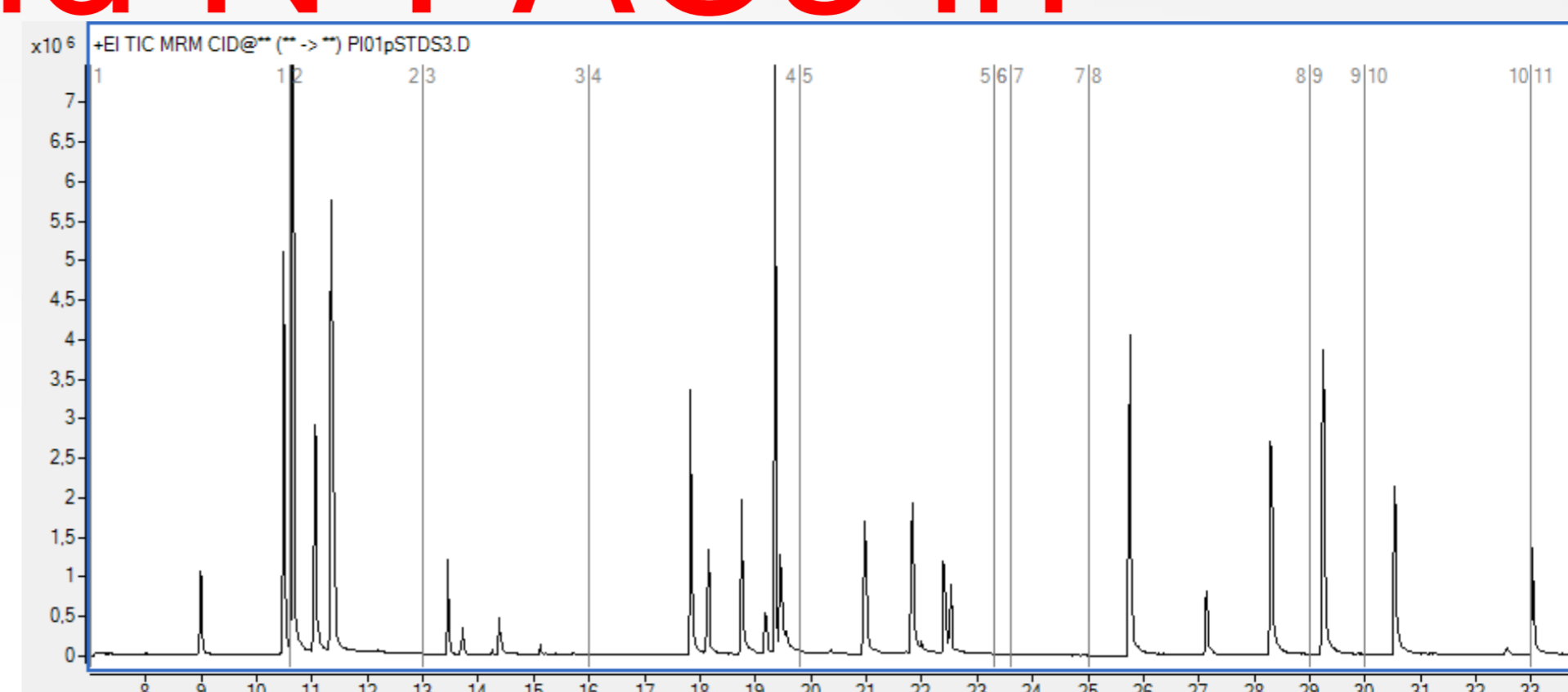




Determination of oxy-PAHs and N-PACs in food products

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Introduction

Polycyclic aromatic hydrocarbons (PAHs) are well known contaminants in food. Their mutagenic and carcinogenic effects lead to significant human health risks [1]. However the oxidized form of PAHs (oxy-PAHs) and the nitrogen containing polycyclic aromatic compounds (N-PACs) have rarely been researched so far.

There have been no thorough studies of their occurrence, stability, dissemination, or potential risks. Therefore coconut oil, as well as fumigated and barbecued products were examined for oxy-PAHs and N-PACs.

Methods

We established two sample preparation methods, size exclusion chromatography (SEC) and dispersive SPE. Tandem mass spectrometry (GC-MS/MS) was implemented for the detection and quantification of these analytes by using deuterated PAHs as internal standards.

Low cost coconut oil (n=3) and smoked products like cheese, ham and salmon (n=6) as well as smoked paprika (n=3) were analyzed. Furthermore meat, fish and cheese (n=17) were also examined before and after barbecuing. All samples were taken from the German market. The barbecue process was performed on conventional charcoal grills.

