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New strategies for reducing the pork back-fat content in typical Italian salami

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ABSTRACT

In this work the possibility to substitute pork backfat with extra virgin olive oil (EVOO), adsorbed on whey protein-based crumb or white bread crumb, in typical Italian salami is addressed. Five types of salami were manufactured, under the usual commercial conditions, by replacing 0 (Control), 60% and 100% of pork backfat with whey protein-based crumb (WP60–WP100) and white pan bread (PB60–PB100), respectively, soaked in EVOO. Results highlighted that pH, weight loss, colour parameters and microbial counts did not show statistically significant differences between the Control and the modified salami. On the other hand, malonaldehyde was slightly lower in PB100, PB60, WP100 and WP60, compared to the Control. Chemical composition was significantly affected by formulations. Modified salami presented a better fatty acid profile showing lower saturated and higher monounsaturated fatty acids than control. Furthermore in all modified salami atherogenic and thrombogenic indices displayed the lowest values. The Control showed the highest values for Warner–Bratzler Shear, hardness, cohesiveness, gumminess and chewiness. Sensory evaluation of WP60 did not show significant differences compared to the Control, whereas PB100 and WP100 were unacceptable for taste.

1. Introduction

Dry fermented sausages are meat products with a high fat content, which is visible when the product is sliced. Commercial sausages usually contain up to 30% fat (Wirth, 1991). Pork backfat used in fermented sausages is rich in saturated fatty acids and cholesterol. It has been shown that high saturated fatty acids and cholesterol consumption is linked to the development of cardiovascular diseases (Enser, Hallett, Hewitt, Fursey, & Wood, 1996). Therefore health organizations all over the world recommend limiting the intake of saturated fatty acids and cholesterol (NCEP, 1988). The incidence of heart disease is relatively low in Mediterranean countries due to the diet rich in monounsaturated fats (olive oil) (Keys et al., 1986). In addition, increased olive oil consumption has been associated with a reduced risk of breast cancer (Trichopoulou et al., 1995).

There are several techniques to reduce the cholesterol level of meat products. It is possible to replace fat with non-meat ingredients such as soy proteins (Sofos & Allen, 1977), vegetable oils (Paneras & Bloukas, 1994) water, olive oil (Bloukas, Paneras, & Fournitzis, 1997; Muguerza, Fista, Ansorena, Astiasaran, & Bloukas, 2002; Severini, De Pilli, & Baiano, 2003) and carbohydrates (Nowak, Von Mueffling, Grotheer, Klein, & Watkinson, 2007) without adverse effects on processing yield.

Olive oil is the most monounsaturated vegetable oil. It contains 56.3–86.5% monounsaturated fatty acids, 8–25% saturated and 3.6–21.5% polyunsaturated fatty acids (IOOC, 1984). It is also rich in tocopherols and phenolic substances that act as antioxidant compounds. Olive oil has a high biological value attributed to its high ratio of vitamin E to polyunsaturated fatty acids content (Viola, 1970). Roche, Gibney, Kafatos, Zampelas, and Williams (2000) showed that olive oil has very novel beneficial effects on postprandial lipid metabolism and thrombosis. Therefore, the positive effects for consumer health could be further improved by producing fermented sausages with a simultaneous reduction of fat level and partial replacement of pork backfat with olive oil. Olive oil, as well as other vegetable oils, has been incorporated in frankfurters and other meat products (Bloukas & Paneras, 1993; Liu, Huffman, & Egbert, 1991; Marquez, Ahmed, West, & Johnson, 1989; Paneras & Bloukas, 1994; Park, Rhee, Keeton, & Rhee, 1989). In other work technologically and sensory acceptable products were developed, reaching a 25% substitution of pork backfat by pre-emulsified soy oil (Muguerza, Ansorena, & Astiasaran, 2003). However, the maximum substitution level by olive oil proposed in the literature, as the most effective, accounts for

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around 40–50% of the total fat. Higher levels of oil provoked a dripping effect, perspiration through the casings, inhibition of molds, separation of the casing from the meat dough and breaking up of cured products. For this reason, the proposal of new strategies to retain higher content of olive oil seems to be of great interest.

The aim of this work was to evaluate the effects of partial and total substitution of pork backfat with extra-virgin olive oil using whey protein based crumb and white pan bread to reduce the water activity and to obtain a structure similar to conventional products. The effects of the new proposed strategies on the microbiological, nutritional, textural and sensorial quality of typical Italian salami were studied.

2. Materials and methods

2.1. Salami formulation and processing

Five formulations of salami were prepared in a sausage factory (Carni SUS, Foggia, Italy) under industrial conditions. The control was produced using 90% pork meat and 10% pork backfat (Control). Other formulations were produced with a substitution of pork backfat with 60% and 100% of whey protein based crumb (WP60–WP100) and white pan bread (PB60–PB100), respectively, soaked in extra-virgin oil for 30 min. Fresh boneless pork meat, fresh pork backfat, extra virgin olive oil, and white pan bread, were used as raw materials, obtained from a local market. Whey protein was purchased from DAVISCO (Food International, Inc., USA) and used to prepare a whey protein-based bread that was obtained by mixing 100 g whey protein, 4 g NaCl, 10 g Na_2CO_3 and 120 ml distilled water. This mixture was cooked at 160 °C for 40–50 min in the oven (Moulinex Activys, France). Whey protein-based bread and white pan bread were separately minced by a Sterilmixer (PBI International, USA) and soaked with extra virgin olive oil (EVOO) in a 1:4 ratio.

