INVESTIGATION OF ANTHRACENE AND ANTHRAQUINONE IN SMOKED FRANKFURTER-TYPE SAUSAGES

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I. INTRODUCTION

Smoking is an important technology for preserving and flavoring meat and meat products. However, undesirable ingredients can be formed during smoking and transferred to the product. These adverse substances include polycyclic aromatic hydrocarbons (PAHs). Numerous previous studies have examined the presence of PAHs in smoked meat products [1]. In these studies, the oxidized forms of PAHs were not considered. Anthraquinone is the oxidized form of the PAH anthracene and has been classified by the IARC (International Agency for Research on Cancer) as a probable carcinogen for humans [2]. During smoking it is possible that anthraquinone is formed and therefore, it is detectable in smoked meat products. In this study, commercial samples were analyzed for the presence and the amount of anthraquinone in comparison to anthracene.

II. MATERIALS AND METHODS

Frankfurter-type sausages were used as sample material. The scalded sausages were purchased from butchers and retail stores in and around Kulmbach. Three samples of supermarkets and four samples of different butchers were analyzed three times (n=3). After fat extraction and purification of the extracts, the samples were separated by gas chromatography and analyzed by mass spectrometry. Deuterated compounds of the analytes anthracene and anthraquinone were used as internal standards for the analysis.

III. RESULTS AND DISCUSSION

The aim of this study was to examine commercial samples of frankfurter-type sausages on the occurrence of anthraquinone and to quantify this for the first time. In all samples, anthraquinone levels above the limit of quantification (0.05 µg/kg, $\alpha = 0.05$) were detected in addition to anthracene (Table 1). The anthracene content ranged from 1.85 µg/kg to 9.67 µg/kg and was thus higher than the anthraquinone content (0.76-3.69 µg/kg). The sample with the lowest content of anthracene also had the lowest content of anthraquinone (Supermarket 1). Conversely, the sample with the highest anthracene level did not show the highest anthraquinone level (Butcher 2).

Table 1 Mean and standard deviation of content (in µg/kg) and ratio of anthracene (ANT) and anthraquinone (ATQ) in Vienna Sausages from retail (n=3)

Sample	ANT	ATQ	ATQ/ANT
Supermarket 1	1.85 ± 0.17	0.76 ± 0.12	0.41
Supermarket 2	4.68 ± 0.69	2.17 ± 0.33	0.46
Supermarket 3	4.44 ± 0.21	2.95 ± 0.01	0.66
Butcher 1	4.18 ± 0.33	0.79 ± 0.07	0.19
Butcher 2	9.67 ± 1.07	3.01 ± 0.20	0.31
Butcher 3	7.83 ± 0.57	3.69 ± 0.11	0.47
Butcher 4	6.59 ± 1.03	2.15 ± 0.38	0.33

On average, sausages from supermarkets had lower levels of the two analytes than the ones from butchers. The ratio between the two analytes was also different depending on the origin of the obtained sample. Frankfurter-type sausages from the supermarket (ATQ / ANT = 0.41-0.66) had relatively more anthraquinone than anthracene compared to sausages from butchers (ATQ / ANT = 0.19-0.47). The different contents and ratios of the analytes of the commercial samples can be attributed to various producers. The use of different smoking systems with diverse parameters can lead to variation in level of analytes.

IV. CONCLUSION

The presence of anthraquinone in smoked frankfurter-type sausages was confirmed in this study. All analyzed samples showed anthraquinone levels below the European limit of 10 µg/kg [3]. A direct correlation between the content of anthraquinone and the content of anthracene could not be observed.

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