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Effect of UV-C radiation on shelf life of vacuum package *Colossoma macropomum* x *Piaractus mesopotamicus* fillets

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Abstract

Colossoma macropomum x Piaractus mesopotamicus (CP) is a freshwater fish with greatest commercial importance in Brazil. Fillets of CP are highly perishable food and preservation technology with UV-C could improve food safety and extend shelf life. Fillet samples were submitted at UV-C (55.83 mJ/cm^2) and examined for mesophilic and psychrotrophic count and biogenic amines over 6 days. UV-C reduced the bacterial growth and number of colonies in the stationary phase; also increase the levels of cadaverine, putrescine and histamine. The results suggest that UV-C enhanced the shelf-life of CP fillets by at least 50%.

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Keywords: UV-C; modelling growth; biogenic amines

1. Introduction

Colossoma macropomum x *Piaractus mesopotamicus* (CP) represents a greatest economic importance in Brazilian aquaculture[1], representing approximately 15.4% (60.463 metric tons) of the total annual production[2]. Healthy fish products are demanded by society. However, the chemical properties of this product during the chain production, promotes the increasing of bacterial load and the formation of metabolites from decarboxylation of amino acids by spoilage bacteria such as biogenic amines that are considered good parameter of food quality[3]. As an

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alternative to reduce these losses, studies about preservation technologies have been constantly performed aiming improve quality and durability to products of fish farming. UV-C radiation consists in a new non-thermal technology employed for superficial decontamination of several food matrices[4,5]. It is low cost and easy implementation, no production of reactivity, chemical waste or undesirable by-products which might alter sensory[6].This study aimed to assess the effects of UV-C radiation on microbiological and physicochemical parameters of vacuum-packed fillets with skin of the hybrid *Colossoma macropomum* x *Piaractus mesopotamicus* during storage at 4ºC.

2. Material and methods

Sixty fillets with skin of CP (weighing 550g each) were vacuum-packed individually in low-density polyethylene and heat-welded using a sealing machine (TECMAQ, AP450; Rio de Janeiro, Brazil). Under these conditions the fillets were submitted to two treatments: T1 (no UV radiation) and T2 (55.83 mJ/cm²). The UV equipment had 12 UV-C lamps (6 of 30W and 6 of 55W; OSRAMHNS, OFR, Munich, Germany) were placed longitudinally around the chamber's inner surface using a balanced pattern. Samples were placed at the geometrical center of the chamber using nylon net[7]. Radiation intensity was determined using a UV radiometer (MRUR-203, Instrutherm Ltda., São Paulo, Brazil). The UV-C radiation dose (mJ/cm²) was changed by altering intensities (switching some lamps on/off) while keeping the same total exposure time (60s). After the UV treatment, samples were stored at 4ºC for 6 days and submitted to microbiological biogenic amines analyses on days 0, 2, 3, 4, 5 and 6. All analyses were performed with experimental and analytical duplicates.

Total aerobic mesophilic (TAMB) and psychrophilic bacteria (TAPB) were evaluated using serial dilutions of 25 g of sample homogenized with 225 mL of 0.1% peptone water. Plate count agar was used to determine the bacterial count. Results were expressed as log cfu per gram. Analysis of biogenic amines was conducted with 5 g of fish meat, extracted with perchloric acid 5% and derivatized with benzoyl chloride (40 µL). The chromatographic system consisted of a Shimadzu Prominence UFLC apparatus (Shimadzu, Kyoto, Japan), a C18 Spherisorb ODS2 (15 × 0.46 cm i.d., 5 µm, Waters) column equipped with a Supelco Ascentis C18 (2 × 0.40 cm, i.d. 5 µm) guard column, under isocratic conditions. The mobile phase consisted of 42:58 (v:v) of acetonitrile (Tedia) and ultrapure water (Simplicity-Millipore, Molsheim, France). Chromatography conditions were 1 mL/min of flow rate, 20 µL of injection volume, column temperature of 20°C, UV absorption at 198 nm, run time of 15 min and cleaning step of 10 min between injections with 100% acetonitrile[8].

Bacterial growth parameters (log and stationary phase) were obtained using the statistical software DMFit 2.0 (IFR, Norwich, United Kingdom), based on predictive microbiology model[9]. A One-way ANOVA was carried out to identify differences between treatments during the storage time. When a significant F was found, additional post-hoc tests with Tukey adjustment were performed. All analyses were performed using GraphPad Prism version 5.00 for Windows (GraphPad Software, San Diego California USA).

3. Results and discussion

Previous to treatment, high initial mesophilic and psychrophilic (5.4 and 4.1 log CFU/g respectively) were detected. Different factors, including water conditions, preservation temperature, transportation and hygienic and sanitary conditions[10] may influence this counts. No lag phase was observed in both bacterial groups assessed, indicating that bacteria adapted quickly to cellular damage caused by UV-C light. The efficacy of this technology for disinfection of food products varies according to a variety of factors, such as characteristics of bacterial strain and species, growth rate[11], initial bacterial population density, composition and food type[12]. Furthermore, the mode of action of this preservation method works only on the food's surface and irregularities in the surface of the matrix may act as physical protection against UV-C rays contributing to bacterial survival. Moreover, it is well known that UV-C radiation promotes biochemical changes such as protein degradation, increasing nutrient bioavailability for the remaining bacteria[13]. This set of factors may have resulted in rapid bacterial adaptation and entry into log phase less than 24 hours, with no identifiable lag phase.