

*Food Biology Series*

# Fermented Meat Products

## Health Aspects

*Editor*

**Nevijo Zdolec**

University of Zagreb, Faculty of Veterinary Medicine  
Department of Hygiene  
Technology and Food Safety  
Zagreb, Croatia



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**Dias, Teresa**

School of Agriculture of Polytechnique  
Institute of Bragança (ESA-IPB)  
Apartado 172, Bragança  
Portugal  
Tel: +351273303298  
Email: tdias@ipb.pt

**Dinsdale, Slim**

FoodSafetyExperts Limited  
Maltyard, Brooke Road, Shotesham  
Norwich NR15 1XL UK  
Tel: +441508550007  
Cell: +447768662188  
Fax: +448704601150  
Email: dinsdale@foodsafetyexperts.co.uk

**Djekić, Ilija**

Food Safety and Quality Management  
Department, University of Belgrade –  
Faculty of Agriculture, Nemanjina 6  
11080 Belgrade  
Republic of Serbia  
Tel: +381112615315/427  
Cell: +38165 5127848  
Email: idjekic@agrif.bg.ac.rs

**Dobranić, Vesna**

University of Zagreb  
Faculty of Veterinary Medicine  
Department of Hygiene  
Technology and Food Safety  
Heinzeloza 55, 10000 Zagreb  
Croatia  
Tel: +38512390191  
Email: vdobranic@vef.hr

**Drosinos, Eleftherios H.**

Laboratory of Food Quality Control and  
Hygiene, Department of Food Science and  
Human Nutrition  
Agricultural University of Athens  
Iera Odos 75, GR-11855 Athens  
Greece  
Tel: +302105294713  
Fax: +302105294683  
Email: ehd@aua.gr

**Estevinho, Leticia**

School of Agriculture of Polytechnique  
Institute of Bragança (ESA-IPB)  
Apartado 172, Bragança  
Mountain Research Centre (CIMO)  
Portugal  
Tel: + 351273303221  
Fax + 351273325405  
Email: leticia@ipb.pt

**Filipović, Ivana**

University of Zagreb  
Faculty of Veterinary Medicine  
Department of Hygiene  
Technology and Food Safety  
Heinzeloza 55, 10000 Zagreb, Croatia  
Tel: +38512390192  
Email: ivanaf@vef.hr

**Franco, Daniel**

Centro Tecnológico de la Carne de Galicia  
Rua Galicia no. 4  
Parque Tecnológico de Galicia  
San Cibrao das Viñas  
32900 Ourense  
Spain  
Tel: +34988548277  
Email: danielfranco@ceteca.net

**Fraqueza, Maria João**

CIISA, Faculty of Veterinary Medicine  
University of Lisbon  
Avenida da Universidade Técnica  
Pólo Universitário do Alto da Ajuda  
1300-477 Lisbon  
Portugal  
Tel: +351213652884  
Email: mjoaofraqueza@fmv.ulisboa.pt

**Frece, Jadranka**

Laboratory for General Microbiology  
and Food Microbiology, Faculty of Food  
Technology and Biotechnology University  
of Zagreb, Pierottijeva 6, 10000 Zagreb,  
Croatia  
Tel: +38514605284  
Fax. + 38514836424  
Email: jfrece@pbf.hr

**Kameník, Josef**

Department of Meat Hygiene and  
Technology, Faculty of Veterinary Hygiene  
and Ecology, University of Veterinary and  
Pharmaceutical Sciences Brno  
Palackého tř. 1/3, CZ-61242 Brno  
Czech Republic,  
Tel: + 420 604 220851  
Email: kamenikj@vfu.cz

**Kimura, Hirokazu**

Department of Life Science  
Shokei University, 2-6-78 Kuhonji  
Chuo-ku, Kumamoto 862-8678  
Japan  
Tel: +81-96-362-2011(452)  
FAX: +81-96-363-2975  
Email: kimura@shokei-gakuen.ac.jp

**Pleadin, Jelka**

Croatian Veterinary Institute  
 Laboratory for Analytical Chemistry  
 Savska cesta 143, 10000 Zagreb  
 Croatia  
 Tel: + 38516123626  
 Email: pleadin@veinst.hr

**Popelka, Peter**

Department of Food Hygiene and  
 Technology, University of Veterinary  
 Medicine and Pharmacy in Košice  
 Komenského 73, 041 81 Košice  
 Slovakia  
 Email: peter.popelka@uvlf.sk

**Radakovic, Milorad**

University of Cambridge  
 Department of Veterinary Medicine  
 Madingley Road,  
 Cambridge CB3 0ES, UK  
 Tel: +44 1223 765048  
 Cell: +44 7917 228664  
 Email: mr412@cam.ac.uk

**Rodrigues, Sandra**

School of Agriculture of Polytechnique  
 Institute of Bragança (ESA-IPB)  
 Apartado 172, Bragança, Portugal  
 Tel: + 351273303221  
 Email: srodrigues@ipb.pt

