AppBrief

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Identification of Flavors in Different Phases of Meat Substitutes by DHS-GC-MS

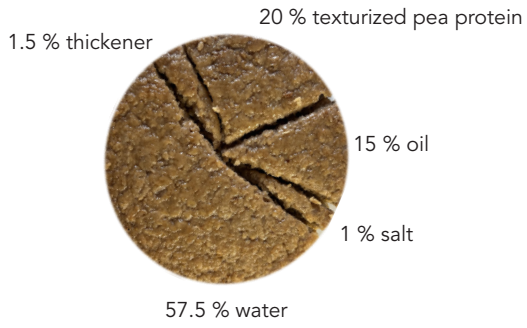
Highlights

- Dynamic headspace GC-MS allows sensitive analysis of flavor compounds in meat substitutes
- Different processing phases can be simulated
- No sample preparation was necessary

Introduction

Meat substitutes are becoming increasingly important as they represent a sustainable alternative to meat products. The released flavors in the different phases (raw, fried and during the frying process) are crucial for the success of the product. The aim of this project is to identify the released flavors in these phases using dynamic headspace gas chromatography-mass spectrometry (DHS-GC-MS).

The present study examines commercially available burger patties from various manufacturers.



Vegan burger patty [1]

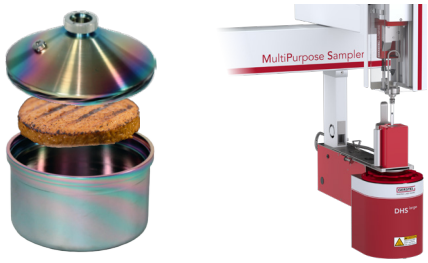
Experimental

Instrumentation

For this application, a GERSTEL LabWorks Platform, supplemented with dynamic headspace (DHS) and an Agilent GC-MS, was used. The GERSTEL LabWorks Platform is a universal system for sample introduction and offers unrivaled capabilities and flexibility to solve your critical challenges. Liquid, headspace, and thermal desorption are all included without the need for additional bench space.

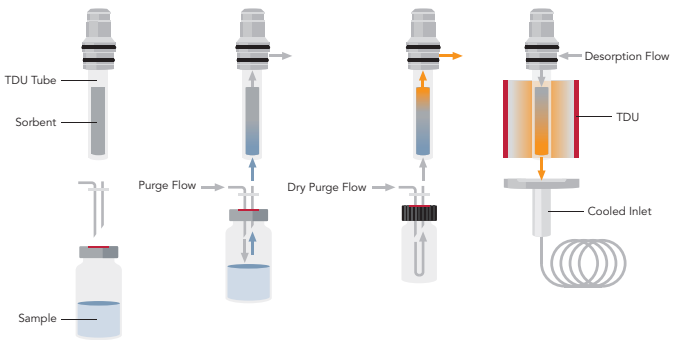
Sample Preparation

A punch was used to obtain 500 mg from the burger patty sample; it was then flattened to achieve a reproducible surface-to-mass ratio and placed in a 500 mL DHS-Large vessel.



Sample Introduction

Dynamic headspace was selected as the sample introduction technique. The dynamic headspace technique enriches volatile and semi-volatile analytes from the gas phase above a liquid or solid sample on a sorbent-filled tube. Analytes are continuously removed from the sample's headspace and transferred to a sorbent-filled tube using a permanent gas flow. This leads to a constant shift in the equilibrium between the headspace and the sample, providing exhaustive analyte extraction. This is in contrast to the classical headspace technique, where only a finite amount of headspace is sampled.



The dynamic headspace workflow from sample insertion to thermal desorption

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The dynamic headspace technique is automated using the GERSTEL MPS. Incubation, extraction, and, if necessary, a drying step of the sorbent are performed in a DHS station mounted on the MPS. The adsorption is carried out on sorbent-filled tubes, which can be packed with different sorbents. Following extraction, these are desorbed in a GERSTEL thermal desorption system and re-focused in a cold injection system (CIS 4) for subsequent temperature-programmed transfer to the GC-MS system. There are no valves, transfer lines, or active sites in the sample path, ensuring the best possible recovery of all analytes.

