MASTITIS NEWSLETTER 24

Mastitis Newsletter aims mainly at disseminating succinct information on the work, plans and achievements of the IDF Standing Committee on Animal health relating to Bovine Mastitis, but also includes information available to the Group from other sources such as the National Mastitis Council (NMC) in the USA. the Standing Committee and the NMC have a close working relationship.

Mastitis Newsletter does not intend to review systematically the vast literature in the field of mastitis nor does it claim to report on all significant developments in the field.

Information given and statements made in Mastitis Newsletter do not commit IDF. They can be reproduced, with indication of source.

Contributions dealing with items of general interest would be welcome for consideration for inclusion in future issues.

Mastitis Newsletter is available from International Dairy Federation (IDF), General Secretariat, Square Vergote 41, B-1030 Brussels (Belgium). It is produced in English only and it is expected to be of interest to persons studying the many aspects of mastitis, to veterinarians, research institutes, students, etc.

Mastitis Newsletter is published in the Bulletin of the IDF. With financial sponsorship from Boehringer Ingelheim Vetmedica GmbH (DE), reprints of this newsletter have been made available free of charge for circulation to subscribers of the Newsletter. Requests for new subscriptions may be sent to the IDF Secretariat and will be met within the limit of the number of re-prints issued.

Editors: dr H. Hogeveen (NL) and dr P. Winter (AT)

CONTENTS

Report of the IDF Standing Committee on Animal health

The Mastitis Newsletter was for many years the product of the former IDF Group of Experts on Mastitis (Group A2). With the restructuring of IDF approximately 2 years ago, the Group A2 was dissolved and the work conducted by A2 was included in the program of work of the new Standing Committee on Animal health (SCAH). While the program of work of Standing Committee on Animal health is broader than that of the former A2, mastitis is still alive and well in member countries and mastitis is a major focus area of Standing Committee on Animal health. The last meeting of Standing Committee of Animal health was in Brussels in January of 2001 and activities of Standing Committee on Animal health that specifically address mastitis are discussed below.

The action team on Mastitis Control Schemes has been working to get a representative of member countries currently a member of Standing Committee on Animal health to produce a document describing mastitis control in individual countries. The intended purpose is to document the extent to which mastitis is controlled, the basic programs in place to control mastitis, the basic elements of the mastitis control program and factors that motivate the use of the particular control scheme. Approximately 12 countries have produced at least a partial document. The current plan is to publish these in this and in future issues of the Mastitis Newsletter as they become available.

An action team, Antibiotic Therapy, under the leadership of Dr Eric Hillerton (UK) is attempting to produce a document on the value of dry cow therapy and potential ramifications to antibiotic resistance. There is an action team on Economics that is being lead by Olaf Österäs (NO). They are attempting to describe the economics of losses from mastitis and the cost of its control. Their approach is to consider losses at the quarter, cow, herd, and national level. Progress is being made and there is hope to have a document by late fall of 2001. An action team on Abnormal Milk, chaired by Dr K. L. Smith (US) has produced a document that is a discussion of normal and abnormal milk based on somatic cell counts and clinical mastitis. This document is currently being evaluated by member countries to determine if it is suitable for publication in a future issue of The Mastitis Newsletter. The action team on Immunology, led by Dr Alfonso Zecconi (IT) has recently completed its work which was the organization of an international mastitis symposium in Stressa, IT, that was held in June of 2000. The conference was well attended and scientifically a resounding success. Other action teams include the Mastitis Newsletter and Dr Henk Hoogeveen is serving as editor. Another involves the Mastitis Research Index. The index is being maintained by Dr. Christian Burvenich (BE) and can be accessed through the following web site, <www.rug.ac.uk>.

Members of Standing Committee on Animal health are looking forward to the year 2005 as the target date for another in the series of 10-year international mastitis symposia. This will be developed at future meetings and those interested in the latest mastitis research should watch for future announcements regarding this meeting. At the moment the venue seems likely to be someplace in Europe. Standing Committee on Animal health will next meet in Auckland, NZ, in conjunction with the annual sessions.

Finally, the Chairman would like to note that the long-standing member of A2 and Standing Committee on Animal health, Dr Joachim Reichmuth (DE), has retired and is no longer a member of our Standing Committee. All of us on Standing Committee on Animal health would like to thank Dr Reichmuth for his numerous contributions to IDF and his many research contributions that have helped us arrive at our current ability to control mastitis in dairy herds around the word. Dr Reichmuth, we will miss you.

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Note from the Editor

The Mastitis Newsletter Within the New IDF Structure

For many years, the Mastitis Newsletter has been an important product of the former IDF A2 working group Mastitis. The goal of the Mastitis Newsletter was to inform interested parties of the work going on in the A2 working group, recent developments in member countries of the IDF represented in the A2 working group, meetings and interesting developments within the international mastitis research.

After the reorganization of the IDF, the IDF A2 working group Mastitis ceased to exist. Their work was included in the programme of work of a new Standing Committee on Animal health (see also the chairman's report). Although the new Standing Committee deals with animal health, mastitis will remain an important disease in the dairy industry. Therefore, it was decided to maintain the work on the Mastitis Newsletter. It will appear in the IDF Bulletin and will be sent separately to those individuals who have made their interest in the Mastitis Newsletter known to the IDF.

The Mastitis Newsletter is not able to exist without the input of the members of the Standing Committee of Animal Health. I would like to express my gratitude to the authors of the contributions. Moreover, the sponsorship of **Boehringer Ingelheim** which enables the IDF to distribute separate copies of the Mastitis Newsletter to interested parties, is gratefully acknowledged.

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Research Communications

MASTITIS IN CERTIFIED ORGANIC DAIRY HERDS IN SWEDEN

A veterinarian studied the health of dairy cows in certified organic dairy herds in mid-eastern Sweden through three visits during one year. The 26 herds that took part in the study ranged in size from 12 to 64 cows, and milk production from 3772 to 10 334 kg per cow and year. In a comparison with conventional herds in the same area, the organic herds were found to have a lower incidence of clinical mastitis and trodden teats and also had a lower proportion of cows with a high somatic cell count (Table 1). The spectrum of udder pathogenic bacteria was similar to that found in other Swedish studies. Treatments of mastitis were found to be similar to what is practised in conventional herds. Homeopathic remedies were not widely used in the treatment of clinical mastitis.

The calves in most of these organic herds suckled their mothers for only a few days, which was not considered to have great impact on udder health. The main management factor that was different from conventional herds was the feeding strategy, where organic herds were fed a larger share of forage and relatively less concentrates, or not more than 50% of the total daily intake of dry matter.

Statistical methods. Presence of disease was measured as annual incidence densities (AID), calculated as (total number of cases/total number of cow-days in herd) x 365 x 100, thus representing the number of cases per 100 cow-years. AIDs were calculated for veterinary-treated cases of mastitis, trodden teats, culling due to mastitis, and UHC.

Associations between herd type, as independent variable, and AIDs were assessed using logistic regression according to the algorithm of the SAS macro GLIMMIX (Littell & others, 1996). The possibly confounding variables average lactation number, herd size, and milk production were introduced to the model as continuous variables. Breed was introduced as a nominal variable.

CONCLUSION

Udder health on organic herds in mid-eastern Sweden was better, with fewer cases treated for mastitis, than on conventional dairy farms of similar size and in the same area. Objective measurements of udder health, such as a statistically significantly lower proportion of cows with high udder health class (UHC = indicator of subclinical mastitis), also support the result. It is hypothesized that the differences seen are due to lower amounts of grain and concentrates fed cows on organic farms leading to a lower intensity of production.

This is an abbreviated version of a report, in Swedish, to the Swedish Board of Agriculture. The title of the report is *Djurhälsan i ekologisk mjölkproduktion*, and can be ordered from the main author.

