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Polycyclic aromatic hydrocarbons in smoked ham

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Abstract

The aim of this work was to determine the content of four polycyclic aromatic hydrocarbons (PAHs) in household-produced smoked meat. Ham was manufactured in traditional drying facilities and smoking cabinets in Serbia. PAHs can significantly influence smoked meat quality and safety. The total content of the PAHs was 11.51 μg/kg in ham manufactured in drying cabinets and 0.16 μg/kg in ham produced in smoking facilities. The most abundant of all PAHs was chrysene. Benzo[a]pyrene was detected in hams manufactured in traditional dryers in southwestern Serbia in concentrations lower than maximum residue level set in current Regulation in Republic of Serbia.

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Keywords: polycyclic aromatic compounds; benzo[a]pyrene; meat dryer; meat smoker

1. Introduction

Despite the increasing awareness of food safety and the significance of the safe food production, there are still some meat products that can contain traces of carcinogenic substances. Smoking is one of the oldest technologies for

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the conservation of meat and fishery products[1]. Smoking is defined as the process of penetration of volatiles resulting from thermal destruction of wood into the surface of meat or fish products[1].

Polycyclic aromatic hydrocarbons (PAHs) are generally classified as relatively persistent organic environmental contaminants[2,3,4]. The most significant PAH compound is benzo[a]pyrene, and food is a significant source of benzo[a]pyrene in Europe due to PAHs in oils, fats and cereals which represent a high percentage of European diets[5]. Chemically, PAHs belong to a large class of organic compounds whose structure consists of two or more aromatic rings. They are characterised by low water solubility. These lipophilic compounds are the product of organic matter combustion, the most significant sources being thermo-energetic facilities (power plants, central heating facilities) and traffic. PAHs are present in atmosphere, geosphere, hydrosphere, etc[6]. Smoking is one of the oldest methods of food preservation and is based on exposure of meat products to smoke originating from wood combustion. Smoke not only gives special taste, colour and aroma to food, but also enhances preservation due to the dehydrating, bactericidal and antioxidant properties of smoke[7]. Jira et al.[8] determined that 99% of all PAHs are located at the surface of the food product, which has a mass fraction of 22% of the total product weight. Significance of PAHs lies in carcinogenicity or suspect carcinogenicity of some of these compounds.

Commission Regulation EU 1881/2006[9] sets maximum residue levels of benzo[a]pyrene in various food commodities. Four EU priority PAHs were measured within this study: benzo[a]pyrene, benzo[a]anthracene, benzo[b]fluoranthene and chrysene. Benzo[a]pyrene is used as the indicator of carcinogenicity. Toxic equivalency factor (TEF) is used in order to estimate carcinogenic potential of measured PAHs in respect to carcinogenicity of benzo[a]pyrene[10].

The aim of this paper is to compare the distribution of measured PAHs in ham smoked in drying and smoking cabinets.

2. Materials and methods

We analysed dried meat, ham manufactured in households from southwestern Serbia and Vojvodina by drying and smoking in traditional drying and smoking cabinets.

Smoking in southwestern Serbia is performed in drying facilities without windows and with modest ventilation systems. Salted meat is hung on hooks at the height of 1.5-2m. Meat smoking takes place during daylight when constant fire is maintained in the facility, while overnight meat is rested as fires are extinguished.

In Vojvodina, dry meat is manufactured in smoking cabinets that have side openings and constant air (smoke) circulation, while smoking takes place using low intensity burning without flame. Meat is positioned higher than 3m from the fireplace.

After processing, meat samples were packed and transported according to the Council Directive 2005/10/EC[11].

2.1. Solutions and standards

The PAH stock standard solution (502 µg/ml of 16 polyaromatic hydrocarbons) was diluted in acetone to yield spiking solutions 0.5, 1, 5,10, 50 µg/ml. The spiking solutions were used to prepare the calibration curves in the matrix blank extract by appropriate dilutions.

2.2. Sample preparation

Dried ham was chopped into small cubes and then comminuted thoroughly to achieve sample homogeneity. The sample extraction method used the QuECHERS method followed by dSPE.

Samples containing 3.0 g of meat were weighed into centrifuge tubes. To each sample, 12 ml aliquot of deionized water and 15 ml aliquot of ACN were added. The samples were vortexed for 1 minute. Then 6 g of $MgSO_4$ and 1.5 g of sodium acetate was added to each centrifuge tube and centrifuged at 3000 rpm for 5 min.

The upper layer (1 ml) was transferred was transferred into a dSPE tube containing 150 mg $MgSO_4$, 50 mg PSA, 50 mg C18 and vortexed for 1 minute. The dSPE tube was then centrifuged on 4000 rpm for 5 min. The liquid from the tube was transferred to a GC vial and analyzed by SIM GC/MS.