JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Development of Alternative Protein Sources based on Submerged Cultivation of Basidiomycetes on Industrial Side-streams: Analysis of Aroma Profiles and Biotransformations

Tobias Trapp[a], Martina Zajul[a], Jenny Ahlborn[a], Alexander Stephan[a,b], Marco A. Fraatz[a], Holger Zorn[a],

[a] *Institute of Food Chemistry and Food Biotechnology, Justus Liebig University Giessen, Heinrich-Buff-Ring 17, 35392 Giessen, Germany*

[b] *VAN HEES GmbH, Kurt-van-Hees-Str. 1, 65396 Walluf, Germany*

1. Introduction

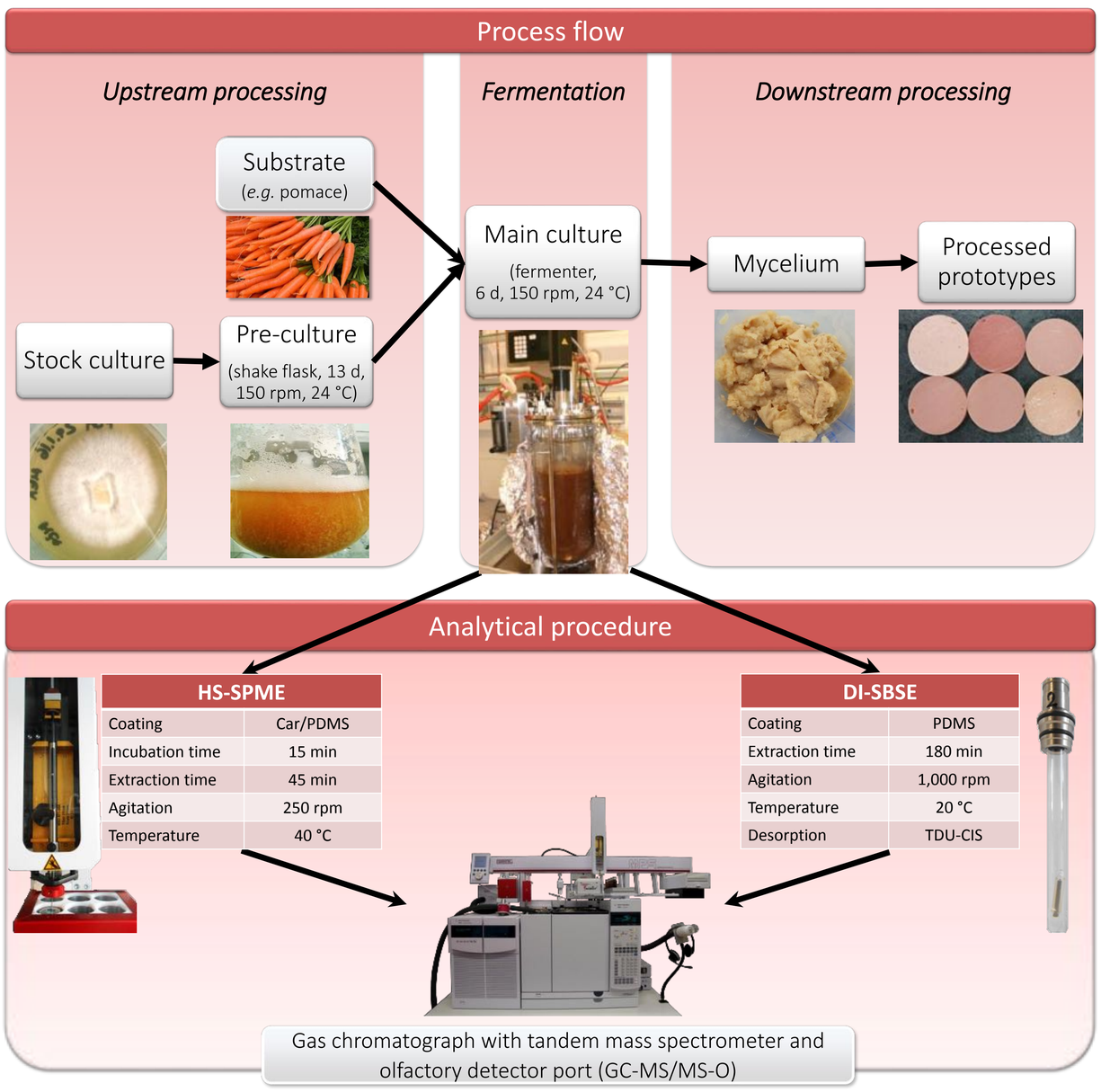
In order to meet the increasing demand for food proteins of a growing world population, the development of alternative protein sources becomes increasingly important. Basidiomycetes – with their unique nutritional and biochemical properties – represent promising candidates for the bioconversion of industrial side streams into valuable food proteins.

