Effects of scalding temperature on the growth of *Staphylococcus aureus* and the formation of enterotoxins in the production of alpine hard cheese

L. Schwendimann, E. Jakob, D. Weik, H.U. Graber, H.P. Bachmann, T. Berger
Agroscope, CH-3003 Bern; www.agroscope.ch

The Swiss Hygiene Ordinance ([1], equiv. CR 2073/2005) stipulates that cheese must be tested for coagulase-positive staphylococci as part of process hygiene control. If the maximum value is exceeded, the cheeses must be tested for enterotoxins and, if necessary, destroyed. Up to now, hard cheeses produced in alpine cheese dairies have been an exception and may not be subjected to this test. In order for the exemption to continue, the legislator now requires proof that it is justified.

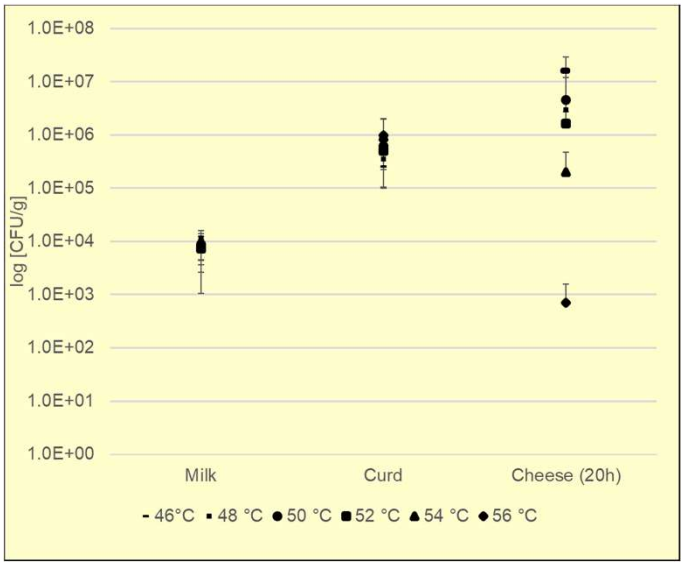

Figure 1: Concentration (CFU/g) coagulase-positive staphylococci (strain C) after adding the inoculum (in milk), in curd before scalding and in cheese after 20 h

Results and Discussion

- The measured parameters of the laboratory cheese (pH, temperature profile, yield) are comparable to the common practice in the cheese dairies (Figure 1, influence on CPS) → **the results for the formation of enterotoxin can be considered realistic**
- The formation of toxin also occurred in part at a high scalding temperature (56 °C) [2] and at lower concentrations (10^3 CFU/g) [3], which contradicts descriptions in literature
- Differences between the strains were greater than between the scalding temperatures (Table 1)

Experimental design

- 6 different scalding temperatures: 46, 48, 50, 52, 54, 56 °C
- 5 different strains of *S. aureus* (a-e)
- Level of contamination: 10^3 CFU / ml

Analysis

- Temperature profile during the whole process
- pH measurment during cooling
- Coagulase-positive staphylococci (TEMPO® STA) in raw milk, curd and cheese after 20 h
- Staphylococcal enterotoxins A-E (SET) in 20 h cheese (qualitative, mini VIDAS®, EURL reference method)

Table 1: Results of enterotoxin detection (SET) in cheese after 20 h, five different scalding temperatures and five different strains (a-e): green = 100% negative, 0% <yellow <85% positive, red> 85% positive

		Strain				
		a	b	c	d	e
Scalding Temperature [°C]	46	neg (5)	pos (5)	pos (6)	pos (5) neg (1)	neg (6)
	48	neg (4)	pos (5)	pos (6)	pos (7)	neg (6)
	50	neg (4)	pos (7)	pos (6)	pos (6) neg (1)	neg (4)
	52	neg (4)	pos (5)	pos (6) neg (1)	pos (3) neg (2)	neg (6)
	54	neg (3)	pos (3) neg (2)	pos (4) neg (1)	neg (6)	neg (6)
	56	neg (2)	Pos (2) neg(4)	pos (1) neg (3)	neg (8)	neg (5)

Conclusions

- Based on these results, the current derogation must be reconsidered
- The mechanisms of toxin formation and the surprising differences between the individual strains need to be better studied

References

[1] Hygieneverordnung des EDI (HyV) vom 23. November 2005 (SR 817.024.1)
[2] Cretenet, M.; Even, S.; Le Loir, Y. (2011). *Dairy Sci. & Technol., 91*. S. 127-150.
[3] Ercolini, D.; Blaiotta, G.; Fusco, V.; Coppola, S. (2004). *J Appl Microbiol, 96*, S. 1090-1096.

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