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Table 1: Distribution of udder health related parameters for organic (n=25) and conventional (n=1102) dairy farms. The means are derived from logistic regression analyses and are corrected for milk yield, herd size, breed, and lactation number

	Organic		Conventional		
	Mean	Range	Mean	Range	p-value
Mastitis treatments, AID[1]	9.1	0-29.6	14.7	0-100	0.038
Trodden teats, AID	0.3	0-2.7	1.8	0-42.1	0.048
Annual average prevalence of cows in UHC[2] 0-2	74.0	55.9-98.0	63.8	25.0-97.9	<0.001
Annual average prevalence of cows in UHC 6-9	10.2	0-20.3	14.7	0-49.4	0.002
Percentage of cows at least once during the year in UHC 6-9	22.8	0-50.0	32.1	0-83.7	<0.001
Culled for mastitis	8.1	0-27.8	8.5	0-44.2	NS

[1] Annual incidence density.

[2] Udder health classes are graded 0-9, where each figure indicates a 10% increase of the probability that the cow has infectious mastitis.

STUDIES ON BOVINE *ESCHERICHIA COLI* MASTITIS IN FINLAND

The following research project is presently on-going in Finland. The studies described here are part of Ph.D. studies of DVM Tanja Kaipainen, and are carried out in the research group of Professor Satu Pyörälä in the Faculty of Veterinary Medicine of the University of Helsinki. In this project, clinical and microbiological aspects of coliform mastitis are studied. The first aim of the study is to gain more knowledge of the virulence factors of *E. coli* bacteria isolated from bovine mastitis and their role in the pathogenesis of coliform mastitis. Secondly, in vitro antimicrobial susceptibility of the bacterial isolates is determined and compared with materials from other countries. Possible differences between countries where the prevalence of the *E. coli* mastitis, herd management and the use of antibiotics are not the same are investigated.

In the study on virulence factors, a total of 273 *E. coli* isolates from clinical cases of mastitis from Finland and Israel have been studied. From these isolates, 100 Finnish and 100 Israeli isolates were taken randomly to analyse the antimicrobial susceptibility. Polymerase chain reaction (PCR) was used to analyse the genes for the important virulence factors such as different fimbriaes, adhesins, aerobactin, CNFs and some other factors. Capsule formation of the isolates was examined by bacteriophages and serum resistance analysed by a turbidometric assay. These data will be compared with the clinical features of the coliform mastitis cases from which the isolates originated, to see if any of the virulence factors had some role in the pathogenesis of mastitis. The mastitis cases were divided to different classes based on the severity of the cases; this was defined by chances in the clinical signs, milk production and SCC. The microbiological data from this material can also be used to study the epidemiology of coliform mastitis, for example to compare mastitis isolates with coliforms isolated from other sources in the herds.

MIC-values of the isolates were determined with eight different antimicrobials which potentially could be used for the treatment of mastitis caused by coliforms. NCCLS methods were used and MIC_{90} and MIC_{50} values of the isolates calculated for all antimicrobials. The results from the in vitro susceptibility testing will be used to study possible differences between countries with different use of antimicrobials and different herd management.

In addition, the coliform mastitis project also includes studies on the host response in endotoxin mastitis model and may also focus on treatment aspects of *E. coli* mastitis in the future.

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RECOVERY OF COW TEATS AFTER MILKING: ULTRASONIC SCANNING

ABSTRACT

Ultrasonic measurement was used to monitor the recovery of teats after milking. The method gave reproducible information on teat parameters. Although teat wall and cistern were recovered within 6 and 3 h after milking, complete recovery of teats took more than 9h.

INTRODUCTION

Milking generates strain in the teat wall, which induces dilation of blood vessels and expandable compartments in the peri-vesicular tissue. Such swelling of the teat may influence the resistance of the teat canal to bacterial invasion during the recovery period after milking. Teat sphincter closure after milking takes about 1 to 2 h. This time is generally assumed to be the recovery time of teats.

MATERIALS AND METHOD

The ultrasonic measurements (scans) were carried out with a 200 VET scanner with a linear Array 7.5 MHz probe (Pie Medical, Maastricht, the Netherlands). The teats were immersed in water in a latex bag. Two teats of 18 HF cows were scanned before milking, directly after milking and 1, 2, to 9 h after milking. Teat properties were measured in duplicate: teat canal length, teat wall thickness, teat cistern width and teat end width (Figure 1).

Table 1: Predicted means per teat parameter (mm) before milking, directly after milking, hours to recover after milking and means of all duplicate measurements with mean difference and sd

	Before milking	After milking	Recovered (h)	Mean	Mean difference	sd
Teat end width	21.7	22.1	>9	21.85	0.84	0.73
Teat cistern width	12.0	7.0	<3	9.64	2.17	2.05
Teat canal length	10.0	11.4	>9	11.12	0.81	0.71
Teat wall thickness	6.8	9.1	<6	7.66	1.15	1.20

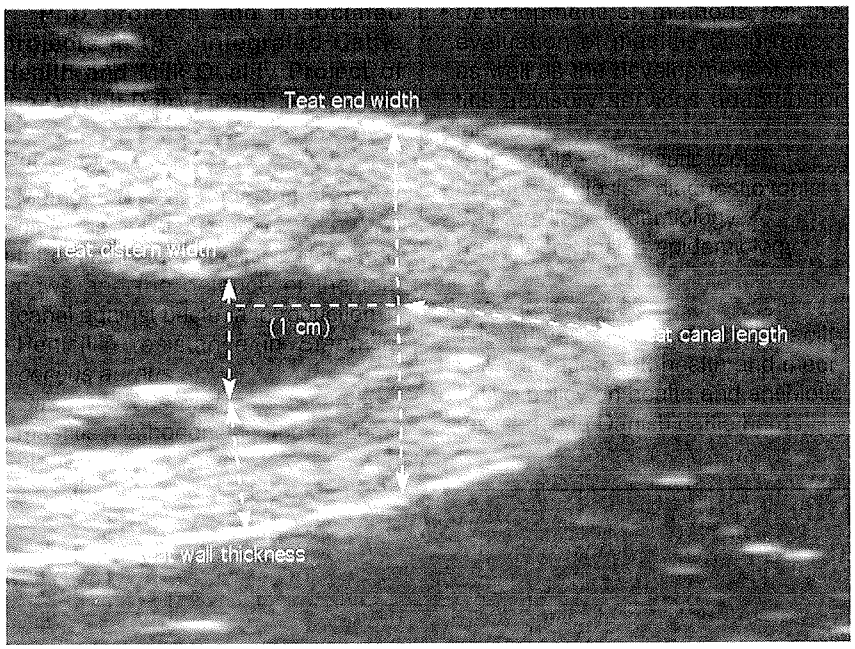

Figure 1: Measurements on ultrasonic image: teat canal length, teat width at the top of the teat canal, teat wall thickness at 1 cm above the end of the teat canal and teat cistern at 1 cm above the end of the teat canal.

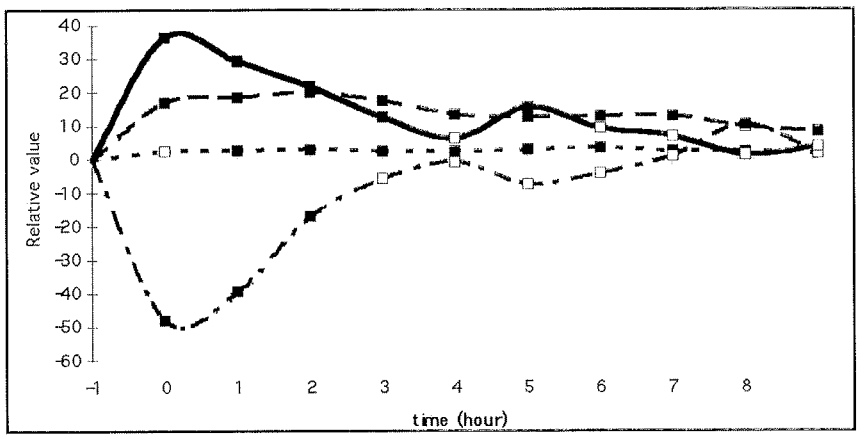

Figure 2: Changes (%) relative to the measurement taken after pretreatment before milking (-1) of teat end width (- -), teat cistern width (– – –), teat canal length (– –) and teat wall thickness (—), just after milking (0) and each consecutive hour after milking (1 to 9) where ■ indicates a significant (P = 5%) and □ indicates a non-significant difference.

