Meat Science 114 (2016) 58–68

Contents lists available at ScienceDirect

Meat Science

journal homepage: www.elsevier.com/locate/meatsci

Valorization of indigenous dairy cattle breed through salami production

Raimondo Gaglio [a], Nicola Francesca [a,*], Giuseppe Maniaci [a], Onofrio Corona [a], Antonio Alfonzo [a], Cristina Giosuè [a], Annamaria Di Noto [b], Cinzia Cardamone [b], Maria Teresa Sardina [a], Baldassare Portolano [a], Marco Alabiso [a]

[a] Dipartimento Scienze Agrarie e Forestali, Università degli Studi di Palermo, Viale delle Scienze 4, 90128 Palermo, Italy
[b] Istituto Zooprofilattico Sperimentale della Sicilia "Adelmo Mirri", via G. Marinuzzi 3, 90129 Palermo, Italy

ARTICLE INFO

Article history:
Received 6 August 2015
Received in revised form 16 December 2015
Accepted 18 December 2015
Available online 19 December 2015

Keywords:
Salami
Cinisara breed
Lactic acid bacteria
Starter culture
Meat fermentation

ABSTRACT

The aim of the research was to produce salami manufactured with meat of three different commercial categories of bovine breed: cow on retirement, beef and young bull. A total of six experimental productions, at small-scale plant, were carried out with and without starter culture inoculums. The evolution of physico-chemical parameters in all trials followed the trend already registered for other fermented meat products. Several LAB species were found during process with different levels of species diversity and frequency of isolation among inoculated (mainly *Pediococcus pentosaceus* and *Staphylococcus xylosus*) and uninoculated (mainly *Enterococcus devriesei*, *Lactobacillus curvatus* and *Lactobacillus sakei*) trials. *Enterobacteriaceae* were found at very low levels during the entire ripening period and no pathogenic bacteria were found in any samples. The multivariate analysis showed that starter inoculums and meat affected significantly the physico-chemical and the microbiological composition of salami. The sensory analysis evidenced the highest overall acceptability was displayed by salami produced with meat from cow on retirement.

1. Introduction

Salami are generally defined as cured sausages, fermented and air-dried meats obtained from one or more species of animals (Francesca, Sannino, Moschetti, & Settanni, 2013). When this product is partially fermented and requires cooking before consumption, it is called "salsiccia", whereas salami is commonly eaten after a variable period of drying and ripening (Francesca et al., 2013).

Historically, salami are made with meat and fat of swine. In the last years, salami of autochthonous breeds are becoming very appreciated by consumers (Francesca et al., 2013). Salami made also with meat of other animal species (Cenci-Goga et al., 2012; Omer et al., 2015) are gaining importance in several European markets, becoming easily available (Bertolini, Zgrablic, & Cuffolo, 2005; Severini, Stocchi, Cenci-Goga, & Scorciarini Coppola, 1999). Bovine salami are typically produced in northern Italy, but to our knowledge no scientific studies have been carried out to monitor the technological/chemical/microbiological parameters during meat transformation.

Meat quality is influenced by several factors, such as animal breed, feeding and pasture availability, breeding system, and animal activity (Bittante, Andrighetto, & Ramanzin, 2008). All these factors contribute to the chemical-organic composition of meat, as well as to the composition and amount of fat reserve, influencing the sensory quality of the final products.

Sicily hosts several rustic animal breeds and, among them, Cinisara represents an autochthonous cattle breed with prevailing aptitude to milk production, belonging to the group of the "Podoliche" breeds (Liotta & Chiofalo, 2007). Cinisara cows feed mainly on poor natural pasture and are commonly associated to the dairy product Caciocavallo Palermitano cheese (Di Grigoli, Francesca, Gaglio, Guarrasi, & Bonanno, 2015; Settanni et al., 2012).

