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Effect of different litter amendments on the litter characteristics

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Abstract
The present study was conducted for 35 days using 180-day old quail chicks randomly distributed in four treatments were as follows: T_1 control group (without any litter treatments), T_2 groups treated with aluminum sulfate, T_3 group treated with sodium bisulfate, and T_4 group treated with aluminum chloride. All the treatment groups were divided into three replicates, namely R_1, R_2, and R_3, with 15 birds in each replicate. Litter characteristics i.e. Litter moisture (%) and Litter pH was determined at a weekly interval for all four treatment groups. Results showed significant effect of different litter amendments on moisture percent (P<0.01). The lowest moisture percent was recorded for the T4 group and the highest for the T1 control group. The litter pH values of the experiment showed a highly significant (P<0.01) effect during all five weeks due to incorporating different litter treatments into the bedding material, highest in the T_1 group, whereas the T_4 group revealed the lowest overall mean pH. It could be concluded that all three litter treatments significantly reduced litter pH and moisture %.

Keywords: Aluminum sulfate, Amendments, moisture percent, litter pH and quail

Introduction

Poultry is domesticated birds, including chicken, geese, duck, guinea fowl, quail, turkey, etc. They are kept for their eggs, meat, and feathers. Japanese quail is a small avian species, and it was first domesticated in Japan. In India, these birds were first introduced in 1974 from California. Mainly two species of quail found in India are the Black-breasted quail (*Coturnix coromandelica*) and the second is Brown color Japanese quail (*Coturnix coturnix japonica*).

In India, rearing birds in a deep litter housing system is standard practice. The bird's performance and economic status of producers and integrators are influenced by the quality and status of poultry litter (de Oliveira *et al.*, 2015) [4]. Following defecation by birds, the breakdown of fecal material occurs in the litter, leading to various gaseous pollutants, whose concentration and emission are influenced by the litter type, management, humidity, and temperature.

Ammonia is one of the most critical gaseous products harmful to the environment, birds, and human health. After excretion from the bird, the Ammonia is produced by chemical and microbial breakdown of uric acid, and it is a colorless, highly irritating gas (Gates *et al.*, 2005). The effects of high levels of ammonia (NH_3) emission in poultry have shown damage to the respiratory tract (Anderson *et al.*, 1964; Nagaraja *et al.*, 1983).

Litter management is the most imperative ways to decrease NH_3 volatilization and pathogenic microbes by creating an environment where enzymes in manure are less likely to mineralize and decompose urea $[CO(NH_2)_2]$. Five types of litter amendments are available to manage ammonia: acidifiers, alkaline material, absorbers, inhibitors, and microbial and enzymatic treatments. Acidic amendments can lower the pH of litter below eight and are the most commonly used litter treatments. As a result, the fertilizer value of litter increased by more N is held by litter as NH_4^+ thereby decreasing volatilization

Hence three types of acidifiers in litter are used in this experiment that is as follows - Aluminum sulfate, commonly referred to as alum, Sodium bisulfate (SBS; $NaHSO_4$) and Aluminum chloride to evaluate their effect litter factors.

Materials and Methods

Experimental procedure

The quail chicks were randomly allotted to four treatment groups with 45 chicks in each treatment in three replications with 15 birds per replication (Table 1).

Table 1: Experimental Design for Different Treatment Groups

S. No.	Treatment Groups		No. of Quail chicks/ replicate			Total No. of Quail chicks in each group
			R_1	R_2	R_3	
1	T_1	Control (without any litter treatment)	15	15	15	45
2	T_2	Alum treated litter (90 gm /sq. foot)	15	15	15	45
3	T_3	SBS treated litter (25 gm /sq. foot)	15	15	15	45
4	T_4	Aluminum chloride (150 gm/ kg of litter)	15	15	15	45

Parameters to be studied

Litter characteristics

(1) Litter moisture (%): The litter moisture content was determined weekly by weight loss after drying litter material in a hot air oven. The Department of Animal Nutrition of the College of Veterinary and Animal Science (Bikaner) estimated the litter moisture content. A litter sample was collected from the room's five places to evaluate the litter moisture content. All five samples were mixed before analysis, and this pooled sample was used to estimate the moisture % of litter material. To calculate the moisture percentage in the litter sample, a clean, dry petri dish was taken and measured its weight. The collected sample (10 g) was placed in the Petri dish, and its weight was measured with the sample. This Petri dish was kept in a hot air oven for 24 hours. After 24 hours, the sample was cooled down, and its weight was measured. After that, the difference in the weight of the sample before it was kept in the oven and the weight of the sample after taking it out from the oven was calculated. This difference in weights was due to moisture content in the litter.

