Technological parameters influence the accumulation of biogenic amines in cheese

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Introduction

Biogenic amines (BA) can be formed in cheese during the ripening process through the activity of bacteria that are capable of decarboxylating amino acids. The main BA found in cheese, such as histamine, tyramine, β-phenylethylamine, cadaverine, putrescine and tryptamine, originate from the amino acids histidine, tyrosine, phenylalanine, lysine, ornithine and tryptophan, respectively. Decarboxylation reactions also release CO_2, increasing eye formation or causing cracking. Furthermore, histamine and tyramine pose a health risk and impair taste. Therefore, knowledge of the formation of biogenic amines in traditional cheese varieties is important.

Material and Methods

A total of 1'441 BA analysis results from cheese were extracted from the Agroscope LIMS database from 2001 to 2024. Before statistical analysis and visualisation, the data were labelled according to cheese type, milk treatment, and type of surface ripening (Table 1). Samples had been analysed for their BA content either because they had a quality concern or because of a regular quality control. Therefore, the results do not represent commercial cheeses of good quality.

Table 1: distribution of the data

cheese type	milk treatment	N
extra-hard	raw	46
hard	pasteurised	3
	raw	455
semi-hard	pasteurised	76
	thermised	83
	therm & raw	103
	raw	589
soft	raw	4

cheese type	ripening	N
extra-hard	smear & dry	18
	dry	28
hard	smear	176
	smear & dry	10
	dry	273
semi-hard	mould	26
	smear	903
soft	mould	4

Results

1. The lower the curd cooking temperature or the higher the water content of a cheese, the higher its BA content, especially of histamine, tyramine, cadaverine and putrescine (see Figures 1 and 2).
2. Interestingly, however, raw milk cheeses do not always have the highest levels of BAs. As shown in Figure 3, the histamine content of semi-hard cheeses was highest when raw milk had been added to thermised milk. The BA-forming bacteria from the raw milk such as *Lentilactobacillus parabuchneri* were able to dominate probably due to minimal competition from the thermised milk.
3. Cadaverine was only found in smear-ripened cheeses or those with a high surface moisture content. Gram-negative bacteria, such as *Morganella morganii, Klebsiella oxytoca* and *Hafnia alvei*, are known to produce cadaverine and putrescine on the surface of cheeses.

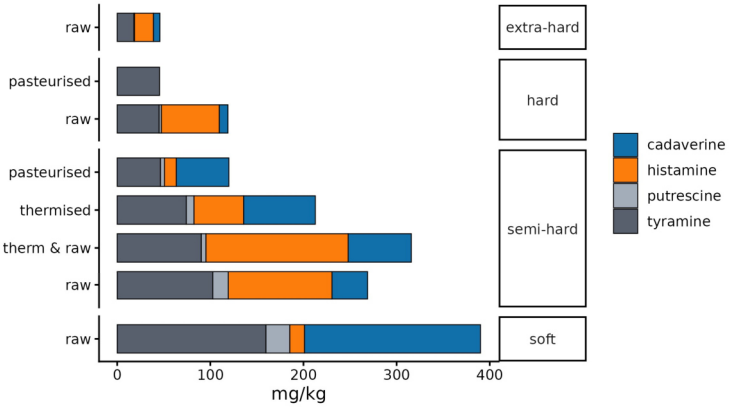


Figure 1: Mean BA content in cheese grouped by cheese type and milk treatment. For sample numbers see Table 1.

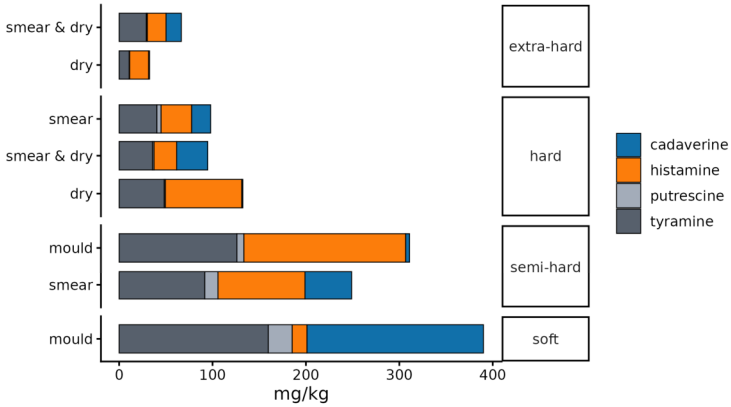


Figure 2: Mean BA content in cheese grouped by cheese type and surface ripening. For sample numbers see Table 1.

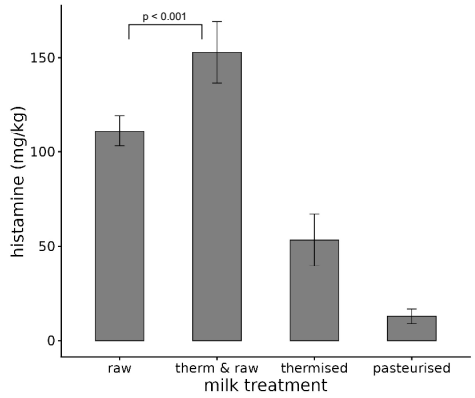


Figure 3: Milk treatment and histamine formation in cheese.

Summary

The influence of technological factors on the extent of BA accumulation was investigated in 1441 cheese samples, including those with quality issues and those routinely tested, which were collected by Agroscope between 2001 and 2024.

Results showed that cheeses with lower curd cooking temperature and higher water content generally contained higher BA levels, particularly histamine, tyramine, cadaverine and putrescine. Semi-hard cheeses made from a mixture of raw and thermised milk exhibited the highest histamine concentrations. Cadaverine was mainly detected in smear-ripened cheeses, likely due to surface-growing gram-negative bacteria.

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