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Daniel L. Vaughn
Southern Illinois University Carbondale

Michael A. Kruge
Montclair State University, krugem@mail.montclair.edu

Use Of Py-GC/MS Analysis Techniques In Animal Waste Management: A Preliminary Survey Of Dairy Manures

Daniel L. VAUGHN and Michael A. KRUGE

Department of Geology and **Environmental Resources & Policy Program**

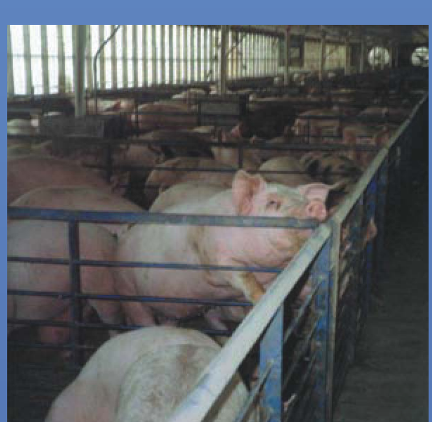
Southern Illinois University, Carbondale, IL 62901-4324 USA

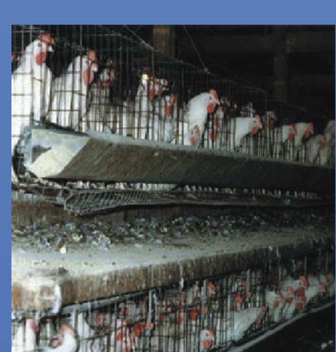
dvaughn@siu.edu, kruge@geo.siu.edu



Introduction

The increasing practice of industrial-scale agriculture tends to concentrate large masses of animal waste in relatively compact areas, potentially leading to excessive release of polluting nutrients into waterways during major storms. Anaerobic treatment conditions are generally favored to conserve nitrate N as an agricultural commodity. However, overall N contents in waste are often in excess of crop fertilization needs: storing excess N in soluble nitrate form increases pollution potential. Thus the perceived needs of agriculture and society-at-large become at odds. Organic nitrogen forms (e.g., proteins) are more environmentally stable and are less subject to unintentional release. Although U.S. farmers tend to view it with disfavor, non-aqueous (aerobic) treatment such as composting holds potential for storing nitrogen in a more stable, environmentally-benign form.

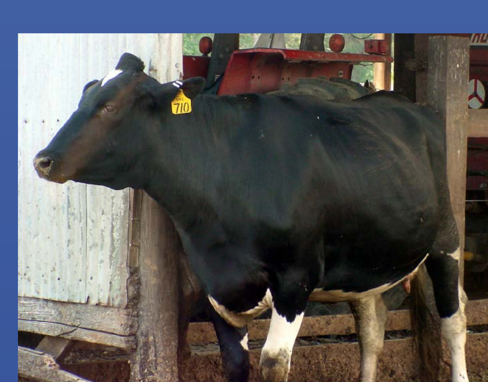




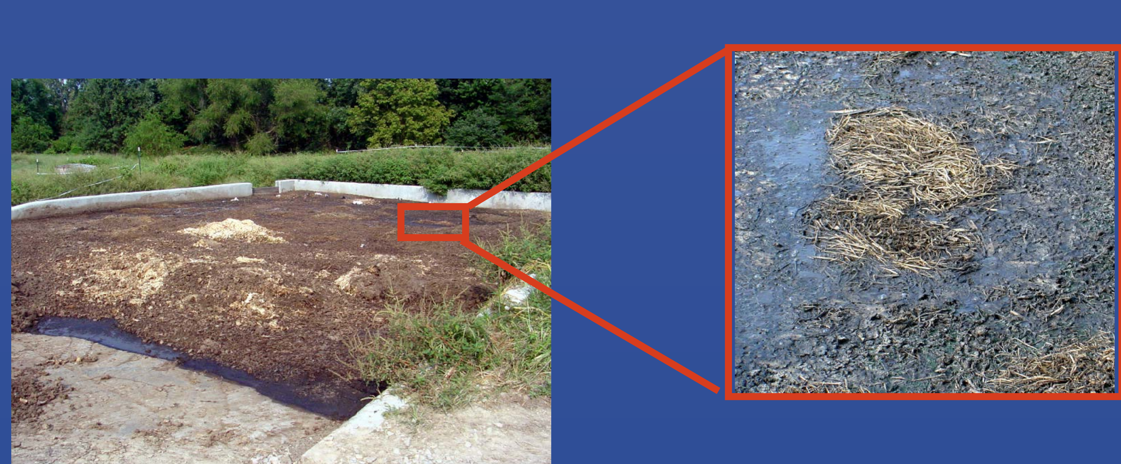

Photos: Farm Sanctuary (www.factoryfarming.com)

