Innovative active biodegradable coatings with bioactive peptides based on biopolymer nanoemulsions for prolonging the shelf-life of meat products

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Introduction: Nanoemulsions are finding application in diverse areas such as drug delivery, food, cosmetics, pharmaceuticals, and material synthesis (Naseema et al., 2021). Their small size leads to useful properties such as high surface area per unit volume, robust stability, optically transparent appearance, and tunable rheology. Bioactive peptides are products of protein hydrolysis and exhibit various biological activities including antimicrobial properties. They are generally considered safe to consume (Daliri, Oh and Lee, 2017) which makes them an ideal candidate as natural food preservatives.

The aim of this research was to develop active nanoemulsions and multilayer coatings based on natural polysaccharides (furcelleran (FUR) and chitosan (CHIT)) in order to extend the shelf life of model meat product. This is a work in progress.

Materials and methods: The nanoemulsions of natural polymers CHIT/FUR were cross-linked with two antimicrobial peptides: RW4 and LL37. Additionally, Cymbopogon citratus essential oil was added to the formed nanoemulsions to enhance the antimicrobial properties. Tween 80 was used as the stabilizer. Nanoemulsions were created by mechanical mixing with the use of magnetic stirrers and ultrasounds. The conditions and stability for its formation were determined by measuring the zeta potential and size of nanoemulsions using Dynamic Light Scaterring method with a detection angle of 173°. Each value was obtained as average from three runs with at least 10 measurements. The initial concentration of furcellaran and chitosan was 1000 ppm.

Raw hermetically packed pork loins were purchased from a local supplier and coated (multilayers) with nanoemulsions. The samples were divided into one of 5 groups: control (no coating), 2- layer coatings with layers of CHIT-RW4/FUR-LL37 (2RW) or CHIT-LL37/FUR-RW4 (2LL) and 4-layer coatings with layers of CHIT-RW4/FUR-LL37/CHI-RW4/FUR-LL37 (4RW) or CHIT-LL37/FUR-RW4/CHIT-LL37/FUR-RW4 (4LL). Each layer was applied through spraying the surface of the samples. Afterwards the samples were hermetically packed and stored at 4 oC for 11 days. The samples were analysed for their total viable counts (TVC) with incubation performed on PCA agar at 30 oC for 72h. The analysis was performed using three independent repetitions.

Results and discussion: The obtained size of the emulsions was in a range of 10-12 nm. The surface charge of nanoemulsions was enough to ensure electrostatic stabilization (± 30 mV). The initial contamination of the pork loin (Day 0) was 3.09 ± 0.40 log cfu/g. The TVC of control sample after 11 days of storage increased to 8.31 ± 0.64 log cfu/g, while in coated samples remained within the range of 4.00 – 4.85 log cfu/g (inhibition of 3.46-4.31 log cfu/g). All multilayer coatings successfully inhibited the microbial growth, however the lowest TVC was observed in 2RW coating (4.00 ± 1.13 log cfu/g) while the highest in 4LL (4.85 log cfu/g). Two-layer coatings of nanoemulsions seemed slightly more effective (4.00-4.32 vs 4.75-4.85 log cfu/g).

Conclusions: This preliminary study showed that CHIT/FUR nanoemulsions with bioactive peptides can be effectively used as multilayer coatings with food preservations purpose. The developed multilayer coatings had high stability and good antimicrobial properties. More physicochemical research is needed to study the effect of such multilayer coatings on the quality parameters of the treated food products as well as to establish the most effective layout of different polysaccharide-peptide layers.

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Literature:

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