^{th} day, the chicks were randomly distributed into four treatment groups, each having 4 replicates of 13 chicks. The litter material used was saw dust which is cheap and readily available in Indian subcontinent. Alum and calcium carbonate were procured from the market and added to fresh litter by top dressing onto its surface. The treatments were T1: control in which no chemical was added to litter; T2: Litter treated with alum @ 25g/kg; T3: Litter treated with calcium carbonate @ 50g/kg and T4: Litter treated with 25g alum and 50g calcium carbonate/kg. Chicks of each replicate were housed in individual floor pens on deep litter for a period up to 6 weeks of age. Birds had free access to feed (commercially available) and water throughout and were maintained on a constant 24 hours light schedule. All chicks were vaccinated against New castle disease with F_1 strain vaccine and Infectious bursal disease with B_2K vaccine on 5^{th} and 16^{th} day of age respectively in accordance with regional veterinary authority. All the treatment groups were maintained in similar rearing conditions as per the standard protocol.

A litter sample was collected weekly from five locations within each pen (four peripheral, equidistant from each pen corner, and one central) and thoroughly mixed to obtain material representative of the entire pen. At least 200 g of litter was stored in a plastic container and refrigerated until a subsample was analyzed in the laboratory. The moisture and pH of litter material was determined at the end of each week by using the standard procedure of Association of Official Analytical Chemists (AOAC, 2005a and b). Soluble reactive phosphorous was determined at the end of each week using the ascorbic acid technique with an auto-analyzer, according to the American Public Health Association method (APHA, 1992). Total Viable count was estimated by using method of American Public Health Association (1992). The colony forming unit per gram (cfu/g) was calculated by taking average number of colonies which were multiplied by reciprocal of the dilution factor and expressed as log cfu/g of contents. Foot pad condition of the birds in various treatment groups was recorded at the end of the trial.

Data generated was grouped and tabulated treatment wise and analyzed using Analysis of variance (ANOVA) as per Snedecor and Cochran, 1980. The difference within the groups was estimated using Duncan's Multiple range test (Duncan, 1955). Statistical software SPSS 15.00 was used for analysis.

3. Results and Discussion

The results of weekly moisture percentage of litter material in different groups have been shown in Figure 1. There was a significant ($p>0.05$) reduction in the litter moisture percentage in alum treated groups (T2 and T3) when compared with the control group. However, there was no significant ($p>0.05$) difference in the moisture percentage in the litter material treated with calcium carbonate (T2) when compared with the control group. These results are somewhat consistent with those of Do *et al.* (2005) and Choi and Moore (2008a) who reported that chemical amendments with alum and calcium carbonate resulted in decrease in the moisture content of poultry litter. The decrease in the litter moisture content by alum treatment and combination of alum and calcium carbonate treatment might be due to hygroscopic nature of alum. However, calcium carbonate being non-hygroscopic substance, did not reduce the moisture content of litter material. Litter wetness has been considered to be the most important factor leading to foot pad lesions in Poultry birds (Mayne *et al.,* 2007).

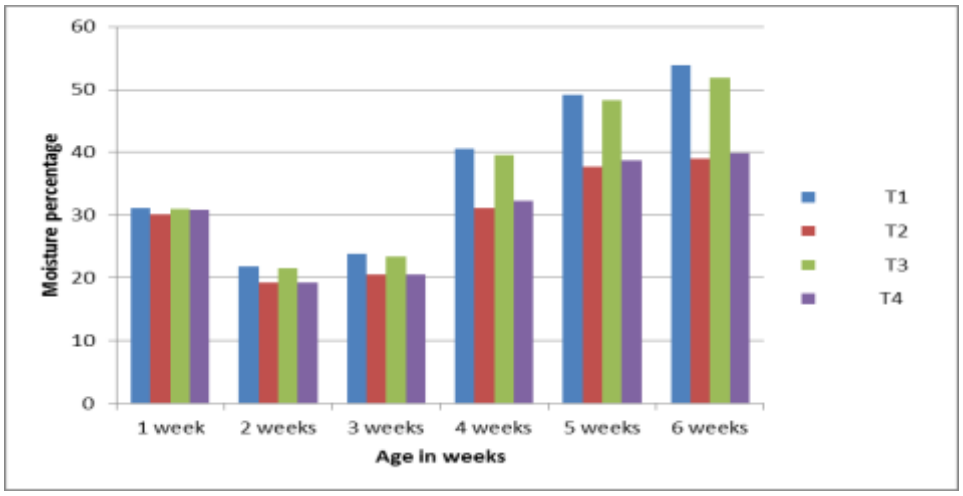


Fig. 1: Litter moisture percentage due to chemically amendment during different weeks

