

The Salt Dilemma with Emmentaler

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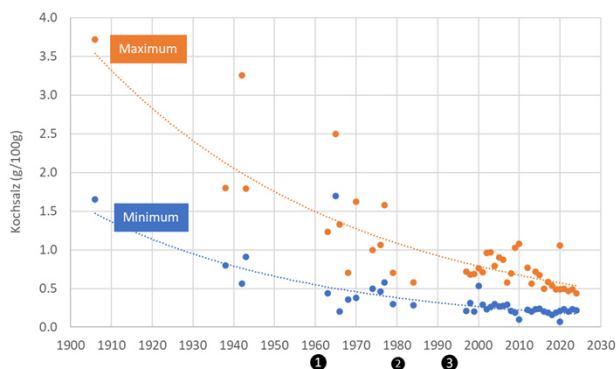
FACE technology group 26.8.2025

www.agroscope.ch | gutes Essen, gesunde Umwelt

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At the beginning...

... salt content was (very) high.



sources: literature & database Agroscope

Author	Year	Mean	Standard deviation	Range
J. B. B. B. B.	1900	10	1.00	1.00 - 1.20
J. B. B. B. B.	1905	12	1.20	1.20 - 1.40
J. B. B. B. B.	1910	15	1.50	1.50 - 1.70
J. B. B. B. B.	1915	18	1.80	1.80 - 2.00
J. B. B. B. B.	1920	20	2.00	2.00 - 2.20
J. B. B. B. B.	1925	22	2.20	2.20 - 2.40
J. B. B. B. B.	1930	25	2.50	2.50 - 2.70
J. B. B. B. B.	1935	28	2.80	2.80 - 3.00
J. B. B. B. B.	1940	30	3.00	3.00 - 3.20
J. B. B. B. B.	1945	32	3.20	3.20 - 3.40
J. B. B. B. B.	1950	35	3.50	3.50 - 3.70
J. B. B. B. B.	1955	38	3.80	3.80 - 4.00
J. B. B. B. B.	1960	40	4.00	4.00 - 4.20
J. B. B. B. B.	1965	42	4.20	4.20 - 4.40
J. B. B. B. B.	1970	45	4.50	4.50 - 4.70
J. B. B. B. B.	1975	48	4.80	4.80 - 5.00
J. B. B. B. B.	1980	50	5.00	5.00 - 5.20
J. B. B. B. B.	1985	52	5.20	5.20 - 5.40
J. B. B. B. B.	1990	55	5.50	5.50 - 5.70
J. B. B. B. B.	1995	58	5.80	5.80 - 6.00
J. B. B. B. B.	2000	60	6.00	6.00 - 6.20
J. B. B. B. B.	2005	62	6.20	6.20 - 6.40
J. B. B. B. B.	2010	65	6.50	6.50 - 6.70
J. B. B. B. B.	2015	68	6.80	6.80 - 7.00
J. B. B. B. B.	2020	70	7.00	7.00 - 7.20
J. B. B. B. B.	2025	72	7.20	7.20 - 7.40

- 1: no dry salting of the surface
- 2: control of late fermentation
- 3: improvement of texture and nutritional properties

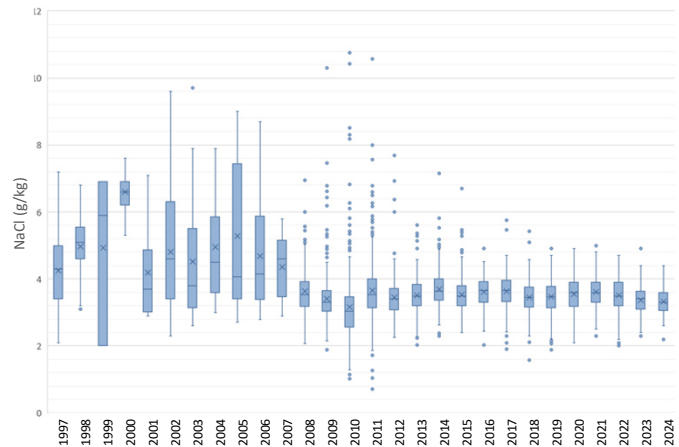
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Successful reduction of NaCl content

The decisive factors were:

