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Positive interactions between lactic acid bacteria promoted by nitrogen-based nutritional dependencies

Fanny Canon, Marie-Bernadette Maillard, Gwénaëlle Henry, Anne Thiery, Valérie Gagnaire
UMR STLO, INRAE, Institut Agro, FRANCE

CONTEXT & AIM
- Lactic acid bacteria (LAB) are associated and interact in fermented food products but the mechanisms underlying their interactions have rarely been investigated in depth.
- Nutritional dependencies, especially those regarding nitrogen sources, govern many microbial positive interactions (Canon et al., 2020).
- This study aims to investigate the exploitation of the proteolytic activity and amino acid auxotrophies of LAB strains to promote positive interactions between proteolytic (“donors”) and non-proteolytic “receivers” strains.

STRATEGY
- Selection of six LAB strains: 3 donors: proteolytic activity + volatile compounds production + lactose consumption 3 receivers: no proteolytic activity + hydrolysis of raffinose family oligosaccharides
- Development of a chemically defined medium containing caseins and lignin proteins as sole nitrogen sources (growth of proteolytic strains only)
- Association of pairs of donor/receiver strains to favour positive interactions (Figure 1)

RESULTS
- Growth of each pair strains in compartmented chambers (Figure 2) to facilitate bacterial growth monitoring at 30 °C for 24 h, orbital shaking 65 rpm
- Characterization of the resulting functional outputs:
  - Carbohydrate consumption, quantified by anion exchange chromatography
  - Volatile compound production, analysed by headspace GC-MS

Volatile compounds

- Ratio culture:control calculated for each volatile compound identified

Co-cultures increased the concentrations of volatile compounds associated with desirable flavours
- Co-cultures influenced volatile compounds production
- More differences were observed with stronger interactions
- Diacetyl (buttery), acetoin (milky), 2,3-pentanedione (butter), benzaldehyde (nutty) concentrations also increased

CONCLUSION & PERSPECTIVES
- The proteolytic activity of LAB can favour the growth of non-proteolytic LAB
- All proteolytic activities are not equally stimulating: moderate activities such as for Lla2125 and Lla244 lead to weak or no interactions
- Positive interactions changed carbohydrate consumption and production of volatile compounds
- The study of the nitrogen compounds used by the receiver strains will be further investigated to understand how the proteolytic and non-proteolytic strains positively interact