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GasAbate treatment reduces gaseous emissions and retains the biogas and fertiliser potential of stored pig and cattle manures

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Abstract
Stored livestock liquid manures are a source of greenhouse gas (GHG) and ammonia emissions. Gaseous nitrogen and carbon losses reduce slurry fertiliser and feedstock value. Here, a novel, peroxide-based additive system, GasAbate, was trialled on stored liquid pig and cattle slurries in 1 m^3 units. GHG emissions were reduced by >80%. The retention of organic carbon was exemplified by a 40-56% increase in biomethane potential from the treated manures. Nutrient retention also made GasAbate-treated slurry a better fertiliser (>20% increased dry matter yield) for ryegrass cultivation.

Keywords (maximum 6) in alphabetical order
Agronomy; Ammonia; Agriculture; Anaerobic Digestion; Greenhouse Gas Emissions; Manure.

INTRODUCTION

Stored livestock liquid manures (slurries) are a significant source of greenhouse gas (GHG) and ammonia (NH_3) emissions, accounting for >10% of agricultural emissions in the EU (Loyon, 2018). Slurry additive treatment technologies are a potential means of mitigating such losses (Petersen *et al.,* 2013). Here, a novel peroxide-based slurry additive system, GasAbate, with previously demonstrated efficacy at lab-scale (Thorn *et al.,* 2022), was assessed during pilot-scale storage of pig and cattle slurry. The effect of the additive on the fertiliser and biogas potential of slurry was investigated during cultivation of ryegrass, and during pilot- and full-scale anaerobic digestion (AD), respectively.

MATERIALS AND METHODS

Pilot trials were performed in 1m^3 tanks with 750 L of fresh slurry at 12-22˚C. The peroxide-based additive (containing 35% hydrogen peroxide) was applied (0.87 g kg^{-1}) via injection using a proprietary dosing system. Continuous air flow over the surface was at 2.12 m^3/hr. Emissions were continuously measured [methane (CH_4), carbon dioxide (**CO_2**), nitrous oxide (N_2O), NH_3] from tank outlets using a photoacoustic multi-gas analyser (Gasera, Finland). Untreated controls were maintained. Slurries were tested for biomethane potential (BMP), and used as feedstocks for pilot- and full-scale AD (100 L/270 m^3). A *Lolium perenne* growth mesocosm (28 cm x 24 cm containers) trial, using a randomized block design, was conducted with two soils: Carryduff (organic matter: 24%), and Maryland (organic matter: 8%). The three treatments tested were untreated slurry (SUT), GasAbate-treated slurry (ST), and inorganic fertiliser [recommended slurry equivalent (RSE)].

RESULTS AND DISCUSSION

CH_4 and CO_2 emissions from GasAbate treated slurry tanks were lower than controls with reductions of 80% in CH_4 and c. 50% in CO_2 emissions. N_2O emissions were approximately 50% lower in treated tanks. NH_3 emissions were slightly elevated initially post-treatment, but then fell below control levels with an overall 20% and 50% decrease achieved for cattle and pig slurry, respectively. The carbon content of the slurry was retained. This was demonstrated, e.g., by a 56% increase in BMP from treated versus untreated pig slurry stored for 30 days (Figure 1; Nolan *et al.,* 2023).

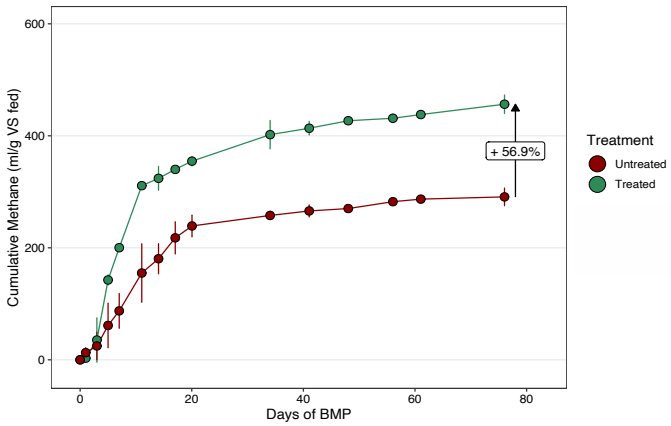

Figure 1. Biomethane potential from GasAbate-treated versus untreated pig slurry samples.

In plant growth trials, GasAbate treated slurry (ST) demonstrated superior performance in terms of dry matter yield across all growth periods, indicating its effectiveness in enhancing grass productivity, for example, by >20% in the case of treated pig slurry (Figure 2).

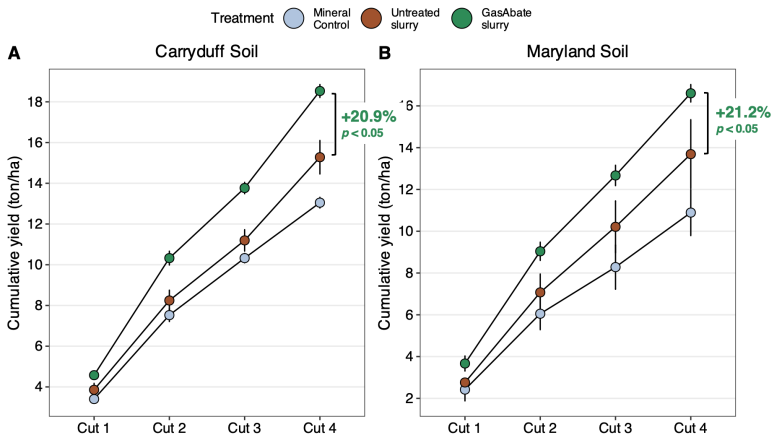

Figure 2. Dry matter yields: recommended slurry equivalent (RSE), untreated slurry (SUT), and treated slurry (ST) across 4 different growth periods.

In conclusion, GasAbate treatment is an effective means of reducing GHG and ammonia emissions, and of retaining the onward use fertiliser and biogas feedstock value, of stored animal liquid manures.

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