

Antimicrobial Activity of 2-Nitro-1-Propanol and Lauric Acid against Gram-Positive Bacteria

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Abstract : Propagation and dissemination of antimicrobial resistant and pathogenic microbes from spoiled silages and composts represents a serious public health threat to humans and animals. In the present study, the antimicrobial activity of the short chain nitro-compound, 2-nitro-1-propanol (9 mM) as well as the medium chain fatty acid, lauric acid, and its glycerol monoester, monolaurin, (each at 25 and 17 $\mu\text{mol/mL}$, respectfully) were investigated against select pathogenic and multi-drug resistant antimicrobial resistant Gram-positive bacteria common to spoiled silages and composts. In an initial study, we found that growth rates of a multi-resistant *Enterococcus faecalis* (expressing resistance against erythromycin, quinupristin/dalfopristin and tetracycline) and *Staphylococcus aureus* strain 12600 (expressing resistance against erythromycin, linezolid, penicillin, quinupristin/dalfopristin and vancomycin) were more than 78% slower ($P < 0.05$) by 2-nitro-1-propanol treatment during culture ($n = 3/\text{treatment}$) in anaerobically prepared $\frac{1}{2}$ strength Brain Heart Infusion broth at 37°C when compared to untreated controls (0.332 ± 0.04 and $0.108 \pm 0.03 \text{ h}^{-1}$, respectively). The growth rate of 2-nitro-1-propanol-treated *Listeria monocytogenes* was also decreased by 96% ($P < 0.05$) when compared to untreated controls cultured similarly ($0.171 \pm 0.01 \text{ h}^{-1}$). Maximum optical densities measured at 600 nm were lower ($P < 0.05$) in 2-nitro-1-propanol-treated cultures (0.053 ± 0.01 , 0.205 ± 0.02 and 0.041 ± 0.01 , respectively) than in untreated controls (0.483 ± 0.02 , 0.523 ± 0.01 and 0.427 ± 0.01 , respectively) for *E. faecalis*, *S. aureus* and *L. monocytogenes*, respectively. When tested against mixed microbial populations during anaerobic 24 h incubation of spoiled silage, significant effects of treatment with 1 mg 2-nitro-1-propanol (approximately 9.5 $\mu\text{mol/g}$) or 5 mg lauric acid/g (approximately 25 $\mu\text{mol/g}$) on populations of wildtype *Enterococcus* and *Listeria* were not observed. Mixed populations treated with 5 mg monolaurin/g (approximately 17 $\mu\text{mol/g}$) had lower ($P < 0.05$) viable cell counts of wildtype enterococci than untreated controls after 6 h incubation (2.87 ± 1.03 versus $5.20 \pm 0.25 \text{ log}_{10}$ colony forming units/g, respectively) but otherwise significant effects of monolaurin were not observed. These results reveal differential susceptibility of multi-drug resistant enterococci and staphylococci as well as *L. monocytogenes* to the inhibitory activity of 2-nitro-1-propanol and the medium chain fatty acid, lauric acid and its glycerol monoester, monolaurin. Ultimately, these results may lead to improved treatment technologies to preserve the microbiological safety of silages and composts.

Keywords : 2-nitro-1-propanol, lauric acid, monolaurin, gram positive bacteria

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