# Physicochemical properties, mineral composition and faecal microbial counts of litter materials in a tropical environment

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## Abstract

This study evaluated the physicochemical properties, mineral composition and faecal microbial counts of five different litter materials used for broiler production. Litter materials used were: wood shavings, saw dust, rice husk, coconut husk and sun-dried chopped leaves of *Tectona grandis* (Teak). The litters were collected from the broiler pen every week, beginning from week 2. The week 2, 3 and 4 represented the starter phase while weeks 5, 6, 7 and 8 represented the finisher stage. Results indicated that *T. grandis* litter had significant ($p<0.05$) results in terms of moisture content (15.82%), pH (6.60), temperature (32.11°C), electrical conductivity (3.83 dS/m), bulk density (85.45 $kg/m^3$), water holding capacity (10.73%), water releasing capacity (9.64%), coccidial oocyst count (0.33 $\times 10^3$ g), ammonia emission (0.04%) and mineral (nitrogen, 2.33%) respectively at the $8^{th}$ week finishing stage. Saw dust litter recorded significant ($p<0.05$) superior values when compared to other litter materials in terms of physicochemical properties (moisture content 15.17%, temperature 24.40°C, bulk density 84.02 $kg/m^3$, water holding capacity 14.61% and water releasing capacity 31.78%); coccidial oocyst count 1.67 $\times 10^3$ g, respectively at 4 week starter phase.Similar non-significant ($p>0.05$) values were recorded for both rice husk and coconut husk litter materials at the starter phase and at the finisher phase. Based on these results, *T. grandis* litter material is associated with inferior water holding capacity, water releasing capacity and water content that resulted in the depression of ammonia emission. However, because of the quality of saw dust it can be considered as the best litter material.

**Key words:** Broilers, litter materials, microbial counts, physicochemical properties

## Introduction

The physicochemical properties like moisture, water holding capacity, pH, and ammonia levels have a direct influence on the microbial population in a litter material, which in turn have an effect on the health of broiler chickens (Bignon *et al*., 2015; Durmus *et al*., 2023). Excessive moisture in a litter material leads to the production of ammonia that causes respiratory diseases and may impair vision in chicks (Dunlop *et al*., 2015). Toghyani *et al*. (2010) had earlier reported that the pH of any litter material below 6 causes the multiplication of harmful bacteria, while a pH above 8 leads to a reduction in the nutrient available in the litter. Stress in broiler chickens can also be caused by the levels of ammonia in the litter (Inthujaa *et al*., 2019).

Some types of litter materials can either increase the moisture content and pH of the litter which can have direct influence on the growth of oocysts (Huang *et al*., 2015; Mondal *et al*., 2020). Coccidiosis is a protozoan disease that can be transmitted by birds through consumption of contaminated litter materials. Moreover, the number of times a litter is replaced also have a great impact on oocyst count (Ritzi *et al*., 2015). Poultry litter is composed of macro and micro minerals, which are very important in agriculture. The mineral composition of any litter is influenced by the type of litter material used and the feeding pattern of the birds. Some of the minerals present in broiler litter are Nitrogen, Potassium, Phosphorus, Calcium and Magnesium (Monira *et al*., 2003). Litter materials impact on the environment and can encourage sustainability of broiler production (Adebayo *et al*., 2009). Therefore, this study determined the physicochemical properties, mineral composition and coccidial oocyst counts of five different litter materials in the tropics.

## Materials and methods

### Experimental Site

The study was carried out at the Poultry Unit of the Teaching and Research Farm, University of Uyo in Akwa Ibom State, Nigeria with an annual rainfall of 2,190 mm and a relative humidity of 81% (University of Uyo Meteorological Centre, 2022).

