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Review of factors impacting on the processing quality of raw milk produced in Ireland



Key external stakeholders:

Policymakers, Food researchers, Food manufacturers, Dairy industry, Dairy farmers

Practical implications for stakeholders:

The outcome/technology or information/recommendation is that any future research programme on milk quality should address the following issues:

- The optimal product mix to maximise export markets for dairy products
- The milk quality requirements to achieve premium quality products
- How to achieve these milk quality parameters within the most profitable production system
- How to manage these milk quality parameters at both milk production and milk processing stages

Main points

This will allow the dairy industry to develop an efficient and valuable milk processing and dairy product marketing sector.

In turn, a stronger dairy industry from farm production stage to product export stage will result in greater national income and employment.

Main results:

The gaps in knowledge identified:

- Chemical residues - occurrence of residues (Quaternary Ammonium Compounds, growth promoting agents, antibiotics [cephalosporins, aminoglycosides], thiouracil and semicarbazide, in food PBDEs and DEHP) and the impact of these residues on dairy product manufacture
- Microbiological perspective - continuous monitoring for pathogens is necessary, development of methods for quantification of *B. cereus* in milk and study of biodiversity and the factors that affect it are also necessary
- Quality parameters such as somatic cell count (SCC) - the relationship between milk volume produced and SCC needs further elucidation
- The milk processor decides on payment on quality parameters based on their product portfolio – more discussion with milk quality personnel and milk producers may assist in improving milk quality.

Opportunity / Benefit:

The identification of gaps in knowledge as a potential impediment to manufacture of premium dairy products from Irish milk will allow all of the stakeholders to focus on these issues in the very near future through research, advice, payment incentives.

Collaborating Institutions:

University College Cork - UCC
University College Dublin - UCD

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1. Project background:

Expansion in milk production towards 2020 will require the Irish dairy industry to process this additional milk while at the same time develop markets for the increased supply of dairy products. This will require milk of the highest standard in terms of milk composition and processability, bacteriological status and residue levels. Much research work on milk quality has been completed in recent years and both the generic definition of milk quality and the factors that affect it are known. However, new research is required to deal with 'harder to attain' current and future quality standards as well as impediments to achieving optimum milk quality from modern, expanded farm systems that need to be profitable and sustainable. Specifically, the concept of individual markets (e.g. infant milk formula [IMF] and cheese manufacturers) requesting specific dairy product quality standards (which is largely determined by raw milk quality) is a particular challenge facing the dairy processor. Criteria for raw milk supply in EU legislation is outlined in EU (2004, 2005), e.g. plate count of $\leq 100,000$ cfu/ml at 30°C and SCC $\leq 400,000$ cells/ml. However, some specific sectors within the industry require specific quality criteria, e.g. trichloromethane (TCM) levels of < 0.03 mg/kg in butter and < 250 μ g/kg of iodine in milk intended for use as a raw material for infant feed formula. There is also a preference by the Russian market for milk of $< 200,000$ cells/ml.

2. Questions addressed by the project:

The essential question is 'What are the knowledge gaps that need to be addressed in order to: (i) meet raw milk quality standards necessary for international markets, (ii) diversify the current product range and (iii) expand the duration of the year for which these products can be manufactured.

To identify these knowledge gaps, the questions asked are:

- What milk quality parameters are used in competitor EU, and other countries, e.g. New Zealand?
- Describe the demography of the Irish dairy cow population and their management with respect to factors that affect raw milk quality, e.g. genetics, age, location, feeding management and stage of lactation
- Determine national trends and cow lactation profile for milk quality parameters including SCC and TBC from grass based systems of production
- Review the state of knowledge of the microbiological quality of Irish milk
- Identify existing and emerging residue contamination concerns for milk and potential impact for the dairy industry

3. The experimental studies:

- Information on the milk quality payment systems in different countries was requested. A questionnaire was designed and sent to colleagues in other countries, and colleagues in the International Dairy Federation. Seventeen questionnaires were distributed and 9 returned.
- Milk recording data on 58,659,604 test day records from 2,789,000 individual cows across 8,669,464 lactations were obtained from the Irish Cattle Breeding Federation national database. Corresponding information on fixed effects of animals including ancestry, breed fractions, date of birth, parity, herd identifier as well as herd information including region of location were also obtained from the national database. On average animals had 21.0 test day records across their lifetime, or 6.8 test day records per lactation. Data were then analysed.
- Bulk tank milk quality data was supplied by ten individual milk processors representing 11,824 individual milk suppliers from across the Republic of Ireland. Data were supplied from 2006 to 2011, inclusive. Trends in SCC and TBC across year, across month and across herd size were quantified using mixed models in ASReml.
- Recent microbiological data on Irish milk was collated, and state-of-the-art methodologies for studying biodiversity were investigated. Experimental studies were conducted to test the effectiveness of a number of milking machine wash routines on the hygienic quality of milk.
- A comprehensive review was carried out on the residues that may be of concern for the dairy industry.

