Speck: a traditional culinary specialty from the Italian Alps. A microbiological, molecular and chemical evaluation

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Abstract

South Tyrol is the northernmost Italian province; its history, geography, and closeness to other European countries, such as Austria and Switzerland, have influenced both culture and food production. Among the South Tyrolean culinary specialties, a type of dry-cured ham called *Südtiroler Speck/Speck Alto Adige* (*Speck*) plays a relevant role and has gained increasing significance both on a national and international level over the last 2 decades. Despite it being a common culinary product in Italian and international markets, there is not much published data regarding the microbiological and chemical features of *Speck*. This study describes the analytical results obtained during a period of 7 years, during which the main pathogens and contaminants were considered.

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Introduction

Speck is a ready-to-eat (RTE) dry-cured ham produced from deboned light pork thighs, salted with herbs and spice mixtures, then further seasoned and smoked. This product has achieved the Protected Geographical Indication (PGI) certification by the European Union in 1996. Productions' guidelines drafted by the official *Speck* Association (MIPAAF, 2017) describe the entire technological process for its production. Along with temperatures and humidity percentages, microbiological and chemical parameters concerning both food safety and hygiene production specific to meat products, as indicated in Regulations No. 2073/2005, No. 1333/2008, and No. 915/2023, are to be considered (European Commission, 2005; European Parliament and European Council, 2008; European Commission, 2023).

The *Istituto Zooprofilattico Sperimentale delle Venezie* (IZSVe) is an Italian public health authority whose aim is the prevention, control, and research in the fields of animal health and food safety. Every year, samples are conferred to accredited self-monitoring laboratories for food business operators (FBO), which perform accredited analyses in accordance with ISO/IEC 17025:2017 standards. Thanks to a mutual agreement between IZSVe and Competent Authority (CA), in accordance with the risk-based principles and the flexibility of certain provisions concerning traditional foodstuffs, a shared analytical plan for *Speck* has been developed to focus resources and interests on the same goal: food safety.

As an RTE product with a long shelf life, a serious hazard for *Speck* consumers is represented by *Listeria monocytogenes* (*Lm*) (MaĆkiw *et al*., 2020), since it is responsible for human listeriosis, one of the most serious foodborne diseases under EU surveillance (EFSA and ECDC, 2022). Both the raw meat, the production environment, and the intrinsic characteristics of animal-origin food correlate with its presence and growth (Montiel *et al*., 2020). Another relevant pathogen to monitor is represented by *Salmonella* spp., the cause of salmonellosis, the second most reported gastrointestinal infection in humans (EFSA and ECDC, 2022).

Furthermore, the evaluation of environmental contaminants is relevant. ß-glucuronidase *Escherichia coli* (β-g*Ec*) is usually found in feces and soil and is considered an indicator of direct or indirect contamination in food, water, and environmental samples (Frampton and Restaino, 1992; Aijuka and Buys, 2019). Along with β-g*Ec*, coagulase-positive *Staphylococci* (CPS) are also considered contaminants, posing a relevant threat in matrixes presenting physico-chemical characteristics supporting their potential growth and toxinogenesis (Hennekinne *et al.,* 2012; Gonzàles-Martìn *et al.,* 2020). Data from the last two EFSA reports (EFSA and ECDC, 2022) highlight frequent detection of CPS in animal-origin food, especially in Italy.

Aspects concerning the use of authorized additives are also relevant: nitrites (E249-250) and nitrates (E251-252) are allowed, according to Regulation No. 1333/2008 (European Parliament and

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European Council, 2008). As a traditional product, the use of nitrates is also permitted in higher quantities (250 mg/kg). On the other hand, PGI productions' guidelines set the threshold at 150 mg/kg. Because of the well-defined smoking process, the development of benzo(a)pyrene (BaP) and polycyclic aromatic hydrocarbons (PAH) should not occur. These substances, well-known for their carcinogenic effects in humans (Chen *et al.,* 2018), are ubiquitous organic compounds whose presence in food may be linked to environmental contamination and the manufacturing process. Their detection in *Speck* is relevant due to the smoking phase the product undergoes.

Materials and Methods

Speck samples were delivered by the FBO at refrigerated temperature (≈ +4°C), in sterile bags. The average number of sampling units (s.u.) was 5, and the mean weight of every s.u. was *circa* 100 g; s.u. had to be representative of the entire piece, including the rind, crust with herbs and spice mixtures, meat, and fat. Stick samples were not considered during the study. Samples were usually conferred right before commercialization at the end of the production process, but few FBOs preferred to deliver samples during the storage phase when they were not completely ripened yet. *Lm* was assessed on 5 s.u. per *Speck* sample, and qualitative or quantitative analyses were performed depending on water activity (aw) and/or pH values (Table 1). The detection of *Salmonella* spp. was performed on one single s.u. per sample through a qualitative method. The detection of both β-g*Ec* and CPS was performed on one single s.u. per *Speck* sample, based on colony count. Quantification of nitrites and nitrates was performed by a colorimetric reaction read using a spectrophotometric reader at 540 nm wavelength (in-house protocol). The analytical method in use for the evaluation of BaP and PAH was high-pressure liquid chromatography (in-house protocol). All diagnostic methods used are listed in Tables 2 and 3.