RESULTS AND DISCUSSION

Differences between duplicate measurements of teat parameters were small (Table 1), indicating that the scanning technique gave reproducible results.

Teat recovery after milking took a considerable amount of time (Figure 2). Teat wall thickness returned to the value before milking within 6 h. Teat end width took more than 9 h to recover. Teat canal length did not recover within the 9 h after milking. Teat cistern returned to the value before milking within 3 h.

CONCLUSION

The ultrasonic scanning technique is a good research tool to monitor changes in teat parameters by machine milking. Although no measurement of teat canal diameter can take place on ultrasonic scanning pictures, there is evidence that the complete recovery of teats after milking takes 6 to 8 h. Shorter milking intervals by increased frequency of milking, as can be found in automatic milking, may lead to incomplete recovery of teats. This can lead to a build up of teat damage.

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CHANGES IN MILK SOMATIC CELL COUNT WITH REGARD TO THE MILKING PROCESS AND THE MILKING FREQUENCY

-Preliminary report-

INTRODUCTION

The basis of mastitis diagnosis consists in the examination of quarter foremilk samples to detect mastitis pathogens and inflammatory changes. For economic reasons cell count and electrical conductivity often are used as indicators for inflammation without parallel bacteriological examination. It should be stressed that changes in inflammatory parameters may indicate trends in the development of udder health, yet a mastitis diagnosis requires also a bacteriological examination. The currently accepted cell count threshold of 100 000 somatic cells /ml foremilk for healthy quarters has been defined on the basis of foremilk samples taken at regular milking times in connection with twice daily milking. With regard to increased herd sizes, labour economics and the possibility to take milk samples at quarter level during milking by application of automatic devices, two main questions have to be discussed:

(1) What is the influence of milk fractions on the cell count ?
(2) What is the influence of milking frequency on the cell count?

To detail some aspects of these questions two papers will be published shortly in "Milchwissenschaft". The main conclusions from these papers can be summarized as follows.

QUARTER MILK FRACTIONS AND CELL COUNT

This study included 8 healthy cows. The different quarter milk fractions used were: (i) the first jets of milk (10 ml) (FIM); (ii) the following 15 ml of milk (FOM); (iii) three samples of 40 ml milk taken during the first and last minute of machine milking at intervals of 20 s (F-1, F-2, F-3 and L-3, L-2, L1), and (iv) manual strip milk (SM).

Table 1: Cell count (log/ml) in different quarter milk fractions (8 cow; 6 milkings)

Milk fraction	Morning milking	Evening milking
FIM	4.80 ± 0.52 c	5.13 ± 0.50 a,b,c
FOM	4.54 ± 0.44 d	4.75 ± 0.44 d
F-1	4.66 ± 0.28 d	4.80 ± 0.38 d
F-2	4.59 ± 0.40 d	4.84 ± 0.41 d
F-3	4.65 ± 0.43 d	4.91 ± 0.42 d
L-3	4.93 ± 0.45 b, c	5.02 ± 0.49 b,c,d
L-2	5.06 ± 0.45 a, b	5.15 ± 0.45 a,b,c
L-1	5.22 ± 0.44 a	5.27 ± 0.41 a,b
SM	5.29 ± 0.37 a	5.37 ±0.38 a

Values with identical letters within a row are not significantly different (P< 0.05).

Table 1 summarizes the cell count means in the different milk fractions at morning and evening milking

The foremilk fraction (FOM) had significantly lower cell counts than the FIM fraction. The first milk jets (FIM), the milking fraction of the last minute of milking (L-3, L-2, L-1) and the strippings fraction (SM) showed significantly increased cell count levels compared to the fraction of the first minute of milking (F-1, F-2, F-3). The highest cell count values were found in the SM-fraction. The results indicate that a standardized sampling is needed to get comparable cell count results. Moreover, it is obvious that the defined cell count threshold of 100 000 cells/ml is only valid for the FOM fraction. If other milk fractions should be used for mastitis diagnosis new reference values for healthy quarters have to be elaborated and defined.

MILKING FREQUENCY AND CELL COUNT

As shown in some recently published articles, once daily milking significantly increased the concentration and the total numbers of somatic cells in milk compared to twice daily milking. Less frequent milking seems to result in a loss of the integrity of the intramammary tight junctions. This may facilitate an increased paracellular influx of somatic cells into the milk. Yet, the mechanisms for this cell count increase are not completely understood.

Another aspect of the influence of milking frequency on the milk cell count concerns the effects of irregular milking intervals as applied under the conditions of automatic milking systems.

A milking study was performed in which 4 healthy cows were milked by a quarter bucket machine at 6 a.m., 10 a.m., 2 p.m. and 6 p.m., which corresponded to milking intervals of 4 h during the day and 12 h overnight. The pre- and post-treatment periods were 4 days each, whereas the treatment period lasted for 12 days. The mean daily milk production was 18 kg per cow and was stable during the study. Cell count was determined in quarter milk fractions: FIM, FOM,SM and quarter composite milk samples (QCM). The observed trends of cell count changes were identical in all different milk fractions. Table 2 details the results of the QCM-fraction.

Comparing the data of the morning milking (6 a.m.) between the pre-treatment and treatment period, a significant decrease in cell concentration and total numbers of cells can be seen in the treatment period. The opposite happened between 6 a.m. and 6 p.m. during the treatment period. After the milking interval of 4 h the cell concentration and the total numbers of cells were significantly increased compared to the values at 6 p.m. during the pre-treatment phase. For statistical reasons the total values for the time interval 6 a.m. – 6 p.m. during the treatment period were used for the comparison.

Despite the fact that the milk yields were not different between the study periods, the cell count values indicated significant changes related to the used milking regime. The mechanisms responsible for these cell count changes are not clear. It is assumed that after short milking intervals of 4 h the ratio of milk accumulated in the alveolar region; the low intramammary pressure and the relatively loosened junctional complexes between the epithelial cells are involved in the regulation of the influx of somatic cells into the milk.

In any case, the results indicate that in relation to varying inter-milking intervals, the cell count values of healthy udder quarters may respond with significant changes in both directions: decrease and increase of the values.

Table 2: Quarter milk yield and concentration and total numbers of somatic cells in QCM-fraction in relation to the used milking frequency

Study period	Milking time	Milking interval	Quarter yield (g)	Cell concentration (x g/ml)	Total numbers of cells (millions)
Pre-treat.	6 a.m.	12 h	2328 a	72 000 a	166 a
Treatment	6 a.m.	12 h	2258 a	57 000 b	126 b
Pre-treat.	6 p.m.	12 h	2208 a	72 000 a	155 a
Treatment	10 a.m.	4 h	647	128 000	80
Treatment	2 p.m.	4 h	754	115 000	86
Treatment	6 p.m.	4 h	729	110 000	79
Treatment Total:	10 a.m. to 6 p.m.	12 h	2130 a	117 000 c	245 c

Values with different letters within a row are significantly different: (P< 0.05).

CONCLUSION

This preliminary set of data shows that the type of the quarter milk fraction and a milking frequency (interval) of more than two milkings a day have significant influences on the cell count values (concentration and total number of cells) in healthy udder quarters, too. These influences should be considered if the cell count interpretation is done with regard to mastitis diagnosis. It should be avoided that these physiological cell count variations lead to a misclassification of the health status of bovine udder quarters.

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MILKING THREE TIMES A DAY AND ITS EFFECT ON MILK PRODUCTION AND UDDER HEALTH

Although a number of studies have been carried out on the effects of higher milking frequencies on milk production [1], not many studies have been carried out on the relation between the frequency of milking and udder health. Moreover, the studies that were carried out were limited for number of herds and gave conflicting results [2,3]. In this study, the influence of milking three times a day on milk production and udder health was studied longitudinally. Milk production and udder health data of 57 herds milking three times a day in a traditional milking system during a limited time (more than 3 months and less than 7 months) were selected from the Dutch Dairy Herd Improvement database. Milk production and udder health before, during and after three times per day milking were compared.

