Effectiveness of Bargamo "Odor Sponge" In Reducing Odors In Slurry Dairy Manure

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September 1997

98-4

I. PROJECT TITLE: Effectiveness of Bargamo "Odor Sponge" Manure Additive in Reducing Odors in Slurry Dairy Manure.

As dairy farms get larger, manure is more likely to be stored anaerobically as a liquid or slurry. While this permits flexibility in scheduling manure applications, slurry manure usually has odors regarded as objectionable by the nonfarm public. This project compares the effectiveness of a commercially available manure additive. "Odor Sponge", in reducing objectionable manure odors.

II. OBJECTIVE

Determine if The Bargamo Corporation's "Odor Sponge" results in decreased objectionable odors in anaerobically stored slurry dairy manure.

III. APPROACH AND METHODS

Nine 265-liter polyethylene stock tanks were buried at the research site to a depth so that 10 cm of tank remained above the soil surface. Ninety-five liters of untreated slurry manure, diluted with water to approximately 5% solids content, were added to each tank. On June 9, three tanks were treated with The Bargamo Corporation's "Odor Sponge" at 1.5 liters per 1000 liters, three tanks were treated with Odor Sponge at 2.25 liters per 1000 liters of manure, and three tanks were untreated controls. The treatments were replicated three times and assigned to tanks following a completely randomized design. Fresh manure from the dairy facility at Miner Institute was used for the trial. The actual solids content of the manure ranged narrowly, from 4.7% to 5.7%. Nineteen liters of treated or untreated manure were added to each tank at weekly intervals. It was intended for manure additions to be made on days 7, 14, 21, 28, and 35. However, difficulty in odor analyses methodology resulted in the research trial being extended for two weeks, with additional treatments made according through day 49.

On day 53 all tanks were agitated, and immediately after agitation samples were taken for laboratory odor analysis and odor panel evaluation following procedures outlined by Miner et al. (1995). The samples were stored for four days to begin decomposition and increase potential volatile gases. (Koelsch, 1993) An apparatus driven by an air pump collected odor emissions through a series of flasks and a vessel containing 8 liters of manure.

Ammonia and hydrogen sulfide concentrations were analyzed using Proc Anova procedures of SAS. Multiple comparisons of means were tested using the Duncan test.

RESULTS AND DISCUSSION

Trial 1

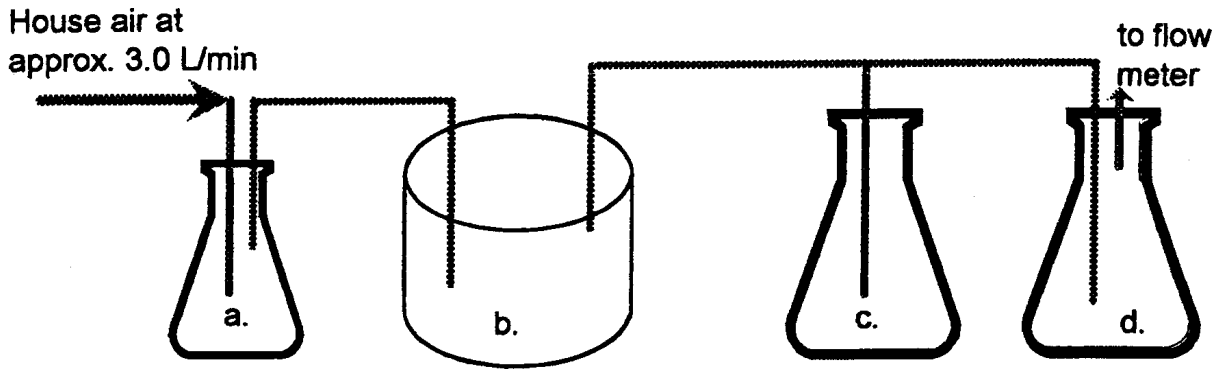
In the initial trial, an absorption flask with dilute sulfuric acid absorbed ammonia for 15 minutes. This liquid was analyzed for ammonia using the colorimetric Nessler's procedure (Miner et al., 1995). An absorption flask with dilute zinc acetate absorbed the evolved hydrogen sulfide for 15 minutes which was analyzed using the methylene blue technique. A flask containing a clean white cotton flannel square, approximately 20 cm square, absorbed the odor for thirty minutes and was subjected to an odor evaluation panel. (Miner and Licht, 1981).

