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ORIGINAL PAPER

Microencapsulation of nisin in alginate-cellulose nanocrystal (CNC) microbeads for prolonged efficacy against *Listeria monocytogenes*

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Abstract The present study was undertaken to develop edible nisin-microencapsulated beads in order to inhibit growth of *Listeria monocytogenes* in ready-to-eat (RTE) ham. Different concentrations of nisin (16, 31, and 63 µg/ml) were microencapsulated into alginate-cellulose nanocrystal beads. Microencapsulation kept the available nisin (63 µg/ml) content 20 times greater compared with free nisin (63 µg/ml) during 28 days of storage at 4 °C. Results showed that 63 µg/ml microencapsulated nisin exhibited 31.26 µg/ml available nisin content after 28 days of storage at 4 °C, whereas there was no available nisin content left for free nisin. Cooked ham slices were then coated by the microencapsulated nisin beads, inoculated with *L. monocytogenes* [~3 log colony-forming units (CFU)/g], and stored at 4 °C under vacuum packaging for 28 days. The beads containing 16, 31, and 63 µg/ml nisin significantly ($P \leq 0.05$) reduced the *L. monocytogenes* counts by 2.65, 1.50, and 3.04 log CFU/g after 28 days of storage compared with free nisin. Furthermore, microencapsulated nisin beads did not change the physicochemical properties (pH and color) of RTE ham during storage.

Keywords Microencapsulation · Nisin · Microbeads · *Listeria monocytogenes* · RTE meat · Cellulose nanocrystals

Introduction

The safety of ready-to-eat (RTE) meat products is of high concern due to the likelihood of contamination by