**Salzano, Giovanni**

Dipartimento di Scienze  
 Università degli Studi della Basilicata  
 Viale dell'Ateneo Lucano 10  
 85100 Potenza, Italy  
 Tel: + 390971205690  
 Email: giovanni.salzano@unibas.it

**Savić, Dragiša**

Faculty of Technology, Bulevar  
 Oslobođenja 124, 16000 Leskovac  
 Serbia  
 Tel: +38116247203  
 Email: savic@tf.ni.ac.rs

**Smulders, Frans J.M.**

Institute of Meat Hygiene  
 Meat Technology and Food Sciences  
 University of Veterinary Medicine Vienna  
 Veterinaerplatz 1, A 1210 Vienna  
 Tel. +431250773301  
 Fax +431250773390  
 Email: frans.smulders@vetmeduni.ac.at

**Teixeira, Alfredo**

School of Agriculture of Polytechnique  
 Institute of Bragança (ESA-IPB)  
 Apartado 172, Bragança, Portugal  
 Tel: + 351273303206  
 Email: teixeira@ipb.pt

**Tomašević, Igor**

Animal Source Food Technology Department  
 University of Belgrade  
 Faculty of Agriculture  
 Nemanjina 6, 11080 Belgrade  
 Republic of Serbia  
 Tel: + 381112615315/272  
 Cell: + 381604299998  
 Email: tbigor@agrif.bg.ac.rs

**Vahčić, Nada**

Faculty of Food Technology and  
 Biotechnology, University of Zagreb  
 Pierottijeva 6, 10000 Zagreb  
 Tel: + 38514605 277  
 Email: nvahcic@pbf.hr

**Vesković-Moračanin, Slavica**

Institute of Meat Hygiene and Technology  
 Kačanskog 13, 11000 Belgrade, Serbia  
 Tel: +381112650655  
 Email:slavica@inmesbgd.com

**Zdolec, Nevijo**

University of Zagreb, Faculty of Veterinary  
 Medicine, Department of Hygiene  
 Technology and Food Safety  
 Heinzelova 55, 10000 Zagreb, Croatia  
 Tel: + 385 12 390 199  
 Email: nzdolec@vef.hr

## **Sheep and Goat Fermented Meat Products—Health Aspects**

**Alfredo Teixeira\*, Sandra Rodrigues,  
Teresa Dias and Letícia Estevinho**

### **1 INTRODUCTION**

The most common sausages use only pork meat and are ripened for long periods. However, some countries with great tradition of sheep and goat meat consumption have the habit of eating some processed products of these meats. In Mediterranean countries as well as in other parts of the world, the meat from young lamb or kid is very usual and appreciated. These young milk fed animals producing lightweight carcasses are highly appreciated by consumers and are traditionally commercialized as quality brands with protected origin designation (PDO) or protected geographical indication (PGI). The animals that come out of these brands, particularly the heavier and culled ones, have very low consumer acceptability and consequently a low commercial value. Meat from these animals is more suitable to be processed as drought, cured or smoked products (Webb et al. 2005). Value may be added to final products by decreasing costs or improving relative value of the final product (McMillin and Brock 2005). With this goal there are several recently studies in goat and sheep meat processed products: Polpara et al. (2008) studied the quality characteristics of raw and canned goat

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\*For Correspondence: Campus Sta Apolónia Apt 1172, Bragança 5301-855, Portugal.  
Tel: +351 273 303206; Fax: +351 273 325405. Email: teixeira@ipb.pt

meat in water, brine, oil and Thai curry during storage; Das et al. (2009) studied the effect of different fats on the quality of goat meat patties; Teixeira et al. (2011) studied the effect of salting, air-drying and ageing processes in a new goat meat product “manta”; Teixeira and Rodrigues (2014) refer the high contents of protein of new sheep and goat meat products (sausages and mantas) concluding that both products are balanced products in protein and fat contents particularly unsaturated fat; and Oliveira et al. (2014) evaluated the quality of ewe and goat meat cured product.

In several countries, culled animals are slaughtered and their meat is processed, for example, the Spanish *cecina de castron* (Hierro et al. 2004), the Italian *violin di capra* (Fратиanni et al. 2008) or the Brazilian *charque* and *manta* (Madruga and Bresan 2011). Devatkal and Naveena (2010) have recently studied the effect of salt and other products as kinnow and pomegrade on color and oxidative stability of goat meat during refrigerated storage.

So, the use of processes as salting, smoking and ripening to preserve meat products as well as to get special flavors was a practice before the global usage of refrigeration. Particularly, sheep or goat sausages as they are made from chopped lean meat and fat mixed with salt, spices and other ingredients, filled into a casing, normally cleaned intestines of cattle, sheep, goat, pigs or increasingly into artificial casings mainly for products with great uniformity. Although it is not a practice that has been commonly studied, Cosenza et al. (2003) evaluated the quality and consumer acceptability of *cabrito* smoked sausage, using goat meat as the sole meat ingredient. Also in Brazil, particularly in northeast the manufacturing of fermented sausages containing goat meat is an alternative use of meat from old animals (Nassu et al. 2003). Leite et al. (2015) reported the effect of different pork fat levels on the physicochemical properties, fatty acid profile and sensory characteristics in sheep and goat meat sausages. About cured products, Tolentino et al. (2016) reported the microbiological safety and sensory characteristics of sheep and goat’s cured legs.

