New Zealand – Seasonal Milking and its challenges in the Laboratory

Special Thanks

- Craig Bell – LIC Testlink Manager
- Steve Holdroyd – Fonterra
- Paul Jamieson - SAITL
Where is New Zealand?

- Total area = 268,680 square Km
- Similar in size to the state of Colorado
- 4 Million People

New Zealand Dairy Industry – long history

- 1800’s: Dairying in NZ began
- 1882: SS Dunedin sailed to London with first refrigerated shipment of butter in the world
- 1900: First Herd testing in NZ
- 1909: Amalgamated Dairies established in London to market New Zealand butter and cheese
- 1927: Many towns have dairy factories in New Zealand
- 1930: Dairy factories merged
- 1963: New Zealand Dairy Board established
- 1970-1990: Dairy factories merged
- 2000: Milk supply by two major companies New Zealand Dairy Group & Kiwi Cooperative Dairies
- 2001: NZ Dairy Board disbanded. Fonterra formed
New Zealand Dairy Industry

- Number of Dairy Companies Operating 1920–2001

![Graph showing the decline in the number of dairy companies from 1920 to 2001.](image)

Current NZ Dairy companies - 2008

- Fonterra, 92.9%
- Westland, 3.2%
- Dairy Trust, 0.4%
- Open Country Cheese, 1.7%
- NZ Dairy, 0.4%
- Synlait, 0.4%
- Tatura, 1.0%

![Pie chart showing the current distribution of NZ dairy companies.](image)
Dairy farming in New Zealand

- Approx 4 million dairy cows
- 11,500 suppliers
- Average herd size approx 350
- Average kg milksolids per cow approx 330
- 20 Billion litres of milk processed each year

Dairy farming in New Zealand

- Pasture based seasonal milk production
- Temperate climate
- Geographic isolation
- Strict border controls and food safety regulations
- No subsidies!
Seasonal milk flow

Dairy exports a vital part of NZ economy

- Forestry 12%
- Meat 14%
- Aluminium 4%
- Horticulture 6%
- Wool/Leather 6%
- Fishing 5%
- Other 32%
- Dairy 21%
New Zealand Milk Production

- Consumed Domestically: 5%
- Exported: 95%

Total New Zealand production is equivalent to 2% of world milk production

Source: Rabobank Global Focus, August 2003

World Dairy Trade

- Fonterra: 40%
- World: 60%

Fonterra provides 40% of all internationally tradable dairy products

Source: Rabobank Global Focus, August 2003
Fonterra’s product mix

- Cream Products
- Proteins
- Powder
- Cheese
- Other

World Dairy Access and Tariffs

- Access All Products / Low Tariffs (0-30%)
- Product Specific Access / Medium-High Tariffs (70-220%)
- Only Butter / Cheese / Protein Quote Access / High Tariffs (>220%)
New Zealand Milk Testing Labs

- LIC – Testlink
  - DHI herd testing (> 95% NZ market)

- SAITL Dairy laboratory
  - Farmer payment (> 96 % NZ Farmers)
  - DHI under contract to small NZ player (<5% NZ Market)

**LIC – Testlink Labs**

- LIC is a dairy farmer owned, farm improvement company providing a diverse range of products and services.
- Test link has two labs
  - 9 CombiFosses in North Island (Hamilton).
  - 5 CombiFosses in South Island (Christchurch).
- Processes over 9 million samples per year.
- Runs two shifts – 8 lab staff per shift (40% permanent rest casual)
LIC Laboratory

Test instruments automated with ILAS robots to reduce staff requirements

Pre automation – 3 shifts 15 staff = 45 staff
Now 2 shifts 8 staff = 16 staff

LIC Test numbers

![Graph showing LIC test numbers from 2007/2008]
LIC herd testing

SAITL Dairy Laboratory

- SAITL = South Auckland Independent Testing Laboratory
- Non Profit Organisation (Industrial Provident Society).
- Provides Farmer Payment services to member Dairy companies
- Established 1984
- Current Member companies
  - Fonterra
  - Tatu
SAITL Dairy Laboratory

- 34 Permanent Staff
- Test samples 365 days per year
- Approx 11,000 Farmers tested – including South Island suppliers.
- 5.5 million samples received each year.
- 96% of all Dairy Farmers in New Zealand
- Provide commercial testing to other Dairy organisations eg. Dairy Goat Co-op, Open Country Cheese, Synlait, NZ Dairies, Dairy Trust, and Ambreed

