Identification des substances odorantes principales dans des fromages à pâte demi-ferme à croûte lavée

Valérie Gagnaire, Marie-Bernadette Maillard, Sébastien Lê, Anne Thierry

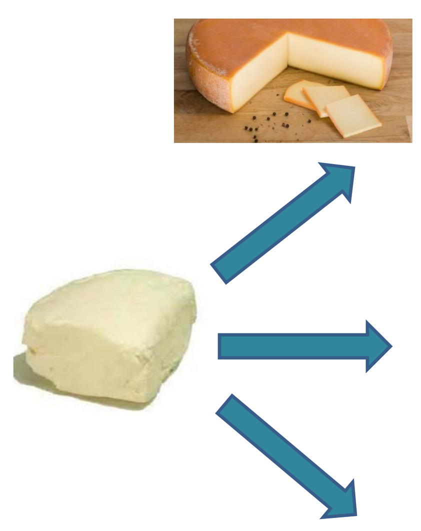
Identification of key odorants in smear-ripened semi-hard cheese

Valérie Gagnaire[1], Marie-Bernadette Maillard[1], Sébastien Lê[2], Anne Thierry[1]
[1] UMR STLO, INRAE, Institut Agro, FRANCE
[2] Applied Mathematics Department, Institut Agro, FRANCE

CONTEXT & AIM

- ✓ Flavor is an important property of fermented foods and largely results from the production of aroma compounds by microorganisms.
- ✓ In smear-ripened cheese varieties, surface microbiota is thought to contribute to the typicity of the aroma.
- ✓ Our objective was to identify key odorants in smear-ripened semi-hard cheese and the role of surface microbiota in their production.

STRATEGY



C: traditional cheese ripened under regular conditions

A: raclette ripened under oxygen-barrier wrapping film A

B: raclette ripened under oxygen-barrier wrapping film B

Figure 1

- ✓ To manufacture three groups of cheeses from the same curd, ripened under regular conditions (C) or under two types of oxygen-barrier wrapping films (A and B), so as to prevent the growth of surface microbiota (figure 1)
- ✓ Several chromatographic methods used:
  - HPLC to quantify organic acids and free amino acids
  - head space trap GC-MS to quantify volatiles
  - solvent-assisted flavor evaporation (SAFE) GC-MS coupled to olfactometry to identify the most potent odorants
- ✓ Cheeses also evaluated by sensory profiling

RESULTS

Cheese composition

Content	Foil-ripened A	Foil-ripened B	Regular ripening C
Dry matter, g/kg	558.9 [a]	562.7 [a]	560.5 [a]
pH, core	5.47 [a]	5.44 [a]	5.53 [a]
pH, surface	5.51 [b]	5.51 [b]	5.96 [a]
Total N, g/kg	224.1[a]	222.2 [a]	222.2 [a]
NCN, g/kg	49.9 [b]	50.0 [b]	55.6 [a]
NPN, g/kg	31.6 [b]	34.2 [b]	35.5 [a]
Total free amino acids, g/kg	16.9[a]	16.1[a]	16.6[a]
Organic acids, g/kg			
Citric acid	1.9 [a]	1.8 [a]	1.8 [a]
Lactic acid	13.9 [a]	14.8 [a]	8.1 [b]
Acetic acid	0.36 [b]	0.30 [b]	1.20 [a]
Pyruvic acid	0.19[a]	0.17 [a]	0.18 [a]
Succinic acid	0.12 [b]	0.10 [b]	0.25 [a]
Butyric acid	0.16 [a]	0.16 [a]	0.14 [a]

- ✓ The three cheese groups had the same gross composition and pH in the cheese core
- ✓ Cheeses C differed from the two other cheese groups:
  - a higher pH at the surface
  - 10% more proteolysis,
  - 2 to 3-fold more succinic and acetic acids and less lactic acid

Metabolites analysed by chromatography (HPLC & GC-MS)