1. No dry salting from the 1970s onwards
2. Aim to consume less salt in food
3. Significantly smoother texture properties
4. Successful reduction in cases of post-fermentation thanks to facultative heterofermentative lactobacilli & Prop 96



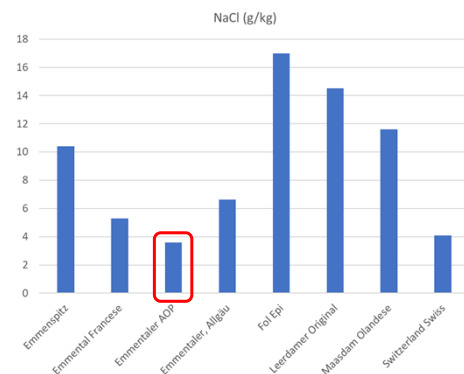
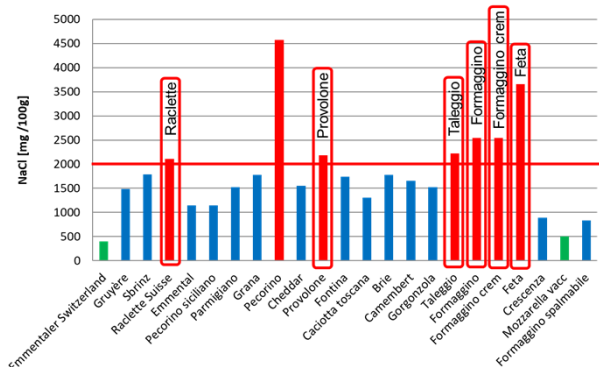
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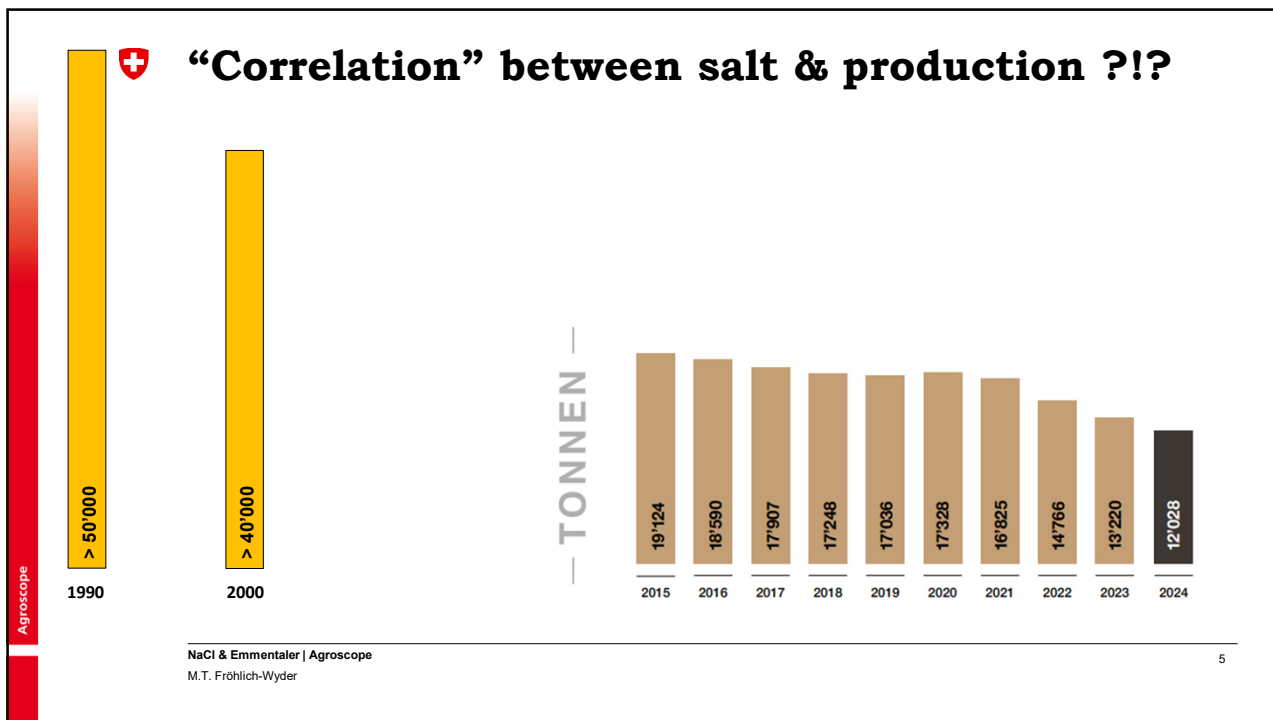
Compared to other (Swiss-type) cheeses

Very low salt content!

