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Production of Traditional Mediterranean Meat Products

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Production of Traditional Mediterranean Meat Products

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Preface

The meat industry is a sector with great importance worldwide. At present, the repercussions of the diet on the health and well-being of consumers condition their attitude towards certain foods. Taking into account that both meat and meat products are important constituents of the diet, the degree to which these foods are perceived as healthy determines their image, as well as the purchase intention of consumers. In addition, not only healthy products but high-quality products are increasingly demanded, made in a traditional way, a specific region, with a specific species or breeds and with added value (e.g., protected with quality marks).

This book arises from the collaboration between different institutions and centers at an international level, which include members of the Healthy Meat network, funded by CYTED (ref. 119RT0568). The Healthy Meat network aims to create a wide Ibero-American network within the food sector for the production of healthier meat products through different strategies and interventions that have an impact on reducing the consumption of some nutrients, and with nutritional and health benefits for the consumers. Therefore, each research group contributes its local and specific scientific-technological knowledge and is transferred to the other groups of the Network in order to catalyze the discovery or development of new ideas or solutions adapted to the specificities of each region and oriented to obtain healthier meat products.

The publication of this book about Mediterranean meat products responds to the need to inventory and characterize traditional meat products within each geographic region and with high economic and social interest. In turn, this book will also facilitate the creation of complementary work groups, taking into account essential aspects such as the scientific knowledge they possess, the similarity of the type of products they intend to study, and the lines of research and areas of knowledge. Finally, the publication of this book is a very useful tool in order to standardize the manufacturing process of the main Mediterranean traditional meat products, since there are several variations between manufacturers or regions.

Therefore, the current book examines the techniques, processing conditions, and ingredients used for meat products manufacture. A complete and comprehensive description of the materials and processing conditions used is made so that each meat product can be manufactured by other researchers or industries. In addition, each book chapter includes explanatory notes and elucidates the possible specific points to take into account for the correct manufacture. The ultimate goal is to support the scientific community, professionals, industries, and food companies in their aim to study and/or manufacture the main Mediterranean meat products. The book consists of 21 chapters.

Chapter 1 provides the complete manufacture description of one of the most popular dry-ripened sausages, the Spanish chorizo. Moreover, the elaboration process of Chouriça de carne, a very similar Portuguese sausage, is also described in Chapter 19.

Chapter 2 discusses the ingredients and processing conditions for the elaboration of Sobrasada, a traditional meat product from the Balearic Islands (Spain).

Chapter 3 provides the necessary information for the elaboration of Botifarra, a typical sausage from Catalonia, Aragón, Murcia, and Comunidad Valenciana (Spain). This sausage is also known as Longaniza or Llonganiza.

The complete processing conditions of Morcilla de Burgos, a blood sausage from the Burgos region, in the north of Spain, are shown in Chapter 4.

In Chapter 5, all manufacturing steps and ingredients for the elaboration of Salchichón, another important Spanish sausage, are explained.

Chapter 6 deals with the composition, ingredients, manufacturing steps, and characteristics of Androlla and Botillo, two similar sausages from Galicia, the North-west of Spain.

In addition to the sausages, in the present book also dry-cured meat products elaborated with whole pieces are covered. Thus, in Chapter 7, a comprehensive explanation about the processing of one of the most important meat products worldwide dry-cured ham is provided.

Another appreciated meat product with similar processing steps to ham is the Lacón. This product is typical of Galicia (Spain). Chapter 8 focuses on the manufacturing steps and the main dry-curing conditions of Lacón.

Chapter 9 provides a complete description of the ingredients, spices, materials, and processing conditions for the elaboration of dry-cured loin. This product is produced worldwide but is typical in Spanish. A similar dry-cured meat product is Coppa, a traditional product from Italy, which is fully described in Chapter 14.

Chapter 10 explains the main steps in the Cecina manufacture. This product is typical of the "León" region in Spain. Cecina is a traditional product similar to Italian Bresaola (which is fully described in Chapter 12) and Turkish Pastırma (which is fully described in Chapter 17).

The description of the comprehensive procedure for the elaboration of Salame Felino, a traditional salame produced in Northern Italy, is provided in Chapter 11.