The results of weekly pH value of litter material in different groups have been shown in Figure 2. There was a significant ($p>0.05$) reduction in the litter pH in alum treated groups (T2 and T3) when compared with the control group. However, there was no significant ($p>0.05$) difference in moisture percentage of litter material treated with calcium carbonate (T2) when compared with the control group. These results are in harmony with Kim and Choi (2009) who reported that the addition of alum to poultry litter decreased litter pH significantly. The decrease in litter pH might be due to the fact that alum being highly acidic, leads to the reduction in pH of litter. The lower pH values in turn decreases harmful ammonia production from the litter (Smith *et al.*, 2001), thus protecting welfare of birds.

The results of weekly total nitrogen content of litter material in different groups have been shown in Figure 3. There was a significant ($p>0.05$) increase in the litter total nitrogen content of litter in alum treated groups (T2 and T3) when compared with the control group. However, there was no significant ($p>0.05$) difference in total nitrogen content of litter material treated with calcium carbonate (T2) when compared with the control group. These results are in harmony with the results of Lee *et al.* (2013) who observed an increase in the total nitrogen content of litter after the addition of alum. The improvement in nitrogen content in litter was probably due to acidification of litter, which reduced pH in litter and converted NH_3 to NH_4^+, a non-volatile substance. In general, the majority of the nitrogen in alum treated litter was in the ammoniacal form which could be easily available for plant uptake, thus improving the manuring value of litter material.

Data regarding total viable count of litter material in different groups have been shown in Figure 4. There was a significant ($p>0.05$) reduction in the total viable count of litter in alum treated groups (T2 and T3) when compared with the control group. However, there was no significant ($p>0.05$) difference in total viable count of litter material treated with calcium carbonate (T2) when compared with the control group. These results are consistent with Rothrock *et al.*, 2008 who reported a significant ($p>0.05$) reduction in bacterial count due to application of alum to the litter. The reduction in the litter microbial population is dependent on pH (Fries *et al.*, 2005) and moisture content (Carr *et al.*, 1985). Atilgan *et al.*, 2010 reported that controlling the moisture level could reduce the ammonia volatilization which is responsible for reduction in bacterial proliferation primarily caused by wet litter and high level of ammonia.

The birds reared on litter material in which no chemical amendment was done had severe lesions showing erosion of skin on their feet, ulcers and scabs, signs of haemorrhages and swollen footpads (Fig. 5a). In alum treated group (T2), the birds had no lesions or very small superficial lesions with slight discoloration on a limited area of the footpad (Fig. 5b). In calcium carbonate group (T4), the birds had mild lesions showing discoloration of the footpad with superficial lesions and mild hyperkeratosis (Fig. 5c). In T4, wherein combination of alum and calcium carbonate were used, the birds showed mild hyperkeratosis with thickening of outer layer of footpad skin or healed area (Fig. 5d). Various litter amendments with chemical and microbiological products have been reported to reduce the occurrence of footpad dermatitis in poultry birds (Shepherd *et al.,* 2010), thus justifying the results of present study and restoring the bird welfare.