(2) Litter pH: The pH of litter was determined at a weekly interval. The litter pH value was estimated at the Department of Animal Nutrition of the College of Veterinary and Animal Science (Bikaner). For evaluating the pH, litter sample was collected from the five places in the room. Five samples were mixed, and from this pooled sample, 10 gm sample were taken in a clean, dry beaker and dissolved into 100 ml distilled water; with the help of a magnetic stirrer, this solution was stirred for 15 minutes. Then with the help of filter paper, this sample solution was filtered. After the sample filtration, the pH of the filtered solution is measured by a pH meter.

Statistical Analysis

The experimental data were subjected to analysis of variance (Snedecor and Cochran 1989). Means showing significant differences were compared by Duncan's New Multiple Range Test (DNMRT) (Duncan, 1955). Statistical significance was accepted at $P \leq 0.05$. The results were interpreted and expressed as means ± SEM.

Results and Discussion

The data on various parameters recorded during the present investigation have been statistically analyzed and the observed results are presented and discussed under the following headings:

Litter Moisture %

The weekly litter moisture % was recorded in various treatment groups presented in Table 2 and in Figure1. The overall weekly average litter moisture % in T_1 (control), T_2, T_3, and T_4 treatment groups were 8.28, 8.06, 8.16, and 7.83%, respectively.

The statistical analysis of data revealed a highly significant effect ($P<0.01$) on litter moisture % during all five weeks and overall litter moisture %. The comparison of means using the DNMR test showed that the highest litter moisture % recorded during I week in the T_1 whereas T_4 group showed the lowest litter moisture % (best). At II week, the highest or worst litter moisture % was recorded in T_1, whereas the T_4 group showed the lowest litter moisture %, though comparable with T_2, in statistical terms. At III week, the highest litter moisture % was recorded in T_1, however the T_4 group showed the lowest litter moisture %, though comparable with T_3, in statistical terms. At IV week, the highest litter moisture % was recorded in T_1, although the T_4 group showed the lowest litter moisture %. At V week, the highest litter moisture % was recorded in T_1. The Overall mean of litter moisture % during the whole trial duration was the highest in the T_1 group, which was undesirable. The T_4 group showed the lowest litter moisture % during the experiment, which was the most desirable.

The results obtained in the present study regarding litter moisture % follow the findings of Do *et al.* (2005) and Chakravati *et al.* (2019) [2]. They reported a significant effect on moisture % due to the addition of different litter amendments into the bedding material of quail chicks.

In contrast to the present result Nagaraj *et al.* (2007) [7] reported that an application of different litter treatments had non-significant effects on the moisture % of chicks at different periods.

Table 2: Effect of different litter treatments on Litter Moisture (%) at different weeks

Treatment Effect	Weeks					Average
	1	2	3	4	5	
T_1	6.82^c	7.40^b	8.09^c	8.86^b	10.26^c	8.28^d
T_2	6.55^b	7.12^a	8.01^b	8.77^b	9.85^b	8.06^b
T_3	6.73^c	7.35^b	7.95^a	8.85^b	9.94^b	8.16^c
T_4	6.09^a	7.07^a	7.94^a	8.48^a	9.58^a	7.83^a
SEM	0.0316	0.0257	0.0162	0.0424	0.0417	0.0183

