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Application of chitosan-sunflower oil edible films to pork meat hamburgers

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Abstract

Edible films were prepared by combining high molecular weight chitosan with sunflower oil. Films were obtained by casting and were applied to the surface of pork meat hamburgers. Chitosan-based films increased the metmyoglobin (MtMb) content of coated hamburgers during cold storage, especially when using lactic acid as a solvent. The incorporation of sunflower oil to the chitosan matrix led to a reduction in MtMb content of hamburgers as compared to samples coated with pure chitosan films. Chitosan films led to a reduction in the microbial counts of samples during storage. However, it is important to modulate the oxygen permeability of films in order to avoid undesirable effects (MtMb formation).

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Keywords: chitosan; film; coating; microbial quality; pork meat

1. Introduction

Chitosan is a cationic biopolymer, which shows antioxidant and antimicrobial properties and can be used as a matrix to develop edible films with different food applications [1]. Chitosan-based films tend to be brittle and show high water vapour permeability. The incorporation of lipid compounds, such as sunflower oil could improve mechanical and barrier properties of chitosan films to adapt them to a

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[illegible] curs mainly at the surface. The use of biodegradable films containing antimicrobial agents could be an alternative to extend meat shelf-life, by maintaining high concentrations of antibacterial ingredients that can also be extended throughout transport and storage period.

The aim of this work is to assess the feasibility of using chitosan-sunflower oil edible films to extend the shelf-life of cold-stored pork meat hamburgers.

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Nomenclature

FFD	film-forming dispersions
CH	chitosan
A	acetic acid
L	lactic acid
S	sunflower oil
RH	relative humidity
PET	polyethylene
TBARS	thiobarbituric acid reactive substances
MtMb	metmyoglobin
WVP	water vapour permeability

2. Materials and Methods

2.1. Preparation and characterization of chitosan-based films

High molecular weight chitosan (CH) (Batch 12913CJ, Sigma-Aldrich, USA), was dispersed at 1 wt% in an acetic acid (A) or lactic acid solution (L) (Panreac, Barcelona, Spain) at 1 wt%. To prepare the composite films, sunflower oil (Koipesol, Madrid, Spain) was added to the chitosan solution at 1 wt%. This mixture was homogenized by means of a rotor-stator (DI25, Yellow Line, IKA®, Germany) at 21500 rpm for 4 minutes. Afterwards, it was submitted to high-pressure homogenization at 165 MPa in a single pass by means of a Microfludizer® M110-P processor (Microfludics, Newton, USA). Films were obtained by casting and drying at room temperature and 60% RH. Surface density was 56 mg/cm^2. Films were peeled off from the casting plates and conditioned at 58%RH and 5ºC for one week. Water vapour permeability and gloss of the films were measured in triplicate following the methodology described by Vargas et al. [3]. Four kind of films (CH_A, CH_A:S, CH_L, CH_L:S) containing CH, acetic acid (A) or lactic acid (L), and sunflower oil (S) were prepared.

2.2. Hamburger manufacture and application of films

Pork meat was obtained from a local supermarket. The meat was ground by using a mincer (Severin Elektrogeräte GmbH, Sundern, Germany) and was moulded in Petri dishes to obtain the hamburgers. The surface of both sides of the hamburgers was coated with the films. Non-coated and coated samples were placed in PET trays (Cubil, Barcelona, Spain) and were stored at 4 ºC.

2.3. Analyses

Thiobarbithuric acid reactive substances (TBARS) and metmyoglobin (MtMb) assays were performed in triplicate following the same procedure described by Fernández-López et al. [4]. All reagents used to perform TBA and MtMb analyses were supplied by Sigma (Sigma-Aldrich, USA).

To perform microbiological analyses, a 10 g aliquot of each sample was aseptically obtained and homogenized in a Stomacher with 90 mL of sterile buffered peptone water. Aliquots were serially diluted in buffered peptone water and plated out following standard methodologies. Total viable counts were determined in Plate Count Agar plates incubated at 37ºC for 48ºC. Coliform counts were determinate

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