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*Short Communication*

# Evaluation of the bacteriological characteristics of poultry litter as feedstuff for cattle

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**The bacteriological characteristics of poultry litter as feedstuff for cattle was evaluated by subjecting it to heat treatment by deep stacking. Litter samples were assayed for pathogens before heat treatment commenced. The litter was bagged, stacked and covered with thick, black plastic cellophane in a roofed building for 21 days. The temperature of the stack was monitored with a thermometer and the readings recorded. At the end of the heat treatment, particles were removed from the litter with a mechanical sieve. Litter samples were subjected to proximate analysis, mineral composition profile, cultured in a McConkey medium and then incubated for 24 – 48 h at 37 – 42°C for various pathogens. Results showed that litter dry matter (DM) and crude protein (CP) contents were 87 and 20% respectively. Mineral composition varied from 0.10% for sodium to 4.50%, for phosphorus. The isolation temperature of pathogens in the untreated poultry litter ranged between 37°C for *Salmonella sp.* and *Mycobacterium*, 41°C for *Clostridium* and *Escherichia coli* to 42°C for *Staphylococcus*. No pathogen was isolated after heat treatment (40.1 – 55°C) for 21 days. Poultry litter can be used as feedstuff for cattle if processed properly to eliminate pathogens and the nutrient levels equalized.**

**Key words:** Bacteriological characteristics, cattle, deep stacking, pathogen, poultry litter.

## INTRODUCTION

The rising cost of animal feeds has continued to be a major problem in developing countries as feed cost is about 70 – 75% of the total cost of production, compared to about 50 – 60% in developed countries (Nwogu et al., 2003). There is therefore the need to source for alternative feed ingredients that can lead to a reduction in the cost of feed and hence the total cost of production. Poultry litter has such potential as it has been found to contain protein, which can replace soya bean meal in rabbit diets (Onimisi and Omage, 2006).

Processing of poultry litter is necessary for destruction of potential pathogens, improvement of handling and storage characteristics, and maintenance or enhancement of palatability (Fontenot, 2000). Pathogenic microbial organisms gain access to the animal body through contaminated feed and water (Youdeowei et al., 1999). The presence of these pathogenic microorganisms impact negatively on feed utilization and physiological functions within the animal system.

According to Simonsen et al. (1987), poultry accounted for 50.1% of all non-human *Salmonella* isolates. Clegg et al. (1995) and Hogg et al. (1990) also confirmed the isolation of many microorganisms from the faeces of hens.

*E. coli* infection, which is responsible for major losses in the poultry industry, is commonly found in poultry litter and faecal material (Fontenot, 2000). Bio-deterioration takes place in poultry manure as part of the metabolic activities of the bacteria present in it (Onion et al., 1981). Some of these microorganisms are pathogenic. The degree of bio-deterioration depends on the moisture content, relative humidity, temperature and pH of the bacterial medium. This study was therefore designed to evaluate the bacterial profile in poultry litter so as to authenticate its safety as cattle feed ingredient.

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**Table 1.** Chemical composition of deep stacked layers' poultry litter (dry matter basis).

| Components | Composition |
|---|---|
| Dry matter (% DM) | 87.00 |
| Crude protein (CP) % | 20.00 |
| Energy (KJ/kg) | 2601.72 |
| Crude fibre % | 10.4 |
| Ether extract (EE) % | 2.20 |
| Ash % | 18.50 |

**Table 2.** Mineral composition of deep stacked layers' poultry litter.

| Components | Composition (%) |
|---|---|
| Phosphorus | 4.50 |
| Calcium | 2.00 |
| Sodium | 0.10 |
| Potassium | 2.05 |
| Magnesium | 0.48 |

## MATERIALS AND METHODS

Shovels were used to collect poultry litter from the layers' section of the Teaching and Research Farm of the Rivers State University of Science and Technology, Port Harcourt (4° 52'N; 6° 57' E). The litter was placed in empty feed bags. Before subjecting the litter to heat treatment by deep stacking, samples were collected to assay for bacterial profile at the Microbiology Laboratory of the Institution.