Previous studies demonstrated that basidiomycetes may be grown in submerged cultures on industrial side-streams, like apple pomace or molasses [1]. Some basidiomycete-substrate combinations imparted interesting flavour profiles, which differed significantly from those of the substrates and of cultures grown in chemically defined media [1,2]. The thus formed protein-rich mycelia appear to be a suitable matrix for the further processing to vegan products with meat-like properties. Prototypes showed good textural and visual characteristics.

2. Methods and results

The poster illustrates the aroma analysis of a submerged culture of *Lentinula edodes* cultivated on carrot pomace as a representative example. The aroma profile was analysed via a combined approach of the two extraction techniques, headspace-solid phase microextraction (HS-SPME) and direct immersion-stir bar sorptive extraction (DI-SBSE) followed by gas chromatography-olfactometry. For each odour, the flavour dilution (FD) factor was determined by means of aroma dilution analysis in order to estimate the respective aroma potency. For that purpose, the split ratio of the carrier gas flow at the GC inlet was varied in order to achieve the desired dilution [2]. It was thus possible to determine FD factors up to 256 (fig. 1).

In order to investigate the fungal aroma genesis, the measured HS-SPME-GC-MS and SBSE-chromatograms of the substrate (carrot pomace) and the submerged culture were compared (fig. 2 and 3).



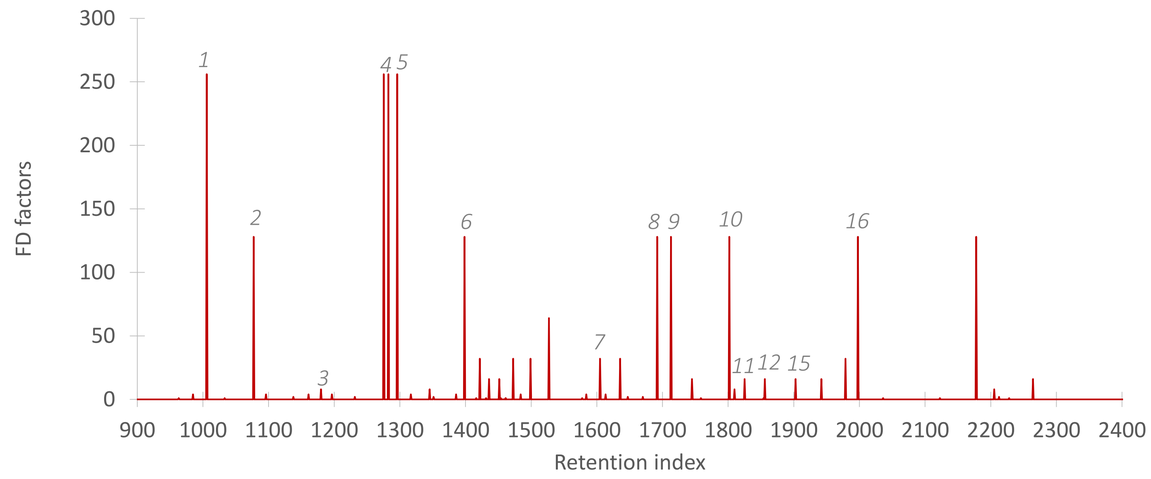


*Figure 1: FD chromatogram of homogenised submerged culture (*L. edodes *cultivated on carrot pomace). Aroma dilution analysis via HS-SPME-GC-MS/MS-O (HP-Innowax).*