Despite the benefits and the control in processing these meat fermented products, some problems related to food safety and public health can occur. The minced meat used to make sausages tends to carry a relatively high level of microbial contamination and some ingredients as sulphite or metabisulphite could be added to control this. The active agent is the sulphur dioxide that is effective against *Pseudomonas* spp. The high content of salt used for drying and reducing the  $a_w$  of these products could result in an excessive sodium intake with negative effect in heart health particularly due to the connection between salt intake and hypertension, and consequently to an increased risk of stroke and premature death from cardiovascular disease.

These products are also considered unhealthy because of their fat content and the use of additives and spices in their formulation. Nowadays the addition of probiotics, particularly to the fermented sausages could promote the health benefits associated with lactic acid bacteria and contribute to the increase in the consumption of such products (Lücke 2000, De Vuyst et al. 2008).

The rediscovering of the traditional sheep and goat meat products associated to a developing of a new generation of fermented meat products as functional foods is an interesting food research field and could be a good strategy to meat industry.

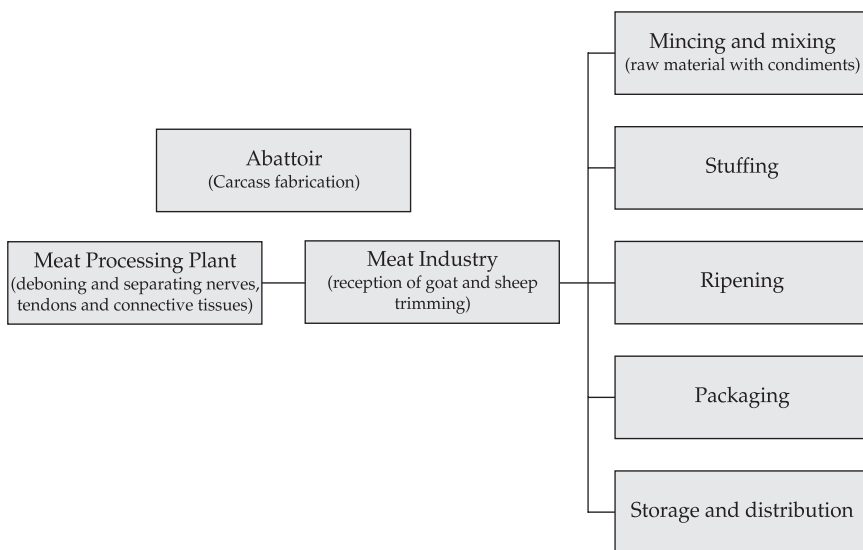
## **2 TYPES OF FERMENTED SHEEP AND GOAT MEATS (RAW MATERIALS AND ADDITIVES)**

The process of fermentation is one of the oldest techniques to preserve meat and meat products. The general principles of the fermentation of dry sausages have been reviewed many times and particularly by Toldrá (2004), Demeyer and Toldrá (2004). Fermented meats are a conserved product resulting from the presence of microbes in meat with salt added. Mixing and grinding meat or different kinds of meat with fats and salt together with spices, herbs and other ingredients produce a product which stability will depend of acidulation from acid lactic production and lowering of  $a_w$  as an effect of salt and cured salts addition.

Basically the principle of fermentation is based in the breakdown of carbohydrates presented in the meat mixtures, mainly the lactic acid. The process depends on the action of fermentation bacteria, the contaminating flora naturally present in the raw meat. The low temperatures (less than 20°C) stimulate the growth of desired flora and the fermentation bacteria produce acids resulting in a decline of pH values, and the spoilage conditions become gradually unfavorable. During fermentation and ripening the reduction of  $a_w$  also avoid the spoilage. The spontaneous fermentation made the sausages stable at ambient temperatures and improves the sensory quality of the product. During fermentation and ripening lipolysis and proteolysis occurred developing the characteristic flavor of fermented cured sausages.

The industrial production of sheep and goat sausages corresponds to a four different products: fresh, semi-dry, dry and emulsion sausages. Fresh sausages containing goat or sheep meat are not fermented, smoked or cooked. The production period of semi-dry or dry sausages is basically separated in two periods: fermentation followed by drying, depending on the technology i.e. the length of ripening. The emulsion sausages are based on the creation of a meat emulsion of sheep or goat with different pork backfat levels (Leite et al. 2015). The different kinds of

meat, sheep, goat or pork with different degrees of mixing with other ingredients or additives and submitted to various temperature and humidity conditions are called fermented sausages and their shelf-life or safety as well as their specific flavour, texture or colour are determined by the acidulation (especially lactic acid produced during the ripening process by various beneficial bacteria such lactobacillus), water activity ( $a_w$ ), salt, curing and drying. There are great variations in size and type of casing, size of meat particles, fat level, salt, water, type and strength of spicing as well as length of fermentation, curing or smoking phases. Fresh sausages are perishable unless refrigerated and must be cooked before consumption, often by frying or grilling. The fermented products with a low  $a_w$  and low pH (< 5.3) associated by vacuum stuffing have a good shelf-life and safety and are not normally cooked before eating and are consumed as cured products.



