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Influence of storage period and packaging method on sliced dry cured beef "Cecina de Leon": Effects on microbiological, physicochemical and sensory quality

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Abstract

Quality aspects of sliced dry-cured beef "Cecina de León" preserved in vacuum and gas mixtures (20%/80% CO_2/N_2 and 80%/20% CO_2/N_2) were studied. The evolution of microbiological, physicochemical and sensory parameters were analysed during storage (210 days) at 6 °C. Although microbial counts at 60 days of the gas-packaged samples were lower than the vacuum-packed ones, they were never higher than the spoilage limit (7 log ufc/g). A slight increase ($p < 0.05$) in pH was observed throughout storage of "Cecina de León" packaged under vacuum and in gas mixtures. However, a decrease ($p < 0.05$) in a_w was observed during storage of "Cecina de León" packaged under vacuum but a_w did not vary ($p > 0.05$) during storage in the gas-packaged samples. No changes were observed ($p > 0.05$) in lightness (L^*), redness (a^*) and yellowness (b^*) in vacuum and gas packaged samples during storage. However, sensorially evaluated colour showed lower values in gas packaged samples during 30 days storage. This difference was decisive in establishing the shelf-life of "Cecina de León" slices preserved in gas mixtures (20%/80% CO_2/N_2 and 80%/20% CO_2/N_2). Therefore, from a microbiological point of view, gas mixtures are more effective in extending the shelf-life of "Cecina de León" slices. It is concluded that vacuum packaging allows longer storage than gas-packaging as it maintains a good visual appearance of "Cecina de León", the main parameter in consumers' perception of meat quality.

Keywords: Vacuum packaging; Modified atmosphere packaging; Shelf-life; Dry-cured beef; Cecina de León

1. Introduction

Nowadays, it is usual to market dry-cured meat products in packaging for easy consumption. "Cecina de León", a dry cured beef product, follows this trend, and usually is displayed in supermarkets in vacuum packaging. "Cecina de León" is a salted, smoked and dried, beef product traditionally manufactured in the region of León (north-western Spain) which has achieved the recognition of a PGI (Protected Geographically Indication). It is an intermediate moisture meat product, made from different anatomical retail cuts, and the preparation method is similar to that used in dry-cured ham manufacture. The final product has a typical red colour, smoked flavour and a slight salty taste.

Consumers demand safe, additive-free food, of high nutritional value. In this sense, packaging in modified atmospheres (vacuum and gas packaging) allow for a longer shelf-life as well as attractive presentation. The use of modified atmosphere packaging (MAP) for salted and dried meat products has increased considerably in recent years. Optimisation of gas composition is critical to ensure the product's quality and safety, and few studies have looked at the preservation of salted meat products. Elías and Carrascosa (2000); Kemp, Langlois, Akers, and Aaron

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(1989) Kemp, Langlois, Akers, Means, and Aaron (1988) studied the effect of vacuum packaging on the microbiological and physicochemical aspects of Iberian and Country style ham. These authors found that refrigeration temperatures were necessary in order to display vacuum-packed dry-cured ham for long periods. Cilla, Martınez, Beltrán, and Roncalés (2005) Garcıa-Esteban, Ansorena, and Astiasarán (2004) found no clear differences in colour, texture, sensory and microbiological quality between vacuum and gas (100% N_2 and 20% CO_2/80% N_2) packaging of dry-cured ham during chill storage. Similar results were found in "Cecina de León" cuts, packaged under vacuum and 80% CO_2/20% N_2, but some sensory deterioration was observed during long-term storage under 20% CO_2/80% N_2 atmospheres (Rubio, 2006). Clear differences were found in dry cured ham depending on the system used for retail sale, since modified atmosphere packaged sliced ham suffered marked changes affecting sensory quality (Cilla et al., 2005).

The aim of the present work was to study the effect of different modified atmospheres (vacuum, 20% CO_2/80% N_2 and 80% CO_2/20% N_2) on the microbiological, physicochemical and sensory quality of dried, cured beef "Cecina de León" stored for a long time (210 days) at 6 °C, after slicing for retail sale.

