Modelling the effect of alternative washing media on surface disinfection of fish

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Food Improved by Research, Science, & Technology

Slurry Fish

INTRODUCTION

Several studies have been conducted recently on the efficacy of washing and sanitizing treatments in reducing microbial populations on perishable food products. Limited work on the effect on fish has been published and no industrial scaling-up has been reported (Thi et al., 2015).

AIM

The objective of the study was to evaluate and mathematically model the effect of surface disinfection of fresh fish, using different organic acids as alternative washing media, on quality stability in terms of microbial growth, physicochemical and organoleptic degradation and on shelf life extension .

METHOD

Whole marine cultured European sea bass (*Dicentrarchus labrax*) was studied.

The incorporation of **organic acids**, namely **lactic acid**, **citric acid** and **peracetic acid (PAA)** at different concentrations in the washing water (100-5000 ppm, depending on the tested acid) during gutting or filleting for different washing times (0-10 min) was investigated.

Microbial enumeration before (control samples) and after washing included several spoilage microorganisms, such as total viable count (TVC), *Pseudomonas* spp., *Enterobacteriaceae* spp., *Brochothrix thermosphacta* and H_2S-producing bacteria (mainly *Shewanella putrefaciens*). Quality evaluation included evaluation of pH, colour and texture measurement and sensory parameters (1-9 scale). A sensory score of 5 was taken as the average score for minimum acceptability.

RESULTS

- *Initial surface decontamination in the range of 1.0-2.0 logcfu/g by the addition of organic acids in the washing water, resulted in 3-4 days shelf life extension of fish stored at 0˚ C.*
- ***Increased microbial load reduction was achieved for higher washing solution concentrations and longer treatment.***
- *Higher reduction of the initial microbial load was observed after treatment with citric acid for TVC, Pseudomonas spp. and H_2S-producing bacteria, with lactic acid for Enterobacteriaceae spp. and with PAA for Pseudomonas spp. and Enterobacteriaceae, compared to other bacteria tested.*

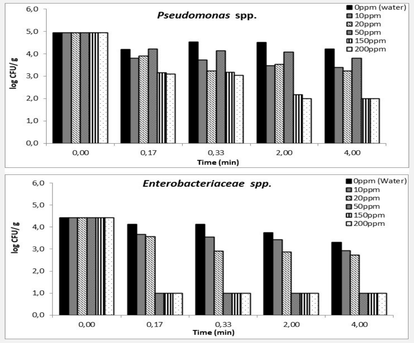

Figure 1. *Microbial load of Pseudomonas spp. and Enterobacteriaceae spp. (logcfu/g) in gutted* sea bass *after surface washing with peracetic acid*

Mathematical models were developed for the inactivation of spoilage bacteria as a function of treatment time and the concentration of acid in the washing water. The experimental data was adequately described by Equation (1):

$$logN = logN_o - a \cdot \sqrt{t} \cdot (C - b) \qquad (1)$$

where No and N are the initial and final (after treatment) microbial load, C is washing solution concentration (ppm), t is treatment (s) and α, b are constants.

Microbial growth during subsequent refrigerated storage of untreated (Control) and treated fish was modeled using the Baranyi Growth Model (Figure 2, 3). Limit of sensory shelf life of gutted fish (score 5 by the sensory panel for overall impression) coincided with a level of 10^7 cfu/g of *Pseudomonas* spp. for gutted samples and of TVC for fillets, respectively, stored at 0˚ C (Tsironi et al., 2019).

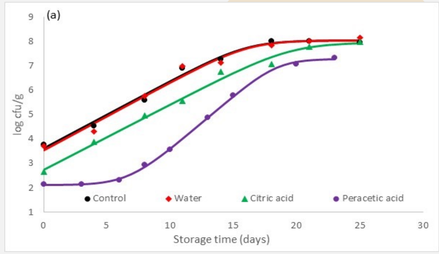

Figure 2. *Pseudomonas spp. (log cfu/g) in gutted sea bass after surface washing with (a) citric acid (200ppm for 10min) and (b) peracetic acid (200ppm for 4min), or water and Control during storage at 0˚ C.*

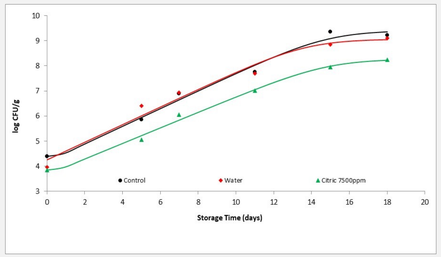

Figure 3. *TVCs (log cfu/g) in filleted sea bass after surface washing with citric acid (7500ppm for 10min), water and Control during storage at 0˚ C.*

Table 2. Shelf life (days) of gutted and filleted sea bass for different processing conditions, stored at 0ºC.

Gutted sea bass	Shelf life (days)
Control	13
Water	13
Citric acid (200ppm/10min)	16
Peracetic acid (200ppm/4min)	18

Filleted sea bass	Shelf life (days)
Control	8
Water	7
Citric acid (800ppm)	8
Citric acid (1500ppm)	8
Citric acid (7500ppm)	11

CONCLUSIONS

The results of the study indicated that the application of washing treatment with acids may result in significant deactivation of spoilage microorganisms in gutted fish and fillets. Washing of fish using organic acids can reduce initial microbial load and significantly extend the shelf life of gutted fish and fillets.

Shelf life extension of fish could open new distant markets currently inaccessible to fresh fish products and contribute to reduction of food waste.

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