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## Buttermilk powder and cheese yield



**Key external stakeholders:**  
Dairy processing industry

### Practical implications for stakeholders:

The chief recommendation is that although buttermilk powder is readily available and despite containing high levels of potential natural emulsifiers, its use to fortify cheese milk protein levels results in significantly reduced adjusted cheese yield due to increased losses of both fat and protein to whey.

- Fortification of cheese milk with buttermilk powder results in cheeses with significantly higher levels of moisture and moisture-in-non-fat-substance levels, while fortification with milk ultra filtration retentate produces cheeses with significantly lower levels of moisture and moisture-in-non-fat-substance levels, in comparison to cheeses produced from control cheese milks
- Fat losses to whey were higher (20-30 %) in cheeses produced from milks fortified with buttermilk powder compared to control cheeses (15-18 %) and were significantly higher when compared to cheeses produced from milks fortified with milk ultra filtration retentate (9-12%).
- Analysis of moisture adjusted cheese yields in which fat and protein contents adjusted to reference levels showed yields of cheeses produced from milks fortified with buttermilk powder (10.48 %) were lower than control cheeses ( 10.85 %) and were significantly lower than cheeses produced from milks fortified with milk ultra filtration retentate (11.42 %).

### Main results:

- This study concluded that despite containing high levels of potential natural emulsifiers, use of buttermilk powder to fortify cheese milk protein levels results in significantly reduced cheese yield due to increased losses of both fat and protein to whey.
- However the study does highlight the potential for the cheese industry for fortification of cheese milk with milk ultra filtrate to reduce losses to whey and to increase cheese production efficiencies.

### Opportunity / Benefit:

The enhanced knowledge base arising from this study is available to industry decision makers to assist moves to increase cheese manufacture yield efficiency.

### Collaborating Institutions:

N/A

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**External collaborators:** N/A

### 1. Project background:

A by-product of buttermaking, buttermilk constitutes the serum phase of cream along with Milk Fat Globule Membrane (MFGM) components released during the emulsion break point when butter is being formed. Buttermilk is usually spray dried or used directly as an ingredient e.g. in baking applications, and has been considered a low value added material (although recent studies have indicated some functional and nutritional properties of specific buttermilk components). However, as MFGM contains a mixture of proteins, glycoproteins, and phospholipids, all of which can act as emulsifiers there is increased interest in its use to increase cheese yield and/or ameliorate poor texture properties of reduced fat cheeses. Some previous research has suggested that incorporation of Ultra-filtered (UF) buttermilk into cheese milk results in increased moisture, protein and potentially fat component retention in cheese. However UF process facilities are not available in all Irish processing plants. Contrary to UF concentrated buttermilk, buttermilk powder (BMP) is widely commercially available within Ireland, is readily transportable and offers stability under storage for long periods if comparison to UF retentate.

### 2. Questions addressed by the project:

Could buttermilk powder be used to:

- fortify protein levels in cheese milk and thus to increase cheese plant throughput?
- enhance cheese yield?
- to reduce fat losses to whey due to emulsification properties of the MFGM components?

### 3. The experimental studies:

We prepared control and experimental cheese milks using various proportions of raw milk, cream, skim milk, milk ultra filtration retentate or buttermilk powder. All cheese milks were standardized to casein to fat ratio of 0.80: 1 to enable comparisons to be drawn between different cheeses produced from the various milks. Control cheese milks were prepared by standardisation of milk to 3.10 % protein while experimental cheese milks were fortified with milk ultra filtration retentate (UFR) or with reconstituted buttermilk powder (BMP), both to a final protein content of 3.90 % protein.

Replicate cheese trials were undertaken at pilot scale (500 L vat scale) in which Cheddar style cheeses were produced from prepared milks and the cheeses were subsequently analysed during ripening to determine yield and compositional data as well as to quantify and compare key ripening and quality indices and sensory quality.

### 4. Main results:

Fortification of cheese milk with buttermilk powder resulted in cheeses with significantly higher levels of moisture and moisture-in-non-fat-substance levels, while fortification with milk ultra filtration retentate produced cheeses with significantly lower levels of moisture and moisture-in-non-fat-substance levels, in comparison to cheeses produced from control cheese milks. An inverse relationship was also observed for cheese fat contents. Fortification of cheese milk protein content with either buttermilk powder or milk ultra filtration retentate had no significant effect on cheese protein, calcium, salt and salt-in-moisture contents

Fat losses to whey were higher (20-30 %) in cheeses produced from milks fortified with buttermilk powder compared to control cheeses (15-18 %) and were significantly higher when compared to cheeses produced from milks fortified with milk ultra filtration retentate (9-12%). This trend was supported by an inverse relationship for fat recovery to cheese. In addition protein losses to whey were significantly higher in cheeses produced from milks fortified with buttermilk powder in comparison to cheeses produced from milks fortified with milk ultra filtration retentate.

Analysis of moisture adjusted cheese yields in which fat and protein contents adjusted to reference levels showed yields of cheeses produced from milks fortified with buttermilk powder (10.48 %) were lower than control cheeses ( 10.85 %) and were significantly lower than cheeses produced from milks fortified with milk ultra filtration retentate (11.42 %).

Fortification with either buttermilk powder or milk ultra filtration retentate had no significant effect on viable counts of starter or non starter lactic acid bacteria counts in cheese over the initial 3 months of ripening. However, cheese pH was significantly lower in cheeses produced from milks fortified with buttermilk powder in comparison to the other cheeses over this time.

Cheeses produced from milks fortified with buttermilk powder had greater and atypical levels of short chain fatty acids and methyl ketone compounds and a higher score for sour, sulphur, brothy and free fatty acid descriptors in comparison to control cheeses and those produced from milks fortified with milk ultra filtration retentate after 3 months of ripening.

#### 5. Opportunity/Benefit:

The knowledge generated enables the cheese manufacture industry to determine that, despite containing high levels of potential natural emulsifiers, use of buttermilk powder to fortify cheese milk protein levels results in significantly reduced cheese yield due to increased losses of both fat and protein to whey. However the study does highlight the potential for the cheese industry for fortification of cheese milk with milk ultra filtrate to increase cheese yield and production efficiencies and to reduce losses to whey.

#### 6. Dissemination:

Sheehan J.J., Maye S., Hannon J., Guinee T.P. and Kelly, J. (2010) 'Fortification of Cheddar-type cheeses with buttermilk powder – impact on quality and yield' Oral Presentation at an industry workshop: Cheddar cheese research- yield, quality and consistency, Moorepark, February 18<sup>th</sup>, 2010

#### Main publications:

Sheehan J.J., Guinee T.P. and Kelly, J. (2010) 'Effect of fortification of cheese milk with UF retentate or buttermilk powder on composition and yield of Cheddar-style cheeses' Poster presentation, World Dairy Summit and Dairy Industry Association of Australia Cheese conference, Auckland, New Zealand, November 10<sup>th</sup>-11<sup>th</sup>, 2010

Sheehan J.J., Maye S., Hannon J., Auty M.A.E., Drake M.A. and McSweeney, P.L.H. (2010) 'Preliminary investigation of fortification of cheese milk with UF retentate or buttermilk powder on ripening quality of Cheddar-style cheeses' Poster presentation, World Dairy Summit and Dairy Industry Association of Australia Cheese conference, Auckland, New Zealand, November 10<sup>th</sup>-11<sup>th</sup>, 2010

Maye S. (2010). Effect of the addition of buttermilk powder on the properties of Cheddar cheese. M.Sc. thesis. University College Cork.

7. **Compiled by:** Diarmuid Sheehan, Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork.