

Antimicrobial Effects of Essential Oils, Nisin, and Irradiation Treatments against *Listeria monocytogenes* on Ready-to-Eat Carrots

Aude Ndoti-Nembe, Khanh Dang Vu, Nicolas Doucet, and Monique Lacroix

Abstract: The study aimed at using essential oil (EO) alone or combined EO with nisin and low dose γ -irradiation to evaluate their antibacterial effect against *Listeria monocytogenes* during storage of carrots at 4 °C. Minicarrots were inoculated with *L. monocytogenes* at a final concentration of approximately 7 log CFU/g. Inoculated samples were coated by nisin at final concentration of 10³ International Unit (IU)/mL or individual mountain savory EO or carvacrol at final concentration of 0.35%, w/w) or nisin plus EO. The samples were then irradiated at 0, 0.5, and 1.0 kGy. The treated samples were kept at 4 °C and microbial analysis of samples were conducted at days 1, 3, 6, and 9. The results showed that coating carrots by carvacrol plus nisin or mountain savory plus nisin and then irradiating coated carrots at 1 kGy could reduce *L. monocytogenes* by more than 3 log at day 1 and reduced it to undetectable level from day 6. Thus, the combined treatments using nisin plus carvacrol or nisin plus mountain savory and irradiation at 1.0 kGy could be used as an effective method for controlling *L. monocytogenes* in minicarrots.

Keywords: carvacrol, Gamma irradiation, *Listeria monocytogenes*, minicarrots, mountain savory essential oil

Introduction

In the last decade, food contamination by pathogenic bacteria has been one of the most important considerations of governments and international organizations, such as WHO (Kaferstein and Abdussalam 1999). Bacteria such as *Listeria monocytogenes*, *Salmonella* Typhimurium, and *Escherichia coli* O157:H7 have been

agents. Studies have found that the addition of natural or synthetic antimicrobial compounds into food products before applying gamma radiation could lead to an increase in the sensitivity of foodborne pathogens to irradiation (Borsa and others 2004, Mohamed and others 2011; Ndoti-Nembe and others, 2013).

Essential oils (EOs) are aromatic oils extracted from plants that