



Reducing odorous VOC emissions from swine manure using soybean peroxidase and peroxides

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HIGHLIGHTS

- ▶ Soybean peroxidase and peroxides were applied to swine manure for odor control.
- ▶ The optimum industrial-grade soybean peroxidase rate was 50 g L⁻¹.
- ▶ Calcium peroxide was more effective than hydrogen peroxide.
- ▶ The primary odorant 4-methylphenol accounted for 68–81% of the odor activity value.
- ▶ A 4-methylphenol reduction of 92% was achieved.

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ABSTRACT

The objective of the research was to determine the optimum application rates of soybean peroxidase (SBP) plus peroxide (SBPP) for reducing odorous VOC emissions from swine manure. Industrial-grade SBP was applied in combination with liquid hydrogen peroxide (H₂O₂) or powdered calcium peroxide (CaO₂) to standard phenolic solutions and swine manure, and emissions were measured in a wind tunnel. The primary odorant in the untreated manure was 4-methylphenol, which accounted for 68–81% of the odor activity value. At the optimum application rate of SBPP (50 g L⁻¹), 4-methylphenol emissions were reduced from the swine manure by 62% (H₂O₂) and 98% (CaO₂) after 24 h ($P < 0.0001$). The CaO₂ had a longer residence time, remaining effective for 48 h with 92% reduction in emission rates ($P < 0.0001$), while H₂O₂ was similar to the control at 48 h ($P = 0.28$).

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1. Introduction

Volatile organic compounds (VOC) are emitted from wastewater treatment plants, food processing plants, landfills, and animal feeding operations (Kim et al., 2006). Volatile organic compound emissions are an important aspect of air quality because many are malodorous. There has been a growing concern in recent years over VOC emissions and the related nuisances from agricultural

operations, prompting several states to enact ambient odor regulations (Sweeten, 1995; Chen et al., 1999; CAQCC, 1999; Redwine and Lacey, 2000).

More than 200 VOC have been identified in air emissions from manure and animal feeding operations (Kai and Schafer, 2004; Akdeniz et al., 2010). These VOC originate from the degradation of amino acids in the intestines of animals and anaerobic decomposition of manure (Mata-Alvarez et al., 2000; Kai and Schafer, 2004; Chen et al., 2008). Ammonia, volatile fatty acids (VFA), sulfides, 4-methylphenol (i.e. *p*-cresol), phenol, indole, and skatole are among the most commonly reported odorants associated with animal manures (Mackie et al., 1998). Many odorous compounds are emitted at animal feeding operations, but it is the phenolic and indolic compounds that dominate the overall odor at distance from these operations (Parker, 2007). As such, these compounds are the

Abbreviations: SBP, soybean peroxidase; SBPP, soybean peroxidase plus peroxide; HRP, horseradish peroxidase; VFA, volatile fatty acid; VOC, volatile organic compound; TD, thermal desorption; GC, gas chromatography; MS, mass spectrometry; DM, dry matter; OAV, odor activity value.

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