Spoilage Potential of *Bacillus* spp. & *Paenibacillus* spp. in Extended Shelf Life (ESL) milk

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Introduction

- Food & milk spoilage
- Extended Shelf Life Milk
  - Ultra-pasteurisation
  - non thermal methods (Hoffmann et al, 2006)
- Microbial diversity in ESL milk (Mugadza & Buys 2015)
  - Bacillus spp.
  - Paenibacillus spp.
Research objective

• Determine the spoilage potential of *Bacillus* spp. and *Paenibacillus* spp.
  - ESL milk processing
  - ESL milk filler nozzles  (Khoza & Buys 2015)
Research Approach

**Bacillus spp. & Paenibacillus spp.**
Isolated from Raw milk, ESL Milk, Pasteurised milk & Filler nozzles

**Enzyme Activity**
Lipolysis
Proteolysis

**Packaged Milk stored at 7°C**
(Analysis at days 0, 14, 28 & 42)

**Inoculation of B. cereus, B. subtilis, B. pumilus & Paenibacillus spp. in Sterile milk**

**Total Plate Count & Isolation of bacteria**

**Identification of Isolates using MALDI TOF MS**
Lipases

- **Loss of sensory characteristics**
  
  short and medium FFA chains have strong flavours (rancid, butyric, astringent aroma) – Andrewes *et al.* 2007; Deeth 2006
  (bitter and soapy taste) - – Andrewes *et al.* 2007

- **Altered functionality**
  
  Depression of its foaming ability when injected with steam e.g. **poor** foam when making cappuccino coffee
  Impaired creaming ability during separation
  Increased churning time in the manufacture of butter
Proteases

- Age gelation
- Bitterness – bitter peptides
- Clotting – (Casein destabilisation)
**B. cereus & B. subtilis**

- All *B. cereus & B. subtilis* isolates were positive on proteolytic activity. \((n=26)\)

- All *B. cereus & B. subtilis* isolates were negative on lypolytic activity
**Paenibacillus spp. and Paenibacillus amylolyticus** cluster analysis of MALDI-TOF MS data prepared using isolates from CSL milk samples, Chill stored ESL milk samples & Filler nozzles

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Enzyme Activity of *B. pumilus* Isolates

- **Proteolysis + Lypolisis**
  - 17 Isolates

- **Proteolysis**
  - 17 Isolates

- **Lypolisis**
  - 17 Isolates

- **Raw Milk**
  - 5

- **Pasteurised milk**
  - 3

- **Packaged ESL milk**
  - 2

- **ESL milk stored at 7°C**
  - 1

- **ESL milk stored at 4°C**
  - 5

- **Filler Nozzles**
  - 4

**Proteolytic Activity**
- 92.6%

**Lipolytic Activity**
- 53.7%

% Dissimilarity

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Shelf Life Studies on Individual Bacterial species stored at stored at 7°C
Shelf Life Studies on a cocktail of *Bacillus* spp. & *Paenibacillus* spp in milk stored at 7°C
Growth rate of *Bacillus* & *Paenibacillus* spp. in Milk stored at 7°C
Conclusions

• *Paenibacillus* spp. is the dominant potential spoilage organism in ESL milk at 7°C

• Potential risk - Presence of the potential psychrotrophic *B. cereus* in ESL milk

• Risk Assessment & FSMS validation necessary for ESL milk process!!!!
Work in Progress

- *B. cereus* molecular characterisation
- Risk Assessment (*B. cereus* in ESL milk)
- Spoilage modelling
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Tatenda

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