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Modified atmosphere packaging and UV-C radiation on shelf life of rainbow trout (*Oncorhynchus mykiss*)

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Abstract

Effects of modified atmosphere packaging (MAP) in combination to UV-C radiation on rainbow trout fillets were examined. The samples were submitted to two treatments: (T1) aerobic package; (T2) MAP+UV-C radiation (80% CO₂/20% N₂; 106.32 mJ/cm²) and were analyzed daily for microbiological (mesophilic and psychrotrophic count) and chemical (biogenic amines) parameters. MAP+UV-C radiation (T2) promoted lag phase formation and lower number of colonies in the stationary phase as well as retarded cadaverine production during storage time. MAP+UV-C radiation retard microbial growth and delay chemical changes enhancing the shelf life of rainbow trout fillets by at least twice.

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1. Introduction

Modified atmosphere technology (MAP) is a conservative technology which operates by replacing the atmosphere inside the package by a mixture of gases [1]. CO₂ is the main gas used as bacteriostatic effect on fish microflora [2,3,4] and high CO₂ levels inhibit microbial growth extending shelf-life and maintaining the quality of fish products during self-life [3,5,6,7,8].

UV-C radiation is a non-thermal technology approved by the Food and Drug Administration (FDA) [9] used in food matrices surfaces to inactivate pathogenic and spoilage-related microorganisms in order to improve safety and extend shelf life of products [10]. This technology ensure several benefits for food industries which

include simple deployment, low price, and no risk of chemical or radioactive accidents as well as presents minor effects on sensory characteristic of products [11].

In this context, the present study was undertaken using microbiological and chemical parameters to evaluate the effect of these technologies applied in combination, on the shelf life of rainbow trout (*Oncorhynchus mykiss*) fillets stored under refrigeration (4°C).

2. Material and methods

Eviscerated and decapitated rainbow trout were obtained from aquaculture farm Rio de Janeiro, Brazil. The samples were transported to the laboratory and was filleted under sterile conditions to undergo the following samples packaged in low-density polyethylene gas-impermeable bags: (T1) aerobic package (with the presence of air) and (T2) MAP+UV-C radiation (without the presence of air and submitted to UV-C radiation and MAP). A vacuum-packaging machine was used to perform modified atmosphere (80% CO₂ and 20% N₂) and a previously constructed stainless steel barrel-shaped chamber [12] to perform UV-C radiation exposure. The UV light intensity applied in fillets was 1,772 mW/cm² for 60 s, resulting in a UV-C dose of 106.32 mJ/cm². After treatment, the samples were stored under refrigeration (4°C) and analyzed daily during 22 days of storage. All analyses were performed in experimental triplicate.

Bacteriological analyses to determine the total aerobic mesophilic (TAMC) and psychrotrophic (TAPC) counts were performed using standard microbiological methods [13]. Analyses of biogenic amines cadaverine and putrescine (extraction and derivatization processes) were conducted according to Lázaro et al. [12]

The bacterial growth curves were performed using the DMFit 2.0 (IFR, Norwich, UK) statistical program idealized by Baranyi and Roberts[14]. One-way ANOVA were applied to microbial growth parameters and to identify differences between biogenic amines (putrescine and cadaverine) from both treatments over the 22-day of storage. When a significant *F* was found, additional post-hoc tests with Tukey adjustment were performed. Statistical significance was set at the 0.05 level of confidence. All analyses were performed using GraphPad Prism version 5.00 for Windows (GraphPad Software, San Diego California USA).

3. Results and Discussion

The changes in TAMC and TAPC in trout fillets as a function of treatments and storage time are shown in Fig. 1A-B. The bacteriological maximum limit of 7 log CFU/g [15] was considered for TAMC as a microbiological criterion to indicate the shelf life of fillets during the storage time. The values reached the upper limit of 7 log CFU/g on the 5th day of storage in T1 and on the 11th day in T2.

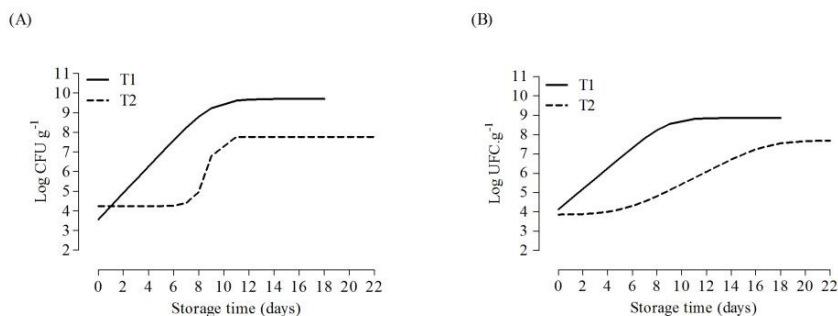


Figure 1. Bacteriological parameters (A) Total Aerobic Mesophilic Count (TAMC) and (B) Total Aerobic Psychrotrophic Count (TAPC) in rainbow trout fillets storage at 4°C under different treatments. T1- aerobic package; T2- MAP+UV-C radiation. UV-C: 106.32 mJ/cm². MAP: 80% CO₂ and 20% N₂.

The growth parameters as a function of bacterial groups and treatments are shown in Table 1. A lag phase formation in T2 was observed as well as in general lower doubling time and number of microbial cells in stationary

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