Chapter 13 provides a complete description of the manufacturing process of pepperoni, an important dry sausage worldwide, but traditionally elaborated in Italy.

Chapter 15 provides an overview of specific ingredients and processing conditions for the elaboration of Lukanka, a popular meat product in Bulgaria, the Balkan Peninsula, and South-East Europe, and widely appreciated for its gastronomical qualities.

Sucuk, a traditional Turkish dry-fermented sausage, is widely produced and consumed in Turkey. Chapter 16 explains in a comprehensive way the main processing steps and conditions for its manufacture.

Alheira is a typical Portuguese sausage whose main ingredients are poultry meat, bread, olive oil, lard, garlic, and paprika. The full manufacturing process is shown in Chapter 18.

The formulation and the different stages of manufacturing of the Portuguese meat-based products Paia de Toucinho and Entremeada are described in detail in Chapter 20.

Finally, the full processing conditions for the elaboration of Salpicão (a traditional meat product from the north region of Portugal) and Paio (a traditional meat product from the south region of Portugal) are covered in Chapter 21. These products have a long tradition of manufacturing and are highly valued by the consumers due to their exquisite sensory characteristics and attractive nutritional value.

Ourense, Spain

José Manuel Lorenzo
Rubén Domínguez
Mirian Pateiro
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Chapter 1

Dry-Ripened Chorizo

Irma Caro, Félix Fernández-Soto, and Javier Mateo

Abstract

Spanish dry-ripened chorizos are highly seasoned red-colored intermediate-moisture, shelf-stable, and ready-to-eat sausages widespread throughout Spain. The characteristic nonmeat ingredients in the chorizo formulation are salt, paprika, garlic, and oregano. This study gathers information from scientific literature describing the characteristics of different types of chorizo and the effects of relevant factors on chorizo quality, technical specifications from national standards regarding chorizo formulation and making process and knowledge and information obtained from the producers. Many chorizo varieties are produced with differences depending on the region and the technology used in their making process. Traditional chorizos are spontaneously fermented, low-acid, and slow-ripened sausages with aw <0.9, while some industrial chorizos are highly fermented and commercialized with higher aw. Chorizos are categorized according to their composition (extra o average), or by the pig breed from which the pork is obtained. Other relevant differences in chorizos are they are the possibility of dry-smoking or mold covering, the amount or type of paprika used and sausage shape and size.

Key words Traditional meat products, Intermediate-moisture meats, Dry-cured sausages, Dry-fermented sausages, Spanish chorizo

1 Introduction

Spanish dry-ripened chorizos are a group of highly seasoned, generally red in color, intermediate-moisture, shelf-stable, and ready-to-eat sausages produced throughout Spain [1]. These dry-ripened sausages are usually made from pork, air-dried varying from weeks to months, and characterized by the use as ingredients of Spanish paprika (*Capsicum annuum* subsp. *cerasiforme* and subsp. *longum* fruits), called "*pimentón*" and garlic (*Allium sativum*) [2–4]. A variety of chorizo specialties are normally linked to specific Spanish regions, such as *Cantimpalos*, *Riojano*, *de Pamplona*, *de Requena*, to mention but a few, with some of them being granted international or regional quality labels. Variability in chorizos results from the quality and quantity of the raw materials used and variations in the making process conditions. In some regions, particular varieties

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of these sausages are named "*longaniza,*" "*chistorra,*" or "*morcón*" instead of chorizos, and there is a variety of chorizo "*chorizo blanco,*" which does not contain paprika [5]. Chorizo consumption in Spain is almost one million kg per year. Although there are still homemade productions in the rural area, most chorizos are produced in the meat industry.

Several studies describing the quality characteristics of dry-ripened chorizos and critical factors affecting their quality can be found in the international literature from over the last three decades. Chorizo chemical composition were reported by Gimeno et al. [6], Ansorena et al. [7], and Menéndez et al. [8], and other studies focused on the microbial population involved in chorizo fermentation and ripening [9–11]. The effects of nonmeat ingredients such as paprika [12, 13] or the use of phosphates [14] Fonseca et al. on the chorizo drying rate, texture, color, and oxidative stability have also been evaluated. Other studies have described the differences between homemade and industrial chorizos in volatile and taste compounds [15, 16] or the effect of the use of starter or flavor-produced cultures in the chorizo sensory properties [17–19]. Moreover, the effect of storage conditions, mainly packaging type or temperature, on the time-related changes in chorizo quality traits and sensory properties has been the subject of other studies [20–22].

