Salmonella Elimination from Recycled Poultry Bedding after Stacking

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Introduction

Recycled poultry bedding (RPB), also referred to as poultry litter, has long been used as a protein and mineral supplement for cattle. This product consists of the bedding material used in the poultry house, as well as feed, feathers and excreta. Concerns regarding the feeding of this product have been raised because of the perceived risks of transmitting potentially pathogenic enteric organisms to cattle and consumers. The primary objective of this study was to assess the survival of *Salmonella* in various areas of RPB stacked to a recommended height of 6-8 ft (deep) or stacked to height of 3 ft (shallow).

Materials and Methods

RPB was stacked in 8x6x8-ft bins on a concrete slab, with two replicates per treatment. During the stacking process, dialysis bags containing 10 gm of RPB seeded with $3x10^8$ *Salmonella typhimurium* were placed at randomly selected points in a three-dimensional grid within the stacks. The grid was designed to represent temperature differences which might affect survival of *Salmonella* and nutritional characteristics of RPB. Sample bags were placed in deep stack 1 (n=54), deep stack 2 (n=48), shallow stack 1 (n=24) and shallow stack 2 (n=24). Thermocouples were attached to half the bags. Stacks were compacted and covered to limit air and water exposure and stacks were undisturbed for 21 days, the recommended length of time for processing RPB. Temperature was monitored daily throughout the study, and hourly for 14-16 hours on two consecutive days, to assess changes and cycles in heating. On the 21st day, the sample bags were recovered. A sample of the RPB was also taken from sites next to sample bags with thermocouples, for analysis of ammonia and protein solubility. Contents of dialysis bags were cultured using protocols for direct quantification, pre-enrichment and delayed secondary enrichment (DSE) on selective media.

Conclusions

Although there are many published studies on the nutrient and bacterial properties of RPB, to our knowledge this is the first study to assess differences in these characteristics so thoroughly throughout stacks. The thermal death of *Salmonella* occurs at 57.2°C for 60 minutes. It is known that the core of properly deep stacked RPB reaches similar temperatures within five days and remains high for an extended period. Although this alone would likely eliminate *Salmonella*, the temperatures reached in other areas of the stack have not been thoroughly investigated, bringing into question possible survival.

This trial demonstrated wide ranges of temperatures within the stacks. Deep stack core temperatures (mean 47.4°C) were significantly higher than shallow stack core temperatures (mean 37.3°C) ($p<0.001$), but had a wider range of temperatures (29-63°C) than shallow (30-49°C). Hourly temperature monitoring demonstrated that samples near the periphery changed more with the ambient temperature than did core samples.

Investigations by the poultry industry have also linked water activity and ammonia content of this product to its 'salmonellacidal' properties. We are assessing differences in ammonia by site. *Salmonella* was eliminated in 98.7% of sites (148/150) regardless of temperature and ammonia concentration. The two samples from which organisms were recovered were located at ground level and at 1ft from ground level, where the average temperatures were below 37°C. There was at least a 5-log reduction in organisms in these two samples, as no growth was discernible by direct quantification. We conclude that, regardless of temperature and ammonia concentration in stacks, RPB is a poor growth media for *Salmonella*.