Ammonia and hydrogen sulfide analyses were performed within one hour of extraction from the manure samples. Ammonia concentrations were very low in for all treatments, averaging 0.4 ppm for the control, 1.0 ppm for the 1.5 liter rate of Odor Sponge, and 0.1 ppm for the 2.25 liter rate. When compared to the work of Patni and Jui, 1993, it was obvious that the initial procedure was not collecting gases in sufficient concentrations for reliable analysis. Hydrogen sulfide concentrations were also very low, as was odor deposition on the cotton swatches to be used by the odor panel. Two preliminary odor panel trials confirmed this, as panelists were not able to detect differences between any treatment.

Trial 2

A second trial was run in early September because of difficulties encountered using the methylene blue procedure for hydrogen sulfide analysis and lack of detectable odor on the cotton swatches. Procedures were reviewed to determine alternatives for detecting hydrogen sulfide and impregnating the cotton flannel swatches with odor. It was determined that the iodometric method was a better alternative for hydrogen sulfide analyses. This method was used as the standard for the methylene blue procedure.

Manure tanks were recharged with Odor Sponge according to the original protocol, and samples taken. Using the apparatus previously described (Figure 1), air was bubbled through two flasks for 30 min. One flask contained 400 ml of 0.04N sulfuric acid to capture ammonia and the other flask contained 400 ml of a solution of zinc acetate to absorb hydrogen sulfide.



a. Flask with distilled water to humidify air
b. Manure tank containing 11L of sample
c. Flask containing Acetate buffer for sulfide analysis
d. Flask containing dilute H2SO4 for ammonia analysis

Figure 1. Apparatus for collection of ammonia and hydrogen sulfide.

Samples for ammonia analysis were taken and refrigerated for subsequent analysis. Samples containing hydrogen sulfide were immediately taken and analyzed using the iodometric method. Ammonia was analyzed using a Wescan Ammonia Analyzer. These adjustments to laboratory protocol resulted in much improved results, especially for hydrogen sulfide analysis. (Table 1)

Table 1. Ammonia and hydrogen sulfide concentrations.

Treatment	Ammonia Ppm	Standard Deviation	Hydrogen Sulfide ppm	Standard Deviation
Control	0.737	0.052	39.74a	14.96
1.5 liters	0.508	0.281	42.50a	6.45
2.25 liters	0.760	0.444	6.20b	5.78

Differing letters are statistically significant at P<.05.

There was no significant difference in ammonia concentration between treated and untreated manure. There was considerable variation in ammonia concentration between the individual tanks treated with Odor Sponge (0.184 to 0.681 for the 1.5 liter rate, and 0.274 to 1.144 for the 2.25 liter rate). while untreated manure ranged from 0.692 to 0.794 ppm. No reason is known for this variation.

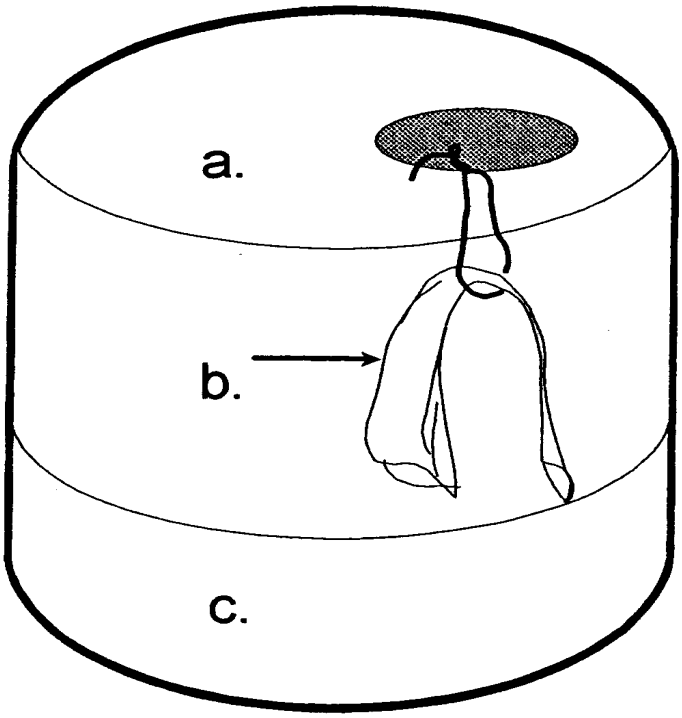
There was no difference in hydrogen sulfide concentration between control and the 1.5 liter rate of Odor Sponge, but treatment at the 2.25 liter rate resulted in significantly lower hydrogen

sulfide concentration (P<.05). All three tanks treated with 2.25 liters of Odor Sponge had considerably lower concentrations of hydrogen sulfide than did any control or 1.5 liter rate tank. This is especially meaningful since hydrogen sulfide is commonly associated with objectionable manure odors, much more so than ammonia. It should be noted that these analyses were performed in triplicate, with very little variation between runs.