SAITL Dairy Laboratory Developments

- Completed transition from screw capped vial to flipcap vial in November 2006
- Completed transition from Barcode to RFID in April this year.
- New vial/ RFID enables automation:
  - Automated opening/closing of vials on Foss instruments.
  - Enabled RFID reading at pipette on Foss instruments
  - Automated inhibitory testing.
Inhibitory Robot

SAITL Dairy Laboratory - Next steps

- 2009/10 Automate Plate counting (Coliforms + Thermodurics).
  - Currently working with a Japanese company who have an automatic plater that meets our requirements.
- 2009/10 Automate test selection process.
  - Have initial concept drawings from a local automation house.
Payment testing

Fonterra 4 head automatic sampler. Other company’s range from manual dip systems to semi automated systems.

Vials colour coded – clear for quality testing, Green for composition testing. Tanker composite sample is pink.

SAITL Member company testing

Two samples – one for composition analysis and one for milk quality analysis. So at peak getting approx 22,000 samples from our member companies
SAITL - Milk Quality Section

Milk Quality tests done on Regime basis – each company slightly different

- Thermudric plating
- Antibiotic testing
- Total Bacteria Estimate
- Coliform plating

Twice Month
Once Every 4 days
Once every 10 days
Twice Month

Antibiotic testing
Total Bacteria Estimate
Coliform plating

- Aflatoxin
- As requested
- Foreign
- Once a Month
- Sensed
- Once a Month
- IgG test
- Start of season
- DDE
- As requested

Milk quality testing

- Drought 2007/8
- June
- May
Screening for Inhibitory Substances

- Samples placed into 8x12 matrix
- Plated onto Copan milk test by robotic system

Copan Testing Plate

- Negative Control
- 0.003IU Control
- 0.006IU Control
Confirmation Testing

- Plated on both Delvo and Copan.
- Must be positive on both before we issue a positive grade.
- Also plated with penase to confirm Beta-Lactam.
- If not Beta-Lactam then carry out other confirmatory tests.
- Also tested on *Bacillus Stearothermophilus* Disk Assay (BSDA) plate for est. concentration.

BSDA Plate

Before Incubation

After Incubation
What do the Inhib Grades Mean

- Grades issued based on estimation of concentration
- 0.003 – 0.006 IU/ml = 12 demerits 60%
- 0.006 – 0.01 IU/ml = 50 demerits 250%
- 0.01 – 0.03 IU/ml = 50 demerits 250%
- >0.03 IU/ml = 100 demerits 500%
- Plus consequential loss.

Less than 0.05% of samples tested are confirmed as positive. Most of these are still below MRL (0.006 IU/ml).

Challenges - Antibiotic testing

- End of season and start of season higher risk.
  - due to higher incidence of mastitis at end of season, and
  - use of dry cow therapy over the off season.
- Dairy companies manage their risk at these times by increasing testing at the start and end of season – eg. daily testing of all samples for antibiotics.
Challenges - Antibiotic testing

- This extra testing at start/end of season has historically meant hiring extra labour resource to help do the plating.
- Last season the inhibitory test was automated thus eliminating the need for this extra labour resource.

Total Bacterial Estimate - Bactoscan

- 3x Foss Bactoscan
- Process 150 samples an hour
- Replaces reference test that takes 72 hours.
- Calibration samples taken daily for SPC.
BScan Grades

- **A+** = Less than 10,000 cfu/ml  |  0 demerits
- **A** = 10,000 – 19,000 cfu/ml  |  0 demerit
- **B** = 20,000 – 49,000 cfu/ml  |  0 demerits
- **C** = 50,000 – 99,999 cfu/ml  |  1 demerit (5%)
- **D** = 100,000 – 199,999 cfu/ml |  2 demerits (10%)
- **E** = 200,000 – 499,999 cfu/ml |  4 demerits (20%)
- **F** = 500,000 – 2,999,999 cfu/ml |  8 demerits (40%)
- **R** = > 3,000,000 cfu/ml       |  20 demerits (100%)

Grade Investigation

- **Purpose** is to indicate if the grade has been primarily due to mastitis or hygiene issues.
- **Grade investigation** carried out on samples with a bacterial count of 50,000 cfu and above.
Thermoduric Testing

- Thermoduric organism is any organism that will survive pasteurization
- 72°C for 15 sec or 62.8°C for 30 mins
- Sample added to petri dish and agar added.
- Incubated for 72 hours at 30°C