**Figure 1** General flow diagram of sausages processing.

The general flow diagram of process technology description with all good manufacturing and hygiene practices is shown in [Figure 1](#). Carcasses were previously deboned and cleaned from nerves, tendons and connective tissues before raw meat was processed at the manufacturing meat industry. Meats used for manufacturing sausages include sheep and goat trimmings. Meats are mincing and mixing with different levels of pork backfat fat (10–30%) salt (2.4%), peppers (0.3%), sugar (0.1%), water and rendimix®. Salt include sodium nitrite ( $\text{NaNO}_2$ ) as curing salt (0.4–0.6%) is also added and considered essential because its antibacterial (particularly the growth of *Clostridium botulinum*), antioxidant, color

preservation and cured flavouring properties. Other additives could be used such as glucose (0.5–1%), acid ascorbic (0.5–1%) to improve the stability of the red pigment, spices as paprika and garlic.

Raw materials and all additives are mixed and chopping in a mincer or cutter with different knives depending of the particle size of the batter wanted. The batter is then stuffed into pork or synthetic casing, hung and stabilized. The ripening is developed in two stages: firstly in a natural or mostly frequent in air-conditioned climate fermentation chambers at high relative humidity (HR 80–90%); and secondly transferred for another chamber for drying to development the sensory characteristics of a cured fermented product with temperatures between 5–24°C and 75 to 55% HR. In Mediterranean traditionally this ripening is processed in fresh air according the local climatic conditions. Sometimes, depending on consumers' preferences, a brief smoking period could precede the fermentation period.

### **3 DEVELOPMENT OF SENSORY QUALITY**

Small ruminants' meat is traditionally worldwide consumed. Generally, and particularly in Mediterranean countries, the consumer demand is for young or light animals (Risvik 1994, Rodrigues and Teixeira 2010), characterized as tenderer than older or heavier animals (Rodrigues and Teixeira 2009). Meat from older and heavier animals has very low acceptability and market value, due to its hardness, poor structure and, normally, unpleasant taste and aroma. Occasionally, it is consumed in traditional dishes cooked for long time and very seasoned. To use this type of meat some processing must be done to transform it, which can be accomplished by salts or smoke and drying or also by the production of a fresh sausage after grinding, mixing with salts, spices, and other ingredients and casing. In the last years, there have been several studies concerning the incorporation of meat from culled sheep and goats in processed products, as fermented sausages (Nassu et al. 2002a, Cosenza et al. 2003, Pellegrini et al. 2008), demonstrating the possibility of taking advantage of meat usually rejected and transform it into well accepted products by consumers.

All over the world, it is well recognised that fermented sausages have as basic ingredient beef and pork meat. Although less frequent, the production of fermented sausages from other animals' meat follows the same procedure.

Stajić et al. (2011) studied the possibility for the use of goat meat in the production of traditional sucuk (Turkish style dry-fermented sausage) and observed that no significant differences were detected in cut appearance, colour and odour. However, in terms of appearance, texture

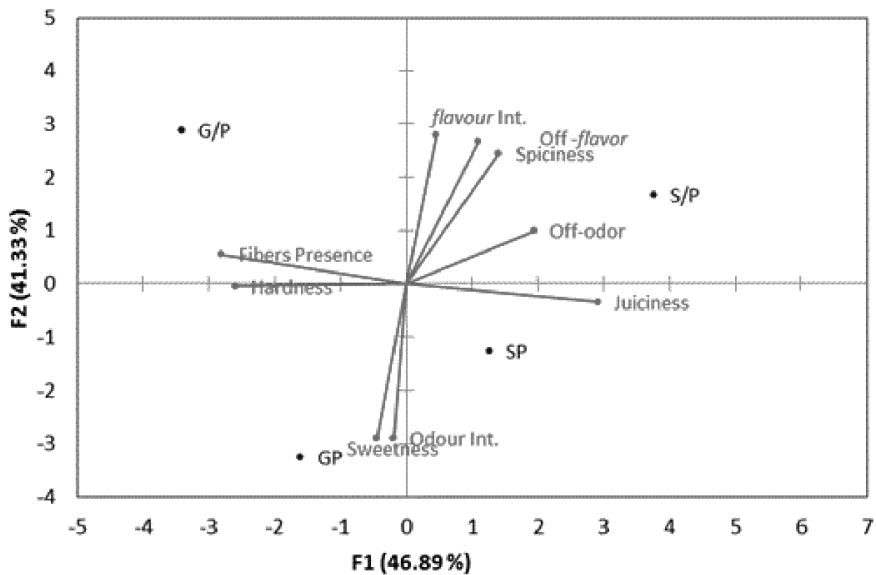
and taste, evaluated in a 9 points scale from 1 (extremely unacceptable) to 9 (extremely acceptable) assessors gave smaller grades to goat than beef sucuk, but they also refer that those grades were higher than 5. The authors suggest the replacement of goat fat by beef fat, to appease the specific goat flavour, to make the product more acceptable to consumers that may not be used to such flavour.

