

Polycyclic aromatic hydrocarbons residues in *Gentile di maiale*, a smoked meat product typical of some mountain areas in Latina province (Central Italy)

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Abstract

Gentile di maiale is a typical meat product prepared in some traditional plants of Latina Province (Central Italy). It is obtained from dehydration, salting, smoking and ripening of swine rectum. Aim of this study was to evaluate the influence of the traditional smoking process on polycyclic aromatic hydrocarbons (PAHs) content by means of high-performance liquid chromatographic/fluorescence detection. Polycyclic aromatic hydrocarbons detected in 8 samples of raw material (swine rectum) and samples of smoked *gentile* were: benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, benzo[a,h]anthracene. Their residues were detected in all samples of finished product. European Regulation 835/2011 established two levels of PAHs content in meat products. According to first levels, in force until September 2014, only 2 out of 8 samples exceeded legal limit. According to the subsequent, more restrictive, limits all samples would be non-compliant. An improvement and a standardisation of traditional smoking procedures are recommended.

Introduction

The Lazio region is known for certain products of animal origin, some of which are protected by trademarks of origin with a large-scale marketing and others characterised by handicraft production, limited, entering in a commercial circuit most private and exclusive. Consumer safety must be guaranteed for these foods, which are very particular to methods of sourcing raw materials and processing, and for which the same knowledge of the dangers rela-

ted is often very poor and consequently the risk analysis is very approximate. In this production sector control by the operator and the competent authority has different levels of surveillance, and also of effectiveness. *Gentile di maiale* is a product derived by rectum of pig, typical in some areas located in Lepine and Ausoni mountains. The craft preparation involves the following steps: it picks up the gut of the pig pulling slightly from the rectum to the spontaneous rupture to obtain a part with a variable length which is washed thoroughly. These sections of the intestine, consisting of a thin fibrous layer of the abdominal serosa to which remain attached small globules of fat, are subjected to a new and more accurate cleaning and grooming; everything is finally seasoned with salt, pepper and garlic, without addition of any additive; the intestine is then turned over and stored at a temperature of about 3°C for a day, and thereafter is placed on special wooden boards at a distance from the source of smoke of about two feet, using wood of mastic, myrtle, holm oak. The process can take several days and is carried out in chimneys or sheds. The finished product is stored at refrigeration temperature for 5-6 days. The processes of traditional smoked with smoking in direct contact with the food, can lead to contamination by polycyclic aromatic hydrocarbons (PAHs), a group of chemicals, some of which are recognised as probably carcinogenic (IARC, 1983; IRIS, 2002). The aim of the study was to evaluate the presence and the amount of PAHs in the raw material and the finished product as markers of technological and proper treatment in order to set an effective chemical risk assessment connected to this product.

Materials and Methods

We analysed a total of 8 samples of rectum of pigs regularly slaughtered and n. 8 samples of smoked *gentile di maiale*. Immediately after slaughter for the sampling of raw material and before the placing on the market for sampling of finished products, samples were collected and subjected to laboratory analysis for the presence of PAHs according to the method of Bosset *et al.* (1997) and Dafflon *et al.* (1995). The analytical determination was performed using a high-performance liquid chromatography Surveyor LC Plus (Thermo Fisher Scientific, Inc. Waltham, MA, USA) with fluorometric detection (Figure 1). PAHs were identified on the basis of retention time and quantification was performed by an external standard method [PAH mix 9, Dr. Ehrenstorfer GmbH, Augsburg, Germany; concentration of each PAH, 100 ng μL^{-1}]. Analytes recoveries were determined by using raw material with solutions containing 25 ng mL^{-1} of the PAHs standard.