Changing the frequency of milking from two to three times a day gave a significant increase in milk production with equal fat and protein levels (Table 1). Also udder health was influenced significantly. The bulk milk somatic cell count decreased from 193 000 cells/ml to 162 000 cells/ml. Moreover, the number of cows with increased somatic cell count (> 250 000 cells/ml) decreased as well as the number of cows with a new increased somatic cell count. When changing back from 3 to 2 times per day milking, the effect was the other way around. More frequent milking has positive effects on milk production as well as on somatic cell count.

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Table 1: Effects of increasing the milking frequency from 2 to 3 times per day on milk yield, fat % and protein %, bulk milk somatic cell count (BMSCC), percentage of cows with a somatic cell count higher than 250 000 cells/ml (High SCC) and percentage of cows with a new high somatic cell count (New high SCC)

Milking frequency	Milk yield (kg/day)	Fat (%)	Protein (%)	BMSCC (cells/ml)	High SCC (%)	New high SCC (%)
2 times/day	24.1[a]	4.46	3.57	193[a]	19[a]	10[a]
3 times/day	27.7[b]	4.46	3.57	162[b]	14[b]	8[b]

[a,b] Values within columns with different superscripts differ significantly (P<0.05).

Mastitis Notes from Member Countries

Denmark

THE INTEGRATED CATTLE HEALTH AND MILK QUALITY PROJECT OF THE DANISH DAIRY BOARD

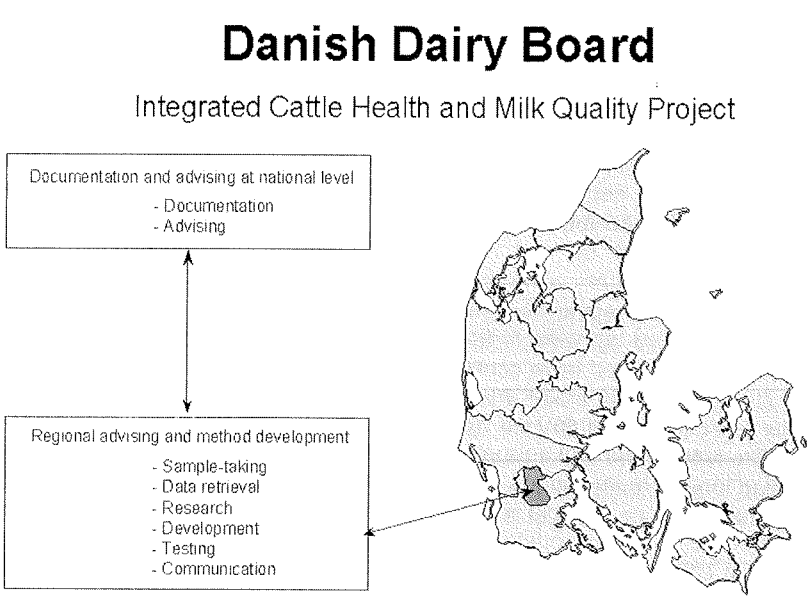

Figure 1: The regional organization of the "Integrated Cattle Health and Milk Quality Project of the Danish Dairy Board".

Local campaigns have been a basic tool in building up programmes for disease control and eradication of infectious cattle diseases in Danish dairy herds in the past 100 years. Examples to be mentioned are the eradication of bovine tuberculosis, bovine brucellosis, bovine leucosis, infectious bovine rhinotracheitis (IBR), and as the most recent example the ongoing eradication of bovine virus diarrhoea (BVD).

The Danish Dairy Board has wanted to focus on diseases such as Johne´s disease, salmonellosis (S. dublin) and mastitis, as well as milk quality areas. Together with the former idea of using "local campaigns," this has led to the "Integrated Cattle Health and Milk Quality Project of the Danish Dairy Board".

The project is taking place in the southern part of Denmark where all (280) milk producers, 15 veterinary surgeons and 8 cattle health advisors were invited to participate (Figure 1). In the region 9 PhD projects within the above-mentioned areas have been initiated. Furthermore there has been a keen interest in the project and currently projects are associated with the overall project and within the structure and organization of data collection, sample taking and laboratory analysis.

The projects shall be oriented towards ongoing and subsequent practical implementation. Consequently, the intermediate results from data collection, data analysis and laboratory examinations should currently be canalized into the herds participating in the project, and be used in the advisory services in the herds. Subsequently, the activities are to be the role model for cattle health and milk quality management in the rest of Denmark.

The projects are expected to take place as "community-based action research", where the results are presented, in larger or smaller fora, on a continuous basis, to the farmers and advisors involved. And where the project participants (PhD students and supervisors) are listening to, and acting on, the input from farmers and advisors. A mutual inspiration and dialogue must exist between the participants in the projects, and the researchers should be the catalysts for an improvement of the cattle health status and the milk quality level in the research area.

In this way the Integrated Cattle Health and Milk Quality Project of the Danish Dairy Board is to be regarded as a mutual development process where researchers, advisors and farmers achieve new recognition and new knowledge.

Many of the projects will use both quantitative research methods to throw light on general epidemiological associations and qualitative research methods to throw light on the possibilities for implementing the results in the practical health management service.

Besides presentation on meetings between researchers, farmers and advisers, the results are available by means of modern web based technology. Every single project should be in a position to use data and samples of milk, blood, and faeces, collected under other projects to obtain as big as possible a synergy effect of the practical and costly work in the herds.

Quality assurance and storing of data from all the projects are done in a central database at the Danish Dairy Board. From this database every individual researcher can pull out data from his own projects. Furthermore, they have access to use data collected under other projects as long as it is not compromising these other projects. In order to maintain the integrity of every single project, each project has entered into a co-operation agreement, carefully specifying the conditions for the use of the data.

PhD projects and associated projects in the "Integrated Cattle Health and Milk Quality Project of the Danish Dairy Board":

PhD Projects

- Methods for differentiation of bacteria in the bulk tank milk
- Introduction to the milking of first calf cows and the defence of the teat canal against bacteria introduction.
- Penicillin resistance in *Staphylococcus aureus*
- *Streptococcus uberis* as a cause of mastitis. Pathogenesis and epidemiology
- Development of methods for the evaluation of mastitis occurrence, as well as the development of mastitis advisory services adapted for the herd
- Salmonella - diagnostic tools
- Paratuberculosis - diagnostic tools
- Salmonella - epidemiology
- Paratuberculosis - epidemiology

Associated projects

- The influence of production facilities, management, health and medication policy on health and antibiotic resistance in Danish cattle herds
- Development of a model for a "health advisory agreement" in organic milk production herds
- Examination of the prevalence of Vero toxin producing Escherichia coli O157 (VTEC O157) in Danish dairy cattle herds

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THE NETHERLANDS

IMPLICATIONS OF THE INTRODUCTION OF AUTOMATIC MILKING ON DAIRY FARMS

A large integrated EU project is started

At the end of 2000, the European commission granted a research proposal on the implications of automatic milking. The project involves 7 research institutes and at least 4 manufacturers of automatic milking systems from 6 countries. The project is managed by the Research Institute for Animal Husbandry, Lelystad, the Netherlands. The project started 1 December 2000 and is expected to be finished in February 2004. In this article a broad description on the background of the project and the work plans of the project are given.