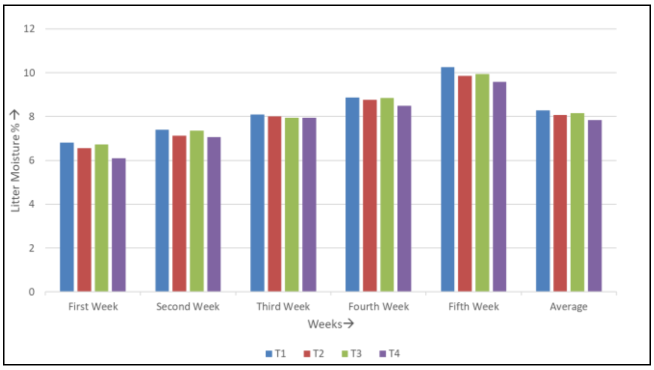

Fig 1: Effect of different litter treatments on Litter Moisture (%) at different weeks

Litter pH

The weekly pH of the litter was recorded in various treatment groups as presented in Table 3 and Figure 2. The overall average pH of litter in T_1 (control), T_2, T_3, and T_4 treatment groups was recorded as 7.13, 4.34, 5.23, and 3.58, respectively.

The statistical analysis of data revealed a highly significant effect ($P<0.01$) on the overall pH of litter during all five weeks of the experiment. The comparison of means using the DNMR test showed that the highest pH was recorded in T_1 during I week, and the T_4 group showed the lowest pH (best). At II week, the highest or worst pH was recorded in T_1, whereas the T_4 group showed the lowest pH comparable with T_2 in statistical terms. At III week, the highest pH was recorded in T_1 whereas T_4 group showed the lowest pH. At IV week, the highest pH was recorded in T_1, and the T_4 group showed the lowest pH. At V week, the highest pH was recorded in T_1, and the T_4 group showed the lowest pH. The Overall mean litter pH during the whole trial duration was highest in the T_1 group, which was undesirable. The T_4 group showed the lowest pH during the experiment, which was the most desirable.

The results obtained in the present study regarding litter pH follow the findings of McWard and Taylor *et al.* (2000) [5], Proch *et al.* (2017) [8] and Toppel *et al.* (2019) [9] who reported the significant effect on the litter pH due to addition of different litter amendments into the bedding material of quail chicks.

In contrast to the present results Choi and Moore *et al.* (2008) [3], and Loch *et al.* (2011) reported that an application of different litter treatments had non-significant effects on the pH of chicks at different periods.

Table 3: Effect of different litter treatments on Litter pH levels at different weeks

Treatment Effect	Weeks					Average
	1	2	3	4	5	
T_1	6.58^{d}	6.98^{d}	7.18^{d}	7.41^{d}	7.52^{d}	7.13^{d}
T_2	3.77^{b}	4.05^{b}	4.30^{b}	4.62^{b}	4.94^{b}	4.34^{b}
T_3	4.50^{c}	5.1^{c}	5.42^{c}	5.51^{c}	5.61^{c}	5.23^{c}
T_4	3.35^{a}	3.66^{a}	3.71^{a}	3.55^{a}	3.63^{a}	3.58^{a}
SEM	0.0057	0.0189	0.0259	0.0282	0.0257	0.0165

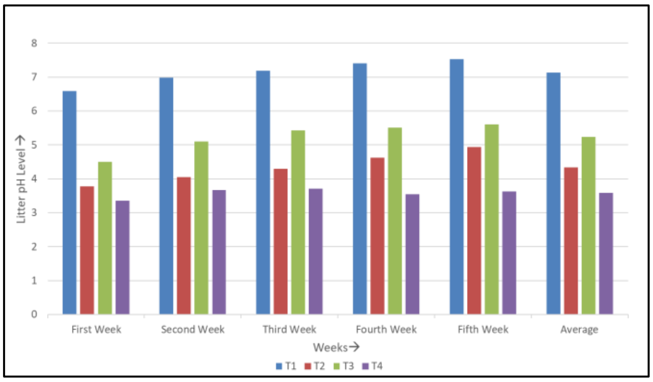

Fig 2: Effect of different litter treatments on Litter pH levels at different weeks

Conclusion

From the present study it could be concluded that all three litter treatments had significantly reduced litter pH and moisture %. compared to control. Further Aluminum chloride had the best effect on litter characteristics compared to other litter treatments and control.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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