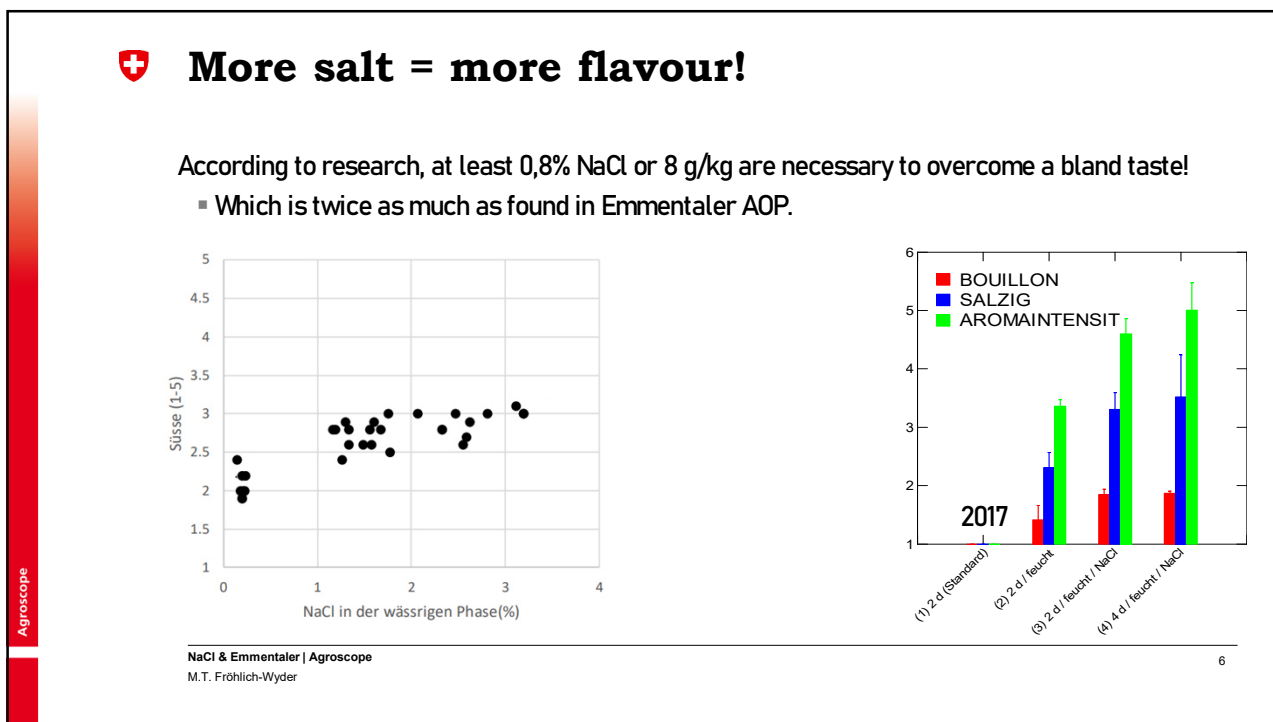


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How can we influence salt uptake?

Brine: concentration, temperature, duration, ...

ALP Focus 2005, No. 34 d

EINFLUSS
DER SALZLAKE AUF DIE KÄSEQUALITÄT
(Einsalzungsregeln)



ALP Focus 2005, No. 35 d

DAS SALZ UND SEINE BEDEUTUNG
(Salzbestimmung)



Lebensmittel
ihre verschärfte
Aufgabe am Beispiel der ...



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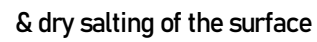
Trials at our pilot-plant with 8 cheese vats



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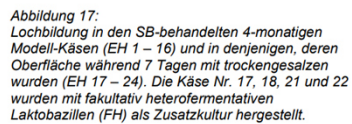
How can we increase salt uptake?