BACKGROUND

The idea of automating the complete milking process has been around for at least the past 25 years. Initially, the major challenge was to develop reliable, swift and practical techniques for locating teats and attaching teat cups. Various pioneering attempts showed the possibilities, but it was only in the late 1980s that machines with potential for commercial exploitation began to appear. The term Automatic Milking System, also indicated as Robotic Milking System or Voluntary Milking System, refers to a system that automates all the functions of the milking process undertaken in conventional milking systems by a mix of manual and machine systems. In contrast to conventional milking, where humans bring the cows to be milked at regular times (usually twice a day), automatic milking places emphasis on the cow's motivation to be milked in a self-service manner several times a day. Supplying a (small) amount of concentrates in the automatic milking system enhances motivation. In addition, specific cow traffic management based on the cow's motivation to eat or drink may be applied to direct her on a path through the feeding and lying areas by control gates in order to achieve an optimum number of milkings per day without human interference. Location of a concentrate dispenser in the exit area of the milking system can also be used as a stimulus to visit the milking system. Main benefits of automatic milking are an increase in milk yield from more frequent milking, reduction of labour and the lack of necessity for the farmer to be present at regular milking times.

Over the past two years automatic milking systems have been installed at an increasing rate, mainly on dairy farms in North-West Europe. Currently, approximately 700 dairy farms in Europe are milking with an automatic milking system. Introduction of automatic milking systems on dairy farms involves far more than just replacing labour by equipment. It changes the whole method of farming. The nature and organization of labour will alter in the sense that manual labour is partly replaced by management and control, and presence at regular milking times is no longer required. Regular visual control on cow and udder health at milking times will, at least partly, be taken over by automatic control. Satisfactory facilities for cleaning of cows and teats, as well as for separation of abnormal milk have to be incorporated into the automatic system. Milking equipment will be used for 24 h a day, which requires a high reliability of the system and adapted cleaning schemes and cooling systems. Permanent admittance to the system will change cow activities, may require adjusted cow routing within the barn and will influence the possibilities of grazing. Moreover robotic milking may have an impact on the public acceptance of dairy farming and dairy products.

Up to now, research on automatic milking has mainly concentrated on technical improvements of automatic milking systems to improve performance and capacity, and on development of cow routing systems which ensure the desired frequency of visits to the milking robot. However, many questions remain in the realms of the following themes:

(1) Farm-level adoption determinants of automatic milking, and on-farm social-economic and environmental implications of adoption;
(2) (Conditions for) societal acceptance of this new technology;
(3) Impact on milk quality and possibilities to produce milk of indisputable quality;
(4) Impacts on animal health and welfare, including combination of automatic milking with grazing;
(5) Requirements for management information systems.

Title	Workpackage manager	Expected achievements
Socio-economic aspects of automatic milking	Prof. Erik Mathijs Catholic University Leuven Belgium	Relevant variables which may affect the adoption of automatic milking identified; Farm-level implications of the adoption of automatic milking, technical as well as social,have been assessed
Public acceptance of automatic milking	Prof. Keith Roe Catholic University Leuven Belgium	It has been established whether and under which conditions automatic milking is a production technology that is or can be accepted by society at large
Redefinition of acceptable milk quality	Dr Morten Dam Rasmussen Danish Institute for Agricultural Sciences, Denmark	Options for (re)definition of acceptable milk quality and abnormal milk in the spirit of directive 89/362/EEC have been developed, and systems to automatically detect and separate abnormal milk have been tested
Milk quality on farms with an automatic milking system	Yvonne van der Vorst M.Sc. Research Institute for Animal Husbandry The Netherlands	Effects of automatic milking on quality aspects of farm milk have been established, technical and managerial factors affecting milk quality have been identified and methods for control have been formulated
Prevention of antibiotic residues	Dr Karin Knappstein Federal Dairy Research Centre Germany	The excretion characteristics of antibiotic residues in milk in a situation of varying milking intervals as they occur during automatic milking is determined
Effectiveness of automatic cleaning of udder and teats and effects of hygiene management	Dr Karin Knappstein Federal Dairy Research Centre Germany	The teat cleaning procedures of automatic milking systems are evaluated and applicable measures for prevention of teat, and subsequently, milk contamination are obtained
Optimal cleaning of equipment	Eric Schuiling M.Sc. Research Institute for Animal Husbandry The Netherlands	The effectiveness of cleaning methods of automatic milking systems, under optimal use of water, energy and chemicals, has been established and proposals for technological optimisation have been identified and tested
Health of dairy cows milked by an automatic milking system	Dr Eric Hillerton Institute of Animal Health United Kingdom	The impact of changing from conventional to automated milking systems on the incidence of diseases has been assessed, best management practices and technical solutions to reduce the disease risk and safeguard milk quality have been formulated
Welfare assessment of dairy cows in automatic milking systems	Prof. Hans Wiktorsson Swedish Agricultural University Sweden	Welfare indicators have been developed for implementation in a welfare assessment protocol,cow welfare on with automatic milking systems has been assessed and relationships have been established between behaviour, physiological,metabolic and health parameters
Automatic milking and grazing	Prof. Hans Wiktorsson Swedish Agricultural University Sweden	Grazing strategies on farms with automatic milking have been surveyed, possibilities have been examined and tested to exploit the cows' natural behaviour in systems combining grazing with automatic milking
Demands and opportunities for operational management support	Wijbrand Ouweltjes M.Sc. Research Institute for Animal Husbandry The Netherlands	Requirements for management information on farms with automatic milking systems have been generated, and possibilities to use data collected by an automatic milking system for management information have been identified

OBJECTIVES

Based on the themes described above, the following objectives were defined:

(1) To identify determinants for the adoption of automatic milking on dairy farms in North-west European member states;

(2) To assess the implications of the adoption of automatic milking systems, in the realms of farm-level social-economic aspects, public acceptance, milk quality, animal health, animal welfare and farm management support requirements;

(3) To generate solutions for any adverse effects of a widespread use of automatic milking in an early stage of adoption;

(4) To disseminate results among research centres, policy makers, farmers and farmers' services, manufacturers of milking equipment and dairy industry.

WORK

The total project is divided into 11 workpackages. A description of the workpackages, including the workpackage manager is given above.

Besides the partners mentioned in workpackage description, the Swedish Institute for Agricultural Engineering and the companies Fullwood, Lely, Prolion and Westfalia are participating in the project.

CURRENT STATUS

At the time of writing this paper, preparatory work on the work packages was being done. It is anticipated that after June 2001, the first experimental work will start, giving first results by the end of 2001.

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Mastitis Control in Member Countries

INTRODUCTION

Nearly all countries that are members of IDF are concerned with control of bovine mastitis. However, there is no single uniform program for controlling mastitis among member countries. As measured by national somatic cell count averages, many countries have achieved considerable progress in mastitis control and progress has often been gained using widely varying methods or approaches among countries. A series of reports were prepared by members of The Standing Committee for Animal Health (SCAH) to document these differences in mastitis control schemes employed among countries. These reports will be published in the current issue of the Mastitis Newsletter and additional reports will appear in future issues.

A series of 9 questions to be answered in each of the documents was agreed upon by the membership of SCAH and were to be used as a guide in preparation of the report. Some of the information requested was not available in all countries and the depth with which questions were answered also varied among authors. Despite the variation in reports we hope readers will find the information of interest and useful. The questions were as follows.

STRUCTURE

What is the structure of the dairy industry in your country? What is the total amount of milk produced; number of herds; number of cows; and distribution of herds by number of lactating cows, (> 1000), (999 - 500), (499 - 100), (99 - 50), (49 - 25), (24 - 15), (14 - 10), (9 - 5), and (4 - 1)? What is the maximum herd size? What are typical culling and replacement rates for dairy producers? Are the cows used for milk production considered to be "dairy" cows or "dual purpose" cows? What are the predominant breeds of cattle used for milk production? What are typical milk yields (kg/lactation). What is the typical number of lactations per cow on dairy farms? What are the most common types of housing (list by frequency, that is, free stalls, tie stalls, loose housing) and to what extent are cows on pasture?

ECONOMICS

What is the price of milk paid to dairy producers? Is milk price subsidized by the government? What is the price of meat (per kg) or cull cow prices? What are the estimate monetary losses due to mastitis: total for your country, per herd and per cow? What are the relevant suppositions in your calculations? Are there monetary adjustments for milk quality and do these adjustments pay for quality or deduct for a lack of quality? What percent of the milk produced in your country enters the export market?