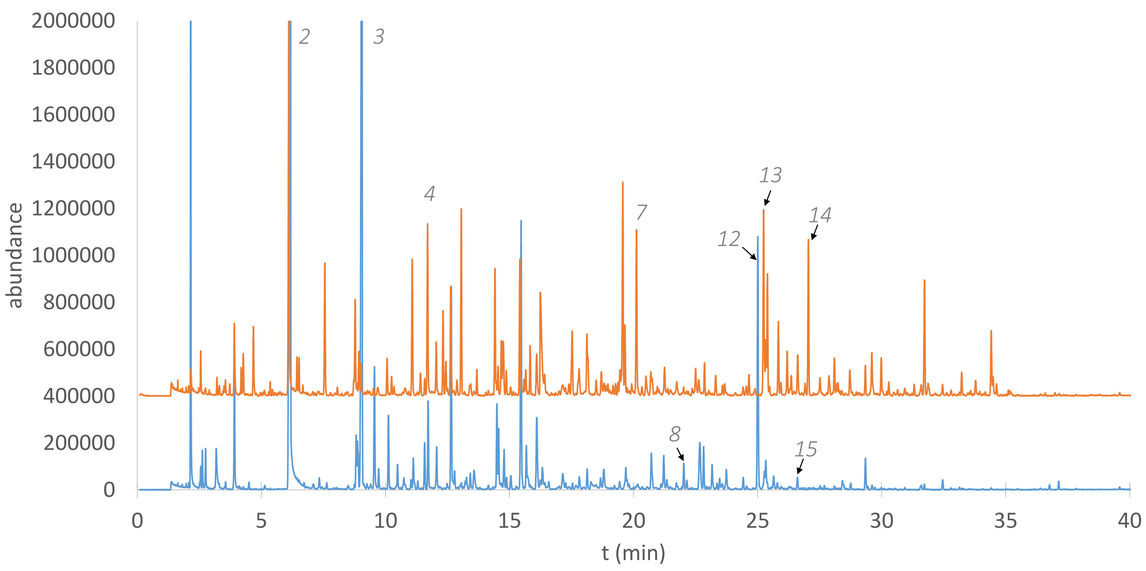


*Figure 2: HS-**SPME**-GC-MS-analysis of submerged cultured* L. edodes (*cultivated on carrot pomace) (blue) and carrot pomace (suspended in water) (orange). GC chromatograms (*m/z *33-300).*