Lu et al. (2014) made a study to compare the sensory characteristics of fermented, cured sausages made from equivalent muscle groups of beef, pork, and sheep meat, referring that the last had no commercial examples and represented an unexploited opportunity. They used seven replicates of shoulder meat and subcutaneous fat, sausages were made with 64, 29, 4, 2, 0.2, and 0.01 percent of lean meat, fat, NaCl, glucose, sodium pyrophosphate, and lactic culture, respectively. They observed that following anaerobic fermentation (96 h, 30°C), there were no significant species differences in mean texture (hardness, springiness, adhesiveness, cohesiveness), and only minor differences were seen in colour. However, the same authors refer that although not consumer tested, it is argued that consumers would be able to pick a texture difference due to different fat melting point ranges, highest for sheep meat.

Lu et al. (2014) also performed a sensory evaluation to understand if the peculiar sheep meat flavour could be covered or even eliminated to please consumers unused with this type of product. They simulated a very strong characteristic producing a mixed sheep meat and beef sausage, spicing it, or not, with 4-methyloctanoic, 4-methylnonanoic acid, and skatole (5.0, 0.35, and 0.08 mg/kg, respectively). They also, variably added sodium nitrite (at 0.1 g/kg and a garlic/rosemary flavour. Results of Lu et al. (2014), using 60 consumers, were that spiked sheep meat flavour caused an overall significant ( $P = 0.003$ ) decrease from 5.83 to 5.35 in mean liking on a 1–9 scale, but when garlic/rosemary were added an increase ( $P < 0.001$ ) from 5.18 to 6.00 was observed. Nitrite had no effect on liking (5.61 vs. 5.58,  $P = 0.82$ ). Conclusions suggest that “sheep meat flavour could be suppressed to appeal to unhabituated consumers. Commercial examples could thus be made for these consumers, but the mandatory use of the name “mutton” in some markets would adversely affect prospects”.

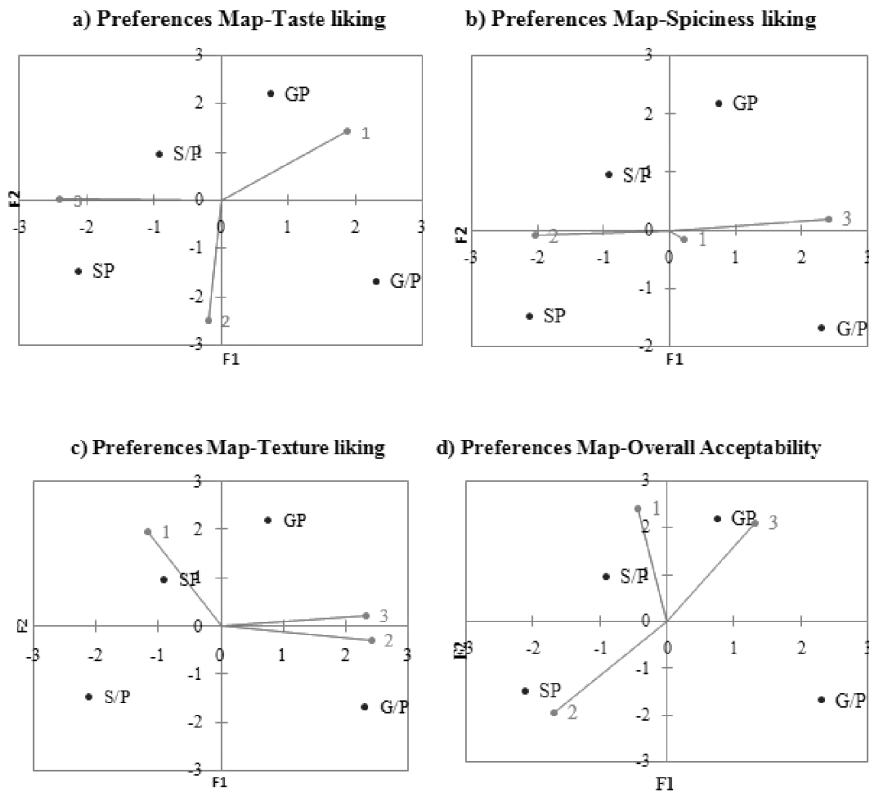
Consumers and processors are concerned about the safety of synthetic food additives, as some products used to mask or improve sensory characteristics can have health implications like synthetic antioxidants. So, a renewed interest in natural antioxidants and its research has increased. The use of natural antioxidants, like rosemary, is well accepted by consumers since it is considered safe, but they have some disadvantages like its cost and its influence in sensory characteristics as colour, after-taste or off flavours (Brookman 1991, Pokorný 1991). However, the use of additives in fermented sausages can improve sensory characteristics,

