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Artisanal Italian salami and soppresse: Identification of control strategies to manage microbiological hazards

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1. Introduction

As of the start of the 21st century, consumers have developed a growing interest in so called "traditional or artisanal" food. The renewed interest in this type of food is explained by consumers' perception of these products. In fact, traditional food has a general positive image across Europe, and European consumers trade off the relative expense and time required for preparation of traditional food for its specific taste, quality, appearance, nutritional value, healthiness and safety (Almli et al., 2011; Guerrero et al., 2009). Such food is often produced by small farms, and so the rural economy benefits from the increase in activity and profits through direct sales at local food markets (Berlin et al., 2009; Carey et al., 2011). Although the term "traditional foods" is widely used, the concept of traditional food products embraces different dimensions and there are hardly any definitions that clearly define traditional foods. In order to identify "traditional" foods, the EU legislation (EC, 2006a; EC, 2006b; EC, 2012) has defined criteria based on product designations that are linked to geographical origin or traditional production methods. In addition, the EuroFIR FP6 Network of Excellence provided a definition of traditional foods which includes statements about traditional ingredients, traditional composition and traditional type of production and/or processing method (Weichselbaum et al., 2009).

Among European countries, Italy is the lead producer of traditional foods and products such as foods with Protected Designation of Origin (PDO) or Protected Geographical Indication (PGI), followed by France, Spain, Portugal and Greece (ISMEA, 2013). Additionally, it is estimated that Italy has around 5000 traditional local food products without any certification (CIA, 2015), which could represent an important resource contributing to the development and sustainability of rural areas, providing ample variety in food choice for the consumer and a remarkable income for the economy. With its 371 typical products, Veneto Region is the fourth Italian Region according to number of traditional food products after Toscana, Campania and Lazio (Mipaaf, 2014). In addition, since 2007, Veneto Region has implemented regional legislation which defines a simplified procedure to sell small quantities of traditional food products at local level directly from the producer to the consumer (DGR, 2007; DGR, 2008). In Veneto Region, many typical fermented sausages such as salami and soppresse are produced with traditional technologies, and so the legislation has been focused firstly on these products and subsequently on other types of meat products (poultry and rabbit meat) and products of non-animal origin (canned food; fruit juices; flour and dried vegetables; bread and bakery products; extra virgin olive oil). In relation to fermented sausages, the legislation defines the production season, the maximum number of animals that can be reared and the minimum rearing period for pigs on the production farm as well as the minimum hygienic pre-requisites of the work areas used for processing pork meat into fermented sausages. Since these sausages are mainly produced following traditional practice in small processing units, starter cultures are not added to the minced pork meat and ripening is carried out in rooms with less temperature and relative humidity control than that used by industrial manufacturers. Therefore, deviations in temperature and/or humidity can result in insufficient fermentation-drying processes, meaning the absence of pathogens in the final products is not assured. The

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presence of food-borne pathogens such as *Listeria monocytogenes*, *Escherichia coli* O157, and *Salmonella* spp. in fermented sausages has been reported.

Concerning *L. monocytogenes*, the pathogen was detected at the end of ripening in 40% of "Salsiccia Sarda" (a traditional Italian fermented sausage) with contamination levels always lower than 100 cfu/g (Meloni et al., 2012), while a prevalence of 15% was reported in fermented sausages produced in northern Italy (De Cesare et al., 2007). Other studies conducted on traditional fermented sausages at the end of the ripening period showed a *L. monocytogenes* prevalence of 10% in France (Thevenot et al., 2005), 16% in Spain (Martin et al., 2011), 42% in Greece (Gounadaki et al., 2008) and 60% in Portugal (Ferreira et al., 2007). The prevalence of *Salmonella* spp. in traditional fermented sausages is lower than *Listeria*: the presence of *Salmonella* was reported in two out of 38 batches of traditional Portuguese sausages (*alheiras*) (Ferreira et al., 2007) and in three out of 21 (14%) batter samples of traditional Greek fermented sausages but not in the final products (ready to be sold) (Gounadaki et al., 2008). In relation to verocytotoxin-producing *E. coli* (VTEC), including *E. coli* serotype O157:H7, for which meat and meat products are considered the main source of infection for humans, an overall VTEC prevalence of 16% was found in fresh pork sausages collected in the southern part of Italy (Villani et al., 2005).