With regard to microbial hazards associated with chorizo consumption, the growth possibilities of *Staphyloccocus aureus* during the drying conditions as a function of temperature-time combination and the behavior of *Listeria monocytogenes* on sliced chorizo during storage [23–25] have been studied. *Listeria monocytogenes* could survive in chorizo or even grow if the levels of the hurdles to control its growth (pH, aw, nitrites, microbial composition, storage temperature) are not sufficiently achieved by producers.

With regards to chemical hazards, various studies have evaluated the effect of different factors affecting the biogenic amine concentration in chorizo such as water activity [26], size [27], the use of starters [28], or the storage conditions in sliced chorizo [29]. The studies by Lorenzo et al. [30] and Ledesma et al. [31] also evaluated the presence polycyclic aromatic hydrocarbons in smoked chorizos.

This chapter aims at describing in detail the formulation and making process of chorizo by considering the information from scientific and technical literature, national regulations and standards regarding chorizo quality, and the producers' knowledge and information.

2 Materials

Dry-ripened chorizos are usually prepared with lean pork cuts, i.e., neck, shoulder, fatty meat cuts such as belly and lean and fatty trimmings. The typical muscle to fat ratio in chorizo formulation is from 70/30 to 80/20, resulting in 30–40% fat content in the final (Table 1); a lower amount of fat would produce less succulence, fast drying and hardness, while higher amounts can downgrade the commercial quality type of chorizo (*see* **Note 1**).

Among dry-ripened chorizos, the greater part is prepared from pork from the Duroc, Landrace and Large White pig breeds. However, approximately 15% of the chorizos commercialized in Spain are prepared from the meat of pure Iberian breed pigs (*see* **Note 2**) or Iberian x Duroc (up to 50%) crossbreeding pig [32]. These chorizos are named "*chorizos ibéricos*" and are usually more expensive than normal ones and considered high-quality ones. On the other hand, a few chorizo varieties, usually lower in quality, include blood, offal or boiled rinds [4, 33]. Furthermore, some specialties are made from beef or game meat together with pork backfat [34].

The most characteristic nonmeat ingredients in the chorizo formulation are salt, paprika, garlic, and oregano, used at c.a. 1.7–2%, 2–3.5%, 0.5–2%, 0–0.5 g/kg of the sausage mixture [4]. The relevance of paprika, which tends to be the most abundant nonmeat ingredient in chorizo formulation, on chorizo quality is explained in **Note 3**. Other spices or condiments such as pepper, white wine, or olive oil are also used in some chorizo varieties [4, 35]. Most homemade and some industrial chorizos have no other ingredients in their formulations [36]. However, it is common in industrial chorizo to use nonmeat proteins such as milk proteins and dextrin, to improve cohesiveness, and the additives nitrite, nitrate, and ascorbate.

Traditional chorizos are low-acid fermented sausages with a long and slow ripening at low temperatures [37], with a final pH of 5.5–6.2 and aw <0.9. However, some industrial chorizos are formulated with sugars, dextrose or lactate, and microbial cultures composed of lactic acid bacteria and *Staphylococcus xylosus* or *S. carnosus* in order to intensify the fermentation process, reduce the final pH and increase the presence of lipolytic and proteolytic activity [17, 38].

The greater majority of chorizos have a red color characteristic because of the paprika (Fig. 1), a highly seasoned flavoring, and a 20–30%-moisture range. The weights of chorizo sausage pieces are usually between 0.4 and 1 kg, and their shapes depend on the casing used for stuffing. Chorizos can be few-cm diameter horseshoe-shaped, named "*sarta*" or "*herradura*" or different diameter stick-shaped (named "*vela*" and "*cular*"). *Cular* chorizos are stuffed into the pig rectum. Dry-ripened chorizos are generally

Table 1
Dry-ripened chorizo composition (protein, fat and salt expressed as percentage of chorizo and SFA, MUFA and PUFA as percentage of total fatty acids)

