An Investigation into the Coliform Growth of Digested Manure Solids on a Large Commercial Michigan Dairy

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Introduction

Anaerobic digesters are a potential solution for increasing sustainability while reducing the environmental impact of dairy farms. Many farms utilize the digester's solid waste product as freestall bedding. It provides good cow comfort and is readily available at a low cost to the producer. However, concerns have been raised about the relationship of this bedding to udder health and milk quality. Currently, little is known about the ideal management of digested manure solids, its use as bedding, and its influence on environmental mastitis. We set out to qualify and quantify the levels of coliform bacteria in the bedding, as well as aspects which would influence management in the freestall by measuring changes over time, surface and deep differences, composting and influence of the cow (i.e., inoculation of the bedding).

Materials and Methods

One freestall barn was chosen as our experimental area. Bedding samples were taken on day 1, 2, and 3 from both these control stalls (no cow access) and stalls in use by lactating cows (CP stalls). When new bedding was added, new CP stalls would be chosen using a random number generator to ensure representative samples from the barn. Surface samples were collected from the area where the udder comes in contact with the bedding. Deep samples were collected three inches (7.6 cm) below the surface. All samples were collected using sterile gloves and transported on ice. Serial dilutions were performed on the samples and incubated at 98.6°F (37.0°C) for 24 hours on MacConkey agar. The post-digestion solids were composted for 10 days. A dilution of $1x10^5$ was chosen as the most representative dilution. Bacterial counts from this dilution were analyzed using t-tests from a statistical software package.

Results

We had six sets of data for each of the four groups (control surface, control deep, CP surface, CP deep). The control stalls showed no changes of bacterial growth over time and remained at 0 colony-forming units/ml (cfu/ml). After incubation there was no significant difference in bacterial load between controls and the CP stalls ($P = 0.56$). There was no significant difference between the control stalls in surface and deep samples ($P = 1$); this was also the case in stalls with CP stalls ($P = 0.62$). The bacterial levels reached a mean maximum limit of 1.49 million cfu/ml within 24 hours. No significant change was seen in these levels over time ($P = 0.17$). The predominant bacteria present was a *Klebsiella* species, all other bacteria were *Escherichia coli*, that only represented 4.69% of total bacterial growth. There was a significant decrease ($P = 0.018$) between incubated fresh bedding (mean = 1.43 million cfu/ml) and incubated samples from the post-digestion compost pile (mean = 100,000 cfu/ml).

Significance

Coliform bacteria in this bedding reached its maximum growth within 24 hours. These levels can be well above the mastitis infective limit of 1 million cfu/ml. This implies management should focus on digester and bedding management before it enters the stalls. *Klebsiella* spp appear to be the main bacteria that are capable of surviving the digestion process and are a concern for causing coliform mastitis. When post-digestion solids were composted for 10 days at an mean temperature of 122°F (50°C) the bacteria counts were significantly lowered below the mastitis infective limit. From our study, we believe that future studies should focus on factors that support coliform growth in the digester and post-digestion bedding rather than the management of the bedding once it reaches the free-stalls. We feel that composting can help reduce coliform counts in this bedding to an acceptable level that will reduce the risk to the udder. With further analysis we should be able to recommend a Hazard Analysis and Critical Control Point (HACCP) approach for use on farms with anaerobic digesters.