Results

Between 2015 and 2021, the number of FBOs who conferred their products to the IZSVe self-monitoring laboratory was 170, with a total number of 3757 *Speck* s.u. processed. Microbiological and molecular analyses have produced results in compliance with microbiological criteria, according to Regulation No. 2073/2005 (European Commission, 2005) (Table 4). Results presented per single year (*Supplementary Table 1*) show that 2019 and 2021 have been the most critical years. The evaluation of chemical parameters led to compliant results during the entire time span, showing a very low percentage (1.2%) of s.u. exceeding the limits indicated in the pertaining regulations (Table 4).

Discussion

The percentage of non-compliant results for all evaluated pathogens and chemicals (Tables 4 and 5) are globally very low (≤6.0%), showing elevated standards of food safety and hygiene criteria during all phases of *Speck* production in South Tyrol. As the so-called "risk zero" is often impossible to achieve, it is noteworthy to mention that from 2015 to 2021 the presence of *Lm* and *Salmonella* spp. has been detected in very few s.u. (*Lm* 54 s.u., *Salmonella* spp. 1 s.u.). Furthermore, of the 54 *Lm* positive s.u., 50 were polymerase chain reaction-positive for *Lm* in samples with intrinsic characteristics (aw/pH) in products still during their storage phase and, therefore, still under FBO supervision and control. They were processed by the qualitative method because aw and pH values were under defined thresholds or a combination of them, under which the presence/absence of *Lm* is required as indicated in Regulation No. 2073/2005 (European Commission, 2005). Only 4 *Lm* positive s.u. were detected in *Speck*'s s.u. before their commercialization, thus not suitable for retail. The increase in *Lm* positive

Table 1. Mean values of intrinsic characteristics (water activity and pH).

Parameter	Mean values
aW	0.90*
pH	6.1**

aw, water activity; *range: <0.78-0.97; **range: 4.6-7.4.

Table 2. Methods for the detection of pathogens and chemicals of interest and their protocols' guidelines.

Parameter	Method	Protocols' guidelines
Lm qualitative	PCR	AFNOR BRD 07/10 04/05
Lm quantitative	Colony count	ISO 11290-2:2017
Salmonella spp.	PCR & Strain viability	AFNOR BRD 07/06-07/04 & ISO 6579-1:2017/Amd1:2020
β-gEc	Colony count	ISO 16649-2:2001
CPS	Colony	
Nitrites and nitrates	Colorimetric reaction	In-house protocol
PAH	High-pressure liquid chromatography	In-house protocol

Lm, Listeria monocytogenes; β-g*Ec*, β-glucuronidase *Escherichia coli*; CPS, coagulase-positive *Staphylococci*; PAH, polycyclic aromatic hydrocarbons; PCR, polymerase chain reaction.

Table 3. Methods for evaluation of intrinsic characteristics and their protocols' guidelines.

Parameter	Method	Protocols' guidelines
aw	Instrumental examination	ISO 18787:2017
pH	Potentiometry	MFHPB-03:2014

aw, water activity.

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Table 4. Methods for the detection of pathogens and chemicals of interest and their protocols' guidelines.

Microorganism	N. of sampling units (s.u.)	N. of positive s.u.	N. of negative s.u.	Percentage of positive s.u. (%)
Lm (quantitative)	2.921	4	2.917	0.1
Lm (qualitative°)	836	50*	786	6.0
Salmonella spp.	755	1	754	0.1
ß-glucuronidase *Escherichia coli*	348	0	348	0
Coagulase-positive *staphylococci*	334	2**	332	0.6

Lm, Listeria monocytogenes; s.u., sampling units; °conducted on s.u. of intermediate products, according to aw/pH characteristics; *confirmed by microbiological method; **30 cfu/g and 64 cfu/g detected.

Table 5. Results of chemical analyses.

Microorganism	N. of sampling units (s.u.)	N. of positive s.u.	N. of negative s.u.	Percentage of positive s.u. (%)
Nitrites and nitrates	1.122	13*	1.109	1.2
PAH (BaP included)	680	8°	672	1.2

PAH, polycyclic aromatic hydrocarbons; BaP, benzo(a)pyrene; s.u., sampling units; *number of s.u. over the incremented limit of 250 mg/Kg; °number of s.u. exceeding the limit forseen for the sum of all PAH (BaP included).

s.u. in 2021 was linked with a single FBO, determined to sell its product abroad (from September to November 2021), asking directly for a qualitative method to achieve a result declaring the absence of the pathogen; it explains why the number of s.u. during that year was higher than in previous ones. The high percentage (25%) of CPS in 2016 is easily explicable because of the very low number of s.u. analyzed for the microorganism during the entire year (4 s.u.). A single positive outcome, still under hygienic limits (30 cfu/g), can easily raise the total percentage.