Moisture	29–44
Protein	14–27
Fat	30–37
Salt	2.1–3.5
SFA	40
MUFA	46
PUFA	14

SFA saturated fatty acids, *MUFA* Monounsaturated fatty acids, *PUFA* polyunsaturated fatty acids, Adapted from [5, 6, 16, 33]

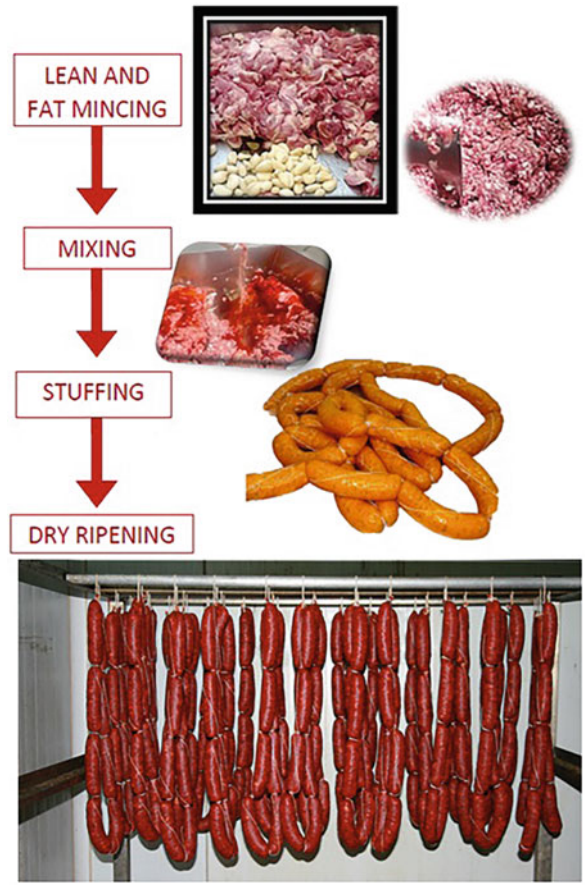

Fig. 1 Different types of dry-ripened chorizos and a mixture of paprika and oregano in the center of the image

consumed raw, sliced, in baguettes ("*bocadillos*") or tapas. Approximately 60% of commercialized chorizo is distributed in the market in sliced presentations and the rest as whole sausage pieces [32]. Slices are normally vacuum packaged or packaged under anoxic modified atmospheres.

3 Methods

The different steps in the dry-ripened chorizo making process include meat and fat mincing, mixing the ingredients to prepare the batter, resting of the batter for 24–48 h (optional), stuffing, and ripening (Fig. 2):

1. Lean and fatty cuts are cut into chunks, and the chunks and trimmings usually minced in a single step by running them through 6–18 mm sieve plates [4].
2. The minced meat and fat are mixed with the nonmeat ingredients for some minutes using paddle mixers, preferably under vacuum, until a homogeneous and cohesive mass is formed.
3. In homemade sausages or small-scale plants where the mixing does not work under vacuum, the batter is compacted and kept into containers for 24–48 h under refrigeration [1], which contribute to a reduction in the batter redox potential before stuffing.
4. The batter is stuffed into 30–60 mm diameter pig, or beef casings [1, 35] or artificial collagen casings and the sausages obtained are tied with thread or metal clips.
5. The ripening in homemade and small-scale industries is performed in conditioned non-automatized rooms, opening and closing of windows depending on the weather conditions to maintain appropriate air moisture, temperature, and air ventilation inside. However, in many industries, ripening is carried out in ripening chambers with automatic control of the air conditions. Traditional chorizos are typically slowly ripened at temperatures under 15 °C for weeks of months, depending on the ripening conditions, sausage composition, such as fat content, and diameter. On the other hand, industrial chorizos can be ripened faster and, in these cases, the ripening includes a one-to-three day fermentation step under high air moisture and temperature (90% and 18–25 °C) to foster the growth of lactic acid bacteria. The ripening process involves the loss of moisture and the development of microbial and enzymatic processes contributing to the flavor and texture of the sausage. Dry-ripened chorizos can be considered as shelf-stable sausages (*see* **Note 4**).