Thermoduric Grades

- Less than 1,500: 0 Demerits
- 1,500 – 4,999: 1 demerit (5%)
- 5,000 – 59,999: 4 demerits (20%)
- >60,000: 20 demerits (100%)
- Spreader – a single organism has taken over
- Normally an indicator of
  - A build up of milk stone within the plant.
  - Perished rubber ware.
  - Or may be due to environmental sources.
Spreader

Thermoduric Grades

- Spore Forming Organisms
  - Indicated if above 50% of total count on plate.
  - Identified by morphology.
  - Can be an indication of poor quality silage.
  - Normally a Bacillus species.
Spore Forming Organisms

Coliform Testing

- Samples tested for presence of total Coliforms
- Use selective media, i.e. VRBA
- Incubated at 30°C for 24 hours
Coliform Testing

Coliform Grades

- Less than 499 cfu/ml 0 Demerits
- 500 – 999 cfu/ml 1 Demerit (5%)
- 1000 – 1,999 cfu/ml 2 demerit (10%)
- >2000 cfu/ml 4 demerit (20%)

- Normally an indicator of faecal contamination or poor hygiene (e.g. no hot wash or chemical clean).
- Characteristic slimy bio-film build up in the Dairy plant with a distinctive odour.
Organoleptic Testing

- Visually Inspect Milk (physical defects eg blood)
- Smell the Milk and identify off taints.
- Final Grade result of consensus between 2 or more testers on senses panel.

Organoleptic Grades

- Grades cover a range of sensory defects.
  Including:
  - Cowy, Fishy, Feedy, Skatol, Sour
- In all cases they smell like they are described
- Can also pick up Kiwifruit, Turnips and other feed taints.
Foreign matter

- Milk Sample passed through a filter (Lintene pad).
- Residue analysed.
- Normally find partly digested plant matter, sand, grit, animal hairs
- Normally indicates that the filter sock is ruptured or full, or that the vat is open.

Grading rates (Fonterra)

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<tr>
<th>Test type</th>
<th>0607</th>
<th>0708</th>
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</thead>
<tbody>
<tr>
<td>Bactoscan</td>
<td>97.5</td>
<td>97.68</td>
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<tr>
<td>Coliform</td>
<td>95.88</td>
<td>95.69</td>
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<td>Thermoduric</td>
<td>92.72</td>
<td>91.12</td>
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<tr>
<td>Somatic Cell Count</td>
<td>97.27</td>
<td>96.16</td>
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<tr>
<td>Inhibitory Substance</td>
<td>99.93</td>
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</tr>
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</table>

<table>
<thead>
<tr>
<th>% Finest (on per test basis)</th>
</tr>
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<tr>
<td>Bactoscan</td>
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</table>
Component test numbers

SAITL Composition testing

- 5 CombiFoss instruments – payment
  - 2 x FT6000 + 3 x MSC4000 (1 x FT600+ on way)
- 2 CombiFoss (MSC 4000) instruments - DHI
- Test Fat, Protein, Lactose, Total Solids, Somatic Cells, Freezing Point on all composition samples received.
- NZ Dairy companies tend to payout on “Milk Solids” (ie Fat + Protein).
SAITL Composition testing

Challenges - Resources

- Need to have enough test equipment and labour to meet requirements at peak.
  - Very inefficient use of resources!!
- For example the lab needs 5 CombiFoss instruments at peak to do 12,000 tests
- However in the off season when we are doing 800 tests only need 1 instrument for a couple of hours.
Challenges – Milk composition

- The composition of the milk changes throughout the season.
  - Calibration issues – milk matrix changes through season and also season to season.
  - Lactation issues – eg start of season potential Colostrum contamination.
  - Unexpected matrix issues due to environmental effects – eg Drought, flooding etc.

Milk Composition - Fat

<table>
<thead>
<tr>
<th>Average of Fat Tests</th>
<th>Upper North Island Suppliers</th>
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</thead>
<tbody>
<tr>
<td>2004/2005</td>
<td></td>
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<tr>
<td>2005/2006</td>
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<td>2006/2007</td>
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<tr>
<td>2007/2008</td>
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</table>
Milk Composition – Crude Protein

Average of Protein Tests
Upper North Island Suppliers

Milk Composition - Lactose

Average of Lactose Tests
Upper North Island

2004/2005
2005/2006
2006/2007
2007/2008
Milk Composition

Average of Total Solids Tests
Upper North Island

Milk Composition – Somatic Cells

Average of Somatic Cell Counts
Upper North Island

ICAR 2008
Niagara USA
Gavin Scott
16th June 2008