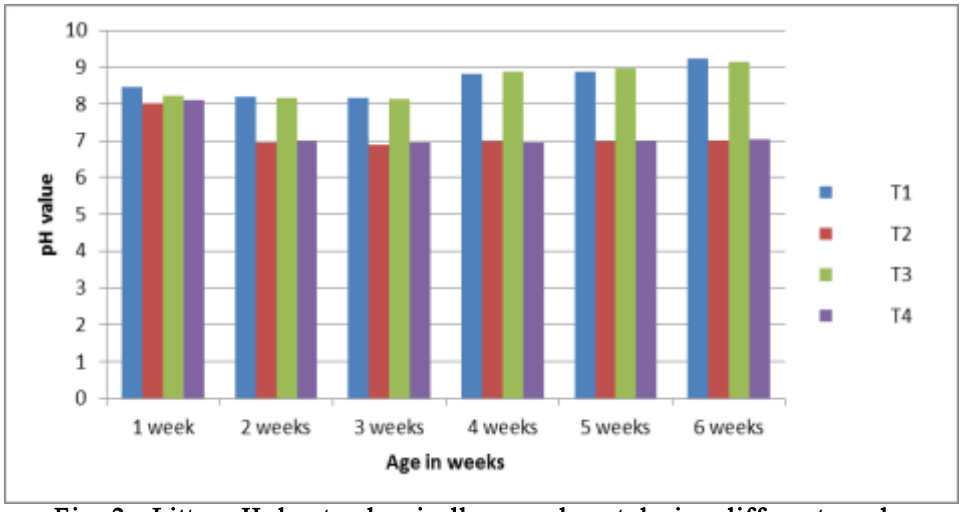


Fig. 2 : Litter pH due to chemically amendment during different weeks

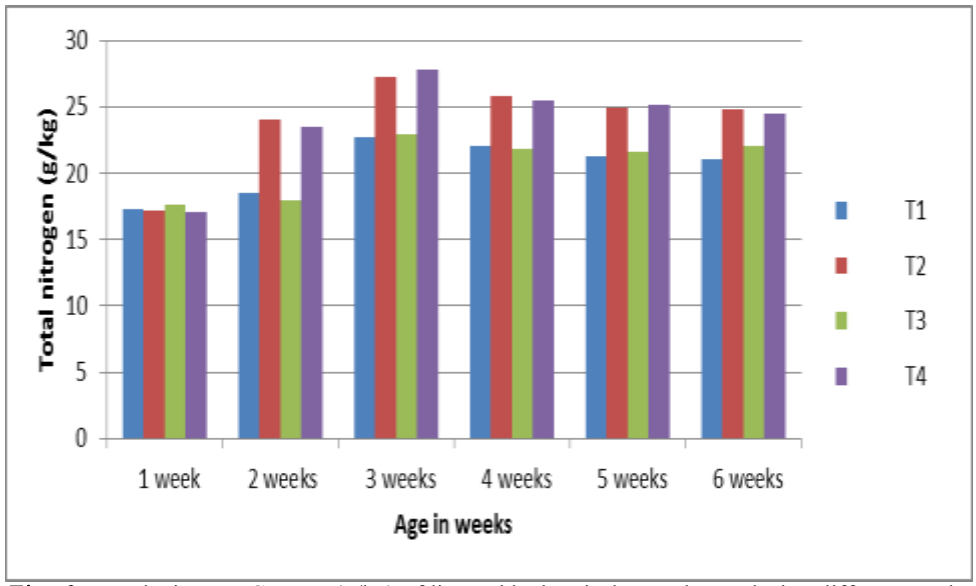


Fig. 3: Total Nitrogen Content (g/kg) of litter with chemical amendment during different weeks

