



IMPACT OF THERMAL PROCESS ON POLYCYCLIC AROMATIC HYDROCARBONS IN RABBIT MEAT

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Abstract. Rabbit meat represents food with a chemical composition beneficial to the human body. Due to its protein content and low fat levels, it is widely used in the diet of people with various health problems. Through preparation and heat treatments, some components lose their value, and these treatments can also increase the content of compounds that can be toxic to the human body. The sensory characteristics obtained after frying and smoking are appreciated by most consumers. The highest average values are for phenanthrene, both in smoked and fried meats and in raw rabbit meat. Among the hydrocarbons analyzed, benzo(a)anthracene is in the lowest quantity. This study shows the influence of some cooking, frying and smoking processes on the content of polycyclic aromatic hydrocarbons in rabbit meat.

Keywords: meat, rabbit, PAH, roasting, smoking, beech wood, willow wood

1. INTRODUCTION

Polycyclic aromatic hydrocarbons also known as PAHs are created by incomplete combustion of wood or gasoline represent an important class of compounds that can be toxic to the body.

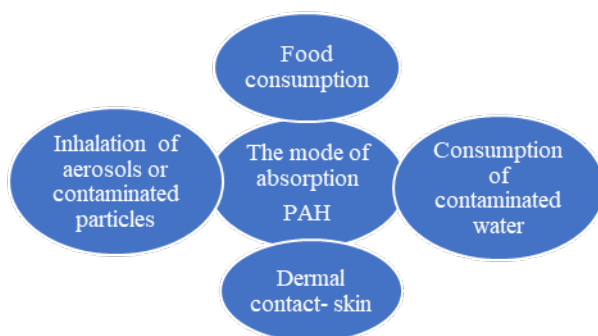


Figure 1. The method of exposure to polycyclic aromatic hydrocarbons

Various studies have shown that food processing methods such as:

- boiling
- frying

- smoking
- grilling

can lead to the formation of polycyclic aromatic hydrocarbons [1-2].

To impart a pleasant smell to the meat, dry aromatic herbs such as sage, juniper, thyme, rosemary can be added during the smoking process. Smoke results from incomplete combustion of wood and can also present a negative role regarding human health.

The color of the meat is influenced by both salt concentration and duration of salting. In order of formation of pink color of meat, which is also stable over time, preservatives are used [3]. Rabbit meat is not very widespread and consumed internationally, even though it has high nutritional and dietary properties [4].

Rabbit meat has the following properties [5]:

- rich in protein
- low in calories
- low in fat
- low in cholesterol

Also, rabbit meat is considered a delicious, healthy and easily digestible food, suitable for children and the elderly [5].

Like it is mentioned in literature, the content of calcium and phosphorus has a greater value in comparison with other types of meat [6]. In addition, rabbit meat is low in purines and presents none uric acid [7].

In rabbits, the quality of the carcass, the composition of meat, the amount and proportion of fatty acids in adipose tissue vary on diet and animal age (mainly increasing intramuscular fat content) [8].

In efficient breeding, they converted up to 20% of the accumulated and consumed protein into meat, which denotes that this value is superior to pigs (15-18%) and cattle (9-12%) [9].

The ash content is quite similar to other animals, and various studies have shown a lower potassium and

phosphorus content for rabbit meat [10.] Like it is mentioned in literature [11], reported rabbit meat to be a source of B vitamins (B2, B3, B5, B12).

Homemade rabbit meat comes mainly from traditional and intermediate farms and less from commercial farms [12].

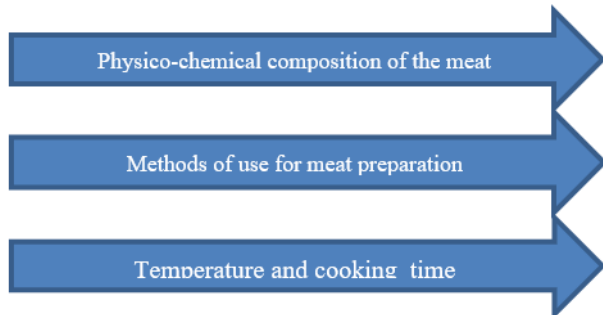


Figure 2. The major factors influencing the physical-chemical composition of meat

The scope of the paper is to evaluate the content of polycyclic aromatic hydrocarbons in rabbit meat according to applied thermal process (frying and smoking) and the method of preparation.