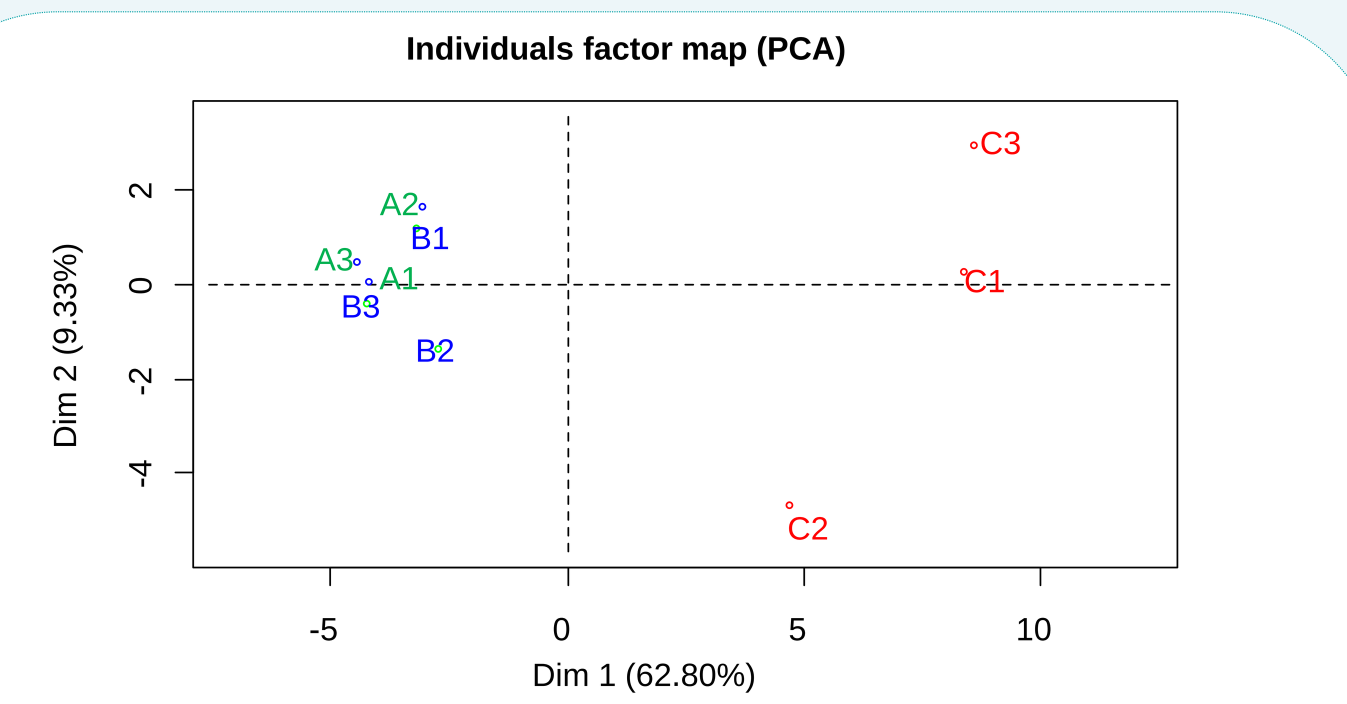


Figure 2 Individual factor map of Principal Component Analysis (PCA) performed on the concentration of 44 metabolites in three types of ripened Raclette cheese

Variables included organic acids, the volatiles from head space GC-MS that showed significant differences between cheese groups), and odorant volatiles from SAFE-GC-MS

- ✓ Cheeses A and B very close and separated from cheeses C on the 1st dimension of PCA, positively associated with most metabolites
- ✓ Metabolites present in a significant greater abundance in cheeses C Include a range of compounds arising from amino acid catabolism and lipolysis likely associated with surface microbiota activity

Olfactometry

Odor descriptors	Odor intensity[a]			Attribution
	A	B	C	
butter	3	3	3	diacetyl
coconut	2.5	1.5	1.5	δ-octalactone
Floral / coconut	1.5	1.5	2	δ-decalactone
floral /plastic	2	1	1.5	γ-dodecalactone
mushroom	2	0.5	1	1-octen-3-one
sweet, caramel	0.5	2	2	γ-nonalactone
Fecal / leather / barn	2	1.5	1.5	p-Cresol
leather / chemical / pungent / green	1	1	2	decanoic acid
grilled / walnut / bread / cooked rice	1.5	1.5	2.5	2-acetyl-2-thiazoline
potato	0	1.5	2.5	methional
fermented	2	1	2	methyl-1-butanol b
fecal, rotten	0	1.5	2	skatole
pungent / plastic	1.5	0	2.5	4-ethenylphenol
barn / plastic / rotten	1	0.5	2	m-cresol
floral / sweet / goat / pungent	0.5	0.5	2	octanoic acid
musty / rotten / cheese	0	0	2	2-methylpropanoic acid
vomit / rancid	0	0	2.5	butanoic acid
cheese / sweat / musty	1	0	3	3-methylbutanoic acid
chemical / vomit / rotten	0	0	1.5	methionol
cheese / rotten / rancid	0.5	0	2.5	hexanoic acid
rotten	0	0	2	non-identified compound