### Experimental Materials and Experimental Design

Litter materials such as wood shaving, saw dust, rice husk and coconut husk were purchased locally from Timber market Uyo, Akwa Ibom State. Leaves of *Tectona grandis*, on the other hand were harvested from the Arboretum of University of Uyo. The wood shavings were thoroughly sun dried again before being packaged into bags and stored at room temperature. The coconut husk, and T. *grandis* leaves litter materials were all chopped and dried to reduce moisture content before being put into bags and stored at room temperature. . The leaves of *T. grandis* were further dried to reduce moisture content and cut before being stored in airtight containers at room temperature.

The study comprised of four treatment groups and a control, where each group was made up of one type of litter material. They were randomly assigned to the treatment groups as follows: wood shavings (T1, control), saw dust (T2), rice husk (T3) and coconut husk (T4). The litter materials were spread to a depth of 0.05 m, and sun-dried chopped leaves of *T. grandis* (T5) (spread to a depth of 0.01 m), all arranged in a completely randomized design using broiler birds.

### Data collection

Samples of the litter materials were collected at both the starter and finisher stages (2-4 weeks and 5-8 weeks, respectively) for the determination of their physicochemical properties (moisture, bulk density, pH, electrical conductivity, temperature, water holding capacity, water releasing capacity, and ammonia) using the appropriate methods described by Smalberger and van Rensburg (2021); AOAC (1995), Brake *et al*. (1992) and AOAC (2000), respectively. Samples were also collected for mineral assay (Nitrogen, calcium, magnesium, sodium, phosphorus and potassium) using the methods described by AOAC (2000) and Udo *et al*. (2009). The data for faecal microbial counts for each of the litter type was also collected and analyzed using the procedure outlined by Karim *et al*. (1994).

### Data analysis

All the data obtained in this study were subjected to one-way Analysis of Variance (ANOVA), using the Statistical Package for Social Science (SPSS) version 21 and significant means were separated using Duncan Multiple Range Test (Steel and Torrie, 1980).

## Results and discussion

### Physicochemical properties of litter materials

The physico-chemical properties of the litter materials (wood shaving, saw dust, rice husk, coconut husk and sundried leaves of *Tectona grandis*) used in this study (weeks 2 – 4) are presented in Table 1. On the other hand, properties for weeks 5 - 8 are presented in Table 2. Results showed significant ($p<0.05$) differences in the measured parameters between the litter materials at weeks, 2, 4, 6 and 8, respectively. However, there was no established pattern in their variation across during the different phases.

One key finding was the change in moisture content throughout the study period. The moisture content in all litter materials increased as the chickens aged. This trend contradicted some previous studies that reported lower moisture content in the first week (Hafeez *et al*., 2009; Abougabal *et al*., 2022). However, the moisture content of rice husk in this study (week 2) was consistent with the findings of Dhaliwal *et al*. (2018). Overall, the moisture content in this study was lower than the recommended range (20-25%) suggested by Dunlop *et al*. (2016) and Gencoglan *et al*. (2017). This difference might be due to variations in how the litter materials were handled.

The pH (5.09-8.63) of the litter materials in this study (week 5) was comparable to the findings of Kuleile *et al*. (2019). The range in this study were however varied more widely than what was reported by reported by Abougabal *et al*. (2022) (7.10 -8.38). These discrepancies can be associated with such factors as moisture content, ventilation of the pen, and the feed composition of the broiler diets.

Temperature measurements in this study ($21.67^{\circ}$-$24.33^{\circ}$C) differed from those of Abougabal *et al*. (2022) who reported higher values (28.02-30.15) in week 1. The lower temperature in this study for wood shavings and rice husks during weeks 2 and 3 might be explained by the removal of heat sources after brooding. It is worth noting also, that the week 4 rice husk temperature in this study did align with the findings of Abougabal *et al*. (2022). Slight differences as this can be attributed to the overall environmental condition of the broiler pen, and this case, temperature was regular in the former study.