Methods

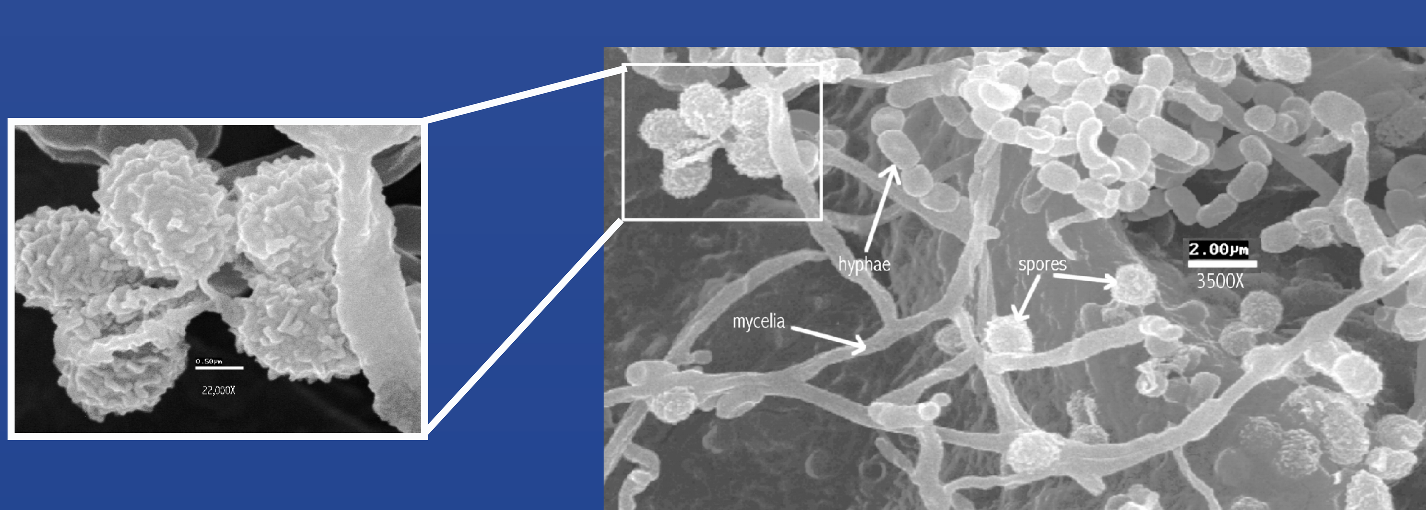
Six dairy farm waste samples were collected. The three samples discussed herein (fresh manure, a waste lagoon deposit, and a dry commpost) were chosen as representative of a waste source and two biochemically different waste treatment scenarios: anaerobic versus aerobic. The fresh sample was a grab sample and represents manure in the unaltred state. The anaerobically-degraded lagoon sample, taken from a six-week old pit sludge at a depth of 80cm, was olive green and exhibited a strong odor. The aerobically-degraded compost was taken from older, mixed-age, lot-edge spillover. The location was open to the air and well-drained, but partly sheltered. The compost was browner in color than the lagoon sample and had an earthy odor. Sub-samples were dried, crushed, and cryo-fractured as preparation for pyrolysis.

Fresh manure, bedding and spilled feed initially accumulate on the stable floor.

