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Natural Ingredient Cheese Solutions



Key external stakeholders:

Dairy Industry, Food Manufacturers

Practical implications for stakeholders:

Methods to augment, accelerate and diversify cheese flavour

- A method to attenuate lactic acid bacteria for use as adjuncts to augment cheese flavour.
- Rapid methods to screen lactic acid bacteria for flavour potential.
- Database of key volatile cheese flavour compounds.
- Protocols for production of cheese concentrates, using attenuated lactic acid bacteria.
- Development of a yeast based encapsulation system to augment cheese flavour development.
- Use of camel chymosin to alter texture in low moisture part-skim Mozzarella.
- Protocols for accelerating and diversifying cheese flavour in ingredient cheese applications.

The study has highlighted a number of approaches to control, augment, accelerate and diversify cheese flavour in a range of different applications.

Main results:

- Microfluidization is a useful technique to attenuate lactic bacteria and yeast to enhance their flavour development capability.
- Attenuated yeast can be used to entrap enzymes critical for cheese flavour development and to control their subsequent release into the cheese matrix during ripening to accelerate flavour development.
- Production of fast-ripened cheeses with diverse flavours for use in ingredient applications
- Model system to rapidly screen lactic acid bacteria, enzymes and yeasts for cheese flavour development.

Opportunity / Benefit:

Researchers involved in this project have the experience and expertise to aid producers to alter existing cheese products or develop new cheese flavour concepts using natural lactic acid bacteria, yeasts, enzymes. Extensive knowledge and expertise exists in the flavour chemistry facility at Teagasc Food Research Centre Moorepark in the extraction, concentration and identification of cheese flavour volatiles. Consultancy and contract research opportunities are available to both national and international clients in the area of cheese flavour development.

Collaborating Institutions:

University of Limerick
University College Cork

Teagasc project team: Dr Kieran Kilcawley (PI)
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External collaborators: Prof Martin Wilkinson (University of Limerick)
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1. Project background:

The use of cheese as an ingredient has grown steadily and is predicted to continue to do so as consumers demand more sophisticated high quality natural semi-processed and processed foods due to less available “quality time”. The market now demands natural wholesome cost effective products and cheese meets this demand as it can provide a multitude of functions, with regard to visual, textural, flavour and aroma appeal. The rationale behind this project involves the development of natural cheese concentrates and a range of cost effective natural ingredient cheeses to meet this growing market. This project explores and exploits natural biochemical pathways in lactic acid bacteria and yeasts to create concentrated cheese flavours and ingredient cheeses with diverse flavours to meet current and future market demands for clean label dairy products.

2. Questions addressed by the project:

- Can cheese flavour development be controlled and accelerated in the production of cheese concentrates, cheese and cheeses for ingredient applications?
- What different mechanisms can be used to accelerate natural cheese ripening that can be practically applied at commercial level?
- Is microfluidization a feasible technique to attenuate lactic acid bacteria and yeasts for use as adjunct cultures in cheese ripening?
- Can concentrated cheese flavours be developed using attenuated lactic acid bacteria?
- Can attenuated yeast be used to deliver key flavour producing enzymes into the cheese matrix to accelerate ripening?
- Can suitable model systems be developed to rapidly screen lactic acid bacteria and yeasts for their ability to produce key cheese flavour compounds?
- What is the impact of adding hydrolysed dairy substrates/concentrated cheese flavours into the cheese matrix during manufacture?
- What is the impact of different chymosin sources on the quality of low-moisture part skim Mozzarella cheese?
- What is the combined effect of applying different techniques to boost cheese flavour formation in semi-hard type cheeses?

3. The experimental studies:

- The results clearly highlighted that incorporation of adjunct cultures and increased ripening temperatures can be easily applied to control flavour formation in semi-hard cheese, but that other strategies, such as incorporation of attenuated yeast, entrapped cell free extract and added hydrolyzed dairy substrates can also be successfully applied.
- Microfluidization was proven to be a very simple, practical technique to control the degree of attenuation of lactic acid bacteria and yeast for use as adjuncts in cheese flavour development.
- Attenuated cultures can be used in combination with commercial enzymes to develop concentrated cheese flavours.
- Yeast attenuated by microfluidization was successfully used to entrap a cell free extract of lactic acid bacteria and subsequently used to augment, control and accelerate flavour development in cheese for ingredient applications.
- Two separate model systems were successfully used to rapidly screen lactic acid bacteria for their cheese flavour potential.
- A spray dried cheese concentrate consisting primarily of hydrolysed sodium caseinate, cream and

water was successfully added to a Cheddar type cheese process during dry salting. This provided more available substrate for metabolic reactions during the early stages of cheese ripening to augment, accelerate and diversify flavour formation.

- The use of camel chymosin did not affect composition or meltability of low-moisture part skim Mozzarella cheese, but did increase proteolysis which subsequently impacted on cheese texture.
- The combined effects of the addition of adjunct cultures, increased ripening temperatures, inclusion of attenuated yeast, entrapped cell free extracts and inclusion of additional hydrolysed dairy substrates modified flavour development in semi-hard type cheeses.

4. Main results:

- Optimisation of attenuation by microfluidization of lactic acid bacteria and yeasts for use as adjuncts in the development of concentrate cheese flavours, cheeses or ingredient type cheeses.
- Successful entrapment of enzymes in attenuated yeast and subsequent use in semi-hard type cheeses.
- Development of model systems to rapidly screen lactic acid bacteria for cheese flavour potential.
- Production of concentrated cheese flavours using enzymes and attenuated lactic acid bacteria.
- Incorporation of spray dried cheese concentrates into cheese curd during production to augment flavour development.
- Comparison of the impact of camel and calf chymosin in the production of low-moisture part skim Mozzarella.
- Development of a data base of key volatile compounds that are involved in cheese flavour.
- Assessment of the impact of a range of combined approaches (adjunct cultures, raised ripening temperatures, attenuated yeast, entrapped enzymes & added cheese concentrates) to augment, control, accelerate or diversify flavour in cheeses for ingredient applications.

5. Opportunity/Benefit:

Consultancy and contract research opportunities are available to both national and international clients in the cheese flavour area.

6. Dissemination:

The information generated as part of this study was disseminated over the project lifespan on 34 occasions (workshops, conferences, symposia and meetings).

Main publications:

Yarlagadda, A.B., Wilkinson, M.G., Ryan, S.P., Doolan, I.A., O'Sullivan, M.G & Kilcawley, K.N (2014), Utilisation of a cell-free extract of lactic acid bacteria entrapped in yeast to enhance flavour development in Cheddar cheese. *International Journal of Dairy Technology*, 67, (1) 21-30.

Yarlagadda, A.B., Wilkinson, M.G., O'Sullivan, M.G & Kilcawley, K.N (2014). Utilisation of microfluidization to enhance enzymatic and metabolic potential of lactococcal strains as adjuncts in Gouda type cheese. *International Dairy Journal*, 38, (2), 124-132.

Moynihan, AC., Govindasamy-Lucey, S., Jaeggi, JJ., Johnson, M.E, Lucey, J.A & McSweeney, P.L.H (2014), Effect of camel chymosin on the texture, functionality, and sensory properties of low-moisture, part-skim Mozzarella cheese, *Journal of Dairy Science*, 97, (1), 85-96.

7. Compiled by: Kieran N Kilcawley