The study also observed significant ($p<0.05$) differences in water holding capacity between the different litter types at every stage of the study. The water holding capacity was found to be increasing with the ages of the broiler and this may be attributed to the increasing volume of excreta as the birds grew older. There was also consistency in the litter type with the highest and the lowest water holding capacities (wood shaving and leaves of *Tectona grandis* respectively), This leading performance of wood shaving was also recorded in Hafeez *et al*. (2009) where wood shaving, sand and wheat straw were compared. Similarly, the bulk density (44.55-134.53 kg/m$^3$) findings in this study differed from those (205.06-1788.75g/cm$^3$) reported by Kuleile *et al.* (2019). There were also some inconsistencies in temperature and pH findings compared to previous researches (Petek *et al*., 2014; Inthujaa *et al*., 2019; Abougabal *et al*., 2022).

**Mineral composition of litter materials**

The study recorded significant ($p<0.05$) differences in the mineral content of five litter materials (sun-dried T. *grandis* leaves, wood shavings, coconut husk, rice husk and saw dust) at both weeks 2 and 8 as seen in Table 3. Some of the trends observed in the mineral composition are as follows: Sun-dried T. *grandis* leaves consistently had the highest nitrogen content throughout the study. Rice husk consistently had the highest phosphorus content. In week 2, rice husk had the highest potassium, but in week 8, wood shavings took the lead. Coconut husk consistently had the lowest potassium content. Sun-dried T. *grandis* leaves consistently had the highest calcium content while rice husk consistently had the lowest. Wood shavings had the highest magnesium content in week 2, but coconut husk took the lead in week 8. On the other hand, rice husk consistently had the lowest magnesium content. Finally, coconut husk consistently had the highest sodium content throughout the study. Sawdust consistently had the lowest sodium content.

In comparison to past studies, the percentage nitrogen disagrees with the previous study by Monira *et al*. (2003) who recorded sawdust litter as having 3.04%, 3.55% in rice husk litter, 2.52% in sugarcane bagasse litter and 2.35% in wheat straw litter. Dhaliwal *et al*. (2018) also in their studies reported rice husk litter to have 3.40 % nitrogen, 1.35 % phosphorus and 0.25 % potassium at week 8. Generally, the present study observed that the mineral composition of the litter materials generally increased with the age of the broiler chickens. The accumulation of minerals in broiler litter as the birds age is primarily due to increased nutrient intake (Czerwinski *et al*., 2010), growth and metabolism (Elarousi *et al*., 1994), feed composition and phase feeding (Kamyab, 2001), feather development and shedding (Leeson *et al*., 1991) and water consumption and urinary excretion (Smith *et al.*, 1998).

**Faecal microbial counts of litter materials**
Table 4 shows the faecal microbial counts (*Coccidial occysts*) of litter materials at the $2^{nd}$, $4^{th}$, $6^{th}$ and $8^{th}$ week of the experiment. The result showed that during each of the weeks, there were significant ($p<0.05$) differences in the faecal *coccidial occyst* counts of these different litter materials. Generally, the count for each litter material was found to be highest in the second week and kept decreasing up to the eighth week. During the $2^{nd}$ week, The T. *grandis* leaves had the highest value (2.42), followed by rice husk (2.32), saw dust (2.12), wood shavings and the least were recorded for (1.79, and 1.68 respectively). At week 4, the highest values were recorded in the rice husk (1.79), followed by the *T. grandis* leaves (1.73) which were statistical similar to wood the rice husk. The least was found in the wood shaving (1.23) but it was statistically similar to the saw dust (1.67). At the $6^{th}$ week, the rice husk and the saw dust had a tie at 0.99 and were both the highest values. They were significantly higher ($p<0.05$) than the T. *grandis* leaves (0.68), the wood shaving (0.62) and the coconut husk (0.59) whose values were statistically similar ($p>0.05$) to each other. Finally, at the $8^{th}$ week, a similar trend as in the $6^{th}$ week was also observed but the highest numerical value was found in the sawdust. The findings of Monira *et al*. (2003) for coccidial oocysts in sawdust litter material at week 2 are almost like the present study for sun-dried leaves of T. *grandis* litter material. The results of Chakma *et al*. (2012) at 14 days of age for wood shavings litter are also similar with the current study although, rice husk and saw dust litter had lower coccidial oocysts when compared with the present study.

