Protection of bioactive peptides using spray coating

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INTRODUCTION

Bioactive peptides, including those produced by bacteria, have many potential health benefits, including significant potency against gut pathogens including antibiotic resistant strains. However, many antimicrobial peptides such as Nisin are inactivated during gastrointestinal transport (Ugurlu et al. 2007).

The aim of this project is to develop encapsulation systems that will protect peptides from inactivation during gastrointestinal transport and release them at the appropriate target sites within the gastrointestinal tract.

Nisin is a broad spectrum bacteriocin that is active against a wide variety of Gram positive bacteria and is widely used as a food preservative(Delves-Broughton 2005). Nisin also has the potential to treat microbial infections such as *Clostridium difficile*, however digestive enzymes in the small intestine, in particular chymotrypsin, can rapidly inactivate Nisin making it unsuitable for oral delivery (Ugurlu et al. 2007; Xiao 2010).

In this study Nisin will be used as a model peptide to develop a colonic delivery system. Nisin will be coated to protect it during transit in the upper gastrointestinal tract and it will be released from the coating in the colon. A range of spray coatings are being investigated including a starch based coating.

MATERIALS AND METHODS

Purification of Nisin

A Nisin containing powder (Nisaplin, Danisco) was enriched by salt precipitation.

Production of the Nisin containing cores

In order to prepare Nisin containing cores with suitable flowability for spray coating the Nisin was blended with a range of carbohydrates and protein. These blends were produced in a bench-top Buchi B-191 spray drier. The effect of operation conditions and formulation on the flowability of cores was investigated. Once the optimum blend and conditions were determined in the bench-top spray drier the process was scaled up to pilot scale using an Anhydro Lab 3 spray dryer. Examples of the Nisin containing cores are shown in Figure 1.

Figure 1 : Nisin containing cores

Quantification of Nisin and determination of Nisin activity

The Nisin content at each process stage was determined by reverse-phase HPLC. The Nisin activity at each process stage was determined using a diffusion assay based on a published method (Ryan et al. 1996) an example of which is given in Figure 2.

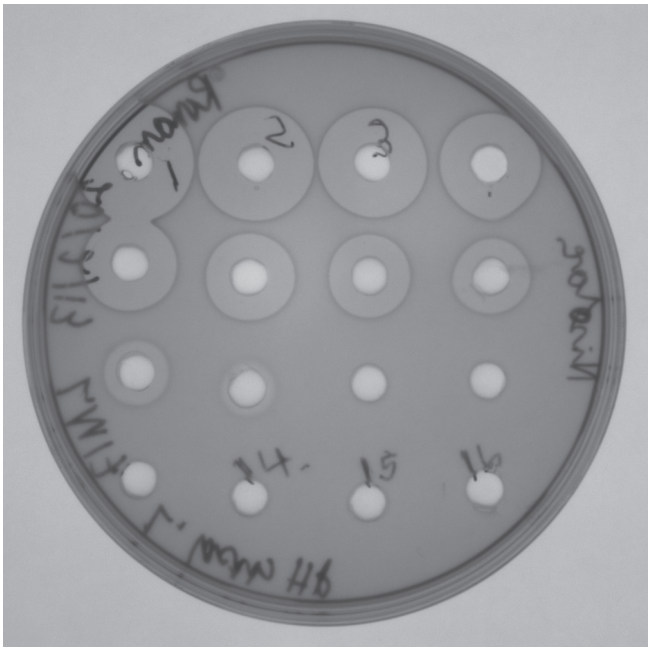

Figure 2 : Activity assay and dilution series of Nisin containing cores post production. This shows that the processing involved in core production does not affect the activity of the Nisin

Preparation of coating solution
The starch is gelatinised prior to use.

Spray coating of the cores with a starch coating
The Nisin containing cores are spray coated in a bench top spray coater (VFC-LAB Micro Flo-Coater) using the Wurster coating method.

Determination of coating efficiency
The efficiency of the coating is being determined by viewing the stained samples through an Olympus BX51 light microscope and by measuring the change in particle size using a Malvern Morphologi G3.

RESULTS AND DISCUSSION

The Nisin content of the Nisin containing powder was increased from 1.82% to 31% through the enrichment stage. Through blending semi purified Nisin with protein, cores with suitable flowability for Wurster style spray coating have been produced. The antibacterial activity of the Nisin in these cores is retained after production by both lab and pilot scale spray dryers. The cores have been coated with starch using a bench top spray coater.

CONCLUSIONS

This system has the potential to allow orally delivered Nisin to target colonic pathogens and may be adapted for the colonic delivery of other bioactive peptides.

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ADDITIONAL AFFILIATIONS

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ACKNOWLEDGEMENTS

This project is funded by the Irish Government Department of Agriculture, Food and the Marine through the Food Institutional Research Measure grant 10/RD/PEPENCAP/TMFRC/701