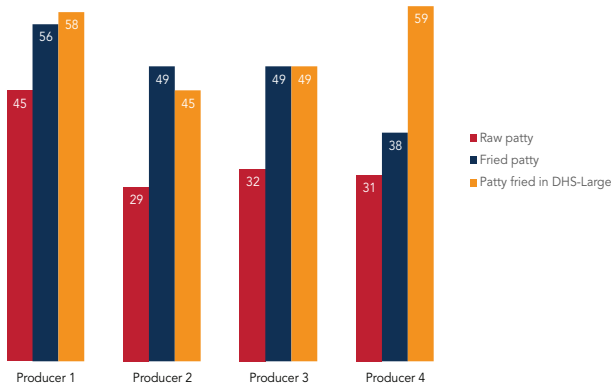
Analysis

The samples were analyzed in the various phases (raw, fried and during the frying process). A purge flow extracted the volatiles fraction from the container and transferred it to the sorbent-filled tube. Subsequently, the tube was dry purged, thermally desorbed and analytes were refocused in the CIS 4 with a Tenax® -filled liner at a trap temperature of 20 °C.

Detection was performed with a mass selective detector from Agilent Technologies in scan mode. The verification of the detected compounds was carried out using deconvolution with MassHunter Unkowns analysis and a NIST library. Furthermore, the flavor compounds were identified with Aroma Office, matching GC-MS data with retention indices and CAS numbers.

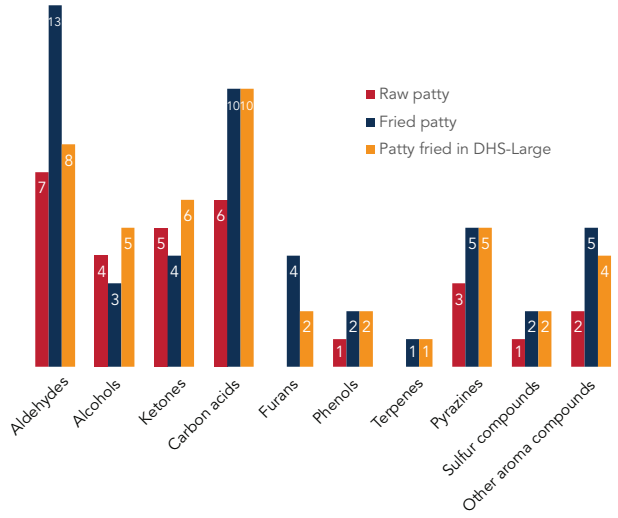
Results and Discussion

The combined automatic alignment of deconvolution, NIST-MS library data and an RI aroma database enables fast and reliable identification of the released flavors.

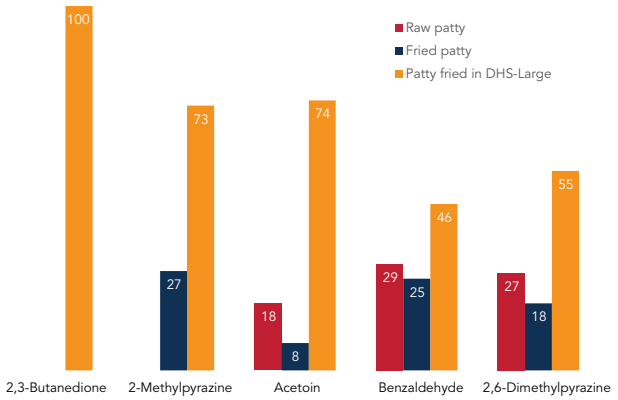


Total number of flavor components in different processing phases of different patties

Patty Producer 1 and Patty 4 show the highest number of flavor components when prepared in the DHS-Large.



Comparison of the flavor components in different processing stages of patty 2, sorted by substance class



Comparison of selected flavor components, including comparison of relative intensities

Conclusions

- A large number of substance classes have been identified, whereby the flavor components differ in the various processing stages
- Some flavor components are already present in the raw patty, while others are only released during the heating process.
- Different processing phases can be simulated using DHS-L.

References

[1] Jolien Devaere et al., *Improving the aromatic profile of plant-based meat alternatives*, Foods (Basel, Switzerland), **2022**.