This study recorded a decrease in coccidial oocysts at week 8 with similar results for rice husk and saw dust litter materials and this is similar to the findings of Durmus *et al*. (2023) who reported that using rice husks as a litter material boosted the microbial load of the litter. This conclusion is analogous to the current study's findings, which included reports of high coccidial oocysts at week 2 of the trial. The period when broiler chickens are most susceptible to coccidiosis could explain why there were more coccidial oocysts at week 2.

## Conclusion

This study generally acknowledges the different properties of the different litter materials studied but specifically reiterates that no matter the choice of litter material, it is important to pay attention to coccidiosis at the earlier stages of the broiler chicken life cycle. In addition, the study revealed that sun-dried T. *grandis* litter material is associated with inferior water holding capacity and high ammonia content at week 8.

## Recommendations

Based on the findings from this study, it is hereby recommended that:

1. All other litter materials including wood shaving, saw dust, rice husk and coconut husk can be used as a replacement for wood shavings except sun dried *Tectona grandis* leaves which were associated with inferior water holding capacity and high ammonia content.
2. All litter materials are highly susceptible to high coccidial oocyst counts during the earlier ages of the birds, hence should me managed more properly at such ages.
3. However, because of the quality of saw dust it can be considered as the best litter material.

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Table 1: Physicochemical properties of litter materials at starter phase (2-4weeks

| Week | Parameters/Treatments | Wood shavings | Saw dust | Rice husk | Coconut husk | Sun dried *T. grandis* leaves | SEM |
|---|---|---|---|---|---|---|---|
| 2 | Moisture (%) | $11.60^{a}$ | $10.44^{c}$ | $11.22^{b}$ | $11.37^{ab}$ | $11.42^{ab}$ | 0.07 |
| | pH | $5.09^{c}$ | $6.83^{a}$ | $6.43^{a}$ | $6.20^{ab}$ | $5.09^{bc}$ | 0.24 |
| | Temperature (°C) | $24.33^{a}$ | $22.07^{b}$ | $22.88^{b}$ | $22.00^{b}$ | $21.67^{b}$ | 0.30 |
| | Electrical conductivity (ds/m) | $2.80^{a}$ | $2.40^{c}$ | $2.39^{c}$ | $2.54^{b}$ | $1.93^{d}$ | 0.02 |
| | Bulk density (Kg/m3) | $75.73^{c}$ | $69.58^{d}$ | $98.49^{a}$ | $85.40^{b}$ | $44.55^{e}$ | 0.83 |
| | Water Holding Capacity (%) | $7.77^{c}$ | $9.70^{a}$ | $8.48^{b}$ | $6.61^{d}$ | $3.72^{e}$ | 0.10 |
| | Water Releasing Capacity (%) | $22.07^{b}$ | $31.77^{ab}$ | $23.13^{b}$ | $37.13^{a}$ | $22.30^{ab}$ | 4.27 |
| | Ammonia (%) | $0.07^{b}$ | $0.09^{a}$ | $0.04^{c}$ | $0.04^{c}$ | $0.05^{bc}$ | 0.01 |
| 3 | Moisture (%) | $14.55^{a}$ | $11.77^{c}$ | $13.36^{b}$ | $11.78^{c}$ | $11.21^{d}$ | 0.10 |
| | pH | $5.40^{c}$ | $6.27^{b}$ | $6.83^{a}$ | $6.40^{ab}$ | $5.90^{b}$ | 0.15 |
| | Temperature (°C) | $23.53^{a}$ | $21.07^{b}$ | $24.23^{a}$ | $24.27^{a}$ | $20.17^{b}$ | 0.37 |
| | Electrical conductivity (dS/m) | $2.85^{b}$ | $2.22^{c}$ | $3.12^{a}$ | $2.68^{b}$ | $2.88^{a}$ | 0.06 |
| | Water Holding Capacity (%) | $10.65^{b}$ | $12.67^{a}$ | $9.20^{c}$ | $8.90^{d}$ | $5.83^{e}$ | 0.09 |
| | Water Releasing Capacity (%) | $22.48^{c}$ | $30.90^{b}$ | $28.63^{b}$ | $35.18^{a}$ | $21.63^{c}$ | 0.83 |
| 4 | Moisture (%) | $14.68^{b}$ | $15.17^{a}$ | $13.67^{c}$ | $11.77^{e}$ | $12.25^{d}$ | 0.09 |
| | pH | 6.50 | 6.63 | 6.60 | 6.47 | 6.20 | 0.20 |
| | Temperature( °C) | $25.83^{b}$ | $24.40^{bc}$ | $29.38^{a}$ | $28.32^{a}$ | $22.28^{c}$ | 0.79 |
| | Electrical conductivity (ds/m) | 3.02 | 3.20 | 3.55 | 2.70 | 2.88 | 4.57 |
| | Bulk Density(kg/m3) | $89.02^{b}$ | $84.02^{b}$ | $104.83^{a}$ | $100.14^{a}$ | $57.37^{c}$ | 2.09 |
| | Water Holding Capacity (%) | $13.52^{b}$ | $14.61^{a}$ | $11.63^{c}$ | $11.38^{c}$ | $7.38^{d}$ | 0.13 |
| | Water Releasing Capacity (%) | $20.70^{d}$ | $31.78^{a}$ | $28.32^{b}$ | $22.48^{c}$ | $20.40^{d}$ | 0.64 |

