Evaluation of antimicrobiological effectiveness of edible biopolymer coatings with bioactive peptides applied on cold stored pork loin

Piotr Kulawik[1], Ewelina Jamróz[2], Paulina Guzik[1], Magdalena Janik[2], Wondyfraw Tadele[1], Vedran Milosavljević[3], Sara Gökdeniz[4], Serkan Kaya[5]

[1] University of Agriculture in Krakow, Department of Animal Products Processing, Kraków
[2] University of Agriculture in Krakow, Institute of Chemistry, Kraków
[3] Mendel University in Brno, Faculty of AgriSciences, Department of Chemistry and Biochemistry, Brno
[4] Eskisehir Osmangazi University, Agriculture Faculty, Food Engineering Department, Eskisehir
[5] University of Pamukkale, Department of Food Engineering, Denizli

Introduction: We have recently developed a novel edible, biopolymer coating solutions based on chitosan (CHIT), furcellaran (FUR) and carp skin gelatin hydrolysate (HGEL). Those ingredients have been previously successfully used in edible coatings (Jamróz et al., 2021; Kulawik, Jamróz & Özogul, 2019). This is the first study in which all of those three components have been successfully used in one coating matrix. Moreover, to enhance the antimicrobial properties the coatings were mixed with antimicrobial bioactive peptides: RW4 and LL37 (Ağçeli & Cihangir, 2020; Phambu et al., 2017). Based on the preliminary studies the coatings solutions showed high in vitro antibacterial properties against different food pathogens. The aim of this study was to evaluate the effectiveness of the developed coatings on inhibiting the microbiological contamination of cold stored raw pork loin.

Materials and methods: Edible coatings solutions were created by mixing solutions of CHIT, FUR and HGEL with final ratio of 0.9:0.1:0.75 v/v/v. Afterwards RW4 and LL37 peptides were added into the solution (2.5 and 5 μg/mL). Fresh sliced pork loin was obtained directly from meat processor. Samples were divided into 4 groups: no treated control (C), dipped into the coating solution without peptides (CF) and dipped into the solutions with RW4 and LL37 peptides (R and L respectively). The samples were then hermetically sealed in PP trays and stored for 21 days at 4 oC. On day 0, 7, 14, and 21 the samples were analyzed for their microbiological contamination: total viable counts (TVC) (72h at 30 oC), total psychrotrophic bacteria (TPB) (240h at 6.5 oC), yeasts and moulds (YM) (120h at 25 oC) and Pseudomonas spp. (P) (25oC for 48h). The analyses were performed in triplicate.

Results and Discussion: The initial contamination of the samples was 3.75 ± 0.15, 3.73 ± 0.19, 2.12 ± 0.39 and 2.99 ± 0.54 log cfu/g for TVC, TPB, YM and P respectively. The inhibitory effect of edible coatings could be observed only after first 7 days of storage when control samples reached TVC of 7.37 ± 0.39 log cfu/g. The TVC of coated samples on that day ranged from 5.01 – 6.30 log cfu/g with R coatings showing the most pronounced antimicrobial effect. Less pronounced but observable effect was observed for TPB and P counts (7.51 vs 5.99-6.73 and 5.55 vs 3.44-5.01 log cfu/g). Both TPB and P were most successfully inhibited by coating with LL37. The YM counts were unaffected by the coatings on day 7. Despite the promising inhibition observed at the beginning of the storage period, the microbiological contamination during later storage periods was similar in all the studied groups. The TVC on day 21 was in the range of 7.44 (CF) – 8.05 (C) log cfu/g. Surprisingly application of coatings seemed to enhance the growth of YM from day 14 onwards, reaching the levels of 5.16 in control vs 6.93 – 7.37 log cfu/g in coated groups.

Conclusions: The treatment with developed coatings successfully inhibited the microbiological growth only during the first week of storage. Afterwards, the samples contamination of treated samples increased at a faster rate then in control, reaching similar levels from day 14 onwards. The presented coatings have to be further improved, either through different application method, or by adjusting the ratio of individual ingredients. Moreover, it is necessary to establish how coatings affect other quality parameters of stored pork loins like oxidation rate, physicochemical parameters or sensory scores

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