To prepare the salami, unfrozen pork meat (about 25 kg) was minced in a cutter to a particle size of about 3 mm and divided in five batches (5 kg). Subsequently, sodium chloride (26 g/kg), pepper (1 g/kg), fennel seeds (3 g/kg), powdered milk (12 g/kg), and EUROSAL (dextrose and saccharose, natural flavouring, E 301, E 252, Europrodotti, Milan, Italy; 6 g/kg) were mixed in each meat batch, before adding pork backfat or oil, as described above. All the mixtures were placed overnight in the refrigerator for equilibration, separately. The day after, the mixtures were used to produce salami 200–250 g in weight, 3–3.5 cm in diameter, using a machine with a capacity of 6 kg. The casings used for the salami were air-dried natural casing produced from cow intestine. The cases were soaked in sodium chloride solution for some minutes before filling. The salami were placed in the refrigerator (4 °C) for three days; subsequently, were placed for 20 days in the ripening room where they remained under the following conditions: in the first five days the temperature decreased from 25 °C to 15 °C and the relative humidity (RH) decreased from 90% to 65%. The final ripening step was carried out at 13 °C and 75–80% RH.

Samples from each formulation were taken for analysis on day 0, 6, 8, 10, 13, 15, 17 and 22. Sensory, colour, nutritional and mechanical properties were evaluated at the final time (22nd day).

2.2. Weight losses

Three strings of salami from each formulation were weighed just before the salami were put into the ripening room. Weight losses were expressed as the difference (%) between the initial and the weight measured at each sampling time.

2.3. pH values

10 g of each sample was blended with 90 ml of peptone water in a Stomacher bag for 30 s using a Stomacher (Interscience, France), and then the pH of the mixture was measured using a pH meter (Crison Instrument, Barcelona, Spain).

2.4. Microbiological analyses

10 g of each sample were homogenized in a Stomacher (Interscience, France) with 90 ml of sterile peptone water for 3 min. Appropriate dilutions of samples were prepared in sterile peptone water blank and plated in duplicate on different growth media. The media and incubation conditions used were as follows: (a) DeMan, Rogosa, Sharpe (MRS) Agar at 30 °C for 48–72 h for lactic acid bacteria, (b) Mannitol Salt (MS) Agar at 37 °C for 24–48 h for micrococci, (c) Violet Red Bile Agar (VRBA) at 37 °C for 18–24 h for total coliforms and (d) Plate Count Agar (PCA) at 30 °C for 48 h for total bacterial count. All media used were from Oxoid (Milan, Italy). The results are expressed as log numbers of colony forming units per gram of meat (log cfu/g).

2.5. Colour measurements

Colour measurements were performed with a Chroma Meter CR-400 (Konica Minolta, Osaka, Japan), according to the standard conditions of the Commission International d'Eclairage (CIE). The samples were sliced with a thickness of 1 cm and were put in petri dishes before taking the readings. The values were measured three times on the surface of the slices. Results were expressed as L^* (lightness), a^* (redness) and b^* (yellowness). Before each series of measurements, the instrument was calibrated using a white ceramic tile having the following values for $Y = 93.0$, $x = 0.3134$, $y = 0.3193$.

2.6. TBARS values

Lipid oxidation was measured as thiobarbituric acid reactive substance (TBARS) by a modified version (Sørensen & Jørgensen, 1996) of the method reported by Vyncke (1970), Vyncke (1975). Each sample (10.0 g) was homogenized (Ultra Turrax T-25, Janke & Kunkel IKA Labortechnik, Staufen, Germany) with 30.00 ml of a 7.5% trichloroacetic acid solution containing 0.1% propygallate and 0.1% ethylenediaminetetraacetic acid, disodium salt and 1 ml of a sulphanilamide solution (0.5 g sulphanilamide dissolved in about 40 ml water, followed by addition of 54 ml concentrated hydrochloric acid and made to a total volume of 100 ml water) for 45 s at 13,500 rpm and filtered through a Whatman filter 0.42 μm. The extract (5.00 ml) was mixed with 0.02 M thiobarbituric acid (5.00 ml) and heated in a 100 °C water bath for 40 min followed by cooling in ice water for 5 min. The absorbance was measured at 532 and 600 nm using a spectrophotometer (Shimadzu UV-1250, Tokyo, Japan) and the difference in absorbance ($A_{532nm} - A_{600nm}$) was calculated. TBARS, expressed as μmol as reported in Fig. 4 malonaldehyde/kg meat, was calculated using malonaldehyde-bis-(di-ethylacetal) as standard.

2.7. Nutritional analysis

Each sample was thawed and ground to homogeneous consistency using a food processor. Moisture, protein, lipid and ash contents in each sample were determined according to AOAC methods (1995).

Lipids were extracted according to Folch, Lees, and Stanley (1957). Briefly, an homogenized salami sample (5 g) was blended with chloroform/methanol (2:1, v/v) twice for 60 s, filtered, placed