$^{a,b,c,d}$Means on the same row with the different superscripts are significantly different ($p<0.05$), SEM = Standard error of mean.

Table 2: Physicochemical properties of litter materials at finisher phase (5-8weeks)

| Week | Parameter/Treatments | Wood shavings | Saw dust | Rice husk | Coconut husk | *T. grandis* leaves | SEM |
|---|---|---|---|---|---|---|---|
| 5 | Moisture (%) | 17.20$^{a}$ | 16.71$^{a}$ | 15.50$^{b}$ | 13.47$^{c}$ | 12.82$^{d}$ | 0.19 |
| | pH | 6.70$^{b}$ | 7.57$^{a}$ | 6.60$^{b}$ | 6.67$^{b}$ | 6.27$^{b}$ | 0.19 |
| | Temperature ( °C) | 29.68$^{b}$ | 27.09$^{c}$ | 31.83$^{a}$ | 32.43$^{a}$ | 23.38$^{d}$ | 0.53 |
| | Electrical conductivity (dS/m) | 3.54$^{b}$ | 3.84$^{a}$ | 3.77$^{a}$ | 3.74$^{ab}$ | 3.16$^{c}$ | 0.07 |
| | Water Holding Capacity (%) | 15.29$^{b}$ | 18.65$^{a}$ | 14.33$^{c}$ | 13.47$^{d}$ | 9.71$^{e}$ | 0.20 |
| | Water Releasing Capacity (%) | 15.58$^{c}$ | 27.25$^{a}$ | 26.03$^{a}$ | 20.54$^{b}$ | 12.62$^{d}$ | 0.59 |
| 6 | Moisture (%) | 17.59$^{a}$ | 18.17$^{a}$ | 17.30$^{b}$ | 13.58$^{b}$ | 13.40$^{b}$ | 0.35 |
| | pH | 6.70$^{b}$ | 7.47$^{a}$ | 6.57$^{b}$ | 7.17$^{a}$ | 6.10$^{c}$ | 0.13 |
| | Temperature (°C) | 33.23$^{a}$ | 27.31$^{bc}$ | 31.70$^{ab}$ | 32.17$^{a}$ | 26.52$^{c}$ | 1.42 |
| | Electrical conductivity (dS/m) | 3.52$^{b}$ | 4.12$^{a}$ | 4.15$^{a}$ | 4.06$^{a}$ | 3.49$^{b}$ | 0.04 |
| | Bulk Density(kg/m$^{3}$) | 113.32 | 109.55 | 118.50 | 118.50 | 71.39 | 14.91 |
| | Water Holding Capacity (%) | 18.68$^{b}$ | 21.03$^{a}$ | 13.92$^{c}$ | 14.60$^{c}$ | 9.97$^{d}$ | 0.31 |
| | Water Releasing capacity (%) | 14.50$^{c}$ | 24.37$^{a}$ | 24.57$^{a}$ | 18.68$^{b}$ | 12.37$^{d}$ | 0.17 |