4. Main results:

- Information on the milk quality payment systems in different countries was obtained. Only one country has a national payment system. The payment systems are confidential to the different processors and not publically available. This gives flexibility to the processors to pay for quality parameters they require for their product portfolio
- All animal and herd factors tested had a significant effect on somatic cell count. Older animals, animals which were younger at calving than contemporaries and Holstein animals have higher somatic cell count than younger alternative breed animals who calve at the median age at calving. In addition, mixed calving production systems and herds in Connaught had higher somatic cell count than spring calving herds in the other regions of Ireland
- There was no consistent trend in either SCC or TBC across years to demonstrate that milk quality is either improving or disimproving. Lowest SCC and TBC were observed in the summer months and in the largest herds. Poor weather appears to have an adverse effect on SCC, however further research is required to quantify the association between rainfall and increased SCC
- Recent microbiological data on Irish milk was collated, and state-of-the-art methodologies for studying biodiversity were investigated. Effectiveness of a number of milking machine wash routines on the hygienic quality of milk was established. Clear guidelines have now been published in the form of four defined milking machine wash routines
- A comprehensive review was carried out of the residues that may be of concern for the dairy industry. Priority residues were identified that may be of concern at present and in the future including, banned substances (i.e. recombinant bovine somatotropin), cephalosporin antibiotics, anti-parasitic agents, biocides (quaternary ammonium compounds, chlorinated disinfectants), aflatoxin M1, plant toxins, plasticisers and persistent organic pollutants (PCBs and brominated flame retardants).

5. Opportunity/Benefit:

- As the information on payment for quality is confidential, the results of this task are of limited value, except to know that other countries don't have a national payment system
- Recent recommendations have promoted calving animals at a younger age however this study has shown that animals that are younger than the average age of their contemporaries at calving have higher somatic cell count. The regional differences observed in somatic cell count indicate that further effort is required in Connaught to reduce somatic cell count and may require greater education or a revision of recommended practices to deal with somatic cell count in production systems in Connaught
- This study provided the first quantification of the somatic cell count and total bacterial count across the majority (66%) of the national herd. The results from this study indicate that SCC and TBC are not improving in the national herd. However in order to quantify improvements, baseline figures are required such as were provided by this study
- The microbiological data will be used to inform future research. The wash routines are freely available and should be widely used by milk producers
- This succinct report identified key residues that are of concern to the dairy industry. This included residues that should be monitored on an ongoing basis and new emerging residues that warrant further research. The latter may become an issue for the industry in the future due to improvements in analytical detection.

6. Dissemination:

Through the 'Milk and Product Quality Forum' that meets bi-annually, the information generated by the study has been shared with Researchers within the scientific community, Irish Dairy Board and Department of Agriculture personnel, Irish regulatory bodies, most Irish milk processors and milk purchasers, Teagasc Advisory service, AHI (Animal Health Ireland), ICBF (Irish Cattle Breeding Federation), ICOS (Irish Co-operative Organisation Society) and IMQCS (Irish Milk Quality Cooperative Society) personnel.

Two milk quality workshops have been held at which different aspects of this work has been disseminated, and a Milk Quality Conference is planned for December 2013. The results have also been disseminated to Teagasc Advisory personnel through in-service training sessions.

Main publications:

Gleeson D., O'Brien B. and Jordan K. 2013. The effect of using nonchlorine products for cleaning and sanitising milking equipment on bacterial numbers and residues in milk. *International Journal of Dairy Technology*, 66: 182-188.

Gleeson D – milking equipment wash routines. Available at:

<http://www.agresearch.teagasc.ie/moorepark/Articles/milking%20machine%20cleaning%20routines.pdf>

McParland S., McCarthy, J. and O'Brien, B. (2013) 'Animal and herd factors associated with somatic cell count of Irish Holstein-Friesians' In: Proceedings of Agricultural Research Forum, Tullamore Court Hotel, 12-Mar-2013, page 97.

Jordan, K.N., Beresford, T., O'Brien, B. and Gleeson, D. (2012) 'Milk quality maintaining standards' *Tresearch* 7 (1) : 34-35.

Teagasc web page: <http://www.agresearch.teagasc.ie/moorepark/milkquality>

7. Compiled by: Dr. Bernadette O'Brien, Dr. Kieran Jordan