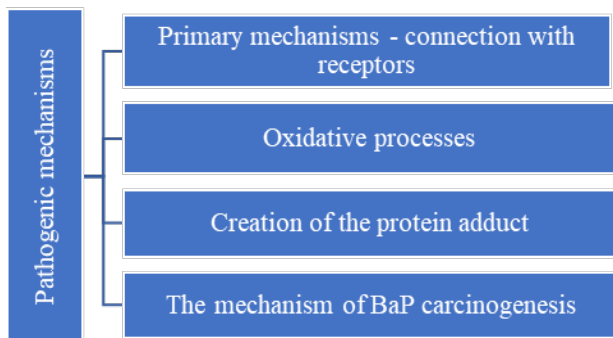


Figure 3. The pathogenic mechanisms of PAH and the formation of carcinogenic effects

2. MATERIALS AND METHODS

The meat samples analyzed came from the Belgian giant rabbit, aged 12 months. In this paper, the following four categories were analyzed:

- 1 - raw meat
- 2 - rabbit steak
- 3 - rabbit pastrami (kept in the bath for 24 hours and smoked with beech wood for 5 hours)
- 4 - rabbit pastrami (kept in brine for 24 hours and smoked with willow wood for 3 hours)

Belgian giant rabbit it comes from Belgium, the Ghent area, having as common ancestor the local populations of rabbits, infused with the wild rabbit.

Like it is mentioned in literature, the rabbit has the following description. Large breed, well conformed,

harmonious, massive and robust, has a long body (60-100 cm), large head, to which are attached straight ears and worn upwards in a V-shape, with a length of 16-19 cm. Body weight is between 6-9 kg in females and 7-12 kg in males [13].

The Belgian Giant breed is mainly exploited for meat and can be harnessed from 2-3 months of age [13]. Analysis of polycyclic aromatic hydrocarbons were analyzed with Perkin Elmer HPLC.

The method used is described by literature in [1-2]. The physico-chemical composition of rabbit meat has been determined by the Soxhlet method. The samples analysed are:

- raw rabbit meat;
- rabbit steak;
- rabbit pastrami smoked with beech wood.
- rabbit pastrami smoked with willow wood.

The ingredients used for rabbit roast are: potatoes, carrots, tomatoes, wine, fresh thyme, salt and pepper. Place the meat in the oven for 50 minutes at 180 degrees temperature.

Rabbit pastrami is kept in the bath for 24 hours and smoked with willow wood for 5 hours: Ingredients used: salt, pepper, paprika, ground garlic, ground onions, bay leaf. Before being put in brine, the meat was boiled in water with various spices.

For rabbit pastrami smoked with beech wood, after boiling, the meat is placed in brine and left for 24 hours, after which it is smoked with beech wood for 5 hours. For rabbit pastrami smoked with willow wood, it is kept in brine for 24 hours and smoked with willow wood for 3 hours.

3. RESULTS AND DISCUSSIONS

The way of slaughtering the animal and the quality control on the technological flow influence both quality and physico-chemical composition of meat [14].

The mean values were:

- for protein 19.33%
- for fat 7.2%
- for moisture 70.5%
- for ash were 1.86%

The results are similar with those published by Siddiqui et al., 2023, on rabbit meat in [15].

The physico-chemical parameters for rabbit meat are shown in figure 4.



Figure 4. The physico-chemical composition of rabbit meat

In [16] Gonzalez-Redondo, 2010 reports for wild rabbit meat (*Oryctolagus cuniculus*) the following chemical composition:

- 23.7% for protein
- 0.2% for fat
- 74.9% for humidity
- 1.2% for ash

In [17] Belichovska et al., 2017 studies the chemical composition and energy value of rabbit meat according to genotype. This study conducted on rabbit meat in [17] reports the following values:

- 2.62% for fat,
- 21.76% for protein,
- 1.23% for ash
- 74.60% for water content.

