

# Establishment of Enabling Technology for Manufacture of Selected Types of Continental and Speciality Cheeses

(Speciality Cheese Manufacture in Ireland)

Armis No. 4213

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## Summary and Conclusions

The broadening of the product base of the Dairy industry has been a major objective of the National Plan. In the case of Irish cheese manufacturers, this means producing a range of cheese types *in addition* to the traditional mainline products such as Cheddar, Mozzarella, Emmenthal and Regato.

In Ireland, diversification into speciality cheeses encounters particular technical obstacles such as seasonality of milk supply, a small home market, a tradition of both production and consumption of Cheddar-type cheeses, a lack of knowledge of manufacture of speciality cheeses at industrial or semi-industrial level and a number of previous negative experiences of cheese diversification.

Despite these obstacles a highly successful model for diversification has been in operation in New Zealand for some time now. The questions we must ask are "How has this occurred?" and "Can this be repeated in Ireland?"

Hence, the objectives in the project were the development of the science and technology for speciality cheese manufacture, identification and overcoming of the technical constraints to the manufacture of soft speciality cheeses in Ireland and the development of Moorepark Technology Limited (MTL) pilot plant as an integrated, flexible pre-commercial manufacturing platform with which to evaluate the market for speciality cheese.

## **The main outputs were:**

A knowledge and skills base, together with a plant/process and technology-transfer infrastructure, has been generated for a wide range of speciality cheese types which had not previously existed and is available as an important part of an overall diversification strategy for the Irish Dairy industry.

Cheese varieties include: mould types e.g. Blue and Blue-Brie; smear types e.g. St-Paulin and Havarti; hybrids of Cheddar, Swiss and Gouda; hard grating types e.g. Parmesan and Asiago; and high acid types e.g. Caerphilly and Wensleydale.

The MTL pilot plant has been developed as a flexible cheese plant, facilitating the production of the above range of cheeses through long or short production runs, with capacity of up to one tonne of cheese per day.

## **Facilities include:-**

- 3 x 500 litre vats for hard and semi-hard cheese,
- 1 x 3,000 litre vat for large scale pre-commercial production,
- segregated units for production of blue type cheeses,
- segregated ripening facilities (with humidification and high temperature) for production of blue and white mould ripened cheeses,
- segregated, high specification humidified ripening facility for smear type cheeses,
- segregated drying down room for smear-ripened cheeses and
- normal ripening room (8 - 12° C) for hybrid cheeses.
- A number of cheese products generated from this programme have been taken up for market assessment by industry. Similarly this project has stimulated a substantial client-funded cheese development programme which has led to the pre-commercial manufacture of one hybrid-type cheese at 3,000 litre scale.
- Samples of both mould and smear-ripened cheeses have been provided to industry clients for exhibition at trade fairs and to prospective customers. Industry interest in diversification has been stimulated, with four Irish companies commissioning work ranging from costings for a diversification project to development of specialized cheese products for market evaluation.
- Based on our experience in this project a successful blueprint for speciality cheese production in Ireland has been developed.

## **The key features include:-**

- a good quality milk supply on a year round basis,
- rigorous quality assurance standards and procedures,
- specialised and segregated manufacturing facilities,
- access to a skills and knowledge base in speciality cheese manufacture,
- a definition of the scale and nature of manufacturing operation required to reach an economic cost base,
- choice of attractive highly flavoured customised novel cheese types,
- an intermediate pre-commercial platform from which industry can assess the market potential, cost base
- and technical/quality requirements prior to full industrial scale manufacture.

## **Research and Results**

### **The New Zealand Model**

The New Zealand model for cheese diversification which has been highly successful, is typified by two companies - Ferndale Dairies, and Kapiti Cheese Company.

Ferndale Dairies is essentially a subsidiary of the large Kiwi Co-operative Dairies Limited (83% shareholding). The company started in the 1960s in the South Island and produces 1,200 tonnes per year of speciality cheeses such as Blue, Camembert, Raclette, Gouda, etc. In all, 30 different cheese types are made, with the flexibility to produce 15 different varieties in a day. The cheeses are differentiated by variety, starter, production conditions, shape and packaging. The plant has a total of 50 employees, 25 in production and 25 in packaging. The manufacturing plant has three areas, namely blue, white and yellow cheeses. In each area there are separate production, ripening and packaging facilities. Each area has its own production and packaging teams; staff are flexible and can perform a number of operations.