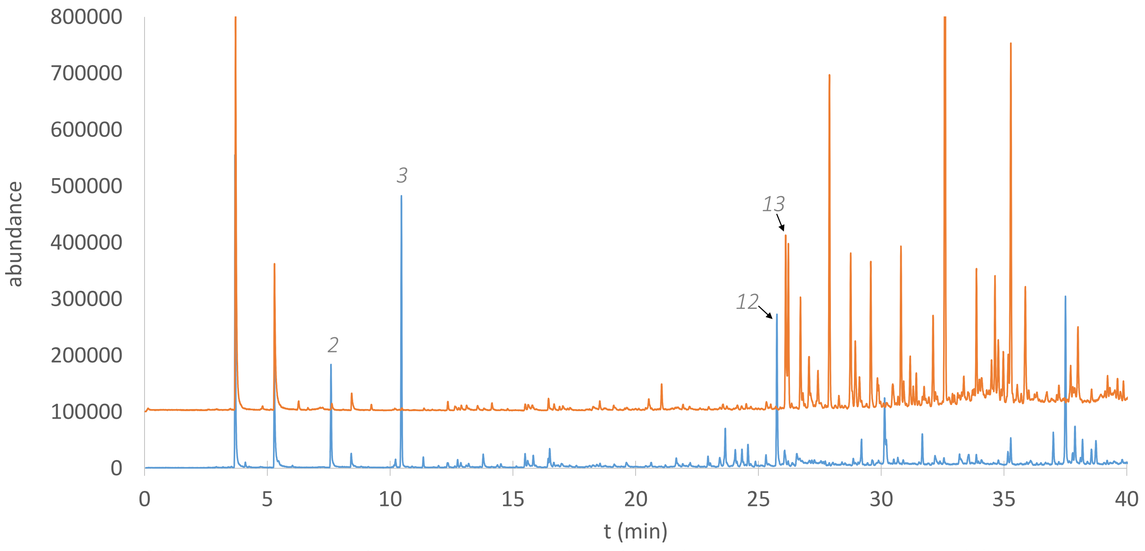
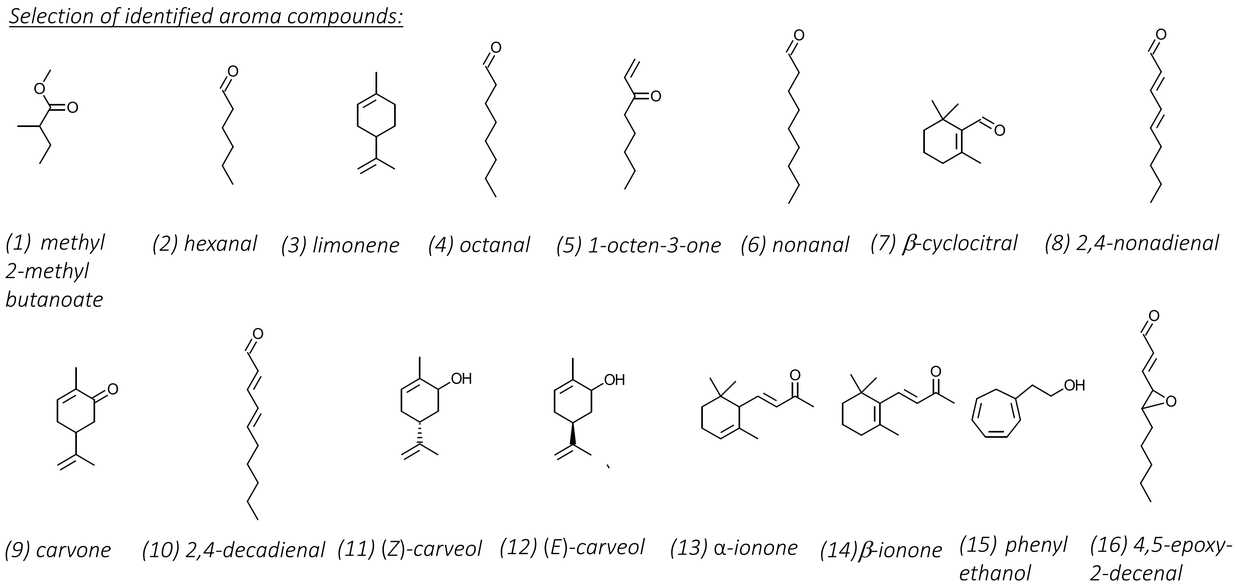


*Figure 3: DI-**SBSE**-GC-MS-analysis of submerged cultured* L. edodes (*cultivated on carrot pomace) (blue) and carrot pomace (suspended in water) (orange). GC chromatograms (*m/z *33-300).*

Selection of identified aroma compounds:



(1) methyl 2-methyl butanoate (2) hexanal (3) limonene (4) octanal (5) 1-octen-3-one (6) nonanal (7) β-cyclocitral (8) 2,4-nonadienal

(9) carvone (10) 2,4-decadienal (11) (*Z*)-carveol (12) (*E*)-carveol (13) α-ionone (14) β-ionone (15) phenyl ethanol (16) 4,5-epoxy-2-decenal

3. Outlook

Various basidiomycete-substrate combinations were analysed via the same approach in order to obtain an optimal matrix for further food manufacturing. For that purpose, the effects of the processing steps on the aroma profile will be investigated more in detail. As shown, this will include GC-MS-O analyses of substrates, pre- and main cultures (cultivated on the respective substrate) to indicate possible fungal bioconversions. For further elucidation of the metabolic pathways, kinetic and labelling studies will be performed

Simultaneously, the formation and losses of aroma compounds during the subsequent downstream processing steps will be investigated. Finally, the developed products will be evaluated by an expert sensory panel. That way, the overall target to optimize the process towards a desirable and appealing food product can be achieved.

References:

[1] Bosse, A.K. et al.: *Formation of complex natural flavors by biotransformation of apple pomace with basidiomycetes*. Food Chem (2013), 141, 2952–2959

[2] Zhang, Y. et al.: *Quantification of key odor-active compounds of a novel nonalcoholic beverage produced by fermentation of wort by shiitake (*Lentinula edodes*) and aroma genesis studies*. Food Res Int (2015), 70, 23-30

Acknowledgement:

This project (HA project no. 478/15-20) is funded in the framework of Hessen ModellProjekte, financed with funds of LOEWE Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz, Förderlinie 3: KMU-Verbundvorhaben (State Offensive for the Development of Scientific and Economic Excellence).