STRATEGY

What is the basic strategy to control mastitis: (a) to control intramammary infection or (b) to control somatic cell counts? Is your country's approach to mastitis control based on: (a) prevention of new intramammary infection and reduction in duration of existing intramammary infections; or (b) a reactive approach of identifying infected quarters and treating with antibiotics? Are there cultural, social, or economical idiosyncracies or concerns that impact or serve as a barrier to mastitis control schemes in your country. (Example - Colostrum is used as a human food in Finland and thus they do not like to use dry cow therapy. Colostrum is never used as a human food in the US). What are the basic components of your mastitis control scheme? What is the mechanism by which you implement mastitis control and who implements mastitis control? Is there a regulatory aspect?

MASTITIS CONTROL AND MILK QUALITY

What is the mean SCC (or best estimate) for your country and the mean or best estimate of bacterial counts (standard plate counts)? Are there legal limits for SCC and bacterial counts in bulk milk and what are these limits? How are the regulatory SCC and bacterial counts calculated and what is the consequence of exceeding that limit? What is the frequency of regulatory testing of bulk milk? If the producer's bulk milk exceeds the legal limit for SCC and/or bacterial count, what happens to that producer's milk? If a producer is not allowed to sell his milk due to high SCC or bacterial count, how does the producer get reinstated so that he may sell his milk? Are there regional variations with regard to these quality parameters and levels of intramammary infection within your country? What does your country consider to be the main mastitis pathogens causing: (a) intramammary infection (sub-clinical mastitis); (b) clinical mastitis, (c) high bulk milk SCC (list pathogens in order of importance when multiple pathogens are indicated)? Is bulk milk tested for the presence of antibiotics - by whom and how frequently? If milk is found to be contaminated by antibiotics, what happens to that milk? What are the safeguards to assure that antibiotic contaminated milk does not enter the food chain?

CONTROL SCHEMES

Is there a mandatory scheme applied to all producers and who formulates and administers this control scheme? What is the control scheme most often recommended? Is pre- and post- milking teat dipping recommended and what are the products (list products by active ingredients) most frequently used in your country? Is dry cow therapy recommended and used? Is dry cow therapy selective therapy or blanket (total) therapy? What antibiotics are most often used to formulate dry cow therapy products? What is the frequency of machine testing and who does the testing? What is the frequency of milking time observations and who does these observations? To what extent are the housing environments evaluated and who does these evaluations? What are the perceived strengths and weaknesses of your country's approach to mastitis control?

ADVICE ON MASTITIS CONTROL

What organizations or institutions are most likely to give dairy producers advice on mastitis control in their herds, that is, universities, dairy associations, government paid veterinary officers, other companies such

as milking machine companies, feed companies etc.? Who is the primary source of mastitis advice to your dairy producers? What services are available to dairy producers who have an intensive mastitis problem (trouble-shooting)? If possible, estimate the number of people who are working with mastitis in your country as: (a) researchers; (b) advisors; (c) administrators; or (d) other appropriate categories.

RECORDS

What recording systems are available in your country for cow SCC, bulk milk SCC, and clinical cases of mastitis? Are such recording systems mandatory in your country?

THERAPY

What proportion of clinical cases by severity type, that is, mild, moderate, and severe, are treated in your country? What antibiotics are most commonly used to treat clinical quarters (cows). What is the general route of administration? Who administers the antibiotics and makes decisions regarding the type of antibiotic to be administered? Are only veterinarians allowed to treat cows? Are sub-clinical cases or high somatic cell count cows treated during lactation? Is the resistance to penicillin and other antimicrobials used to routinely treat cows in you country known? What is the strategy for therapy in your country and what are you trying to achieve.

FUTURE

What changes are likely to occur in your countries mastitis control scheme in the future and what will likely be the motivation behind these changes?

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DENMARK

STRUCTURE

Distribution of the herd size:

1 - 14 cows	170	herds	1.7%
15 - 29	1 209		2.0%
30 - 49	3 315		3.0%
50 - 99	4 594		5.7%
100 or more	72		7.7%
Total	10 060		100.0%

The maximum herd size: 493 cows

The typical culling rate: 40%

Number of lactations on average: 2.3

Nearly all cows are considered to be dairy cows and HF is the predominant breed.

The average milk yield is: 7532 kg – 4.16% butterfat – 3.35% protein

Types of housing: 65% tie stalls - 35% loose housing

75% of the cows are on pasture

ECONOMICS

Price of milk paid to the producer: 246 Danish ore/kg

The milk price is not subsidized by the government but the FEOGA-support was 41 ore/kg milk in 1995/96

The price of meat for cull cows (1996): 1255 Danish ore/kg slaughter weight.

60% of the milk production is exported

MASTITIS CONTROL STRATEGIES

In the mastitis control schemes used in Denmark it is for-bidden by law to use antibiotics as a preventive tool (for instance in dry cow treatment). One can call it cultural or social, or one can call it based upon pre-ventive measures against development of resistant mastitis pathogens (or other pathogens) - or taking into consideration the consumers' wish to consume clean milk from healthy animals and produced with a minimum use of antibiotics.

The Danish Dairy Board is by regulation responsible for the overall mastitis control.

The Danish Dairy Board - Veterinary and Milk Quality Department employs veterinarians, laboratory technicians and milk quality advisors.

At the Cattle Health Laboratory (part of the Veterinary and Milk Quality Department) analyses of quarter milk samples for mastitis pathogens and bulk tank milk samples for S. agalactiae is carried out.

The milk quality advisors visit farmers with quality problems or farmers who just want to improve their udder health status.

The milk quality advisors carry out testing of milking equipment, instruction of milking, dynamic testing during milking, testing and measurement of housing conditions and taking out quarter milk samples for bacteriological analyses.

The veterinary practitioner is considered as the central mastitis advisor and is, together with the farmers and the dairy companies, the person who contacts the milk quality advisor if the udder health needs to be improved in the herd.

In Denmark only a veterinary practitioner is allowed to carry out the first antibiotic treatment in the herd - follow-up treatment can be done by the farmer in those herds where a special appoint-ment regarding health control is signed.

In relation to mastitis about 30 - 50% of all treated mastitis cases are examined bacteriologically by the veterinary practitioner.

The basic components of our recommended control scheme are taking into consideration milking, milking equipment, housing conditions, feeding and ongoing herd health management with regular observa-tions of groups of cows.

Furthermore, management of heifers around parturition receives special consideration; preventing new infections within the first 30 days post-calving is a very central point in the mastitis control programme.

However, what is recommended is not necessarily what is going on in the herd – in practice, the actions taken are highly variable which makes it impossible to make any reliable general conclu-sion.

MASTITIS CONTROL AND MILK QUALITY

The mean BMSCC in 1997 was 247 000 cells/ml

The mean bulk tank milk bacterial count in 1997 was 8400 cfu/ml

The rules followed are those of the EU but due to these rules it is only manda-tory to examine the BMSCC 3 times every 12 weeks; in Denmark these tests are performed every week.

The bulk tank milk is tested once every four weeks for inhibitors and

the lorry is tested the other three of the four weeks.

Based upon bacteriological examinations of quarter milk samples the main pathogens are *S. aureus* (most widespread) followed by *S. uberis*, *E. coli* and *S. dysgalactiae* (no clinical signs taken into consideration).

CONTROL SCHEMES

There are no mandatory control schemes.

Pre-milking teat dipping is not allowed due to the risk of disinfectant residues in the milk. Post-milking teat dipping is not as a rule recommended but evalu-ated from herd to herd.

Dry cow therapy is not as a rule recommended and clinical signs or intramammary infections (found on the basis of laboratory examination) have to be found before the use of dry cow treatment is allowed.

Most farmers have made a service appointment with the milking equipment companies so that the milking equipment is tested regularly. At the same time the milking equipment is tested by the milk quality advisors.

The milk quality advisors also carry out the evaluation of the housing conditions in relation to visits in relation to udder health tasks.