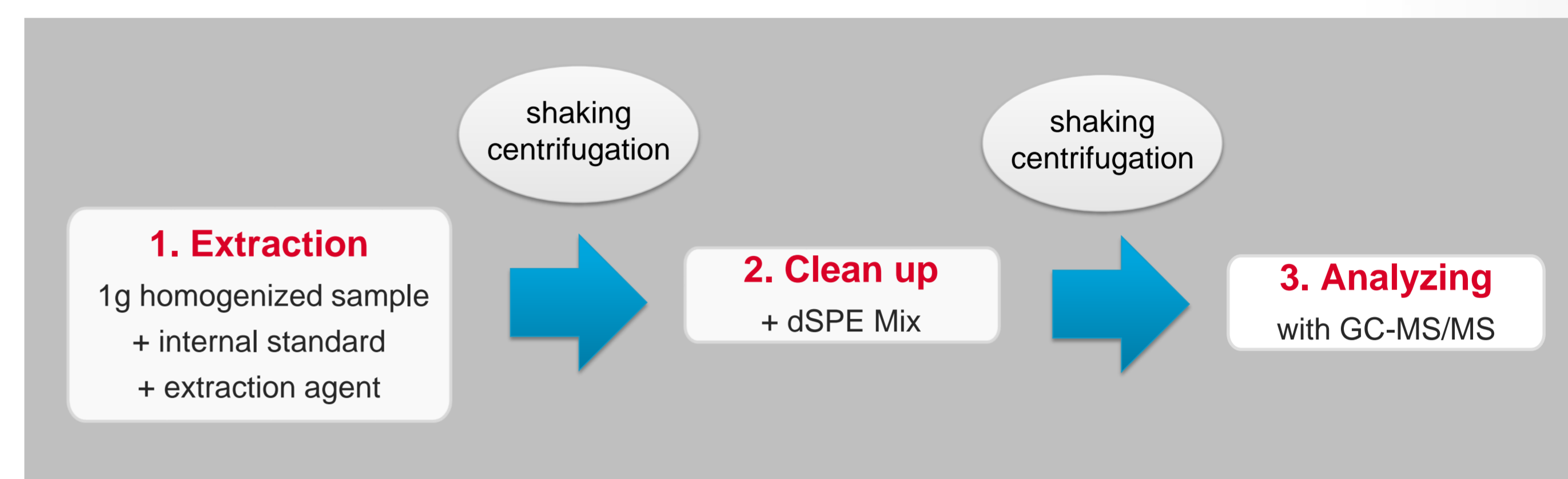


figure 1. flow diagram of the SPE method for analyzing PAHs, oxy-PAHs and N-Pacs in food products

Results

Substance	ham	salami	smoked cheese	smoked salmon	coconut oil
Phenanthrene	86	6,8	5,3	2,1	-
Pyrene	8,0	-	-	-	-
Chrysen	1,2	-	1,6	-	-
2-Methylanthrachinone	2,8	-	-	-	-
1-Methylnaphthaline	162	7,6	3,1	-	11
2-Methylnaphthaline	132	2,6	-	-	7,3
4HCyclopenta[def]phenanthren4one	-	-	-	-	-
1-Indanone	40	164	28	44	-
9-Fluorenone	96	3,5	-	-	-
9,10-Anthraquinone	6,4	-	-	-	-

table 1. PAH and oxy-PAH concentration in a selection of various food products in µg/kg

Our research reveals the presence of some oxy-PAHs in smoked products, especially the contents of 1-Indanone and 9-Fluorenone (3.5 - 164 µg/kg) are high (table 1). At the same time the analyzed PAH contents are relatively low and comply with the regulation for PAHs in foodstuff [2]. Under barbecue conditions a large number of oxy-PAHs were found in animal products like cheese, various meat products and salmon (table 2.). The highest content was found in barbecued hip steak with 700 µg/kg 9-Fluorenone. 2 out of 3 spices have a particularly high load of oxy-PAH up to mg/kg. Also PAHs could be found in barbecued food and smoked paprika.

N-PACs were detectable in barbecued products, but smoked paprika showed the highest contamination.

Substance	hip steak		bratwurst		smoked paprika
	non-barbecued	barbecued	non-barbecued	barbecued	
Benzo[a]pyrene	-	2,7	-	-	49
7HBenz[de]anthracen7one	-	-	1,2	3,1	66
4HCyclopenta[def]phenanthren4one	-	5,2	-	1,6	26
2-Methylanthraquinone	-	3,1	-	1,0	44
1-Methylnaphthaline	-	38	-	-	1410
2-Methylnaphthaline	-	13	-	-	1151
1-Indanone	-	18	-	4,0	1096
9-Fluorenone	-	700	-	75	420
9,10-Anthraquinone	-	18	-	2,6	153
Benzo[a]fluorenone	-	2,5	-	-	27,3
6HBenzo[cd]pyren6one	-	-	-	-	8,3
5,12-Naphthacenequinone	-	-	-	-	2,1
1,2-Benzanthraquinone	-	1,3	-	1,2	2,5
Quinoline	-	7,6	-	-	137
9H-Carbazole	-	4,5	-	-	72

table 2. PAH, oxy-PAH and N-PAC concentration in barbecued food and smoked paprika in µg/kg

Conclusions

Our results indicate the presence of oxy-PAHs in low cost coconut oil, as well as smoked and barbecued products. Formation and/or contamination pathways are unknown and cannot be determined by the results. But the contamination of the barbecued products with oxy-PAHs and PAHs could result from the barbecue process, because of the high load of particle phase and the smoke with oxy-PAHs and PAHs. However, the load of the smoke and the particle phase is higher with PAHs than with oxy-PAHs [3] and thus it does not explain the

distribution of the results of the barbecued products, cause our results show a higher load of oxy-PAHs.

A possible way of contamination with N-PACs, as a component of coal tar [4] in barbecued products could be the use of charcoal.

The distribution of the main detected substances in the individual product groups, which differs, reveal different formation processes or contamination sources.

References

- [1] Tsutomu Shimada (2004): *Metabolic activation of polycyclic aromatic hydrocarbons to carcinogens by cytochromes P450 1A1 and 1B1*. In: Cancer Sci, vol. 95, no 1, 1-6.
- [2] Commission Regulation (EC) No 1881/2006 in combination with Commission Regulation (EC) No 835/2011
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- [4] Heinrich Ratte(1957): *Fractional distillation of coal tar*. In: United States Patent Office, June, 11, 1957