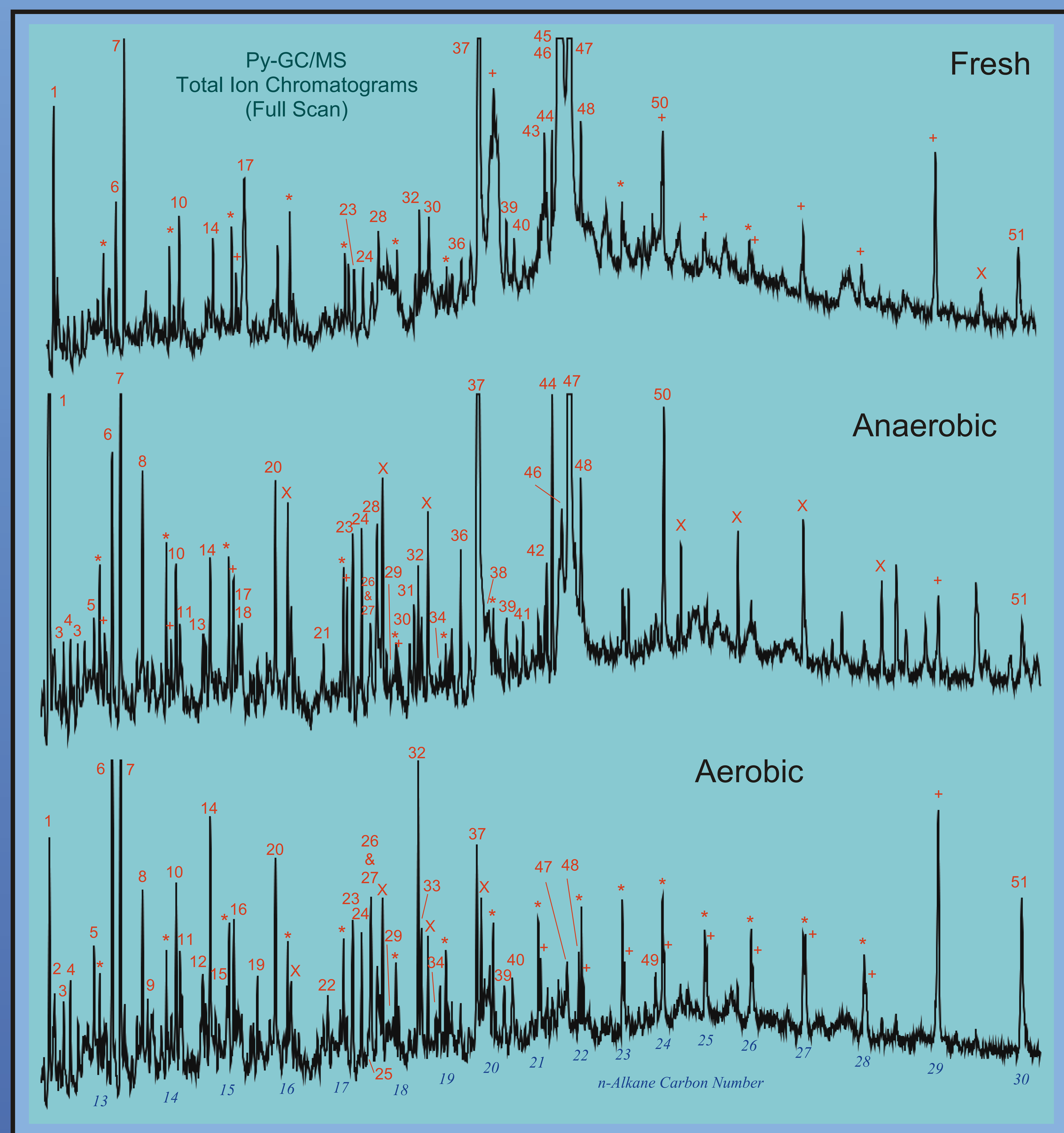


Stable floor litter is transferred to a lagoon, where it undergoes *anaerobic degradation*.



Scanning electron micrographs of composted (*aerobically-degraded*) manure showing abundant actinomycete hyphae, mycelia and spores.

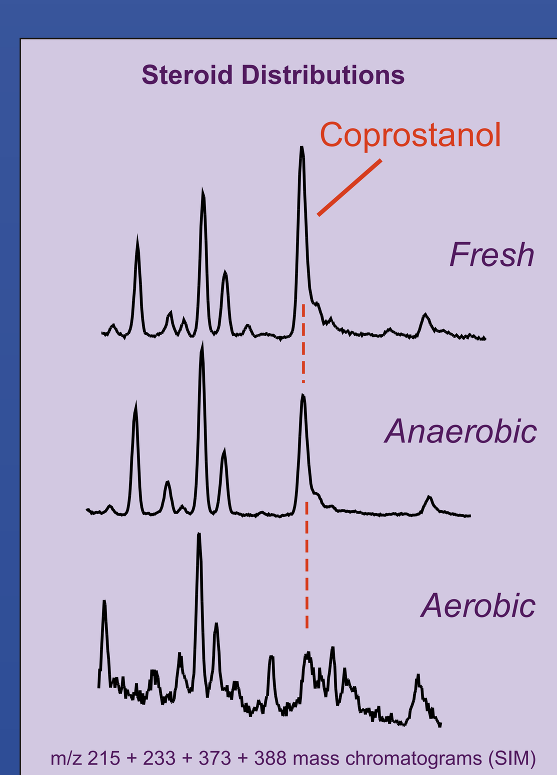
Thanks to Professor Kenneth Griswold, Department of Animal Sciences, Food & Nutrition, Southern Illinois University



CDS Pyroprobe, 600oC, 20 sec., HP 5980 GC; 50m/0.2mm/0.3um DB5-ms col.;
40°C (5 min.), 40-300°/min, 300° (20 min.); HP 5780 MSD, 50-440 Da, 0.9 scans/sec.