Kapiti Cheese Company began in 1985 with its goal of import substitution of speciality cheeses. It now employs 110 people (from the original 4), makes 45 cheese types and distributes another 73 cheese types. In total, the company manufactures and distributes over 1,000 tonnes per year. The company processes 5,000 - 6,000 litres of milk per day and targets its cheeses at the hospitality and food service industries, it also exports to the wider Asia - Pacific region. The major attribute of this operation, in common with Ferndale Dairies, is flexible plant and personnel with the production of a wide range of products through long or short production runs.

In both companies, the advantage of producing a range of speciality cheeses is fairly obvious in that a single new variety of cheese will not have an instant impact. Hence a mix of products such as mould, smear-ripened or eye cheeses with modifications such as shape, fat, moisture, salt levels, portioning and attractive packaging have been found to be a better way to evaluate the market preference and also to stimulate consumer demand. In purely economic terms, a plant producing a diversity of products, which in many cases are simply variants on a particular cheese type is more likely to succeed, as scale of production spreads costs over a broader base.

### **Technical Constraints to Cheese Diversification in Ireland**

Ireland has a tradition in the manufacture of high volume hard and semi-hard cheese types. Lack of a knowledge and skills base in the manufacture of speciality cheeses is however a major constraint to diversification. While the Farmhouse cheese sector has developed a number of soft speciality type cheeses, production has not yet developed to significant industrial scale e.g. 1,000-1,500 tonnes per year. The New Zealand diversification model used to reach these volumes require skills in, and knowledge of, the production and quality control of a wide range of technically difficult cheeses at a semi-industrial scale prior to their scale up to industrial manufacture, at which level consistency of quality must be assured and safety guaranteed. Speciality cheeses such as mould and smear-ripened cheeses have short ripening times and a shelf life of 4 - 6 weeks.

Therefore production must continue on a year round basis if continuity of the market supply is to be maintained. This demands a high quality milk supply also on a year round basis.

Hence the challenge in this project was to learn from the success of the NZ experience, confronted as it was with technical and seasonality problems similar to ours, and develop a successful model and technological support base for speciality cheese production in Ireland.

## The Moorepark Strategy for Speciality Cheese Production: key elements

- Creation of a database on speciality cheeses.
- Development of manufacturing technologies for speciality cheeses.  
Establishment of a HACCP (Hazard Analysis Critical Control Point) programme for speciality cheese production and
- Development of a flexible segregated multi-purpose manufacturing facility in the Moorepark Technology (MTL) pilot plant.
- Overcoming seasonality challenges.



### Creation of a Database on Composition and Proteolysis of Speciality Cheeses

A range of speciality cheeses were obtained from retail outlets in Ireland and France and were analysed to determine and illustrate compositional differences between speciality cheeses and a typical Cheddar cheese.

Table. Composition of range of commercial cheese samples.

Cheese type	% Moisture	% Fat	% F.D.M.	% Protein	% Salt	pH
Pont l'Evêque	49.45	25.00	49.46	22.89	1.80	5.54
Chaumes	50.91	26.50	53.98	20.16	2.17	5.78
Epoisses	54.12	26.00	56.67	19.49	2.91	6.01
St. Morgen	46.83	30.00	56.42	21.70	1.79	7.31

Blue-Brie	41.50	41.00	69.50	15.00	1.80	5.60
Milleens	48.97	28.50	55.85	20.17	1.20	5.02
Port-Salut	46.41	28.00	52.24	21.20	1.79	6.13
Cheddar	37.10	33.00	47.69	27.30	1.92	5.22

It is immediately apparent that all the cheeses are characterised by a higher moisture (46.41% - 54.12%) and pH levels (5.78 - 7.31) than are found in Cheddar cheese. Salt levels were also highly variable (1.79% to 2.91%) and the data reflects the diversity of the procedures used in the manufacture and ripening of these cheeses.

Information gleaned from this study gave us the compositional, textural and flavour parameters needed in the manufacture of a number of speciality cheeses.

One of the most technically challenging cheese types appeared to be a Blue-Brie mould ripened cheese ripened by an external white mould and an internal blue mould; and a bacterial surface ripened cheese (smear-ripened) cheese such as St-Paulin. Both cheeses would require thorough understanding of the principles of soft cheese manufacture along with the development of highly specialized and segregated ripening facilities within a single plant.

