Identification, quantification and odor impact of selected volatile sulfur compounds in Swiss Tilsit cheese by headspace-GC/pulsed flame photometric detection and GC-Olfactometry

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Introduction

Volatile sulfur compounds (VSCs) such as methanethiol, hydrogen sulfide and sulfides are key flavour compounds found in a variety of cheeses. They are mainly derived from the decomposition of the sulfur-containing amino acids cysteine and methionine. Due to their low odor thresholds, their sensory properties are very pronounced even at very low concentrations, and they can have a significant influence on cheese flavour. Given their high volatility and reactivity, VSC analytics remain challenging.[1–5]

Objectives

- **Determination/quantification of VSCs** in Tilsit cheese using gas chromatography and sulfur specific detection (pulsed flame photometric detection, GC-MS/PFPD)
- **Obtain physiological information on odor quality and impact of target VSCs** on the overall Tilsit cheese odor by GC-MS-olfactometry (GC-MS-O) on a 2-way-GC-O-system where two panelists judge a sample simultaneously

Experimental

Commercial Tilsit cheese was used.

Headspace solid phase microextraction (HS-SPME) sampling

- Fiber: CAR/PDMS 85 µm 1 cm
- For GC/PFPD[6]: T= 60 C; $t_{incubation}$= 10 min, $t_{adsorption}$= 30 min
- For GC-O: T= 30 C; $t_{adsorption}$= 360 min

VSC determination by GC/PFPD

- Use of two internal standards (*IS*) to correct for variations
- External calibration curve for correction factor and quantification
- Analyses were conducted in triplicate

GC-Olfactometry

- Trained judges (total n= 8; two at a time) described the perceived odors and rated their intensity on a three-point-scale
- Data were processed taking into account detection frequency and odor intensity using the Acquisniff® software[7,8]

Results

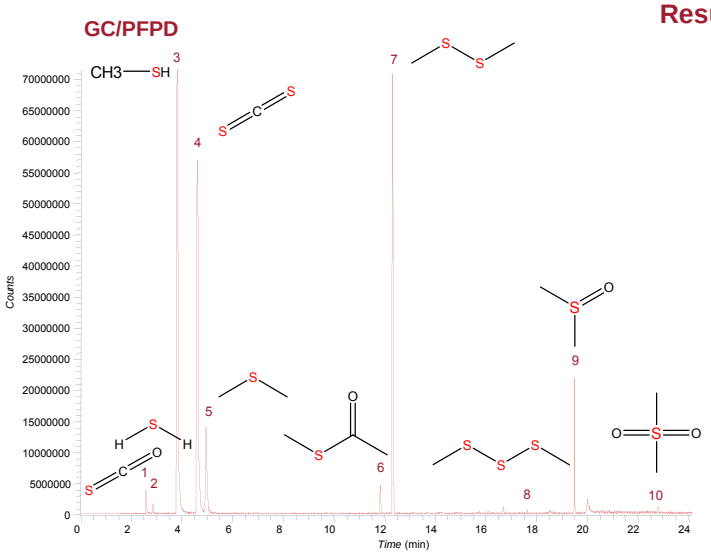

Fig. 1 PFPD signal of Tilsit headspace extracted with a CAR/PDMS 85 µm 1cm SPME fibre

Tab. 1 Quantification of target VSCs in Tilsit using two internal standards and an external calibration curve

N Fig. 1	Name	Odor characteristics (literature)[9-12]	Odor threshold In water [ppb]	Concentration [µg kg^{-1}= ppb]
1	Carbonyl sulfide	burnt rubber, carbamate	50[12]	*n.d.*
2	Hydrogen sulfide	rotten egg, sewage-like	2.1–5[11]	*n.d.*
3	Methanethiol	rotten cabbage, burnt rubber	1.8–2[11]	*In progress*
4	Carbone disulfide	sweet, ethereal, slightly green, sulfidy	50[11]	*n.d.*
5	Dimethyl sulfide	canned corn, cooked cabbage, asparagus	0.3–1[9]	4
6	Methyl thioacetate	sulfurous, eggy, cheese, dairy, vegetable, cabbage	50 [11]	0.1
7	Dimethyl disulfide	vegetal, cabbage, onion-like at high levels	0.16–12[10]	1.7
8	Dimethyl trisulfide	sulfurous, alliaceous, cooked, savory, meaty	0.005–0.01[10]	0.5
9	Dimethylsulfoxide	garlic	*NA*	*n.d.*
10	Dimethylsulfone	sulfurous, burnt	*NA*	*n.d.*

n.d.= not determined, *NA*= not available

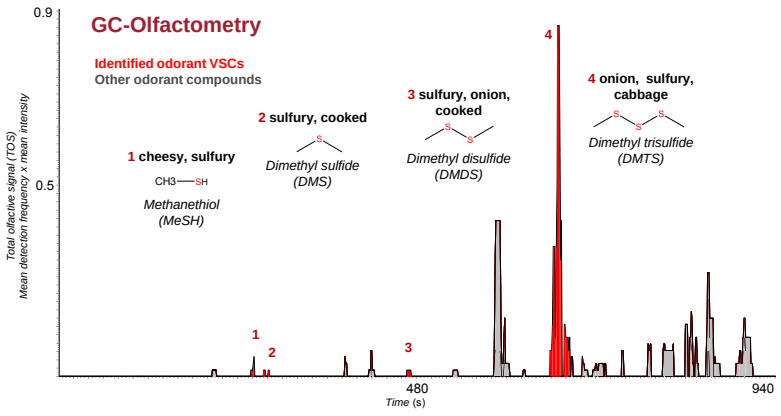

Fig. 2 Aromagram of Tilsit cheese indicating identified odorant VSCs and odor descriptors in this study

Conclusion

About a dozen VSCs were detected in different concentrations in the studied Tilsit cheese. Hydrogen sulfide, methanethiol, dimethyl sulfide, methyl thioacetate, dimethyl disulfide and dimethyl trisulfide were found at ppb and ppt levels. In addition, carbonylsulfide, carbon disulfide, dimethylsulfoxide and dimethylsulfone were identified.

GC-olfactometry revealed that MeSH, DMS, DMDS and DMTS were the only identified VSCs found to have an impact on the odorant profile of the tested cheese sample. However, in the employed conditions, MeSH, DMS and DMDS showed a minor, and only DMTS a strong odor impact; the latter seeming particularly important due to its low sensory threshold. Other odorant VSCs seem to be below odor threshold. Various other odorant compounds were also detected, but not further examined in the present study.

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