EFFECT OF ANTIOXIDANT AND SALIVA ADDITION ON THE RELEASE OF AROMATIC COMPOUNDS FROM DRY-FERMENTED SAUSAGES IN IN-VITRO MODEL MOUTH SYSTEM

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Abstract

The release of aroma compounds from dry fermented sausages was studied by extracting the headspace at different times using a solid phase micro-extraction device. The effect of the addition of an antioxidant and saliva on the release was determined. The compounds were analysed by gas chromatography using a flame ionization detector and identified by mass spectrometry. The addition of butylated hydroxytoluene to dry fermented sausages produced a significant reduction of the release of linear aldehydes indicating an oxidation process during sampling. The addition of water and saliva to the dry fermented sausages produced a higher release of pentanal, hexanal and octanal, while propanal and phenylethyl alcohol showed a lower rate of release.

Introduction

The typical aroma of dry-fermented sausages cannot be attributed to a single compound and is due to a mixture of volatile compounds in the appropriate amounts [1]. However, the aroma perception in meat products depends on the concentration and odor thresholds of volatile compounds and on their interactions with other food components that will affect its gas phase concentration. Hundreds of volatile compounds have been identified in dry fermented sausages [2-4] although only a few of them are the main odorants responsible for the dry-cured aroma [1].

Meat products have a very complex matrix that mainly contains proteins and lipids. In this sense, dry fermented sausages are composed by almost 30 % lipids that affect the aroma release. The flavour development in dry fermented sausages is mainly formed by lipid oxidation reactions and from bacterial metabolism [5]. Many studies have been focused on the lipid oxidation phenomenon during processing but there are not studies about the release of these volatile compounds from the meat matrix. However, the stability of these lipids is a major fact that should be previously controlled. Therefore, the aim of the present work was to study the effect of the addition of an antioxidant and water and saliva on the release of volatile compounds from dry fermented sausages.

Experimental

Dry fermented sausages were made with lean pork (80 %) and pork back fat (20 %) as described by Marco et al., [5]. At the end of the process (44 days), three sausages were sliced, vacuum packaged and stored frozen at –20°C until analysis.
Release of aromatic compounds from dry fermented sausages in in-vitro model system. The release was studied using a 10 ml HS vial, sealed with a PTFE faced silicone septum (Supelco, Bellefonte, PA, USA) containing three grams of minced sausage. The frozen sausage was minced using a Waring blender (Waring Comercial 8010, CT, USA). Three experimental conditions were analysed, sausage alone, sausage in the presence of water (3 ml) and sausage in the presence of saliva (3 ml) [6]. The addition of 10 mg butylated hydroxytoluene (BHT) during sausage mincing was also analysed. The extraction of volatile compounds from the vial was performed using a solid phase micro extraction (SPME) device (Supelco, Bellefonte, Pennsylvania, USA) with a 85 µm carboxen/polydimethylsiloxane fibre (CAR/PDMS stb). The released volatile compounds were extracted by exposing the SPME fibre for different times (0.5, 1, 2 and 3h) to the headspace maintained at 30°C. Each experimental point was done in triplicate. The compounds adsorbed by the fibre were quantified and identified by gas chromatography analysis.

Identification and quantification of volatile compounds. The identification was done in a gas chromatograph (GC HP 5890 series II, Hewlett Packard, Palo Alto, CA), with a HP 5972 mass selective detector, following the procedure described by Marco et al. [4]. The quantification of volatile compounds was done as described Gianelli, Flores and Toldrá [7]. The content of each of the volatile compounds in each experience was calculated from the FID area and expressed as area units.

Statistical analysis. The effect of the different experimental conditions and the addition of the antioxidant on the volatile compounds were tested by two-factor analysis of variance (ANOVA) using the statistic software Statgraphics plus (v 5.1).

Results

The rate of release for each volatile compound in each experience was determined through the calculation of the initial slope obtained from the linear regression of the compound area vs the extraction time (Figure 1). The initial slope was calculated from the two or three first points depending on the compound. This parameter has been previously used to measure the rate of flavor release [8-9].

![Figure 1. Release of nonanal from dry fermented sausage with or without BHT.](image)

The volatile compounds were grouped according to their possible origin. Those coming from the lipid auto-oxidation process and those originated from the bacterial metabolism being this latest group divided in compounds coming from carbohydrate fermentation, amino acid catabolism, staphylococci esterase activity and lipid β-
oxidation. In Figure 2 are shown the initial slopes for the groups of volatile compounds and can be observed that in all cases the addition of BHT produced a significant decrease except for those compounds derived from the lipid β-oxidation process. Also, the different experimental conditions analysed affected the initial slope.

![Graph showing initial slopes for aroma compounds derived from lipid auto-oxidation process, staphylococci esterase activity, carbohydrate fermentation, amino acid catabolism, and lipid β-oxidation generated from dry fermented sausages in the presence of water, saliva, and antioxidant.]

**Figure 2.** Slopes of the aroma compounds derived from the lipid auto-oxidation process; staphylococci esterase activity; carbohydrate fermentation; amino acid catabolism and lipid β-oxidation generated from dry fermented sausages in the presence of water, saliva and antioxidant.

In Figure 3 is shown the rate of release of the linear aldehydes and it was affected by the experimental conditions. Propanal showed a higher release in the sausage alone while the release of pentanal, hexanal, and octanal was higher in the presence of water and saliva. Also, nonanal showed a higher release when saliva was added. In addition, the effect of BHT was significant for these compounds. BHT produced a reduction in the slopes therefore, BHT addition to meat products is necessary to avoid the oxidation of the lipid fraction during sampling.

![Graph showing initial slopes of linear aldehydes generated from dry fermented sausages in the presence of water, saliva, and antioxidant.]

**Figure 3.** Slopes of linear aldehydes generated from dry fermented sausages in the presence of water, saliva and antioxidant.
The higher release of linear aldehydes in the presence of water and saliva is partially in accordance with the results obtained by van Ruth and Roozen [10] in the study of flavor release in mouth conditions from sunflower oil and its emulsion. During mouth conditions the addition of water increased hexanal release but with artificial saliva a decreased release was detected. The decrease in the release by the addition of saliva detected in both techniques was explained by the presence of proteins (mucin and alpha-amylase) in the artificial saliva responsible of the aroma binding [11].

Until now, there are a few studies about the binding ability of sarcoplasmic and myofibrillar proteins obtained from fresh pork muscle and dry-cured ham [12]. These authors reported the ability of sarcoplasmic and actomyosin proteins to bind several compounds including hexanal, although the binding was highly affected by the ionic strength and protein conformation. Therefore, the addition of water and saliva could have affected the binding of hexanal to proteins producing a release from the matrix.

The initial slopes of the compounds derived from amino acid catabolism are shown in Figure 4. Only a few of them were affected by the two factors studied. Phenylethyl alcohol showed a reduction in the rate of release with the addition of saliva and water. Moreover, BHT addition produced a significant reduction in the release rate of benzaldehyde.

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References