EH-Nr	Tag	Bedingungen Salzbad [° Bé]:	Temperatur [°C]:	Zeit [h]:
1	7.9.	15° Bé	11°C	24h
2		21° Bé	11°C	24h
3		15° Bé	11°C	72h
4		21° Bé	11°C	72h
5		15° Bé	16°C	24h
6		21° Bé	16°C	24h
7		15° Bé	16°C	72h
8		21° Bé	16°C	72h

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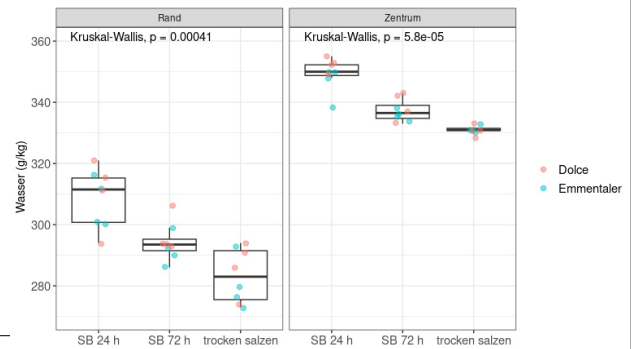
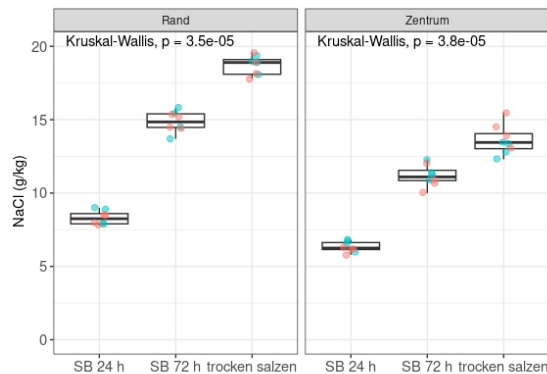
Strongest impact: time

Duration and dry salting:

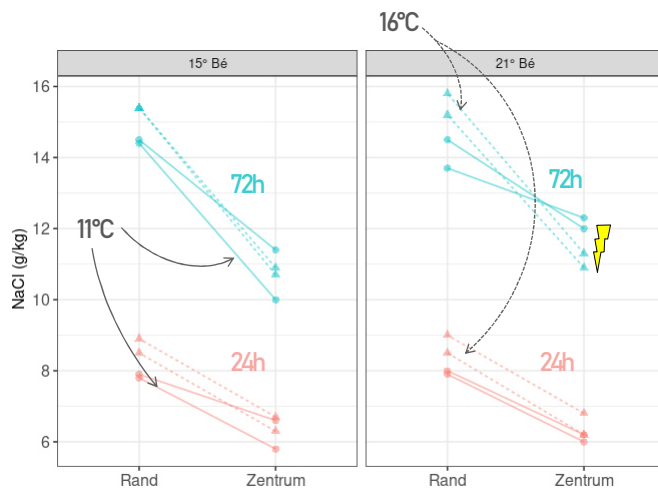
- The longer in the brine
- And dry salting after 24 h in the brine

But:

- Greater water loss!



Contradictory impact: temperature



Higher brine temperature of 16°C:

- Higher salt uptake ONLY in the outer zone
- Lower salt uptake in the inside of the cheese

Probably:

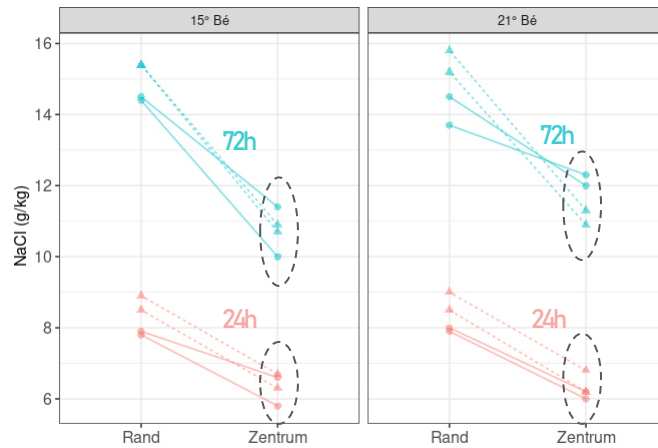
- less permeable cheese surface at 16 °C due to more liquefied milk fat and/or to the lower porosity of the interface at 16 °C compared to 11 °C

Highest salt uptake:

- 72 h and 11°C



No or weak impact: concentration



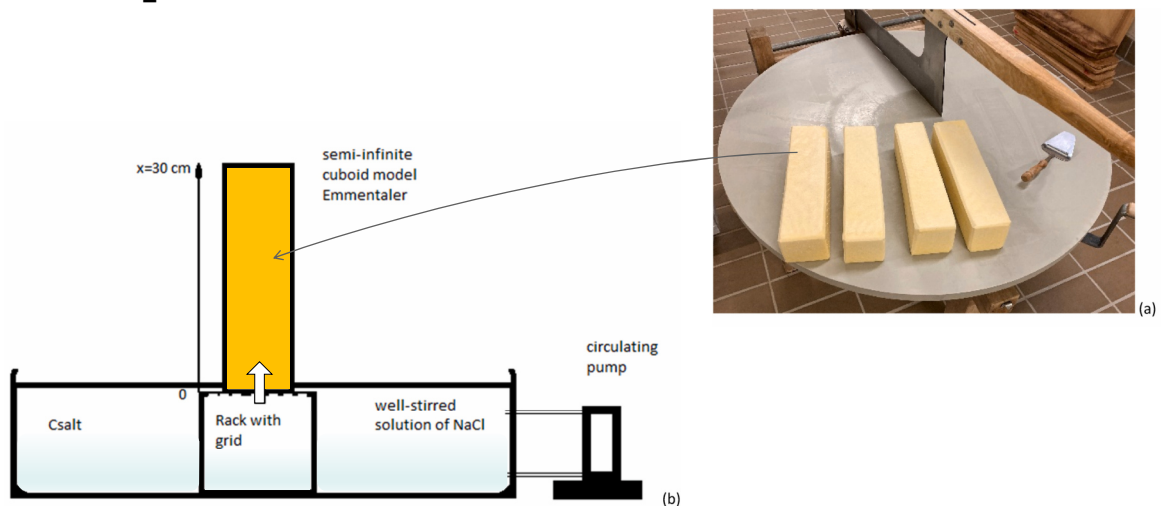
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Experiment with cheese cuboids



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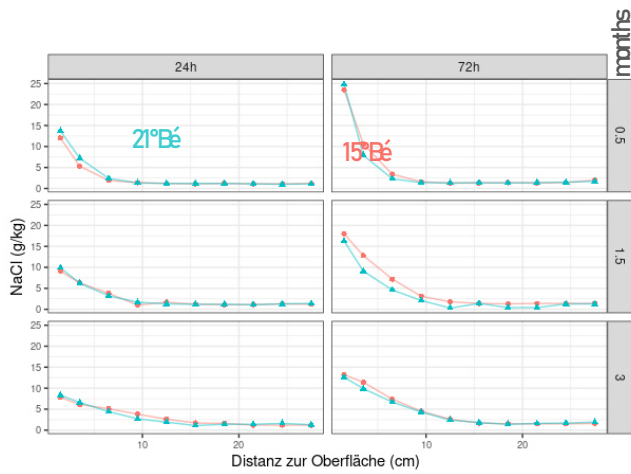
Adapted from: D. Guggisberg, W. Bisig, F. Loosli, R. Stoop, R. S. Schmidt, M.T. Fröhlich-Wyder (2025). Optimizing NaCl uptake in experimental Emmentaler cheese: Effects of brining concentration, temperature, and duration, IDJ, 170, 106383, <https://doi.org/10.1016/j.idairy.2025.106383>

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Same impacts on salt uptake



Strongest impact

- 72h in the brine of 11°C

Contradictory impact

- 16°C

No (relevant) impact

- Concentration of 15°Bé compared to 21°Bé

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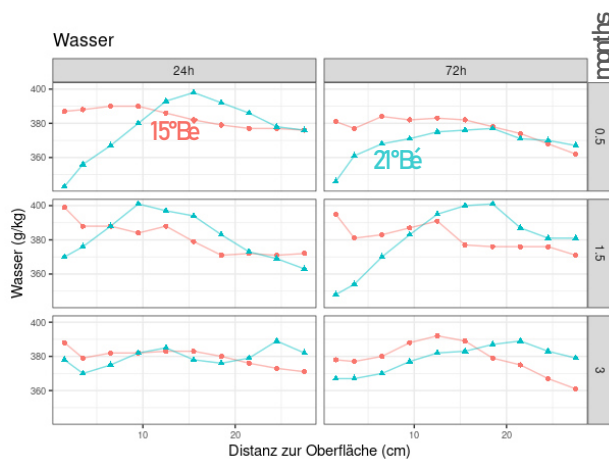
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Impact on water distribution