| **7** | Moisture (%) | 19.56$^{a}$ | 19.20$^{a}$ | 17.37$^{b}$ | 14.52$^{c}$ | 14.17$^{c}$ | 0.24 |
| | pH | 7.03$^{c}$ | 8.20$^{a}$ | 7.47$^{b}$ | 7.43$^{b}$ | 6.67$^{d}$ | 0.09 |
| | Temperature (°C) | 32.90$^{a}$ | 33.53$^{a}$ | 31.70$^{a}$ | 33.47$^{a}$ | 26.39$^{b}$ | 0.70 |
| | Electrical conductivity (dS/m) | 3.62$^{c}$ | 4.30$^{a}$ | 4.30$^{a}$ | 4.09$^{b}$ | 3.62$^{c}$ | 0.06 |
| | Water Holding Capacity (%) | 18.70$^{b}$ | 25.43$^{a}$ | 17.52$^{c}$ | 16.67$^{d}$ | 10.38$^{e}$ | 0.23 |
| | Water Releasing Capacity (%) | 13.82$^{c}$ | 21.44$^{a}$ | 22.07$^{a}$ | 18.09$^{b}$ | 10.75$^{d}$ | 0.32 |
| 8 | Moisture (%) | 19.42$^{b}$ | 22.27$^{ab}$ | 23.01$^{a}$ | 16.42$^{c}$ | 15.82$^{c}$ | 0.64 |
| | pH | 7.50$^{b}$ | 8.63$^{a}$ | 8.27$^{a}$ | 7.17$^{bc}$ | 6.60$^{c}$ | 0.19 |
| | Temperature (°C) | 32.14 | 34.68 | 33.37 | 34.40 | 32.11 | 0.76 |
| | Electrical conductivity (dS/m) | 4.40$^{a}$ | 4.55$^{a}$ | 4.48$^{a}$ | 4.13$^{b}$ | 3.83$^{c}$ | 0.06 |
| | Bulk density (kg/m$^{3}$) | 125.17$^{ab}$ | 109.67$^{c}$ | 134.50$^{a}$ | 134.53$^{a}$ | 85.45$^{d}$ | 3.69 |
| | Water Holding Capacity (%) | 19.61$^{b}$ | 29.37$^{a}$ | 19.39$^{b}$ | 19.08$^{b}$ | 10.73$^{c}$ | 0.22 |
| | Water Releasing Capacity (%) | 12.33$^{d}$ | 19.78$^{b}$ | 21.95$^{a}$ | 17.42$^{c}$ | 9.64$^{e}$ | 0.11 |
| | Ammonia (%) | 0.12$^{a}$ | 0.14$^{a}$ | 0.06$^{b}$ | 0.06$^{b}$ | 0.04$^{b}$ | 0.01 |

$^{a,b,c}$ Means on the same row with the different superscripts are significantly different ($p<0.05$)

Table 3: Mineral composition of the different Litter Materials at Week 2 and 8 as expressed in Percentage (%).