Recently, the meat of Cinisara cows reared according to the traditional production system has been investigated for its characteristics. The studies showed that this meat is chemically and physically similar to those of the specialized beef breed and possesses a good protein and intramuscular fat amount (Liotta et al., 2011).

During salami production, the microorganisms naturally present on the raw materials and eventually inoculated as starters are responsible for the fermentation process. This process involves a succession of events in which all conditions characterizing the dripping, drying and ripening phases need to be monitored to assure high level of hygienic safety and sensory quality of the final product. The aim of this research was to monitor the production of salami manufactured with bovine meat under different technological and microbiological conditions. To determine the quality of the resulting products, the influence of three different commercial categories (cow on retirement, beef and young bull) on physico-chemical, microbiological and sensory properties of Cinisara salami was studied. This study is part of a project mainly aimed

* Corresponding author.
E-mail address: nicola.francesca@unipa.it (N. Francesca).

http://dx.doi.org/10.1016/j.meatsci.2015.12.014
0309-1740/

to find commercial alternatives for the meat of autochthonous breed appreciated in the market.

2. Materials and methods

2.1. Animals and salami formulations

Fermented bovine salami were produced with meat of the Sicilian bovine breed Cinisara, and the experimental design is shown in Fig. 1. In details, the animals used in this study included retired cows (120 months old), beefs and young bulls. The animals belonging to the categories beef and young bull were of 18 months old but they differed in terms of grazing period. In details, the beefs were breed by grazing until 15 months of age and subsequently they were kept in housing barn until slaughter; on the other hand the young bulls were breed by grazing until slaughter. After slaughter, the carcasses were stored at low temperature (from 4 to 8 °C) for 8 days (aging period); after cutting and deboning the flesh, the meat was cleansed of fat, tendons, and other connective tissues. Per each type of animal categories, the meat was separately mixed with swine fat (20% w/w) of the autochthonous Suino Nero dei Nebrodi swine breed. The mix was minced with plate of 6 mm to obtain the mixture. Subsequently, each mixture was furtherly separated into two batches that differed for the inoculums (with and without) of starter cultures.

The entire salami production was performed two times following the same experimental design (Fig. 1).

By this way, two independent productions were performed, once per week, during February 2014. All salami were manufactured by an experienced craftsman, at the Salumi Lipari sausage factory located in Alcamo (Sicily, Italy).

2.2. Salami manufacturing and sample collection

The experimental salami types were produced as follows: the meat of three animal categories was separately minced and placed into three different stainless steel vats. Subsequently, the content of each vat was divided in two stainless steel vats for a total of six (100 kg each) experimental trials.

Three trials (SP1, SP2, and SP3) were uninoculated with the starter culture preparation since they were spontaneously fermented, while the other three trials (ST1, ST2, and ST3) were added with *Staphylococcus xylosus* and *Pediococcus pentosaceus* freeze-dried cultures (Tec-AL. s.r.l., Italy) to a final concentration of approximately 10^7 CFU g^{-1}.

After inoculation, the meat of each experimental trial was mixed with the other ingredients into a blender and separately stuffed into natural casings. Each salami sample was formed at approximately 35 cm in length and 7 cm in diameter. Subsequently, the salami were dripped for three days [20 °C and free relative humidity (RH)]. After that they were fermented and dried for a total of seven days in accordance with the following protocol: 20–22 °C and 62–72% RH at day 1; 19–21 °C and 64–74% RH at day 2; 18–20 °C and 66–76% RH at day 3; 17–19 °C and 68–78% RH at day 4; 16–18 °C and 70–80% RH at day 5; 15–17 °C and 72–82% RH at day 6; 14–16 °C and 74–84% RH at day 7; 13–15 °C and 76–86% RH at day 8; 12–14 °C and 78–88% RH at day 9; 12–14 °C and 78–88% RH at day 10. Afterward, samples were fermented and ripened for a total of 45 days (11–13 °C and 80–90% RH).