The litter was subjected to a heat cycle treatment created by deep stacking. This was achieved by stacking the bagged poultry litter, which was then covered with thick, black plastic cellophane in a roofed building for 21 days. The temperature of the pile was constantly monitored with a thermometer and the readings recorded. At the end of the heat treatment, particles were removed from the litter with a mechanical sieve. Litter samples were subjected to proximate analysis and mineral composition profile (Tables 1 and 2), procedures of AOAC (1990). Samples were also cultured in a McConkey medium and then incubated for 24 – 48 h at 37 – 42°C for various pathogens (Table 3).

## RESULTS AND DISCUSSION

The chemical and mineral compositions of the deep stacked layers' litter are shown in Tables 1 and 2. The dry matter (DM) and crude protein (CP) contents were 87 and 20%, respectively. The values obtained for energy, crude fibre, ether extract and ash were 2601.72 KJ/kg, 10.4, 2.20 and 18.50%, respectively. The mineral composition of the recycled poultry litter in Table 2 shows that Phosphorus (P), Calcium (Ca), Sodium (Na), Potassium (K) and Magnesium (Mg) have values of 4.5, 2.00, 0.10, 2.05 and 0.48%, respectively. Phosphorus (P) had the highest value when compared with the other minerals.

The bacterial organisms isolated in the layers' poultry litter before and after heat treatment are shown in Table 3. In the present study, the isolation temperature of pathogens in untreated poultry litter ranged between 37°C for *Salmonella* and *Mycobacterium,* 41°C for *Clostridium* and *E. coli* to 42°C for *Staphylococcus*.

**Table 3.** Pathogenic organisms isolated in layers' poultry litter before and after heat treatment.

| Pathogens | Before heat treatment | After heat treatment | Isolation temperature (°C) |
|---|---|---|---|
| *Escherichia coli* | + | NPI | 41 |
| Salmonella sp. | + | NPI | 37 |
| Mycobacterium | + | NPI | 37 |
| Shigella | NPI | NPI | - |
| Listeria | NPI | NPI | - |
| Mould | NPI | NPI | - |
| Yeast | NPI | NPI | - |
| Clostridium | + | NPI | 41 |
| Proteus | NPI | NPI | - |
| Staphylococcus | + | NPI | 42 |

+, Scanty; NPI, No pathogen isolated.

The differing bacterial presence in the untreated poultrylitter confirmed the findings of Olutiola et al. (1991). The high core temperatures, (41 – 42°C) and (37 – 39.5°C) reported by Charles (1975) and Fielding (1991) in birds and rabbits respectively, confers a natural-infection-control device against some bacteria. Most of the bacteria isolated in this study were those that are commonly experienced by man and animals in their day-to-day exposure and to which their bodies have developed some degree of relative resistance (Onimisi and Omage, 2006). These findings are in agreement with earlier results obtained by Fuller (1973); Thornton and Gracey (1976); and Awoniyi et al. (2004), who used maggot meal based diets (another unconventional feed ingredient) on broiler chickens and isolated bacterial organisms in their visceral organs.

With regard to the safety aspects of using poultry litter in cattle rations, the results obtained in this study showed that, pathogens were not isolated after heat treatment (40.1 - 55.0°C) for 21 days. This was due to the action of heat to which the pathogens were subjected (Davis, 1999). It is worthy of note that the survival of microorganisms in dietary ingredients varies widely with its moisture content (Onion et al., 1981). The destruction of bacterial organisms observed after the heat treatment may also be aided by a reduction in the moisture content of the poultry litter (Fontenot, 2000). In this study, a moisture content of 13% was observed. The maximum temperature obtained during the heat treatment was 55°C. This result is in agreement with the findings of Chaudhry (1990), who obtained a temperature of 54.6°C at 15% moisture content. Fontenot (2000) reported that increaseing the moisture content above 35% resulted in lower maximum temperatures. The maximum temperature therefore appears to be related to the moisture level in the lit-

ter.

The observed gradual increase in temperature to the maximum level attained (55°C) during the heat treatment, was due to the biological activity of the microorganisms which might have contributed to the killing of pathogenic organisms.

## Conclusion

The nutritional value of poultry litter as feedstuff for cattle has been well established by many authors. Poultry litter can be used as feedstuff for cattle if processed properly to eliminate pathogens and the nutrient levels equalized. This study, which evaluated the bacterial profile in poultry litter, is vital and complementary to its suitability as feedstuff in cattle rations.

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