The respect for good hygiene practices is well supported by microbiological results: only 2 of 344 s.u. were positive for CSP and always under the set limits (100 cfu/g). The high percentage (25%) of CPS in 2016 can be considered a *unicum*, thus not representative. Furthermore, the results show that the mutual agreement between CA and IZSVe has reached its aim, helping FBOs in focusing their resources and interest on a common goal concerning food safety for food consumers.

The results described in this study were achieved thanks to compliance with the food law system, with special attention to the recently released Commission Regulation 2021/382 on "food safety culture" (chapter XIa) and the successful collaboration of the involved parties (European Commission, 2021).

Conclusions

Considering the very low percentage of positive s.u. to main pathogens, *Speck* can be considered a safe food, taking into account the care of raw materials and the hygiene of abiotic and biotic surfaces (*i.e.*, working tables, cutters, producer's hands), which are indirectly involved in the entire process.

In conclusion, this study evaluates the applicability of the current analytical procedures at IZSVe as a valuable tool for both FBO and CA to produce and control an RTE-meat product. The study suggests a correlation between longer ripening time, lower aw values, and low percentages in positive outcomes. The authors are convinced that this work can give good advice to both expert and beginner FBOs, both in terms of technological aspects and in terms of legislation.

References

Aijuka M, Buys EM, 2019. Persistence of foodborne diarrheagenic Escherichia coli in the agricultural and food production environment: Implications for food safety and public health. Food Microbiol 82:363-70.

Chen Y, Cai K, Tu Z, Nie W, Ji T, Hu B, Chena C, Jiang S, 2018. Prediction of benzo[a]pyrene content of smoked sausage using back-propagation artificial neural network. J Sci Food Agric 98:3022-30.

EFSA & ECDC, 2022. The European Union one health 2019 zoonoses report. EFSA J 20:e0766g.

European Commission, 2005. Regulation (EC) No 1333/2008 of the European Parliament and of the Council of 16 December 2008 on food additives. In: Official Journal, L 338, 22/12/2005.

European Commission, 2021. Commission Regulation (EU) 2021/382 of 3 March 2021 amending the Annexes to Regulation (EC) No 852/2004 of the European Parliament and of the Council on the hygiene of foodstuffs as regards food allergen management, redistribution of food and food safety culture. In: Official Journal, L 74, 4/03/2005.

European Commission, 2023. Commission Regulation (EU) 2023/915 of 25 April 2023 on maximum levels for certain contaminants in food and repealing Regulation (EC) No 1881/2006. In: Official Journal, L 119/103, 5/5/2023.

European Parliament, European Council, 2008. Commission Regulation (EC) No 2073/2005 of 15 November 2005 on microbiological criteria for foodstuffs. In: Official Journal, L 354, 31/12/2008.

Frampton EW, Restaino L, 1992. Methods for Escherichia coli identification in food, water and clinical samples based on beta-glucuronidase detection. J Applied Bacteriol 74:223-33.

Gonzàles-Martìn M, Corbera JA, Suàrez-Bonnet A, Tejedor-Junco MT, 2020. Virulence factors in coagulase-positive staphylococci of veterinary interest other than Staphylococcus aureus. Vet Q 40:118-31.

Hennekinne JA, De Buyser ML, Dragacci S, 2012. Staphylococcus aureus and its Food poisoning toxins: characterization and outbreak investigation. FEMS Microbiol Rev 36:815-36.

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ISO, 2017. General requirements for the competence of testing and calibration laboratories. ISO/IEC Norm 17025:2017. International Standardization Organization ed., Geneva, Switzerland.

MaĆkiw E, Stasiak M, Kowalska J, Kucharek K, Korsak D, Postupolskii J, 2020. Characteristics of Listeria monocytogenes in ready-to-eat meat products in Poland. J Food Prot 83:1002-9.

MIPAAF, 2017. Disciplinare di produzione della Indicazione Geografica Protetta «Speck Alto Adige», «Südtiroler Markenspeck», «Südtiroler Speck». Available from: https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/1963.

Montiel R, Peirotén Á, Ortiz S, Bravo D, Gaya P, Martínez-Suárez JV, Tapiador J, Nuñez M, Medina M, 2020. Inactivation of Listeria monocytogenes during dry-cured ham processing. Int J Food Microbiol 318:108469.

Online supplementary material:
Supplementary Table 1. Results of microbiological and molecular analyses per year.

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