Evaluation of biopolymer coating solutions enriched in bioactive peptides as materials for extensions of microbiological quality of fish

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Introduction: Chitosan (CHIT) and furcellaran (FUR) are natural polysaccharides, with valuable properties such as biocompatibility, non-toxicity and biodegradability [Shariatinia & Jalali, 2018, Júnior et al., 2020]. Bioactive peptides can be used as antioxidant / antimicrobial compounds in active film-forming materials due to the diversity of their functional groups [Jamróz et al., 2019]. The aim of the study was to evaluate the antimicrobial effect of active CHIT/FUR solutions containing LL37 and RW4 bioactive peptides when applied to raw Atlantic mackerel fillets during chilled storage.

Materials and methods: CHIT/FUR coatings (0.9:0.1v/v) mixed with bioactive peptides (LL37, RW4) (final concentration of 5 µg/mL) were applied to mackerel fillets through dipping method. The fillets were divided into four groups; control (C), coated in CHIT/FUR without peptides (CF), and coated in CHIT/FUR solution with RW4 (R) or LL37 (L). The samples were stored at 4 °C for 14 days and analyzed on day 0, 7 and 14. The samples were analyzed for their water activity (aw) (Novasina LabMaster-aw water activity measuring device), TVB-N (distillation method) as well as microbiological contamination. The microbiological analyses included total viable counts (TVC) (PCA agar, 30 °C, 72h), total psychrotrophic bacteria (TPB) (PCA agar, 6.5 °C, 240h), and yeasts and moulds (YM) (DRBC agar, 25 °C, 120h). The experiment was performed using three independent repetitions.

Results and Discussion: The water activity increased from 0.959 ± 0.002 on day 0 to 0.986-0.987 on day 14. The aw did not differ significantly between the studied groups. TVB-N increased significantly during storage from 16.3 ± 2.7 on day 0 till 55.9-64.2 mg/100g and exceeding the established quality limits of 35 mg/100g even after 7 days. The initial contamination of the fish fillets was high, with TVC, TPB and YM of 5.55 ± 0.18, 5.54 ± 0.12 and 3.69 ± 0.07 log cfu/g respectively. The contamination after 7 days increased to 7.49-7.84, 7.70-8.06 and 5.02-5.12 log cfu/g respectively and remained relatively stable between days 7 and 14, reaching the final bacterial concentrations of 7.53-7.86 (TVC), 7.76-8.03 (TPB) and 5.22-7.8 (YM) log cfu/g. The microbiological analyses corresponded well with the increase in TVB-N. The application of coatings groups, despite promising preliminary in vitro results (results not shown), did not result in inhibition of bacterial growth during storage of Atlantic mackerel fillets. This might be due to high initial contamination of the fish fillets, which rendered the coatings ineffective. Moreover, many poly- and oligosaccharides, such as FUR show growth promoting activity of some strains of bacteria [Jamróz et al., 2021], which might have also affected the obtained results.

Conclusions: The newly developed bioactive coatings have proven ineffective in inhibiting microbial growth on the cold stored Atlantic mackerel despite the promising preliminary in vitro results. The research should be continued with the use of animal-based samples (meat or fish) with lower initial microbial contamination.

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