

# Are micro-organisms settling on rapeseed responsible for sensory bad quality virgin rapeseed oil?

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## Introduction

Sometimes virgin rapeseed oil is characterized by an unpleasant perception for musty or fusty off-flavor strongly impairing the quality of the product. This impression is associated with the occurrence of higher amounts of certain volatile aroma compounds such as 2- and 3-methylbutanal, acetoin and others. It has not yet been investigated whether these compounds can result from the metabolism of microorganisms that colonize rapeseed.

## Aim

In the present work the profile of volatile compounds formed as result of a microbial infestation of rapeseed should be investigated to identify compounds also found in virgin rapeseed oil with unpleasant sensory characteristic.

## Workflow

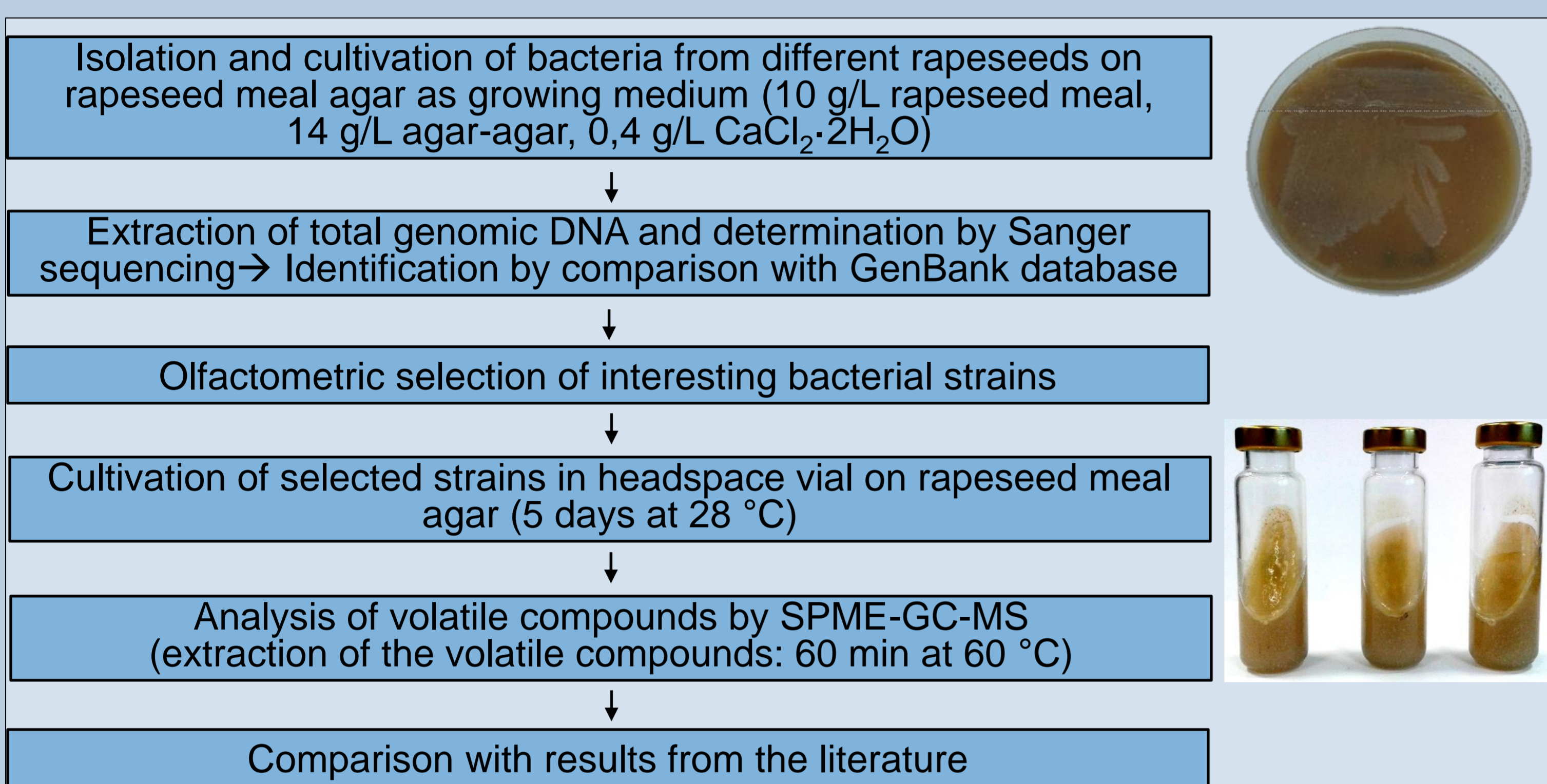


Fig. 1: Experimental approach for isolation of relevant bacteria strains and analysis of volatile compounds.