Fig. 2 Diagram of the dry-ripened chorizo making process

6. Optionally and generally, in the regions of Spain with more humid climates chorizos are smoked during the ripening, e.g., chorizo *de León* variety (Fig. 3), using oak firewood, with temperatures ranging from 10 to 40 °C for some days and a few hours per day. Smoking increases the oxidative stability of chorizos and prevents the growth of molds (*see* **Note 5**).

4 Notes

1. According to Spanish chorizo standards, there are two quality commercial types: extra "*extra*" and average "*normal*" depending on chorizo formulation and composition. *Extra* chorizos must have a fat content in dry matter lower than 57%, except for Pamplona chorizo and Iberian chorizo varieties, which can have up to 65%. Moreover, *extra* chorizos should have more than 30% protein-in-dry matter, a ratio collagen/total protein lower than 0.16, and less than 2% carbohydrates, with all these limits being more permissible for *Pamplona* and Iberian chorizo. Finally, extra chorizos only allow for less than 1% added proteins (nonmeat proteins, such as milk proteins) [35].
2. Iberian breed pigs "*cerdos ibéricos*" are out-door and slow-growing animals, traditionally reared in the Mediterranean *Dehesa* ecosystem, following extensive ("*de bellota*") or semi-extensive ("*de cebo de campo*") production systems [39]. Some of the Iberian pigs are also fed on commercial feed concentrates

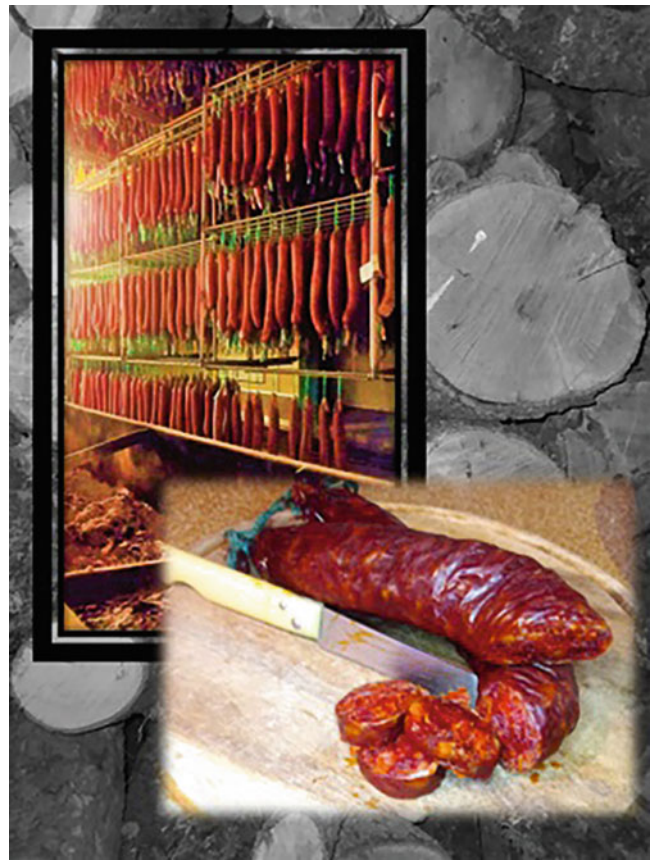

Fig. 3 Dry-ripened smoked "*chorizo de León*"

and legumes under intensive systems (these are named "*de cebo ibérico*").

Iberian breed pigs or their Duroc crossbreeds are heavier and older at slaughter than standard white pigs, and the pork from these animals has greater subcutaneous and intramuscular fat contents and is associated with superior eating quality.

3. The powdered paprika used in Spain can be prepared from dried-smoked, oven-dried or sun-dried *C. annuum* fruits, and is mainly produced in the regions of Extremadura and Murcia [40]. Their flavor can be sweet, semi-hot "*okal*" or hot, only being used in hot chorizo "*chorizo picante*" varieties. Paprika exerts a relevant effect on the chorizo drying and ripening process [16, 41] since it is a source of fermentable sugars (1–2 g/kg of sausage mix), minerals, natural antioxidants and fiber. Paprika is also mainly responsible for both the characteristic chorizo flavor and redness. Spanish paprika is highly colored, i.e., more than 100 ASTA units [12], and this result in a high redness and yellowness in chorizo, i.e., a* and b* color values from 14 to 24, and 9 to 18, respectively [6, 42].