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Results and Discussion

Results are shown in Table 1. It can highlight that in all the samples of the raw material PAHs levels are close to the limit of detection of the method. Residues of PAHs at different concentrations were instead found in all samples of smoked *gentile di maiale*, in particular the levels of BaP ranged from 3.3 to 6.8 $\mu\text{g}/\text{Kg}$. The Commission Regulation No 835/2011 (European Commission, 2011) amended Regulation (EC) n. 1881/2006 as regards maximum levels for PAH in food, and in particular, based on the conclusions of a previous opinion EFSA (2008) it was concluded that benzo(a)pyrene is not a suitable marker for the occurrence of PAHs in food and that a system of four specific four PAHs [benzo(a)pyrene, chrysene, benzo(b)fluoranthene, benzo(a,h)anthracene] would be the most suitable indicators of PAHs in food. Such system would ensure that PAH levels in food are kept at levels that do not cause health concern and that the amount of PAH can also be controlled in those samples in which benzo(a)pyrene is not detectable, but where other PAH are present. The above mentioned regulation quotes that maximum levels for PAHs must be safe and as low as reasonably achievable based upon good manufacturing and agricultural/fishery practices. Data collected by EFSA panel indicate that background levels of PAHs are lower than previously assumed in certain foodstuffs such as meat and smoked meat. Nevertheless, adaptations of current smoking technology may be necessary in some cases. Therefore, a two step procedure should be established for smoked meat and smoked fish which grants a transition of two years from the date of application of this

Regulation before lower maximum levels become applicable according to the scheme shown in Table 2. Results show that in 2 of 8 samples PAHs concentrations detected are higher than legal limits for both BaP and for the sum of 4 PAHs; starting from 01/09/2014 all the smoked *gentile di maiale* samples would not comply. Results presented should not be underestimated for the analysis of the risk associated with the consumption of these products, the risk that obviously cannot ignore the amount of food ingested on a regular basis and that it must, in this case, not very frequent. The variability of the concentrations show, although all the analysed samples were smoked in the same structure, that the level of contamination is due to a smoking technology not standardised based on the subjective assessment of the operator only. Therefore, it is necessary to provide a standardisation of the smoking process in which are fixed temperature/time suitable to ensure the acquisition of typical organoleptic characteristics of finished product and able to reduce the levels of PAHs within those, very restrictive, provided by the Regulation (EU) N. 835/2011 (European Commission, 2011).

The EU regulatory framework, in particular the EC Regulation 852/2004 (European Commission, 2004), reaffirms the possibility of granting exemptions from the general requirements of hygiene for the agro-food production that make use of traditional methods. EC Regulation 2074/05 (European Commission, 2005) laying down implementing measures for certain products under Regulation (EC) No 852/2004 shows that *Flexibility is needed so foods with traditional characteristics can continue to be produced. Member States have already granted derogations for a wide range of such foods under the legislation in force before 1 January 2006. Food business operators should be able to continue without interruption to apply existing practices after that date. Foods with traditional characteristics should therefore be defined and general conditions applicable to such foods should be laid down, by way of derogation from the structural requirements laid down in Regulation (EC) No 852/2004, with due regard to food health objectives.*

The same regulation underlines that establishments producing traditional products may access to individual or general derogations as regards the type of materials of which the instruments and the equipment used specifically for the preparation, packaging and wrapping of these products are made.

Conclusions

The results of our study, coupled with a

Table 1. Levels of polycyclic aromatic hydrocarbons found in the samples analysed.

PAH ($\mu\text{g}/\text{kg}$)	Rectum pork (min max \pm SD)	Smoked gentile (min max \pm SD)
Benzo(a)anthracene	0.3-0.7 (\pm 0.01)	15.2- 32.8 (\pm 0.15)
Chrysene	ND	ND-0.7 (\pm 0.05)
Benzo(b)fluoranthene	ND	1-1.9 (\pm 0.18)
Benzo(k)fluoranthene	ND	0.8-1.5 (\pm 0.2)
Benzo(a)pyrene	ND-0.2	3.3-6.8 (\pm 0.3)
Dibenzo(a,h)anthracene	ND-0.3	ND-0.7 (\pm 0.01)

PAH, polycyclic aromatic hydrocarbons; SD, standard deviation; ND, not detected.

Table 2. Levels of Bap and 4 polycyclic aromatic hydrocarbons marker [benzo(a)pyrene, chrysene, benzo(k)fluoranthene, benzo(a,h)anthracene] set by Reg. CE 835/2011.