The strength of our mastitis control approach is that focus on medication is very limited which makes it much easier to motivate the farmers and advisors to prevent mastitis.

Furthermore, the milk quality advisors follow the bulk tank milk somatic cell count in every single herd and react upon any rise in cell count above 300 000 cells/ml by visiting or contacting the farmer.

ADVICE ON MASTITIS CONTROL

Number of people working with mastitis:

Researchers:	10
Milk quality advisors:	20
Local veterinary practitioners:	150
Administrators:	2
Veterinarians supporting advisors:	4

RECORDS

More than 90% of the farmers participate in the monthly yield control but it is not mandatory.

Disease recording is performed but the values obtained depend on the farmer's threshold for calling the veterinarian (who is recording the treatment).

THERAPY

The strategy for therapy is to treat cases only where you estimate the effect to be higher than 75%.

Furthermore the strategy is to stop treatment of old chronical cases of S.aureus both during lactation and in the dry cow period.

We are trying to find the true new infections.

The main drug used is penicillinprocaine, injected parenteral and in mixed prep-aration intramammary (normally both ways of administration are used).

FUTURE

The future change in mastitis control schemes will be directed more and more towards the single herd and the specific problems in that particular herd instead of general recommendations.

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FINLAND

STRUCTURE (1998)

Dairy cows and farms

No. of dairy cows	382 000
No. of dairy farms	28 700
Mean no. of cows per farm	14.5

Distribution of herds by size

No. of cows	% of farms
1-9	24
10-14	26
15-19	25
20-24	15
25 and more	11

Milk production (1998)

Total milk production (10^6 litres)	2376
Average yield/cow (all cows), kg	6230
Average yield in milk recording herds, ECM, kg	7564

Cattle breeds

Breed	% of dairy cows
Ayrshire	74
Holstein	25
Finncattle	1

The dairy herd size in Finland is small, 14.5 cows per herd in 1998. 66% of the herds and 72% of the cows were in the milk recording system. Average number of lactations was 2.5, the culling rate 40%, age at first calving 25.8 months and calving interval 390 in 1998. Prevalence of mastitis in 1995 was 17% on quarter level and 38% on cow level. Mastitis in a quarter was assumed if there were more than 200 000 cells / ml in the milk from the quarter or if the quarter had been dried off during lactation.

94% of the herds are in tie stalls, 6% are housed in cubicles (free stalls), mainly in insulated buildings, less than 1% in uninsulated buildings. Most of the new buildings are cubicle houses. The pasture period is 3 to 5 months, varying geographically and with weather (May - September). In Finland, 32% of the cultivated area is grassland.

ECONOMICS

Milk price

Annual average milk producer price was 1.87 FIM/litre in 1998. The change has been very rapid over recent years: 1994 (before Finland joined EU) the price was 2.66 FIM/l. The EU subsidies equal on average 0.58 FIM/l in 1998.

Milk price adjusted for quality

All producer prices are adjusted for milkfat and protein and also SCC and total bacterial count. If SCC is less than 250 000/ml (geometric mean of two samples in one month), bonus is about 2.5%. Penalties for antibiotics and water are severe.

Losses

Estimated losses from mastitis are on the level of 200 million FIM annually, including lower production, discarded milk, penalties in milk price, extra culling of mastitis cows, treatment costs and extra labour.

Market

Consumption of liquid milk products was 193 l/capita, that of butter 4.4 kg, cheese 17.0 kg and ice cream 13.2 litres/capita. Import of dairy products was at 1998 633 million FIM and export 1312 million FIM.

STRATEGY

In Finland, there is no mastitis control programme fixed by law. Most of the local dairies recommend voluntary mastitis control measures and, in many cases, also produce different mastitis control services. The role of the local veterinarian is very important on most farms. At the end of the 1970s, the biggest dairy cooperative, Valio, started a national campaign to control mastitis. Since that time, plenty of advisory work has been done, and the point of advise has varied from milking machine service and milking technique to renovation of stalls and culling of infected cows. In the 1980s, bacteriological sampling of all cows and quarters was a common procedure when problem herds were investigated.

The herd health programmes recommended by the dairies and many veterinarians include monitoring of udder health (BTSCC twice a month for all farms and cow SCC every 2 months on milk recording farms), recording of all antibiotic treated cases of mastitis on cow cards used in all herds, regular evaluation of predisposing factors (milking machine, milking practice and hygiene, stall hygiene etc.), action plan after the discussion between farmer , his veterinarian and dairy technician (including treatment and culling recommendations and plan for management changes), and follow-up plan. Some dairies have included herd health plans in their quality assurance agreements.

The basic strategy for mastitis control is to prevent new intramammary infections by reducing the duration of udder infections and by correcting risk factors on farms. Both acute clinical and subclinical mastitis cases are treated during lactation. Subclinical cases, especially immediately after calving, are treated with antibiotics usually after an evaluation of the worth of the treatment. Infections caused by coagulase negative staphylococci are very common and they often heal without treatment. This is one of the factors that has reduced the use of antibiotics markedly in recent years. About 30% of the cows are treated with antibiotics during lactation.

Sampling of acute and subclinical cases for bacteriological examination is commonly carried out. Drying off of one chronic or tramped teat quarter during lactation is also recommended by many veterinarians. Prudent, limited use of antibiotics is strongly advised by dairies. Teat dipping and dry cow therapy are generally not recommended. About 20% of the cows are treated with antibiotics at drying off, mainly because they have an infection in the udder or if the herd is a problem herd. Milking order according to the health status of the cows and culling of chronic cows is commonly used.

MASTITIS CONTROL AND MILK QUALITY

The only regulatory order concerning mastitis is that bulk tank milk having above 400 000 cells per ml (3 months geometric mean) may not be delivered to the dairy. Many of the dairies have advisory personnel to visit farms having mastitis problems. They usually visit the farm immediately after the first BTSCC over 400 000 to help the farmer to attain better milk quality.

Counts are made by milk buyers based on random sampling of bulk tank twice a month. Milk in every lorry tank coming to the dairy plant is tested for antibiotics. If antibiotics are found, every farm on that collection line is tested. Some of the dairies sample every farm every day, but test only if antibiotics are found in the lorry tank. Producers suffer a great price penalty if antibiotics are found. Milk found positive is kept away from human consumption. It is used for animal feed or mixed with manure or waste water. 0.18% (6 samples) of tests for antibiotics were positive in a random sampling of the bulk tanks in 1998. A microbiological test, Valio T101, was used. Only two cases (0.05%) were confirmed positive by chemical analysis.

The share of best class milk (less than 250 000 cells/ml 3 months rolling geometric mean, 50 000 CFU in bacterial count, no antibiotics, no other reclamations) has increased strongly during the 1990s, as seen in the Table below. The bonus in milk price of that milk is about 2.5% for the farmer.

In 1998 the main pathogens causing mastitis were, according to the

The arithmetic and geometric mean BTSCC for Finland

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
Arithm. mean	282	247	215	186	179	177	170	176	166
Geom. mean	205	179	156	138	134	133	131	136	129

In 1998 the distribution samples in different cell count classes was (581 693 samples) as follows

BTSCC	< 250 000	250 000- 400 000	> 400 000
% of samples	83.5	11.2	5.3

and total bacterial count.....

Year	1996	1997	1998
Arithm. mean	12100	12500	11800
Geom. mean	4900	5000	4900

The share of best class (E-class) milk

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
%	55.2	64.4	73.9	81.6	83.4	87.7	88.3	88.4	90.6

National Veterinary and Food Institute analyses, in per cent of all bacteria found (bacteria found in 55.8% of samples), selected material:

Main pathogens	% of pathogen in mastitis
Staph. aureus	19.2
CNS	36.5
Strep. agalactiae	0
Strep. dysgalactiae	4.2
Strep. uberis	9.0
E. coli	6.9

CONTROL SCHEMES

There is no mandatory scheme applied to all producers except that all medicines used in production animals must be recorded. The veterinary officers visit all dairy farms once in 3 years to control the hygienic conditions on the farms. The quality payment scheme and the health-recording scheme recommended for every herd also serves mastitis control. Some dairies have strong recommendations for quality assurance purposes and almost all producers in those areas follow them.