Tab. 1: 22 bacterial strains with sensory perceptions of typical rapeseed oil off-flavours

Code	Identified bacteria <sup>a</sup>	Total smell intensity <sup>b</sup>	Attributes most often mentioned
A1	Stenotrophomonas rhizophila	6	musty, wet seeds
A2	Paenibacillus sp.	10	fusty, sour
A6	Erwinia amylovora	4,5	fusty, sour
A8	Pseudomonas sp.	4,5	fusty
A9	Erwinia sp.	5,5	musty, fusty
A10	not identified	4	musty, fusty
A12	not identified	8	musty, fusty, faecal
B4	Paenibacillus sp.	4	sweetly, sour
B5	not identified	11	musty, fusty, mushroom-like
B7	Paenibacillus sp.	5	cheese-like, fusty
B9	not identified	6	sour, fusty
C4	not identified	4	musty
C5	Pseudomonas sp.	6,5	musty, sour, aromatic
C7	Sphingobacterium sp.	10	cheese-like, meaty, aromatic
C8	not identified	17	scruffy, fusty, cheese-like
D1	Pantoea agglomerans	6	musty, aromatic
D3	Stenotrophomonas sp.	11	fusty, cheese-like
D6	Pseudomonas sp.	6,5	musty, fusty
D7	not identified	12	fusty, meaty
D8	not identified	5	cheese-like, fusty
D9	Pseudomonas sp.	7	fusty
D10	Pseudomonas sp.	18	noticeable different, fermented

<sup>a</sup>Genera or rather species of 46 bacterial strains isolated from rapeseed and identified by Sanger sequencing and GenBank database comparison of determined DNA sequences. <sup>b</sup>summed intensity of the sensory fault detected by four of six panelists.