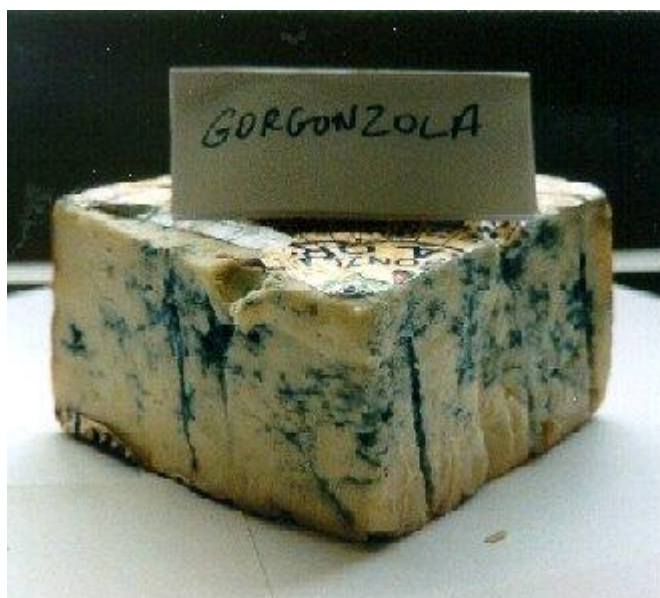


Fig 1. Gorgonzola (Italy).

Example of an internal Blue mould ripened cheese. Other examples of this cheese type are: Danish Blue, Cashel Blue, Stilton.



Fig 2. Talleggio (Italy).

Example of a bacterial surface ripened (smear-ripened) cheese. Other examples of this type are: St-Paulin, Gubbeen, Ardahan, Limburger, Port-Salut, Reblochon.

#### Establishment of the Manufacturing Technology

The cheeses chosen for development were a smear-ripened St-Paulin type cheese, a cheese similar to this was brought to industrial production by Avonmore plc, and a Blue-Brie type cheese brought to semi-industrial scale in UCC. Commercial production of these cheeses was not successful either because of technical or market difficulties. Therefore, a mix of residual knowledge, negative experience, but an identified market opportunity of the manufacture of speciality cheeses existed within the Dairy industry. It was our goal to take these experiences and build on them in a project designed to overcome the technical and technology transfer difficulties associated with speciality cheese manufacture in Ireland.

For St-Paulin cheese, 3 separate recipes (including starter culture blends, drainage pH, cooking profile, curd washing steps and brining conditions) were developed along with the implementation of segregated ripening operations and development of a specification for the humidity and temperature requirements in the ripening areas. For Blue-Brie cheese, the transfer of the manufacturing technology from UCC to MTL pilot plant was achieved by a number of trials undertaken to establish optimum process and ripening conditions i.e. Vat configuration, Bulk versus DVS starters, cutting programme, mould filling equipment and procedures. A segregated manufacturing and ripening facility was also successfully developed for the manufacture of this cheese.

Trials were also carried out to develop a number of hybrid cheese types with variations in starter culture blends, cooking temperatures, salt levels. Tasting of cheeses indicated some promising avenues for further hybrid development and this provided the basis and direction for a hybrid cheese development section within the project which generated a range of cheese types, a number of which were taken up by the Dairy Industry.

#### Establishment of HACCP programme

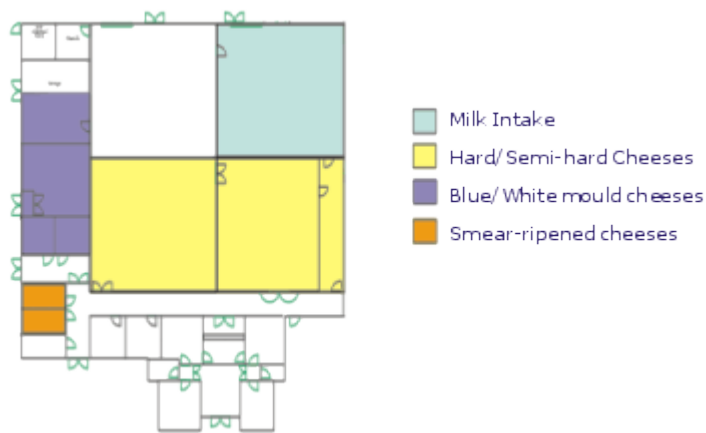
The HACCP plan was focused on ensuring product safety and conformance to standards. It involved development of documentation, recording procedures, acceptance and rejection

procedures covering various aspects of speciality cheese manufacture from raw milk, through to final despatch of product. This led to the award of DAFF Health mark for the manufacture of cheese products in the MTL pilot plant.