- 72h: highest water loss
- 21°Bé: heterogeneous water distribution
- 15°Bé: homogenous water distribution from the starting point

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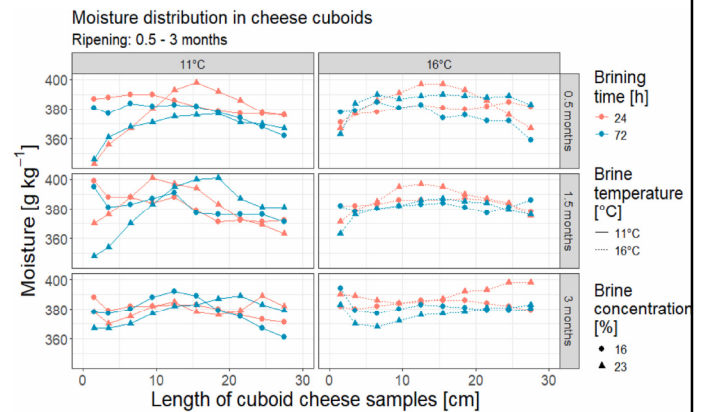
Temperature of 16°C

Water :

- More homogeneous
- Lower water loss

Conclusion:

- The sealed surface (liquefied fat or less porous protein matrix) inhibited not only NaCl uptake but also water loss.



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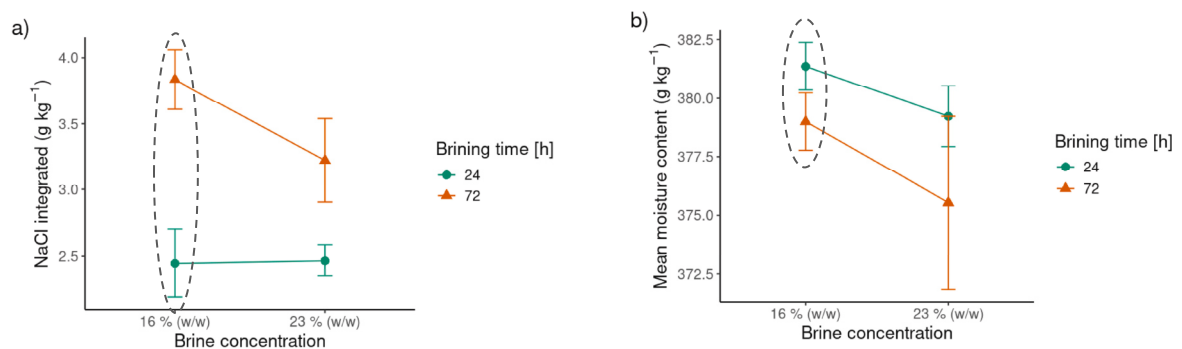
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Promising factor combination

Lower brine concentration and longer period of time in the brine

- Higher salt uptake, but comparably lower water loss



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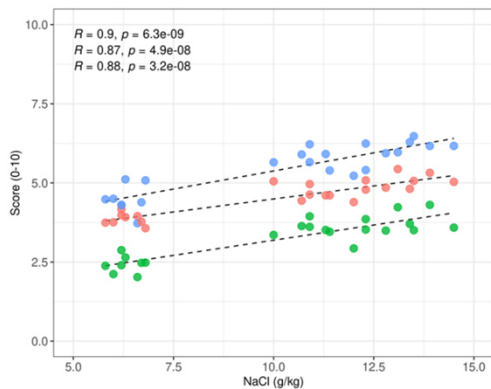
D. Guggisberg, W. Bisig, F. Loosli, R. Stoop, R. S. Schmidt, M.T. Fröhlich-Wyder (2025). Optimizing NaCl uptake in experimental Emmentaler cheese: Effects of brining concentration, temperature, and duration, IDJ, 170, 106383,
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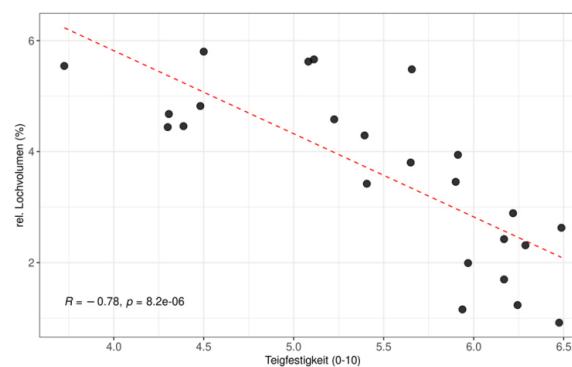
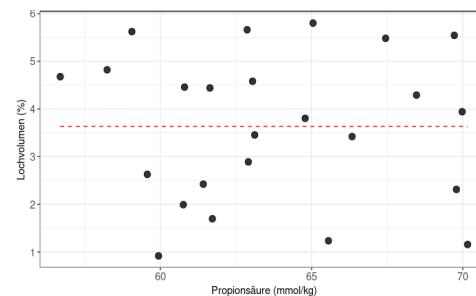
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Further results