2. Materials and methods

2.1. Preparation of samples

The study was carried out on 6 pieces of "Cecina de León" manufactured according to the specifications of Protected Geographical Indication "Cecina de León" (Boletín Oficial de Castilla y León, 1994). The shortest manufacturing time of this product is 7 months. The knuckle, comprising mainly *Quadriceps femoris*, was the cut used. The manufacturing time of the pieces used was 11 months. This time includes the salting, rinsing, post-salting, smoking, drying and aging steps. The final product had a weight of 6.86 ± 0.27 kg.

The six knuckles used were divided into three groups (2 pieces per group): (1) vacuum packed, (2) 20%/80% CO_2/N_2 packed and (3) 20%/80% CO_2/N_2 packed. The outside of each piece was removed with a knife and the ends of the each piece were cut off. Then each piece was sliced (1.5 mm thick) with a slicing machine. The slices were cut transversally to the muscle fibre direction. The slices from each piece were placed in polystyrene trays (100–150 g per tray).

2.2. Packaging and storage of samples

The trays with "Cecina de León" slices were individually packaged either:

(a) In plastic bags (polyamide/polyethylene with an oxygen transmission rate of 30–40 cm^3/m^2/24 h/bar at 23 °C and 50% RH and a water vapour transmission rate of 2.5 g/m^2/24 h at 23 °C and 50% RH, supplied by WK Thomas España S.L., Rubı́, Spain) which were subjected to vacuum and sealed (A-300 TECNOS.CVP, Barcelona, Spain). The vacuum pump is placed inside the vacuum chamber and the vacuum is controlled with a sensor. The packer also has a function of static vacuum controlled by time. The vacuum program was: Initial vacuum amount = 98%, static vacuum = 5 s, sealing time 1.3 s, sealing temperature = 120 °C.

(b) Were flushed with the selected gas mixture: 20%/80% CO_2/N_2 or 80%/20% CO_2/N_2, supplied by Abelló Linde S.A. (Barcelona, Spain), and were closed by heat-sealing with a packer (Linvac 400 TECNOVAC, Barcelona, Spain) in a high barrier film (with an oxygen transmission rate of 1.8 cm^3/m^2/24 h/bar at 20 °C and 65% RH, supplied by Fibosa Packaging S.L., Tordera, Spain). Packages had a headspace volume ratio of 1:1 (MØller et al., 2003).

All trays were stored in darkness at 6 °C. Twenty eight trays were used for each packaging treatment (2 pieces per batch, 14 trays per piece), 2 trays for each analysis day (a tray for carrying out microbial, pH, a_w and instrumental colour analyses and a tray for carrying out the sensory evaluation).The packs were opened for subsequent analysis after 0, 15, 30, 60, 90, 150 and 210 days of storage. Results corresponding to day 0 were calculated as the average value resulting from analysis carried out on the 6 pieces.

2.3. Analyses

2.3.1. Gas composition

The gas composition (% O_2 and % CO_2) was analysed using a gas analyzer 1450 B3 Servomex (Aries, Madrid, Spain). During storage, the gas composition was measured in empty packages as well as the packages containing the "Cecina de León" slices, in duplicate, using a different package for each sample time.

2.3.2. Microbial analyses

Ten grams of each sample were taken aseptically and homogenised with 90 ml of tryptone water (Scharlau, Spain) for 2 min in a sterile plastic bag in a PK 400 Masticator (IUL, S.A., Barcelona, Spain). Serial decimal dilutions were made in sterile tryptone water and in duplicate 1 ml or 0.1 ml samples of appropriate dilutions were poured or spread onto total count and selective agar plates.

The microbiological analyses were: mesophilic aerobic bacteria determined on 3 M Petrifilm Aerobic Count Plate (Bioser, Spain) incubated at 30 °C for 48 h, psychrotrophic bacteria on Plate Count Agar (Scharlau, Spain) incubated at 7 °C for 10 days, anaerobic bacteria on Schaedler Agar (Scharlau, Spain) overlayed with 5 ml of the same medium and incubated at 37 °C for 48 h, enterobacteria on 3 M Petrifilm Enterobacteriaceae Count Plate (Bioser, Spain)