as registered by Nassu et al. (2003). In a study on using goat meat in processing of fermented sausage, salami type, they observed that the incorporation of rosemary minimized oxidized goat aroma and flavour. Also, Paulos et al. (2015) observed that the use of paprika had influence on the presence and intensity of flavour, spiciness, and off-odour (Figure 2) in sausages made from heavy sheep and goat meat when studying their sensory characteristics. Sausages without paprika presented higher spicy intensity, flavour intensity, and off-flavour than sausages with paprika, which had higher odour intensity and sweetness. Paprika masks the less pleasant sensory characteristics of this type of meat. Related to species, these authors found that goat sausages were harder and more fibrous, while sheep sausages were juicier.



**Figure 2** Consensus configuration: joint representation of the correlation between the sensory parameters and their first two dimensions, and groups of sausages sensory analysis. F1 = first principal component of generalized Procrustes analysis (GPA); F2 = second principal component of GPA; SP= sheep with paprika, S/P= sheep without paprika, GP= goat with paprika and G/P= goat without paprika (Paulos et al. 2015).

Besides the effect of additives in sensory characteristics, results of Paulos et al. (2015) show that consumers generally accepted fresh (fermented) sausages made of sheep and goat meat, with an average of 6 in a scale of 10, and no marked preferences were observed for sheep, goat or seasoning, used to mask some unpleasant characteristics as taste, odour or flavour. Figure 3 shows the preference maps obtained by these authors.



**Figure 3** Preferences map for a) taste, b) spiciness, c) texture and overall acceptability; SP = sheep with paprika, S/P = sheep without paprika, GP = goat with paprika and G/P = goat without paprika (Paulos et al. 2015).

**Table 1** Mean predicted values for the consumers’ evaluation

	Goat meat sausages				Sheep meat sausages				Significance		
	G0%	G10%	G30%	SEM	S0%	S10%	S30%	SEM	Species	Fat level	Sp x FL
Taste	5.09 <sup>e</sup>	5.75 <sup>b</sup>	7.23 <sup>a</sup>	0.05	5.88 <sup>d</sup>	6.37 <sup>b</sup>	6.10 <sup>c</sup>	0.05	NS	**	***
Spicy taste	4.83 <sup>a</sup>	4.61 <sup>a</sup>	4.78 <sup>a</sup>	0.55	5.36 <sup>a</sup>	4.13 <sup>a</sup>	4.02 <sup>a</sup>	0.56	NS	NS	NS
Texture	5.18 <sup>d</sup>	6.17 <sup>c</sup>	7.56 <sup>a</sup>	0.06	5.40 <sup>d</sup>	6.83 <sup>b</sup>	6.27 <sup>bd</sup>	0.04	NS	***	***
Overall acceptability	5.12 <sup>e</sup>	5.92 <sup>c</sup>	7.42 <sup>a</sup>	0.06	5.59 <sup>d</sup>	6.67 <sup>b</sup>	5.95 <sup>b</sup>	0.05	***	***	***

SEM – Standard error of the mean. NS - not significant ( $P > 0.05$ ), \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\*  $P < 0.001$ ; G0% goat sausages without pork fat; G10% goat sausages with 10% of pork fat; G30% goat sausages with 30% of pork fat; S0% sheep sausages without pork fat; S10% sheep sausages with 10% of pork fat; S30% sheep sausages with 30% of pork fat.

As already referred, one aspect to consider when processing fermented sausages is the fat addition. With the purpose to verify the effect of the addition of different fat contents (5, 10 and 20 percent) in the sensory acceptance of a goat meat fermented sausage, Nassu et al. (2002a) observed no significant differences for any of all measured sensory attributes (appearance, aroma, taste, texture and global acceptability) using a 1–9 hedonic scale. However, Leite et al. (2015) found a significant effect of the fat content on taste, texture and overall acceptability of sheep and goat sausages, as can be observed in [Table 1](#).

