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Influence of fresh date palm co-products on the ripening of a paprika added dry-cured sausage model system

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ABSTRACT

Date palm co-products are a source of bioactive compounds that could be used as a new ingredient for the meat industry. An intermediate food product (IFP) from date palm co-products (5%) was incorporated into a paprika added dry-cured sausage (PADS) model system and was analysed for physicochemical parameters, lipid oxidation and sensory attributes during ripening. Addition of 5% IFP yielded a product with physicochemical properties similar to the traditional one. Instrumental colour differences were found, but were not detected visually by panellists, who also evaluated positively the sensory properties of the PADS with IFP. Therefore, the IFP from date palm co-products could be used as a natural ingredient in the formulation of PADS.

1. Introduction

Paprika-added meat products, also known as red line meat products, are well known in Spain. There are a lots of types of this product, from a hard texture (chorizo) to an unctuous consistency (sobrasada) (Martínez, Garrido, & Bañón, 2008; Rosselló, Barbas, Berna, & López, 1995) and from fresh products (fresh red sausage) to dry-cured (chorizo) (Gómez, Álvarez-Orti, & Pardo, 2008). They show a typical red or red-orange colour, with a paprika flavour, since they are highly seasoned with paprika (2–12%). During the processing and storage of paprika-added meat products, degradation of paprika pigments can occur, leading to discoloration of the product, often with quality loss and economic consequences (Cuvelier & Berset, 2005). To overcome this problem synthetic antioxidants are added, but these additives have been associated with negative effects on health (Shahidi, 2000). As a consequence, the meat industry is trying to offer healthier products to reinforce its competitiveness. Therefore, the use of natural resources, such as antioxidant dietary fibres, natural extracts and other ingredients from plant materials, might be alternatives to fulfil consumer demand (Pérez Álvarez, 2008). However, the incorporation of these new ingredients may affect to the technological or sensory properties of the product and studies to adapt them to traditional working conditions are needed.

Several plant materials have been assessed in dry-cured meat products, such as antioxidant fibres concentrates from citrus co-products (Fernández-Ginés, Fernández-López, Sayas-Barberá, Sendra, & Pérez-Álvarez, 2004; Fernández-López et al., 2007), from cereals (García, Domínguez, Gálvez, Casas, & Selgas, 2002), from tuber co-products (Sánchez-Zapata, Díaz-Vela, Pérez-Chabela, Pérez-Álvarez, & Fernández-López, 2011), essential oils (Martín-Sánchez et al., 2011), and polyphenolic-rich extracts from green tea (Bozkurt, 2006). Other natural non-meat ingredients, as sources of dietary fibre and natural antioxidants are date palm (*Phoenix dactylifera L.*) co-products. In fact, addition of date palm co-products into a cooked cured meat product protected against lipid oxidation during storage (Martín-Sánchez et al., 2013). Date co-products also improved the technological, nutritional and sensory quality of bologna sausages (Sánchez-Zapata, Fernández-López, Peñaranda, Fuentes-Zaragoza, Sendra, Sayas, & Pérez-Álvarez., 2011; Sánchez-Zapata, Fernández-López, et al., 2011; Sánchez-Zapata, Fuentes-Zaragoza, et al., 2011).

These date palm co-products come from fresh dates discarded because of inadequate ripening, size, texture or a low quality as table fruit, but they are safe for human consumption (Al-Farsi et al., 2007; Vilella-Esplá, 2008). Fresh dates are rich in compounds, potentially beneficial for human health such as dietary fibre, vitamins, minerals

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and antioxidants (Al-Farsi & Lee, 2008; Fu et al., 2011); showing considerable antioxidant and antimicrobial activity (Dhaouadi et al., 2011; Shraideh, Abu-Elteen, & Sallal, 1998).

Incorporation of dates into paprika added meat products may provide new benefits during processing and in the final product, and thus be an opportunity to use these co-products. There are no references about the incorporation of date palm into paprika added meat products. The addition of non-meat ingredients into meat products can modify the technological, nutritional and sensory characteristics of these products. These changes are particularly problematic in dry-cured sausages, as a new ingredient can disrupt the normal evolution (chemical, biochemical, enzymatic, microbial) of the products during ripening (Pérez Álvarez, 2008), having a positive or negative impact on the quality of the final product (Sayas-Barberá, Viuda-Martos, Fernández-López, Pérez-Álvarez, & Sendra, 2012). It is known that certain compounds present in these ingredients, such as polyphenols, can act as anti or pro-oxidants (Estévez & Cava, 2006; Estévez, Morcuende, Ventanas, & Cava, 2004).

The aim of this work was to evaluate the influence of fresh date palm co-products on the main quality characteristics (pH, water activity, moisture, lactic acid content, colour, residual nitrite content, lipid oxidation and sensory attributes) during ripening of a paprika added dry-cured sausage (PADS) model system.

2. Materials and methods

2.1. Intermediate food product preparation from fresh date co-products

Non-commercial fresh date palm fruits (*Phoenix dactylifera* L. c.v. Confitera) were collected at the "khalal stage" (immature). These fruits were immediately processed in the IPOA Research pilot plant, at Orihuela Campus (Miguel Hernández University), following the procedure described by Martín-Sánchez et al. (2013) to obtain the intermediate food product (IFP). The major components of the IFP on a wet basis were: 66.41% moisture, 18.61% sugars, 5.29% total dietary fibre, 1.07% ash, 0.96% proteins, 0.05% fat, 1.27 g/100 g total organic acids, and 1.45 g gallic acid equivalents/100 g (phenolic content). Its colour parameters were: L^*, 67.65; a^*, 3.51 and b^*, 28.61 (Martín-Sánchez et al., 2013).