Observations

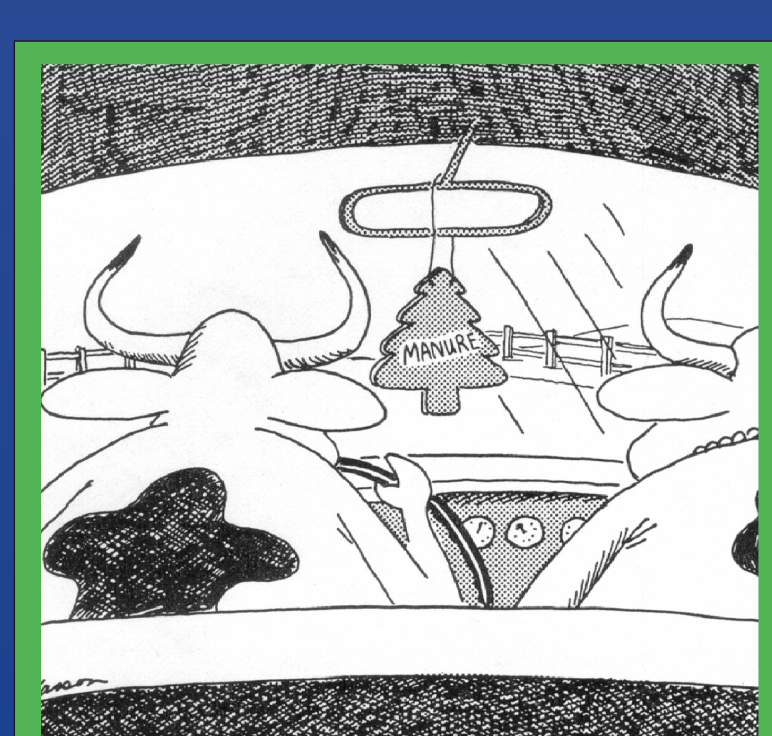
Significant differences between the pyrolyzates were noted: The
lagoon sample is strongly enriched in fatty acids relative to
post. As anaerobic systems tend to be lower in pH, this com
expected. A more detailed examination of the pyro- might be
that, while both have many compounds in grams reveals
methoxyphenols derived from the plant common, such as the
tive proportions may vary considerably. matter in the feed, rela
appears to be relatively enriched in The compost pyrolyzate
(indoles and dipeptides), as well as organonitrogen compounds
carbons. This conservation of organiclong-chain aliphatic hydro
that aerobic manure management, N lends support to the idea
be a more desirable agricultural such as by composting, could
practice.



The fecal steroid coprostanol is relatively much less abundant in the aerobically-degraded compost.

Py-GC/MS peak identification. *: n-alkenes, +: n-alkanes, x: silane & phthalate contaminants. Numbered peaks identified below.

1) dihydrobenzofuran
2) 2-methoxy-4-methylphenol
3) methyethylphenol
4) benzenepropanenitrile
5) 2-methoxy-4-ethylphenol
6) indole
7) 2-methoxy-4-vinylphenol
8) 2,6 dimethoxyphenol
9) 2-methoxy-4-(prop-1-enyl)phenol
10) methylindole
11) 2-methoxy-4-formylphenol
12) 1,2-hydroxyphenyl-ethanone
13) $C_8H_8O_4$ (?)
14) isoeugenol
15) indoledione
16) 2-methoxy-4-(propane-2-one)-phenol
17) levoglucosan
18) tetrahydronapthalenamine
19) 1-(4-hydroxy-methoxyphenyl)-ethanone
20) 2,6-dimethoxy-4-vinyl-phenol
21) unknown
22) 1-phenyl-1H-pyrrole-2,5-dione
23) 2,6-dimethoxy-4-(pro-2-enyl)-phenol (trans)
24) prist-1-ene
25) dipeptide (Pro-Ala)
26) bisphenol
27) acetosyringol
28) tetradecanoic acid
29) Pro-Gly, Pro-Lys
30) pentadecanoic acid
31) unknown acid
32) phtyadiene
33) phytene
34) Pro-Val, Pro Arg
35) tetradecanitrile + unspec. acid
36) hexadecanoic acid methyl ester
37) hexadecanoic acid
38) hexadecanitrile
39) methylpyridoindole
40) pyridoindole
41) heptadecanoic acid
42) octadecanitrile
43) nonadecan-2-one
44) octadecanoic acid, methyl ester
45) octadecadienoic acid
46) octadecenoic acid
47) octadecanoic acid
48) hexadecanamide
49) biphenoldiol
50) octadecanamide
51) C_{30} alkene or alcohol ?



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