The experience gained in this project through the manufacture of a range of speciality cheeses has taught us the necessity for attention to detail and constant monitoring of the curd manufacturing and ripening processes. Consistent production of speciality cheeses and avoidance of defects means cheeses must be constantly monitored and particular aspects of the process must be carried out with a high degree of care e.g. application of surface cultures and drying stage prior to packaging.

### **Development of a Flexible, Segregated Multi-purpose Manufacturing Facility in the Moorepark Technology Limited (MTL) pilot plant**

The provision of a segregated manufacturing and ripening facility suitable for the manufacture of a range of varied and technically challenging cheeses was obviously a major requirement for this project and much effort went into achieving this. Segregated manufacturing and ripening facilities are a must when making soft mould ripened and bacterially ripened smear cheeses within the same plant. Cross-contamination can occur as moulds or bacterial smear can colonise the surface of either cheese type and must be physically separated from each other, likewise personnel working with either cheese must be physically segregated from each other and observe a set of strict plant entry and exit protocols. On a purely product safety consideration, speciality cheeses with high moisture and pH levels, ripened at high temperatures and humidities, are particularly vulnerable to contamination, either by personnel or airborne microflora, and only therefore minimal contact with non-necessary personnel and other cheese types should occur.



Hence a segregated manufacturing and ripening facility was developed with specialized cheese vats, moulding equipment, packaging equipment, brining facilities, drying rooms, humidified temperature controlled ripening rooms, cold storage areas.

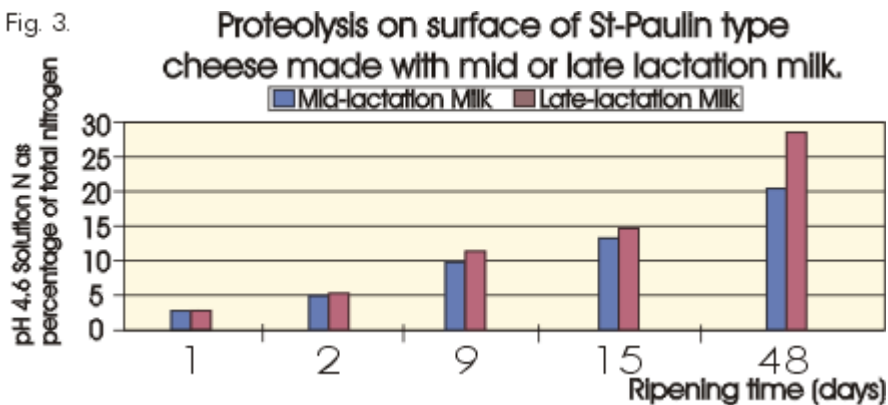
### **Overcoming Seasonality Challenges**

Preliminary observations on the effects of seasonality of the Irish milk supply on the manufacture of speciality cheese indicate the unsuitability of late lactation milk for manufacture of soft speciality cheeses with weak gels, increased curd damage and poor drainage of whey from moulds resulting in non-standard composition and altered ripening characteristics. This finding was investigated by a detailed biochemical and microbiological study on the effect of seasonality of the milk supply on the manufacture and ripening of St-Paulin type cheese.

In this study, using mid- or late lactation milk for cheesemaking, distinct differences were noted for moisture, pH development, and proteolysis during ripening. (see Fig 3.)

Cheeses made with late lactation milk had a faster rate of surface pH development and a higher moisture content. Proteolysis, as measured by Nitrogen solubility in various solvents, proceeded more rapidly and to a higher level in cheeses made with late lactation milk. The use of milk of varying lactational status for the manufacture of soft speciality cheeses generates a varying and non-standard ripening pattern, necessitating that the manufacturer modifies the ripening regime to take account of a faster ripening cheese at certain times of the year. The use of blends of milk from various calving patterns to alleviate the use of LL milk is also a potential avenue to alleviate the more extreme effects of late lactation milk in speciality cheese manufacture.

Fig. 3.



## Overall Conclusion

As a result of this project a model for diversification has been set up in Moorepark consisting of the following elements:

- a knowledge and skills base for the development and manufacture of speciality and hybrid cheeses including data on a range of commercial speciality cheeses and familiarity with the manufacturing and ripening protocols for a wide range of soft, semi-hard, and hard cheeses,
- assistance for commercializing partners to establish a market presence for a number of selected varieties using MTL pilot facilities as the manufacturing base, and
- assistance in the transfer and scale up of the manufacturing technology of cheeses from the MTL pilot plant.
- validation of the New Zealand model for speciality cheese manufacture by provision of a flexible plant producing multiple varieties in response to market demand and the spreading of both risk and cost over a number of varieties.