PAH-s content in the changed smoking process of the chicken breast

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ABSTRACT

The aim of this study was to determine the polycyclic aromatic hydrocarbons (Polycyclic aromatic hydrocarbon; PAH) with a focus on benzo (a) pyrene in smoked chicken produced in controlled conditions, changing the temperature values and time at constant pressure. The technological process of thermal degradation, drying and smoking semi-dry meat products of poultry meat is done in automated thermal chambers. The current process of smoking is performed by heat treatment to make the temperature at the center of the product 72° C for 40 minutes, followed by smoke at a temperature of 65° C, to achieve certain characteristics (odor, color). First category deboned chicken meat was used for testing. It was prepared in accordance to the familiar preparing raw material procedure for process of smoking already existing process of smoking is compliant with specific knowledge in science as well as principles of good manufacturing practice with a special focus on the time and temperature of smoke that led to certain changes in terms of the sensory properties of smoked products like presence and said polycyclic aromatic compounds (PAHs). The product was smoked at various temperatures ranging between 52.5 and 62 °C, over 10 to 30 minutes. In determining PAH compounds (polycyclic aromatic hydrocarbons), has been allocated said benzo (a) pyrene which is an indicator of the presence of harmful substances in products. Smoked meat changed the way smoking was ranked very acceptable

Keywords: *smoked chicken, changed smoking process, polycyclic aromatic hydrocarbons*

INTRODUCTION

Dried meat products represent one of the most important groups of meat products, whitc are prepared from cattle meat and poultry. Complex technological process consists of the following operations: technological salting processes or brining in combination with other conservation method: cold smoking, fermentation (ripening), or thermal treatment with or without smoking. All these processes are essential for getting optimum physical characteristics as well as the appropriate sensoric quality.

For smoking process of chicken breast raw chicken breast halves that were previously separated and released from the skin were used. Chicken breast halves are obtained when the breasts are cut into two approximately equal halves, using the "chest" section (Đermanovic, 2005).

After the formation of chicken fillet pieces the procedure of brine preparation is followed. The procedure is complicated, but is used for sustainability, the creation of a specific flavour and colour. For the brining process certain additives such as nitrite salt, a universal blend of additives, sodium lactate, mixtures of spices extracts and cold water are used. After preparation of brine the injection procedure on Pickl injector is followed as well as tumbling. Upon completion of the tumbling procedure meat samples are hanged on metal rods and placed in thermo smoked chamber for the thermal treatment. The process lasts until the temperature of 72°C in the center of the product is reached. During thermal processing, the meat suffers complex physical, chemical and structural changes (Wirt et al., 1997). Thermal treatment removes moisture excess, stabilizes color, consistency, flavor and aroma.

Smoking is one of the oldest food preservation technologies, based on the exposure of meat and meat products to smoke, which is produced by wood burning. Products subjected to thermal processes of drying and smoking are exposed to the possibility of contamination with PAH compounds (Polycyclic aromatic hydrocarbon; PAH) during heat treatment. Various parameters influence the amount of PAHs in smoked foods, such as wood moisture content, wood combustion temperature and oxygen concentration in wood combustion chamber (Toth, Blaas, 1972). Research on PAHs penetration in the interior of smoked meat products show that

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99% of all PAHs are found in the outer part of the sample, which makes 22% of the total weight of analyzed products (Jira et al., 2006; Ciecierski, Obiedzinski 2007).

MATERIALS AND METHODS

In this paper chicken meat prepared by standard, already described process of preparation was used. The prepared samples were treated with different smoking time and temperature, while the relative humidity was constant. 5 models (shapes) of chicken meat were used in order to examine the effect of various influencing factors. Following parameters were obtained:

- Smoking before and after heat treatment (I and II),
- Temperature and duration of smoking before and after heat treatment,
- The presence of PAH compounds in the product.

The process of heat treatment and the smoking of raw material lasted about 3 days, 3 hours a day, in a controlled environment. Unlike standard smoking procedure, before the heat treatment process at each stage of the experiment the product is smoked for 5 minutes, with various changes of temperature and time, as shown in Table 1.

Table 1. The heat treatment of the meat samples

SMOKED CHICKEN					
Sample mark	A Preparatory drying, surface humidity t_{ts}=65°C t_{vs}=20min.	I Preparatory drying before thermal treatment	B Thermal treatment Heating till the temperature at the center of the product t_{tto}=72°C t_{vto}=40min	C Roasting t_{tp}=75°C t_{vp}=10min	II Final smoking
Sample P1		t_{tdI}=62.5°C tvdI=5 min			t_{tdII}=62.5°C t_{vdII}=10 min
Sample P2		t_{tdI}=60.0°C tvdI=5 min			t_{tdII}=60.0°C t_{vdII}=15 min
Sample P3		t_{tdI}=57.5°C tvdI=5 min			t_{tdII}=57.5°C t_{vdII}=20 min
Sample P4		t_{tdI}=55.0°C tvdI=5 min			t_{tdII}=55.0°C t_{vdII}=25 min
Sample P5		t_{tdI}=52.5°C tvdI=5 min			t_{tdII}=52.5°C t_{vdII}=30 min

*t_{ts}-drying temperature, t_{vs}-drying time, t_{tdI}-first smoking temperature, t_{tdII}-second smoking temperature, t_{vdI}-first smoking time, t_{vdII}-second smoking time, t_{tto}-heat treatment temperature, t_{vto}–heat treatment time, t_{tp}-baking temperature, t_{vp}-baking time.