| Week | Parameters/Treatments | Wood shavings | Saw dust | Rice husk | Coconut husk | Sun dried *T.grandis* leaves | SEM |
|---|---|---|---|---|---|---|---|
| 2 | Nitrogen | 1.43$^{b}$ | 1.24$^{c}$ | 1.14$^{d}$ | 1.04$^{e}$ | 1.82$^{a}$ | 0.02 |
| | Phosphorus | 0.76$^{c}$ | 1.29$^{b}$ | 1.39$^{a}$ | 0.62$^{d}$ | 0.82$^{c}$ | 0.03 |
| | Potassium | 0.17$^{c}$ | 0.21$^{b}$ | 0.28$^{a}$ | 0.16$^{c}$ | 0.15$^{c}$ | 0.01 |
| | Calcium | 1.59$^{b}$ | 1.76$^{a}$ | 1.25$^{c}$ | 1.51$^{b}$ | 1.73$^{a}$ | 0.03 |
| | Magnesium | 0.42$^{a}$ | 0.34$^{b}$ | 0.44$^{a}$ | 0.49$^{a}$ | 0.45$^{a}$ | 0.02 |
| | Sodium | 0.34$^{c}$ | 0.20$^{d}$ | 0.44$^{b}$ | 0.53$^{a}$ | 0.13$^{e}$ | 0.02 |
| 8 | Nitrogen | 1.72$^{c}$ | 1.78$^{c}$ | 2.33$^{b}$ | 1.60$^{c}$ | 2.62$^{a}$ | 0.07 |
| | Phosphorus | 0.72$^{d}$ | 1.18$^{b}$ | 1.44$^{a}$ | 0.56$^{e}$ | 0.93$^{c}$ | 0.02 |
| | Potassium | 0.25$^{a}$ | 0.21$^{b}$ | 0.22$^{b}$ | 0.14$^{c}$ | 0.16$^{c}$ | 0.01 |
| | Calcium | 1.52$^{c}$ | 1.64$^{b}$ | 1.26$^{d}$ | 1.50$^{c}$ | 1.92$^{a}$ | 0.03 |
| | Magnesium | 0.46$^{bc}$ | 0.42$^{c}$ | 0.34$^{d}$ | 0.65$^{a}$ | 0.52$^{b}$ | 0.02 |
| | Sodium | 0.42$^{c}$ | 0.49$^{b}$ | 0.40$^{c}$ | 0.73$^{a}$ | 0.32$^{d}$ | 0.02 |

$^{a,b,c,d,e}$Means on the same row with the different superscripts are significantly different ($p<0.05$) SEM = Standard error of mean.

Table 4: Faecal microbial count (Coccidial oocysts) cfu x$10^{3}$) of the Different Litter Materials for Week 2, 4, 6, 8 Expressed as Percentage

| Weeks/Treatment(s) | Wood shavings | Saw dust | Rice husk | Coconut husk | *T. grandis* leaves | SEM |
|---|---|---|---|---|---|---|
| 2 | 1.68$^{c}$ | 2.12$^{ab}$ | 2.32$^{a}$ | 1.79$^{b}$ | 2.42$^{a}$ | 0.05 |
| 4 | 1.23$^{c}$ | 1.67$^{b}$ | 1.79$^{a}$ | 1.31$^{c}$ | 1.73$^{ab}$ | 0.04 |
| 6 | 0.62$^{b}$ | 0.99$^{a}$ | 0.99$^{a}$ | 0.59$^{b}$ | 0.68$^{b}$ | 0.04 |
| 8 | 0.32$^{b}$ | 0.77$^{a}$ | 0.73$^{a}$ | 0.36$^{b}$ | 0.33$^{b}$ | 0.03 |

$^{a,b,c}$Means on the same row with the different superscripts are significantly different ($p<0.05$)., SEM = Standard error of mean.