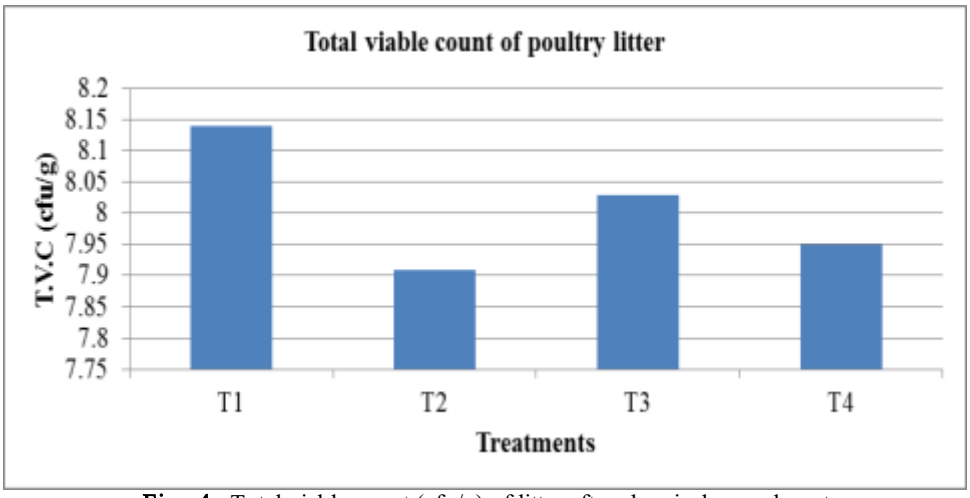
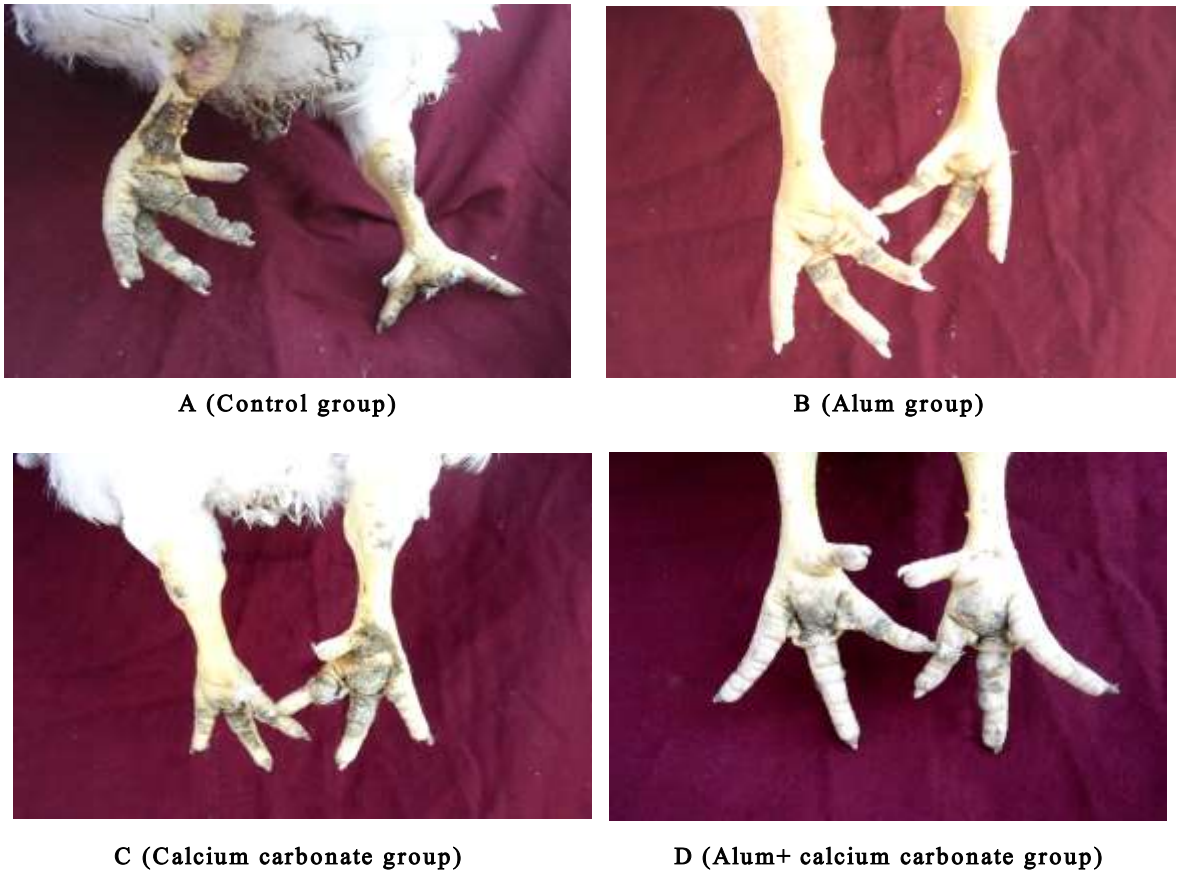


Fig. 4: Total viable count (cfu/g) of litter after chemical amendment

4. Conclusion

In conclusion, litter amendments especially with alum resulted in improving the litter condition in terms of reducing the moisture, Ph, total viable count and increasing total nitrogen content. Further, addition of litter with alum restored the bird welfare in decreasing the incidence of footpad dermatitis.



A (Control group) B (Alum group)

C (Calcium carbonate group) D (Alum+ calcium carbonate group)

Fig 5. Footpad lesions in birds reared on without and with chemically amended litter material

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