- ✓ higher olfactometry scores observed in cheese C for 12 out of the 20 odorants identified by GC-olfactometry

Sensory analyses of cheeses

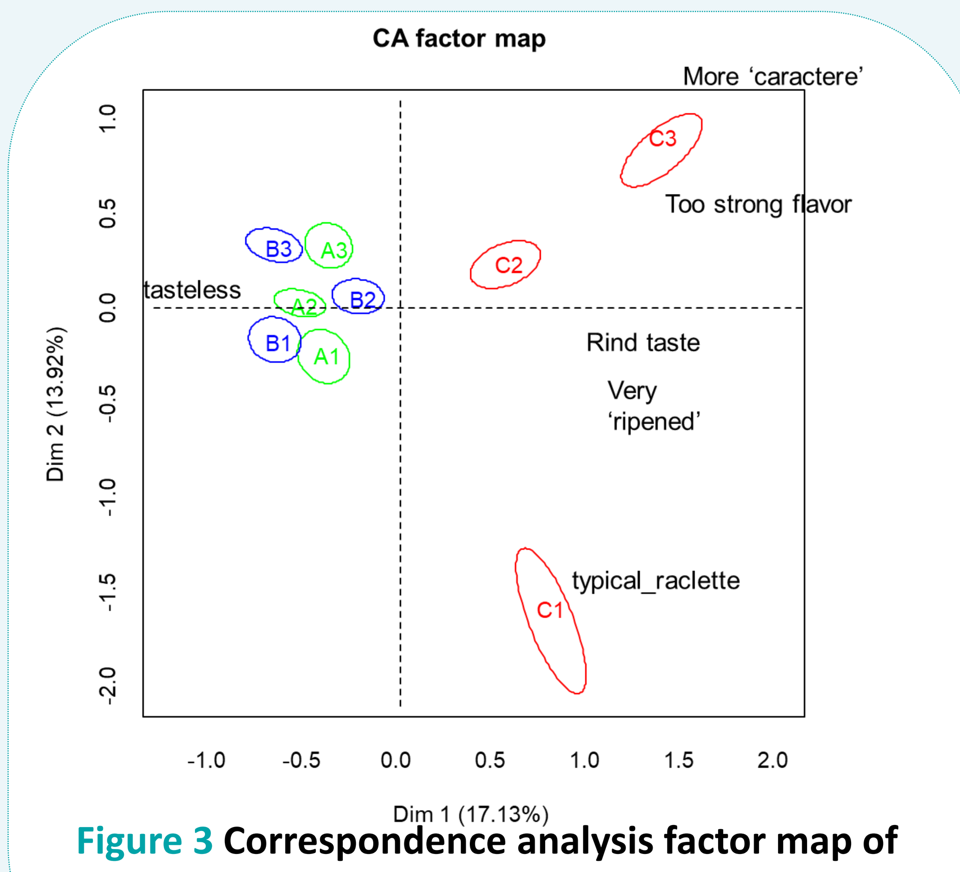


Figure 3 Correspondence analysis factor map of sensory data

only a few flavor descriptors are shown

- ✓ **Methods:**
  - Sensory evaluation of cheese slices heated in a equipment for raclette by panel of 48 untrained judges
  - Data analyzed using the R *FactorMineR* package by generating a contingency table.
  - Correspondence analysis (CA) performed from the contingency table and plotted with confidence ellipse
- ✓ **Results:**
  - Cheeses A and B very close for their sensory characteristics; cheese C distinguished from cheeses A and B on the 1st dimension of CA
  - Cheeses A and B ripened under oxygen-barrier wrapping films described as tasteless, while cheeses C with a natural smear characterized by a stronger and typical flavor and odor

CONCLUSION

- ✓ The combination of several chromatographic methods, including the use of two extraction methods coupled to GC-MS led to the identification of > 90 metabolites.
- ✓ 20 odorant volatiles identified by GC-olfactometry.
- ✓ The metabolites present in a significant greater abundance in cheeses C include a range of compounds arising from amino acid catabolism and lipolysis likely associated with surface microbiota activity
- ✓ These results contribute to a better knowledge of key odorants in smear-ripened cheeses and confirm the crucial role of surface microbiota in their production.

Centre Bretagne - Normandie
65 rue de Saint Brieuc
35 042 Rennes Cedex
anne.thierry@inrae.fr