When writing about fermented products, particularly fermented sausages, we must take into account the use of starter cultures. Already in 1970, Everson et al. referred that the right physiologically active starter culture would improve the uniformity of fermented products in terms of flavour, appearance and texture. Sensory evaluation of fermented mutton sausage, using *Pediococcus acidilactici* H and *Lactobacillus plantarum* 27 as starter cultures, had shown acceptable scores after 60 days of storage at 4°C (Wu et al. 1991). To produce dry-fermented sausages, Erkkilä et al. (2001) used starter cultures of *Lb. rhamnosus* strains, as well as *Pd. pentosaceus* and *Lb. plantarum*, reporting their suitability for use as probiotic starter cultures in fermenting dry sausage with respect to flavour profile compared to the commercial starter culture. The use of different starter cultures in processing of goat meat fermented sausages by Nassu et al. (2002b) produced average values between 5.5 and 5.9 for global sensory acceptability, using a 9 points hedonic scale. Global acceptability, aroma, taste and texture mean values presented no significant differences for all treatments, but appearance had the smallest value when the treatment with SPX (*Staphylococcus xylosum* and *Pd. pentosaceus*) culture was used. The authors refer the use of isolated observations from the judges as “rancid”, “soap”, which can be attributed to the products fat oxidation or even to the lipolytic action of microorganisms present in the used cultures. Using lactic starter cultures of *Lb. casei*, *Lb. plantarum* and *Pd. pentosaceus* Mukherjee et al. (2006) studied the effect of fermentation and drying temperature on the characteristics of goat meat (Black Bengal variety) dry sausages. Results were that the samples fermented at 30°C, followed by drying at 10°C, were the most acceptable samples respecting sensory characteristics as taste, flavour, texture and overall acceptability in a 5 points hedonic scale. The coagulase-negative *Staphylococcus* (CoNS), such as *St. xylosum*, *St. saprophyticus* and *St. carnosus*, are described as the main species that contribute in the formation of colour and flavor in the meat products. In sheep and goat “manta”, a new product developed by Teixeira et al. (2011), appreciated by the consumers, *St. xylosum* has been found as dominating CoNS (data not shown).

## 4 MICROBIOLOGICAL SAFETY, HEALTH BENEFITS AND HAZARDS

### 4.1 Microbiological Safety

For assess microbiological safety, several procedures and analysis are performed in order to achieve the safety and quality of food involved to safeguard public health and provide assurance on food safety (Centre for Food Safety 2007), but microbiological analysis alone cannot guarantee the safety of food and microbiological criteria should be used to support good hygienic practice (GHP), good manufacturing practices (GMP), good agricultural practices (GAP) and implementation of food safety risk management systems such as hazard analysis and critical control point (HACCP) systems (Health Protection Agency 2009, van Schothorst et al. 2009). The food industry has a duty to ensure that microorganisms are eliminated or minimized to the extent that they cannot cause harm to human health (Anonymous 2004). Therefore microbiological safety plays an important role to be taken both by government and food industry for identifying, assessing and managing risks associated with the consumption of food and drink (Stringer 2005). Even though public authority is of paramount importance in the insurance of consumer's protection, the food industry itself plays a key role in that process, being responsible for handling the product during all the stages of the manufacturing process until its deliver to consumer. For taking on these microbiological roles, the authorities could follow the recommended stepwise by International Commission on Microbiological Specifications for Foods (ICMSF 1997), for the management of microbiological hazards in foods in international trade, applying existing Codex documents in a logical sequence (van Schothorst 1998).

Fermentation and drying has been reported as the oldest methods for food preservation known to mankind consequently the consumption of these products by humans dates from immemorial times (Nassu et al. 2003). Even today fermented foods are still among the most popular type of food consumed due to the fact that these products provides a means for producing safe and well preserved foods.

Recent studies focused on fermented foods, including fermented meat products, proved that these products are an excellent source of microorganisms with probiotic characteristics (Nova et al., Chapter 13 in this book). Schillinger and Lücke (1990) reported that lactic acid bacteria (LAB) enhance the safety of the product through the production of antimicrobial compounds such as lactic acid, acetic acid, hydrogen peroxide, carbon dioxide and bacteriocins. In general way fermented meat products are considered safe due to the reduction in  $a_{wv}$  pH and the

presence of LAB that produce organic acids, mainly lactic acid and acetic acid that are effective antimicrobial agents *i.e.*, could reduce and prevent the growth of several pathogenic food microorganisms and competing for the nutrients (Schillinger and Lücke 1990, Lee 1994, Ferreira et al. 2007). The technology of lactic fermentation could be defined as the fermentation process involving a group of Gram-positive, non-sporing, non-motile, catalase-negative, non-aerobic organisms, which ferment carbohydrates to produce lactic acid as the sole or major organic acid (Oyewole 1997). Studies done by Paleari et al. (2002) observed the inhibitory effect of  $a_w$ , pH and the produced LAB on the pathogenic bacteria's during the fermentation process. At the beginning noted the normal flora in the raw materials as the presence of *St. aureus* and coliforms in all the samples and none had salmonella or *L. monocytogenes*. Nevertheless at the final of the fermented process noted an increase of LAB that exerts an antagonistic action on contaminating flora.

## 4.2 Microbiological Hazards

Wherein the presence of pathogenic microorganisms in food products represents a health hazard to the consumers, therefore, the need of reinforce and urgent implementation of the measures in meat processing industries and also in market points regarding the stability and safety of these meat products along shelf life period are required (Matos et al. 2013). Even that the fermentation inhibits the growth of some pathogenic bacteria's should not be expected to reduce the level of mold (mycotoxins) or bacterial (enterotoxins, botulinum toxin) so that the role of fermentation in reducing mycotoxins in food shows contradictory results.