Odor panel evaluation

Materials & Methods

Dry cotton flannel swatches, 7 cm x 7cm, were used to compare the odor intensity of untreated dairy manure, manure treated with 1.5 liters of Odor Sponge/1000 liters dairy manure, and 2.25 liters Odor Sponge/-1000 liters dairy manure. The swatches were prepared by heating at 92 ^{o}C for four hours to remove any volatile absorbed gases, then stored in a sealed plastic bag until used. The vessels, each containing 11 liters of untreated or treated manure, were agitated and sealed with the cotton swatches suspended from the cover for 24 hours (Figure 2.). At no time did the swatches come into direct contact with the manure.



A flannel swatch (b.) is suspended above 11L of manure (c.) in the manure tank (a.) for 24 hours.

Figure 2. Setup for preparing flannel swatches used in odor evaluation panel

After the exposure period, the cotton squares were assembled into a triangular test design and nine groups of three swatches were bagged individually. Two of the swatches in each set were from the same vessel. Panel members were asked to identify which of the three swatches was

different from the other two. Research by Miner & Licht (1981) indicated that if the odors are different, panel members will be able to identify the swatch that is different. If they are not different, approximately one third of the panelists will select the correct answer by guessing. To minimize sensory fatigue, panelists were presented one group of swatches for three consecutive days, a total of three groups of swatches per panelist. These represented the three comparisons that were evaluated:

1. Untreated manure vs, manure treated at 1.5 L Odor Sponge/1000 L manure.
2. Untreated manure vs. manure treated at 2.25 L Odor Sponge/1000 L manure
3. 1.5 L Odor Sponge/i 000 L manure vs. 2.25 L Odor Sponge/1000 L manure.

Panelists were asked to identify the swatch that was different and if the identified swatch was more or less offensive than the other two swatches.

Results

The odor panel results (Table 2) show that 6 out of 12 panelists were able to select the correct swatch after a 24 hour exposure to the gases emitted from manure treated with the 1.5 liter rate of Odor Sponge. Only 1 panelist was able to select the correct swatch when the 2.25 liter rate of Odor Sponge was compared to untreated dairy manure. These findings indicate there are no differences between treatments when sensory evaluations are performed using the procedures followed in this study.

The odor panel results may appear inconsistent with the dramatically lower hydrogen sulfide concentration for manure treated at the 2.25 liter rate of Odor Sponge. It would appear that odor-producing compounds other than hydrogen sulfide were present in sufficient quantities to mask any odor differences due to lower hydrogen sulfide concentration in the 2.25 liter rate of Odor Sponge.

Table 2. Odor panel results.

Source of two Like swatches	Source of the single different swatch	No. of panelists	No. of panelists identifying unique swatch	Comments about unique swatch
Untreated dairy manure	Dairy manure treated with 1.5 L Odor Sponge	12	6	Less offensive (4) More offensive (2)
Untreated dairy manure	Dairy manure treated with 2.25 L Odor sponge	12	1	Less offensive (1)
Dairy manure treated with 1.5 L Odor Sponge	Dairy manure treated with 2.25 L Odor Sponge	11	5	Less offensive (3) More offensive (2)

VI. UNANSWERED QUESTIONS AND FUTURE RESEARCH NEEDS

1. Why did the 1.5 liter rate of Odor Sponge cause no reduction in hydrogen sulfide, while the 2.25 liter rate dramatically reduced hydrogen sulfide concentration?

2. What effect does the solids content of manure have on the effectiveness of Odor Sponge? While we diluted the manure to approximately 5% solids content to agree with the required protocol of the research project, the slurry manure on many dairy farms averages 7-8%, or approximately 50% higher solids content than that used for this research project.

VII. LITERATURE CITED

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