2.2. Paprika added dry-cured sausage elaboration process

Spreadable paprika added sausages were elaborated at the IPOA Research Group pilot plant facilities following the traditional formula (Sayas, Pérez Álvarez & Fernández-López, 2002): 40% lean pork, 30% pork dewlap, and 30% pork backfat; and the rest of ingredients were added: 10% paprika, 5% ice water, 2.3% salt, 1.5% caseinate, 0.2% black pepper, 0.05% oregano, 0.05% sodium ascorbate, 0.03% potassium nitrate and 0.015% sodium nitrite. This original mixture was split into two batches, to which IFP was added in different concentrations (0 and 5%).

The cold meat and fat cuts were ground in a IPS grinder (Mainca, Barcelona, Spain) through a 4 mm hole plate diameter (Olotinox, Olot, Spain). Minced meat and fat were mixed with the rest of ingredients and additives for 10 min, and stuffed into artificial casings of 60 mm diameter. Ripening was carried out at 16–18 °C and 80–85% relative humidity for 28 days. Samples from each batch (0 and 5% IFP) were taken at days 0, 7, 14, 21 and 28 for analyses. This experiment is representative of three independent elaboration processes.

2.3. Chemical and physicochemical analysis of the PADS

2.3.1. Moisture content and water activity

Moisture was determined in triplicate by loss in weight after heating the samples to constant weight at 105 °C, according to the AOAC method (AOAC, 2000). Water activity was measured at 25 °C in a Novasina (TH-500, Axair Ltd., Pfaeffikon, Switzeland) in duplicate.

2.3.2. pH and lactic acid content

The pH was determined with a pH-metre (Model 507, Crison Instruments S.A., Barcelona, Spain) equipped with a thermometer and a combined electrode for solids (Cat. No. 52, Crison Instruments S.A., Barcelona, Spain), by insertion into five different parts. Total acid contents (as lactic acid) were measured by titration with 0.01 N NaOH solution and expressed as percent lactic acid (AOAC, 2000).

2.3.3. Residual nitrite level

Residual nitrite level (mg/kg) was determined in triplicate by following ISO/DIS 2918.26 (1975).

2.3.4. Colour analysis

The CIELAB colour space (L^*: lightness; a^*: redness/greenness; b^*: yellowness/blueness) was determined, and the total colour differences (ΔE^*) between treatments and ripening days were also estimated considering the control (day 0) as the reference: $\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$. Recommendations of the AMSA (2012) were followed, taking nine replicates ($n = 9$) of each sample by means of a spectrophotometer (Minolta CM-2600 illuminant D_{65}, 10° observer, SCI mode, 11 mm aperture of the instrument for illumination and 8 mm for measurement). A spectrally pure glass (CR-A51, Minolta Co., Osaka, Japan) was put between the samples and the equipment. For colour measurements, infinite solid was obtained according to Sánchez-Zapata, Fuentes-Zaragoza et al. (2011).

2.4. Lipid oxidation (TBARS) and Rancimat assay

Lipid oxidation was assessed in triplicate by the 2-thiobarbituric acid (TBA) method of Botsoglou et al. (1994). Extracts were filtered through active carbon, and TBARS values were calculated from a standard curve of malonaldehyde (MDA) and expressed as mg MDA/kg sample.

Lipid oxidation stability was analysed by the Rancimat assay. Fat from each sample was extracted with petroleum ether overnight being continually shaken in a shaking water bath (Selecta S.A., Barcelona, Spain) at room temperature. Then, the extracts were dried with anhydrous sodium sulphate, evaporated in a R-200 Rotavapor (Büchi, Switzerland) under vacuum at 50 ºC, and dried with nitrogen. Afterwards, 3 g of the extracted fat were used to evaluate the lipid oxidation stability with a Rancimat 743 apparatus (Metrohm, Switzerland) at 120 ºC under an air flow of 20 L/h. An increase of electrical conductivity due to the formation of molecules from lipid oxidation is an indicator of the induction time. The antioxidant activity index (AAI) was calculated from the measured induction times, according to the formula proposed by Forster, Simon, Schmidt, & Kaltner (2001):

$$\text{AAI} = \text{Induction time of each sample} / \text{Induction time of control sample at day 1.}$$

An AAI higher than 1 indicates an antioxidant effect against lipid oxidation, while an AAI lower than 1 shows a pro − oxidative effect. Thus, the higher the value, the better is the antioxidant effect.

2.5. Sensory analysis

A descriptive analysis was performed on the final product by a trained panel (seven people, three male and four female, 23–42 years of age selected from staff members of the AgroFood Technology Department at Miguel Hernández University). It was performed under white fluorescent lights in individual booths constructed according to the specifications of the International Standards Organization (ISO, 2010). Pieces of the two batches were served with a spoon, a knife and unsalted crackers. Mineral water was also provided to clean the palate between samples. A scale from 0 to 10 was given asking for the intensity of