The starter culture preparations as well as the other ingredients (swine fat, pepper, salt and sugar mixture, and also the gats) were sampled.

Minced meat was sampled before addition of starter cultures and the following samples were collected during production: mixture of meat and other ingredients at time 0 (meat mixture just after stuffing), day 10 (end of drying process and fermentation phase), day 25 (ripening and fermentation phases) and day 45 (end of ripening process). At each sampling time, five salami for trial (starter and control) were collected, 3 subsamples per each salami were analyzed.

All samples were collected in triplicate, placed into sterile containers, immediately refrigerated and transported at controlled temperature (with a portable fridge) to the laboratories of Agricultural Microbiology (University of Palermo) and to the Instituto Zooprofilattico Sperimentale della Sicilia "A. Mirri" (Palermo, Italy).

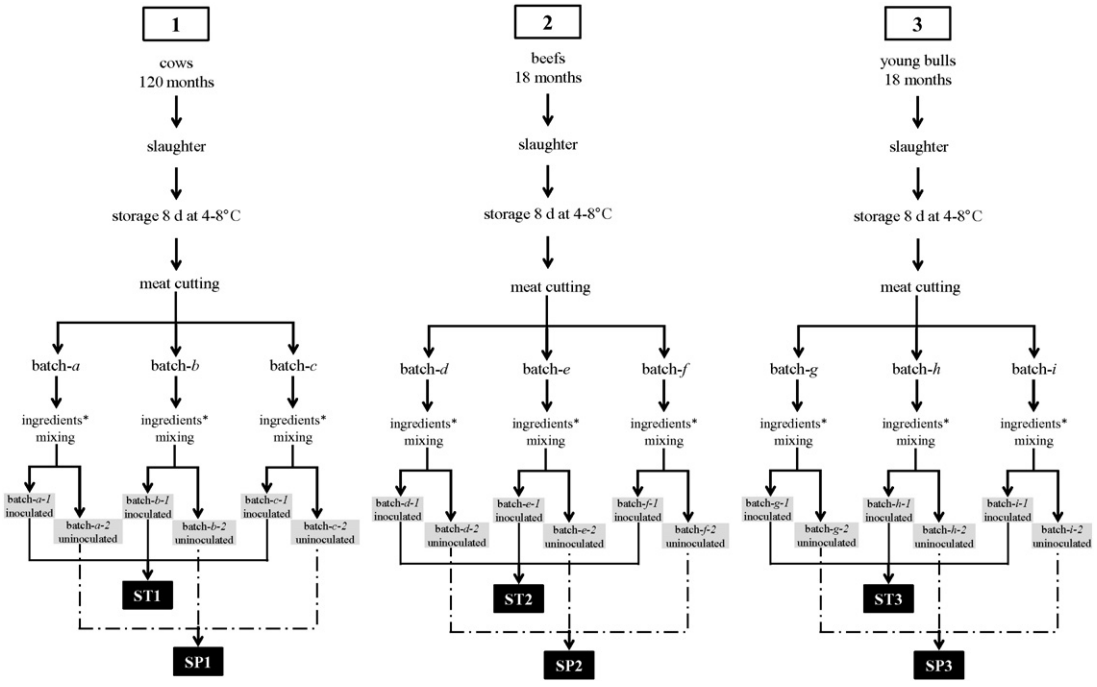

Fig. 1. Experimental design of bovine salami production. 1, cows at 120 months old; 2, beefs at 18 months old; 3, young bulls at 18 months old. Abbreviation: codes of batches from *a*-1 to *i*-2 refer to replicates within each trials; codes from ST1 to ST3 refer to trials inoculated with starter cultures; codes from SP1 to SP3 refer to trials spontaneously fermented. *NaCl (2.5% w/w); sucrose, dextrose and malt dextrin and sodium ascorbate (160 ppm); sodium nitrate (100 ppm) and sodium nitrite (100 ppm).