In addition, food-borne outbreaks associated with the consumption of fermented meats are reported in the literature. In Veneto Region of Italy, in January 2004, a family outbreak of *E. coli* O157 infection caused by a dry-fermented traditional salami made with pork meat and produced in a local plant occurred (Conedera et al., 2007). In Norway, an outbreak caused by *E. coli* O103:H25 involving 17 patients was attributed to the consumption of fermented sausages (Sekse et al., 2009). Concerning *Salmonella*, an outbreak of *Salmonella* Typhimurium DT104A involving 63 cases associated with the consumption of traditional pork salami was reported in Lazio Region of Italy (Luzzi et al., 2007). Another outbreak of *Salmonella* Typhimurium associated with the consumption of unripened salami was reported in Lombardia Region of Italy (Pontello et al., 1998). *L. monocytogenes* outbreaks associated with the consumption of fermented sausages have not been reported, to our knowledge, even though *L. monocytogenes* has been implicated in several listeriosis outbreaks linked to the consumption of pre-sliced ready-to-eat deli meats (Thevenot et al., 2006). The infective doses of the above-mentioned micro-organisms can vary widely according to several factors such as the strain, the susceptibility of the host, and the food matrix involved. In case of *L. monocytogenes* in susceptible individuals, it is unlikely that fewer than 1000 cells may cause disease (EFSA, 2007). Concerning *Salmonella* the infective dose is variable but often low numbers of cells (between 10 and 1000) are sufficient to cause disease, the same for EHEC which is known for its low infective dose (Strachan et al., 2005; Teunis et al., 2010). The difference in dose-response relationship between the three pathogens may also, to some extent, explain the difference in stringency in surveillance. In European Regulation 2073/2005 (EC, 2005), tolerance of up to 100 cfu/g of *L. monocytogenes* in ready-to-eat meat products is accepted at the end of shelf life, whereas usually action limits of absence of *Salmonella* and EHEC per 25 g are applicable.

In order to avoid the marketing of potentially hazardous traditional fermented pork sausages (Italian salami and soppresse) produced within the Veneto region, this study was initiated by the regional competent authorities in collaboration with the small-scale producers with the following aims: a) investigate the production process of traditional salami and soppresse in Veneto Region of Italy; b) identify the microbiological hazards associated with this type of food, and finally; c) identify control measures easily applicable directly by the Food Business Operator (FBO) with the supervision and control of the regional Competent Authority (CA) in order to manage the hazards associated with this type of traditional meat product.

2. Materials and methods

2.1. The artisanal salami and soppresse production process in the Veneto Region of Italy

With the word *salami* we intended the traditional fermented pork sausages, characterized by a weight of 600–800 g, a diameter of 6–8 cm and a length of 20–30 cm, while with the name *soppresse* the traditional fermented pork sausages of 1.5–2 kg of weight and a diameter of 10–12 cm is addressed.

The following steps can be recognised in the salami and soppresse production process: sorting meat cuts; grinding the meat; manually mixing the minced meat with the ingredients (salt, spices) according to the recipe; stuffing the sausage batter into natural collagen gut casing; labelling the product. Next, salami and soppresse move to the fermentation phase, which can be divided into two periods: the drying and the ripening. On average, the drying period lasts 7 days for salami and 20 days for soppresse while the ripening period is usually 30–40 days for salami and at least 120 days for soppresse. On average, 200 kg of minced meat is obtained from two pigs, which in terms of production, means 40 salami, each approximately 1 kg and 15 soppresse, each approximately 2.5 kg.

2.2. An explorative pilot study: the production season 2008–2009

In order to collect information on the variability of the production process, the microbiological quality and the occurrence of pathogens in traditional fermented pork sausages (salami and soppresse), a *pilot study* was performed during the production season 2008–2009. The study involved 21 producers, all located in Veneto Region in the North-East of Italy. Samples of at least one salami-soppresse batch (identified by the production date) per producer were collected by the local veterinary authorities. Sampling took place at primary production (one faecal sample from pigs on farm), at slaughter (one lymph-node sample from pigs), at processing on the day batter was stuffed into casing (one sausage batter sample), and then during the ripening period (one salami or one soppresse) (Table 1).

The collected samples were analysed according to the ISO reference methods for the following food-borne pathogens: *Campylobacter* spp. (ISO 10272-1:2006), *E. coli* O157 (ISO 16654:2001), *Salmonella* spp. (ISO 6579:2002/Cor 1:2004 (E)) and *L. monocytogenes* (ISO 11290-1:1996/Amd 1: 2004 (detection) and ISO 11290-2:1998/Amd 1: 2004 (enumeration)). In addition, in the case of batter samples and salami or soppresse samples, a_w and pH were measured. The a_w was measured with an electric hygrometer (AquaLab) according to the ISO 21807:2004. The pH was measured by immersing a pH probe of a digital pH meter (Crison Basic 20) in a diluted and homogenized sample containing 3 g of sausage batter or salami-soppresse and 30 ml of KCl 0.1 M according to the ISO 2917:1999.

2.3. The elaboration of a food safety control strategy: the production season 2009–2010

Building further on the results of the pilot study, a general sampling plan (including 32 producers) and an intensive sampling plan (including four selected producers) was elaborated and applied during the salami and soppresse production season