In [18] Herc, P., 2021 evaluates effect of natural zeolite on rabbit meat from chemical composition perspective.

They state that after administration of zeolite, the linolenic acid content of the dorsal muscle in rabbit meat increased significantly, having a beneficial effect on rabbit meat and nutritional value, but claim that linolenic acid can influence the oxidative stability of rabbit meat during storage.

By boiling, frying or grilling, rabbit meat improves its sensory characteristics. These characteristics are influenced by the chemical composition of the meat, the anatomical region, but also by the thermal processes applied [1-2].

The lowest values are for benzo(a)anthracenes, benzo(k)fluoranthenes and chrysene. All PAHs were affected by roasting and smoking. The chemical composition of meat is different even within the same species, varying from individual to individual depending on the ratio of different tissues, age of the animal, fattening status, feed and maintenance system [1,4].

PAHs in raw rabbit meat compared to fried and smoked rabbit meat are shown in Table 1.

Table 1. PAHs in raw rabbit, steak and smoked meats Evolution

Parameter	Raw rabbit meat (1)	Steak rabbit (2)	Rabbit pastrami (smoking with beech wood, 5h/bath 24h) (3)	Rabbit pastrami (smoking with willow wood, 3h/brine 24h) (4)	p value
Naphthalene	4.42c	8.10b	8.55ab	9.10a	<0.0001
Acenafte	5.45b	8.39a	9.01a	8.69a	<0.0001
Fluorene	16.55b	21.25a	20.32a	19.77ab	0.0045
Phenanthrene	36.68b	46.94a	40.64ab	37.04b	0.0012
Anthracene	1.31	1.66	1.61	1.27	0.6225
Fluoranthene	4.19b	6.13a	5.93a	5.88a	0.0002
Pyrene	2.24ab	3.16a	1.76b	1.87b	0.0031
Benzo(a)anthracene	0.39b	1.35a	1.14ab	0.86ab	0.0144
Crisen	0.66b	1.61a	1.38a	1.34a	0.0010
Benzo(k)fluoranthene	0.63b	1.35a	1.60a	1.46a	0.0022

Meat quality is conditioned by a lot of factors, which can act both during the life of the animal, and after its slaughter. In addition to factors such as species, breed, sex, state of maintenance and age, there are also factors such as the direction and speed of biochemical processes after slaughter, which play a very important role in meat quality [19-20].

Polycyclic aromatic hydrocarbons (PAHs) are potentially toxic compounds that depend on the structure and level of meat and fat content. PAHs are a large group of different chemicals formed during incomplete combustion [1,21].

Muscle fat, excluding storage fat, up to a certain limit confers superior qualities on meat, but a high fat content causes changes in hydrocarbon content [1,21,22]. Heat treatments also bring some positive changes, such as: improving taste, smell, color and digestibility, but also destroying microorganisms, parasites and toxins [22].

The concentration of benzo(a)pyrene in grilled meat according to data reported by Banu et al., 2007 in [23] is 10.5 µg/kg, compared to dried salami where it is 0.8 µg/kg.

According to European Commission Regulation (EC no. 1881/2006) [24], the upper permitted level for benzo(a)pyrene for smoked meats and smoked meat products is 5.0 µg/kg. The type of grill and its position (horizontal and vertical) influence the level of PAHs. On the vertical grill, values up to 30 times lower were observed compared to the horizontal one. All the species from which the meat comes influence the PAHs[25].

4. CONCLUSIONS

Meat from rabbits has a chemical composition that is good for humans. It is frequently included in the diets of patients with a variety of health issues due to high protein content and low fat content. Certain components lose value during preparation and heat treatments, and these processes can also raise the concentration of substances that may be harmful to human health.

The majority of customers find value in the sensory qualities that are produced after smoking and frying. Phenanthrene has the highest average values in raw rabbit meat, fried and smoked meats. Benzo(a)anthracene had the lowest concentration of all the hydrocarbons examined.

This study demonstrates how certain cooking, frying, and smoking methods affect the amount of polycyclic aromatic hydrocarbons in smoking and roasting process influences the PAH content of rabbit meat. Of the PAHs analyzed, the highest amounts are for phenanthrene, fluorene, naphthalene and acenaphthene.

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