Levels of bap	Foodstuffs	Maximum levels ($\mu\text{g}/\text{kg}$)	
6.1	Benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene, chrysene	Benzo(a)pyrene	Sum of benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene
6.1.4	Smoked meat and meat products	5.0 until 31/08/2014; 2.0 as from 01/09/2014	30.0 as from 01/09/2012 until 31/08/2014; 12.0 as from 01/09/2014

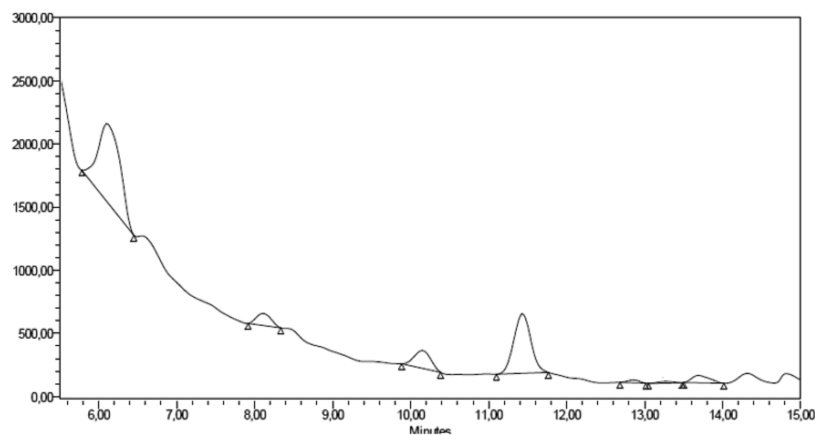


Figure 1. Chromatogram of a sample of *Gentile di maiale*. Triangles represent the limits of the curve of the analyte.

microbiological evaluation, are a valuable aid in the risk assessment and a key element to optimise the activity of competent authority during the control of production of such food, providing useful information to establish the monitoring frequency in order to assess the safety of product.

References

Bosset JO, Bütikofer U, Sieber R, Dafflon O, Koch H, Scheurer L, 1997. [Polyzyklische aromatische Kohlenwasserstoffe in Käsen]. [Article in German].

Agrarforschung 4:411-4.

Dafflon O, Gobet H, Koch H, Bosset JO, 1995. [Le dosage des hydrocarbures aromatiques polycycliques dans le poisson, les produits carnés et le fromage par chromatographie liquide à haute performance]. [Book in French]. Station de recherches laitières Publ., Université de Louvain, Heverlee-Louvain, Belgium.

IARC, 1983. Evaluation of the carcinogenic risk of chemicals to humans, polynuclear aromatic compounds: chemical, environmental and experimental data. IARC Publ., Lyon, France.

IRIS, 2002. Summaries for benzo[a]anthracene, chrysene, benzo[b]fluoranthene,

- benzo- [k]fluoranthene, benzo[a]pyrene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene. Integrated Risk Information System, Environmental Protection Agency Publ., Washington, DC, USA.
- EFSA, 2008. Polycyclic aromatic hydrocarbons in food. Scientific opinion of the panel on contaminants in the food chain. Available from: <http://www.efsa.europa.eu/it/efsa-journal/doc/724.pdf>
- European Commission, 2004. Regulation on the hygiene of foodstuffs, 852/2004/EC. In: Official Journal, L 139/1, 30/04/2004.
- European Commission, 2005. Regulation laying down implementing measures for certain products under Regulation (EC) N. 853/2004, n. 854/2004 and (EC) N. 882/2004, derogating from Regulation (EC) N. 852/2004 of the European Parliament and of the Council and amending Regulations (EC) N. 853/2004 and (EC) No. 854/2004, 2074/2005/EC. In: Official Journal, L 338/27, 22/12/2005.
- European Commission, 2011. Regulation amending Regulation (EC) N. 1881/2006 as regards maximum levels for polycyclic aromatic hydrocarbons in food, 835/2011/EU. In: Official Journal, L215/4, 20/08/2011.