The next microbiological hazard in fermented meat products are bacteria resistant to antibiotics and their transfer to consumers (Zdolec et al., Chapter 14 in this book). However, due to lower antibiotic pressure in small ruminant husbandry, it could be expected that antimicrobial resistance is of lower importance in production of goat/sheep fermented meat products. In general, the food chain has been associated as one of the main routes for transmission of antibiotic resistant bacteria between animal and human populations (Witte 1997), and in particular, fermented meats that establish direct link between the indigenous animal microflora and the human gastrointestinal tract microflora had been described as a potentially vehicle for horizontal transfer. Several studies *in vitro* and also *in vivo* reported the influence of the natural fermentative and ripening microflora in the dissemination of antibiotic resistance. For example the transfer of tetracycline resistance genes from *Lb. plantarum* to *Lactococcus lactis* and *Enterococcus faecalis* (Toomey et al. 2010), of erythromycin resistance genes from *Lb. fermentum* and *Lb. salivarius*, and of tetracycline resistance genes from *Lb. plantarum* and *Lb. brevis* to *E. faecalis* (Nawaz

et al. 2011) from *Lb. curvatus* and *E. faecalis* to *Lb. curvatus* (Vogel et al. 1992) of tetracycline and erythromycin resistance genes among *E. faecalis* isolates (Cocconcelli et al. 2003), and of tetracycline from *E. faecalis* to *L. monocytogenes* and *L. innocua* (Bertrand et al. 2005). This transfer was also reported in the digestive system of mice by Doucet-Populaire et al. (1991), Gazzola et al. (2012) found that the human isolate *E. faecalis* OG1RF with tetracycline and erythromycin resistances genes on plasmids were able to colonize the meat ecosystem with similar growth kinetics to that of food origin enterococci and to transfer the resistance genes to endogenous microflora (enterococci, pediococci, lactobacilli and staphylococci) present during raw fermented dry sausage ripening. At same time Jahan et al. (2015) confirmed the transfer from food isolates to human-associated *Enterococcus* strains.

In developed countries antibiotics are used especially in the industrialized production of food animals namely in the production of chickens and pigs and calves. On the other hand in Mediterranean area the goats and sheep production is essentially done traditionally without using antibiotics. Therefore the consumption of goat and sheep meat products can be helpful since it can reduce the problems related to the occurrence of antibiotic resistance in the food-chain. Fermented meat products may harbor also chemical hazard which are connected with microbiological activities, and the most relevant are biogenic amines (see Chapter 19 in this book).

In the literature there are not available data, about the presence of biogenic amines in sheep and/or goat fermented products, maybe because these products are not usual. However, due to the high biological value, demand for the sheep and goat meat has increased. Thus, in the last years it increased the effort to develop new products from this raw material. As a result were developed some fermented sausage made from sheep meat (Lu et al. 2015, Leite et al. 2015) and from goat meat (Nassu et al. 2003, Cosenza et al. 2003, Stajić et al. 2011, Leite et al. 2015). On the other hand, Bovolenta et al. (2008) analyzed the physicochemical, microbiological and sensory properties of Pitina, a traditional fermented sheep meat product from Italy.

However, these works are focused principally in the physio-chemical and sensorial characteristics, nevertheless the production principles remain the same; the presence of salt and sugars, and pH falls as lactic acid accumulates, suggesting intensive microbial activity and therefore these products must have the potential for BAs formation.

## 5 CONCLUSION

Even if sheep and goat are the most widely consumed red meat in the world the sheep and goat fermented products are not so popular.

However sheep and goat fermented product have peculiar sensory quality with high nutritional and nutraceutical characteristics with great demand and very well appreciated in several countries, particularly in Mediterranean area, Middle East, North Africa and Central Asia, as well in specific delicatessen markets, and among Ethnic Groups in Europe and North America. Today also in these products the main consumer concerns are food safety, aspects of health and environmental impact.

Certainly all good practices in manufacturing process and food analysis, to enhance the quality and to improve consumer-safety would be the most important trends in the near future. Research efforts should be addressed to improve the knowledge about the complex food fermentation ecosystems. Such knowledge will allow the determination of critical microbial variables, such as pathogen detection, microbial profiling, determination of survival of starter cultures and pathogens over food manufacturing and ripening, and predicting product shelf life and consequently improving the food quality and safety. Furthermore, it will help understand the relations between microflora and sensory characteristics. Another approach in food safety will be the selection of starter cultures with the ability to produce specific antimicrobial compounds, such as bacteriocin, against pathogenic bacteria or undesirable microorganisms and at same time genetically unable to produce biogenic amines.

Additionally new functional fermented goat and sheep products will be developed. Today a major expansion in functional meat products is related to probiotics cultures mainly LAB or bifidobacteria. However, there is scarce scientific evidence in literature about the positive effect of probiotic meat products on human health. Therefore, more research is required for identifying the strain or strains that produce the greatest health effect as well explore processes that improve the viability of probiotics on final product as well in the body. New functional products will be developed with other advantages than probiotics, such as fermented meat products enriched with different prebiotics.

*Key words:* goat, sheep, meat, fermented products

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