

# Effects of citrate addition in presence of lactic acid bacteria on cream and butter aroma

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## Introduction

Citrate-metabolizing lactic acid bacteria (LAB) are able to produce buttery aroma compounds such as diacetyl and acetoin in fermented dairy products. The majority of the studies on citrate metabolism have focused on batch fermentations in defined growth media or milk [1–3]. Only a few have described the effects of citrate addition on the final dairy products [4,5].

## Objective

The effects of citrate addition on diacetyl and acetoin formation, first in cream fermentations and then in bench-scale butter fabrication simulating a real dairy production process, were investigated. The formation of target compounds was monitored analytically, and corresponding “buttery/creamy” odor and aroma notes were evaluated by sensory descriptive analysis. Additionally, the panelists indicated their preference for the different butters.

## Experimental

**First step:** *Lc. lactis* subsp. *lactis* biovar. *diacetylactis* FAM18027 was selected from the Agroscope Strain Collection for its ability to produce diacetyl and acetoin in full-fat cream (with a natural citrate content of about 0.2 %, but also an increased content of about 1 %) after fermentation at 30 °C for 24 h.

**Second step:** The formation of diacetyl and acetoin by FAM18027 in butter made from supplemented (1 % of citrate either in starter culture or in the fermentation cream) and non-supplemented cream was investigated (fermentation during butter production: 22 °C, 18 h).

## Analyses:

- Diacetyl/acetoin: monitoring by headspace solid phase microextraction-gas chromatography-mass spectrometry (HS-SPME-GC-MS) and quantification by HS-GC/flame ionization detection (HS-GC/FID)
- Citrate was measured by enzymatic assay (R-Biopharm AG)
- Sensory analysis: intensities of “buttery/creamy” odor and aroma were evaluated by a trained sensory panel ( $n=12$ )

## Results: First step: fermentation in cream

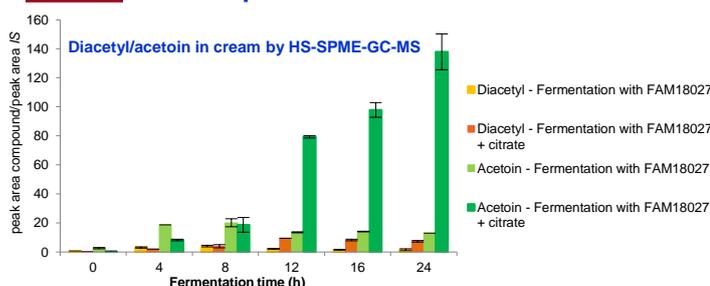


Fig 1. Monitoring of diacetyl and acetoin formation during fermentation of strain FAM18027 in cream (24 h, 30 °C) with and without citrate supplementation. Mean values and mean relative deviation of two independent experiments. IS= internal standard

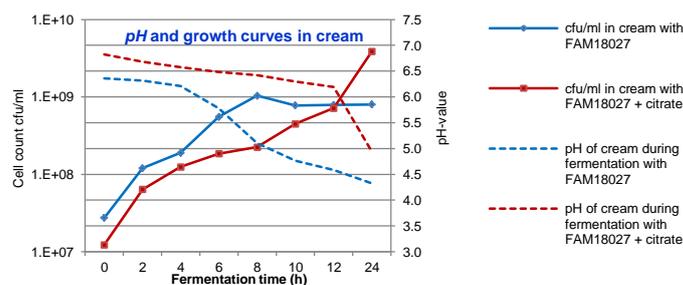


Fig 2. Cell count of FAM18027 and pH-curves of cream during fermentation for 24 h at 30 °C with and without citrate supplementation. Mean values of two independent experiments.

- after 12 h of fermentation in supplemented cream, diacetyl and acetoin signals were about four and six times higher compared to samples fermented without citrate addition (Fig. 1)
- citrate supplementation slowed down strain growth and consequently delayed acidification, in particular until 11 h of fermentation (Fig. 2)

## Results: Second step: butter production

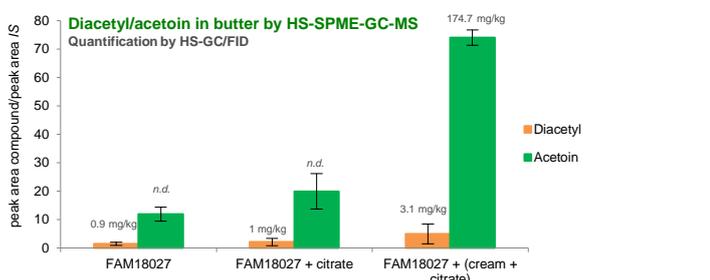


Fig 3. Diacetyl and acetoin formation in butter with and without citrate supplementation. Mean values and mean relative deviation of two independent experiments. IS= internal standard; in gray: quantitated content determined by HS-GC/FID; n.d.= not detected by HS-GC/FID quantitative method; ranges of measurement of the quantitative method are 0.5–200mg/L for diacetyl and 10–1100mg/L for acetoin

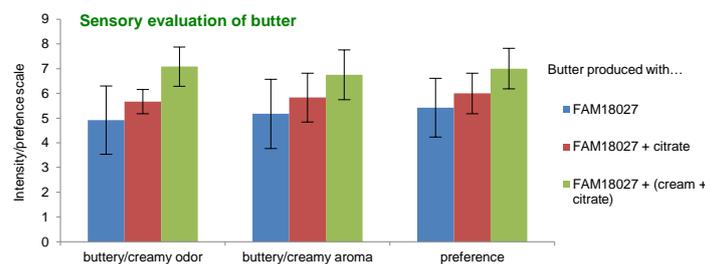


Fig 4. Sensory evaluation of the odor and aroma attributes “buttery/creamy” and panelist preference of butter samples with and without citrate supplementation. Panel  $n=12$

- butter samples made from supplemented cream showed higher signals for diacetyl and acetoin (Fig. 3)
- in all trials, citrate was completely metabolized by FAM18027 by the end of the fermentation (data not shown)
- target odor and aroma notes “buttery/creamy” were in general more intensely rated in butters made from supplemented trials, and especially when citrate was added directly to the cream and not only to the pre-culture. These samples were also preferred by the panelists (Fig. 4)

## Conclusion

Addition of citrate led to higher signals for buttery aroma compounds such as diacetyl and acetoin in both fermented cream and butter samples. Furthermore, the enhancement of buttery and creamy flavor notes due to citrate addition was clearly perceived by the panelists during sensory evaluation and resulted in a tendency towards higher intensity ratings as well as a higher preference for citrate supplemented samples.

## References

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