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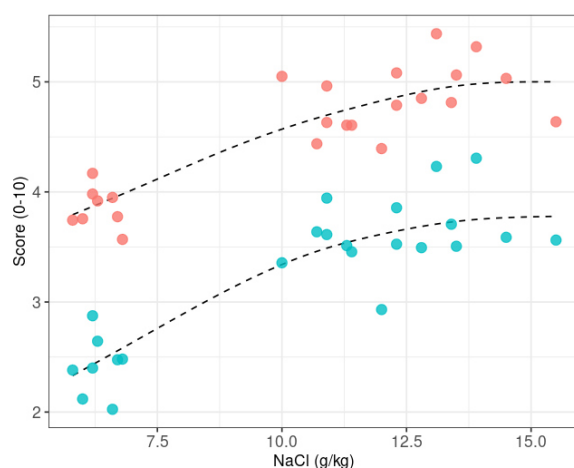


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Continued



Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.05816	0.49672	2.13	0.05282 .
C2	0.04061	0.01025	3.96	0.00163 **
NaCl	0.14182	0.01384	10.25	1.35e-07 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.203 on 13 degrees of freedom
Multiple R-squared: 0.9137, Adjusted R-squared: 0.9004
F-statistic: 68.83 on 2 and 13 DF, p-value: 1.213e-07

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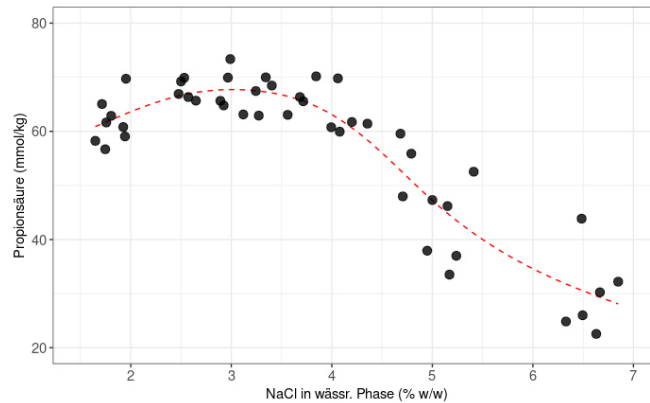
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Continued: propionic acid fermentation

All data of model cheeses: Optimum at ~3 % in aqueous Phase
Optimum at ~9-10 g/kg



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Final conclusion

A minimal salt content of 9 g/kg is needed:

- Flavour
- Propionibacteria (strain dependent)

New insights:

- Best salt uptake with minimalized waterloss at a concentration of 15°Bé (16 % (w/w)), 11°C and 72 h
- Higher brine temperature can inhibit salt uptake



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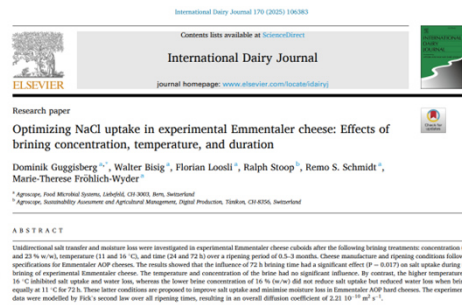


Results are very complex

For details look at our publications:



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Danke für Ihre Aufmerksamkeit

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