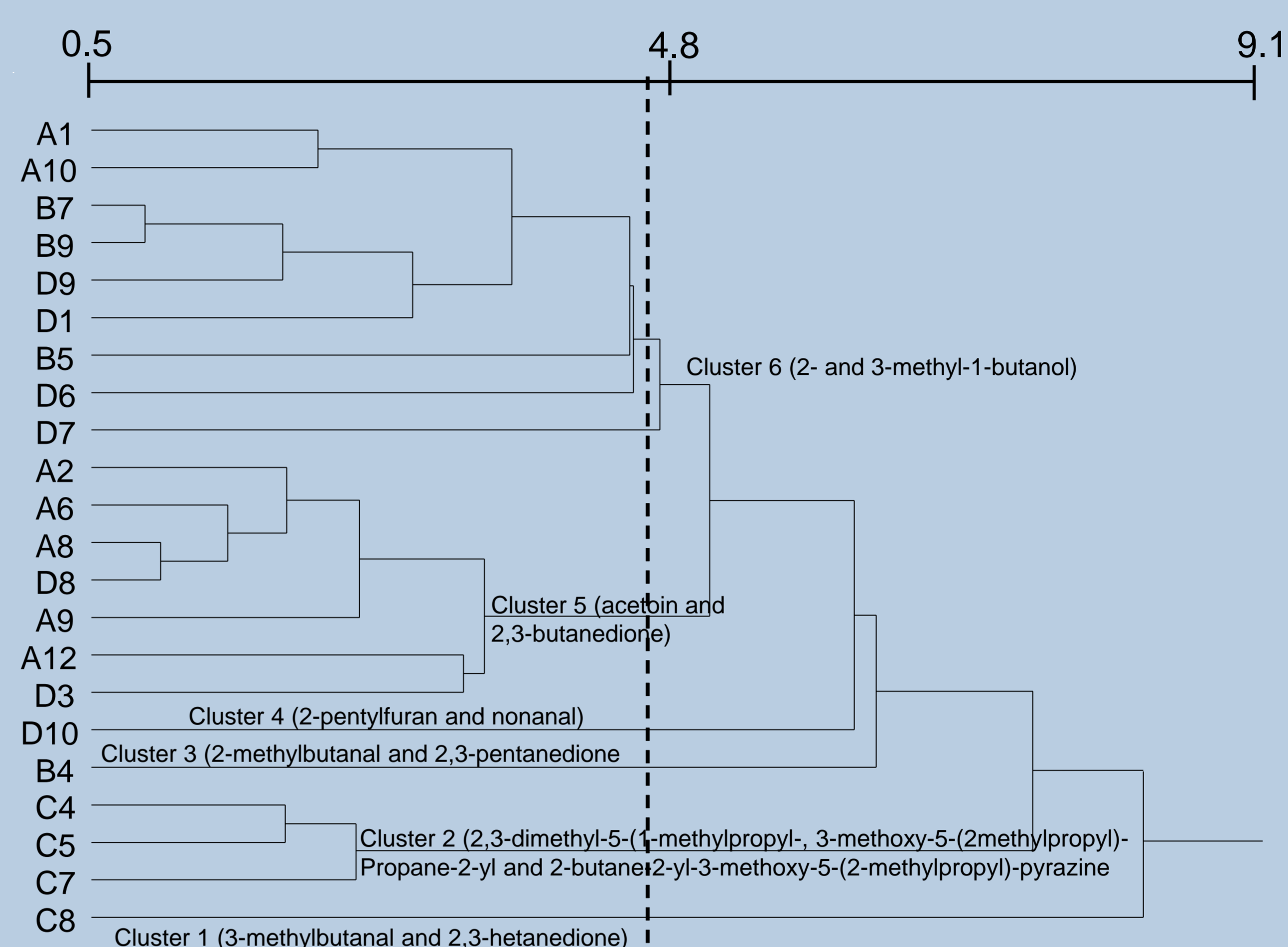


Fig. 2: Hierarchical clustering based on volatile aroma-active compounds as metabolic products of 22 bacterial strains (A1 - D10) populating rapeseed. Cluster 1 - 6 show bacterial strains with similar volatile profiles.

Tab. 2: Volatile aroma-active compounds derived from the 22 bacteria strains of Table 1 cultivated on rapeseed meal agar. Highlighted compounds were also found and described as aroma-active in virgin rapeseed oils

No.	Compound	RI	Aroma attribute
1	<b>dimethyl sulfide</b>	<b>545</b>	<b>cabbage</b>
2	2,3-butanedione	562	butter
3	2-methylfuran	570	ethereal
4	<b>3-methylbutanal</b>	<b>595</b>	<b>malty</b>
5	<b>2-methylbutanal</b>	<b>602</b>	<b>cacao, almond</b>
6	2-pentanone	621	ethereal, fruity
7	2,3-pentanedione	629	cream, butter
8	<b>acetoin</b>	<b>641</b>	<b>cream, butter</b>
9	<b>3-methyl-1-butanol</b>	<b>671</b>	<b>malty</b>
10	<b>2-methyl-1-butanol</b>	<b>676</b>	<b>onion</b>
11	dimethyl disulfide	680	onion, cabbage, foul
12	2,3-heptadione	839	fruity, butter, oily
13	<b>2-methylbutanoic acid ethyl ester</b>	<b>851</b>	<b>fruity</b>
14	Tricyclene	920	flowery
15	<b>2-pentylfuran</b>	<b>990</b>	<b>green beans</b>
16	<b>nonanal</b>	<b>1104</b>	<b>lemon, soapy</b>
17	2,3-dimethyl-5-(1-methylpropyl)-pyrazine	1185	nutty
18	3-methoxy-5-(2-methylpropyl)-2-propane-2-ylpyrazine	1333	<sup>a</sup>
19	2-butane-2-yl-3-methoxy-5-(2-methylpropyl)-pyrazine	1384	<sup>a</sup>

<sup>a</sup>described as intense with no further specification

## Results and Discussion

- **Bacteria identified** on rapeseed by DNA sequencing (Sanger sequencing) and GenBank database comparison of determined DNA sequences: *Stenotrophomonas rhizophila*, *Stenotrophomonas sp.*, 4 *Paenibacillus spp.*, *Pseudomonas fluorescens*, 2 *Pseudomonas spp.*, *Erwinia amylovora*, *Bacillus spp.*, *Pantoea agglomerans*, 33 further strains (not identified) (Tab. 1).
- The **smell of 22 bacteria strains** was characterized olfactometrically as similar to the **typical off-flavor of virgin rapeseed oil** (Tab. 1).
- 19 aroma-active compounds have been identified as metabolic products from 22 bacterial strains shown in Table 1 after cultivation on rapeseed meal agar (Tab. 2).
- **Acetoin, 2-methylbutanoic acid ethyl ester, 3-methylbutanal** were also found in sensory bad virgin rapeseed oil, **dimethyl sulfide, 2-methylbutanal** are also described with aroma values > 1 in the literature; **nonanal, 2-methyl-1-butanol, 3-methyl-1-butanol, 2-pentylfuran** were also found in virgin rapeseed oil (Tab. 2).
- **Clustering of bacterial strains** resulted in six groups (clusters) with **similar profile of volatile compounds** (Fig. 2).

## Conclusion

- **Micro-organisms** populating on rapeseed during storage may **strongly influence the sensory quality of virgin rapeseed oil** by the development of volatile aroma-active metabolic products.