After completing the experimental smoking and heat treatment, influence and evaluation of properties that have arisen as a result of altered ways of smoking and impact of these variable factors on the presence and amount of PAHs were established.

After completing the smoking process, we started sampling of products from different locations and different heights on the metal poles on which the products were hanged in the smokehouse.

For the analysis of polycyclic aromatic compounds from each smoked chicken model we took one sample, a total of five samples and one commercial sample of smoked chicken (manufacturer known to the author). For each sample three repetitions were done.

Separation and identification of polycyclic aromatic hydrocarbons (PAH) present in smoking meat were determined using gas chromatography-mass spectrometry (GC-MS, Clarus 680) (EN 15527: 2008). According to Toth (1971) accumulation of PAHs occurs on the surface of a sample and is, therefore, necessary to properly take the sample and homogenize it. The ion chromatograms of samples are recorded, and on the basis of the absolute retention time determined the peaks attributable to certain PAH's. Found peaks are integrated. The obtained concentration of polycyclic aromatic hydrocarbons is calculated for the sample volume or sample mass.

Data were analyzed using the software package Microsoft Office Excel 2007. For all analyzed variables we calculated descriptive statistics (minimum, maximum, mean, standard deviation, coefficient of variation using PROC MEANS procedures) (SAS, 2002). The main method used for processing statistical data from the obtained experimental data is the average value (Komic, 2000).

RESULTS AND DISCUSSION

The study examined the content of PAH compounds with special emphasis on the presence and representation of BaP in products treated at different temperatures and in different smoking time. Results for the 10 priority PAH compounds are shown in Chart 1, while the amount and detachment of benzo (a) pyrene is shown in the chart 2.

Chart 1 shows the mean concentration of PAHs in samples of smoked chicken. The concentrations of a compound covered by the analysis are expressed in mg/kg.

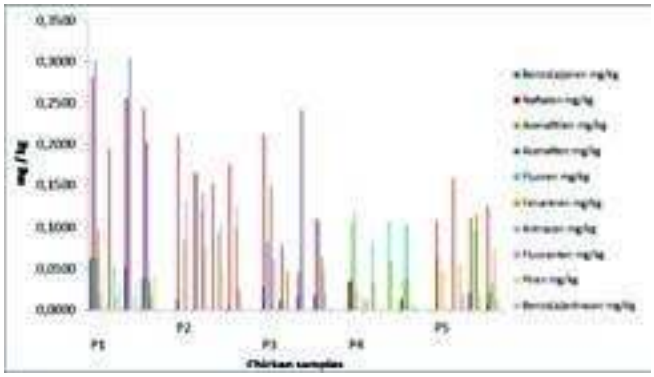

Chart 1. PAH compounds in smoked chicken

Since the benzo(a)pyrene (BaP) is an indicator of total polycyclic hydrocarbons presence in smoked meat (Anon, 2005) Figure 2 shows the values of this compound in samples of smoked chicken. The values obtained are similar to research of Ciecierski et al. The minimum content of BaP compounds in samples of smoked chicken was showed in a sample P1 with a value of 0.0042 mg/kg and the highest content of this compound occurs in the sample P5 and values 0.0295 mg/kg.

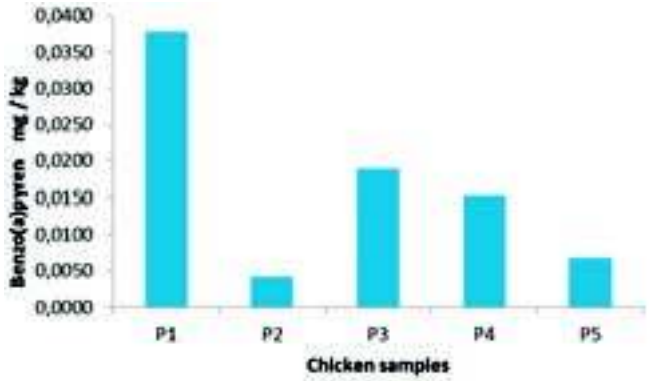

Chart 2. The presence of benzo(a)pyrene in smoked chicken

In a commercial sample concentration of benzo(a) pyrene has been tested, which in the smoked chicken was much higher compared to the treated samples. The obtained concentration of benzo(a)pyrene in commercial samples of smoked chicken was 0.0295 mg/kg.

It is known that direct exposure to smoke leads to the possibility of particles and harmful substances accumulation from smoke to the sample. These substances are, among others, polycyclic aromatic hydrocarbons (Andres et al., 2007; Kuhn et al. 2009; Karolyi 2011). Some of the compounds such as benzo(a)pyrene are indicators of toxicity, and they are carcinogenic (Nisbet et al., 1992).

Charts show that the presence of BaP in smoked chicken samples is largest in sample P5 where the smoking temperature was 52.5°C for 30 minutes, and the lowest concentration of benzo(a)pyrene has been recorded in the sample P1 with the smoking temperature of 62.5°C and time of 10 minutes. Naphthalen showed the highest concentration of all polycyclic aromatic compound analyzed. Statistical analysis showed no significant differences in analyzed PAHs. This phenomenon can be explained by differences in the smoking mode, less time exposure of product to smoke as well as the size of sample and the sampling method for analysis (Djinović et al. 2008).

CONCLUSION

In order to reduce the allocations benzo(a)pyrene it is necessary to control the temperature and duration of product smoking for pyrolysis reduction and the creation of harmful substances that can endanger human health, if we consumption such products. The tested samples of smoked meat showed that the content of BaP in the product decreased significantly after controlling the temperature or the exposure time of the product to smoke.

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