Pre-milking teat dipping is forbidden in the EU-directive for milk hygiene. Post-milking teat dipping is recommended as a control tool in herds with contagious udder pathogen problems. About 20-25% of the dairy farms use post-milking teat dipping. The most common disinfectants are iodophores.

Only selective dry cow therapy is used in Finland. The most common antibiotics are penicillin with dihydrostreptomycin, cloxacillin sometimes with ampicillin and cephalexin with dihydrostreptomycin. The trend is to get rid of the aminoglycosides in medicines used for mastitis.

Many dairies and some local advisory centres have personnel to test milking machines. Before Finland joined the EU (1995), all new milking machine installations on farms had to be tested by officially accepted test personnel. This is continuously recommended, and milking machine testing is commonly performed if the farm has mastitis problems.

All new bulls used in artificial insemination have an index for mastitis treatments and somatic cell count. The genetic increase of predisposition to mastitis has stopped during the 1990s due to a breeding programme including these traits.

The strength of the mastitis control in Finland is that farmers pay much attention to the SCC, and the dairies get high quality milk. The use of antibiotics has markedly decreased during recent years, and the use of disinfectants is also limited. Strep. agalactiae is very uncommon on farms. No mycoplasmas have been found in intramammary infections.

The weakness is the failure to control mastitis cases caused by CNS and, on some farms, also by Staph. aureus. The advisory work done by the dairies has problems because of the hard competition in the milk industry in the country and in the EU. A national herd health service is being planned.

ADVICE ON MASTITIS CONTROL

Dairy companies and local vets are the most important bodies to give dairy farmers advice on mastitis. Several area projects financed by dairies, communities and partly the EU are going on, in order to create regular herd health planning on dairy farms. In advisory work, especially giving courses to the farmers, Faculty of Veterinary Medicine and the National Veterinary and Food Institute have a role.

The number of people currently working with mastitis in Finland is: researchers 5 to 10, veterinarians in dairies and projects 5, advisors in dairy companies and local advisory associations 50, veterinarians working on dairy farms 300, administrators 2 to several (depending on how big the share of their work on mastitis or milk hygiene questions covers).

RECORDS

All Finnish herds are tested for BTSCC twice a month. These results are reported twice every month to the farm. A national society, Milk Hygiene Association, collects the data from all dairies and reports it annually. In herds in the milk recording system individual cow milk SCC are measured every second month and reported to the farms and to the Finnish Animal Breeding Association.

All farms have a cow health and AI card for each cow where all veterinary and producer treatments and diagnoses can be recorded. The data collection using these cards is voluntary, and covers about 77% of the dairy farms in Finland. For herds in the milk recording system the disease records are collected quite well and reported to every farm three times a year. These reports also include additional SCC and fertility information.

About one third of the practicing veterinarians have portable computers on farm visits to record the treatments and diagnoses.

Recording the use of all medicines on farm is mandatory, but no national data collection is organized.

THERAPY

The number of treated udder disease cases has varied as follows

The treatment of mastitis is typically treated by a veterinarian with intramuscular injections of penicillin or some other antibiotic, with intramammary tubes also in approximately 60% of cases. Only injections are given in about 20% of cases and only tubes also in 20% of cases. Most of the mild clinical mastitis and part of the subclinical mastitis cases are treated with intramammary tubes prescribed by a veterinarian but administered by the farmer. The farmer cannot buy any antibiotics without a prescription from a veterinarian.

Treatment of acute mastitis

Treatment includes an aseptic milk sample. Based on the bacteriological result, treatment can later be corrected according to the pathogen isolated (rapid diagnosis requires milk culturing by the veterinarian; cow side tests such as LIMAST are also recommended). In other words, there is no standard treatment but treatment includes *bacteriological diagnosis* and recommendations for subsequent measures (follow-up therapy, prevention of infection, dry cow therapy, etc.). Earlier diagnoses (possible penicillin resistance of staphylococci)

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Treatments/ cow	0.22	0.20	0.27	0.30	0.31	0.31	0.27	0.26	0.28	0.27

are useful when new cases are treated.

Penicillin-susceptible Gram-positive bacteria (streptococci, beta-lactamase-negative staphylococci)

Penicillins, systemic treatment

- benzyl penicillin G -K or -Na 15 000 IU/kg i.m./slowly i.v. BID (2x10 million IU/day). Rapid concentration in milk and short residues. Also for initial treatment before bacteriological diagnosis.
- benzyl penicillin procaine 20 000 IU/kg i.m. SID (10-12 million IU/day). Do not overdose, long residues are possible. Test milk for residues before delivery.

Penicillins, intramammary treatment

Advantages of intramammary (IMM) treatment are lower consumption of antibiotic and animal welfare reasons (no pain due to injections). IMM drug may distribute poorly throughout mammary tissues in acute mastitis when udder is very swollen. Frequent milking-out may be difficult with IMM treatment. After the acute stage and in milder cases of mastitis IMM can be used. In the infections of the milk compartment, such as streptococcal mastitis, the superiority of parenteral treatment over IMM in acute mastitis has not been proven. In mastitis due to *S. aureus*, systemic or combination treatment may be superior to IMM treatment only. The dosing of IMM treatment depends on the milk yield etc. Most intramammaries contain aminoglycosides in combination with penicillin G but there is no evidence of the superiority of this combination compared with penicillin G alone.

Normal dosing: intramammaries containing penicillin G procaine once a day.

Penicillin-resistant Gram-positive bacteria (beta-lactamase positive staphylococci)

Mastitis due to penicillin-resistant staphylococcal strains should in principle not be treated and the the cow should be culled or the quarter dried-off, especially if both susceptible and resistant bacterial strains have been isolated from the herd. If these cases are treated, at present IMM treatment is practically the only choice as no efficient parenteral antibiotics are available.

Beta-lactams

- cloxacillin intramammaries twice a day (combination of cephalexin and dihydrosteptomycin not recommended, too wide spectrum here)

Others

- spiramycin 10 mg or 26 000 IU/kg/day i.v./i.m. SID. Risk of residues, especially if administered i.m. In diagnosed penicillin resistant *S. aureus* cases after sensitivity testing only. According to limited clinical studies: very poor efficiency.

(oxytetracycline 10-20 mg/kg i.v. Not recommended, too wide spectrum here. Milk interferes with the activity of tetracyclines, and high dosage is needed to achieve therapeutic concentrations. Tissue irritation if i.m. No evidence of clinical efficacy. Risk: increases selection pressure towards antibiotic resistance.

Coliforms

No antimicrobials generally needed as infections are normally eliminated spontaneously (*E. coli*). Exception: antibiotic treatment is recommended during puerperal period and in serious cases (often heavy growth on agar plate)

- enrofloxacin i.v./s.c. 5 mg/kg SID. In diagnosed, serious Gram-negative cases (*E. coli, Klebsiella, Pseudomonas*). Does not eliminate bacteria but may prevent massive growth.
- trimethoprim-sulpha i.v. about 48 mg/kg SID or BID. Not recommended i.m. (tissue irritating, large volumes). As alternative to enrofloxacin for initial treatment of serious cases before bacteriological diagnosis. Milk interferes with the activity of this combination.

Follow-up treatment

The type of follow-up treatment is based on clinical signs (general signs, oedema, need for frequent milking), the number of diseased quarters, the fate of the cow, the bacteriological diagnosis and the opinion of the owner. If injectables are left on farm, careful instructions shall be given in writing. The duration of treatment is from 0 to 5 days. The length of treatment is based on the condition of the cow, bacteriological diagnosis and objective of the treatment. A long treatment is given for young cows, in the beginning of the lactation period, and if the infection is not chronic. The objective in these cases is the elimination of bacteria from the quarter. Mastitis caused by *S. aureus*: 5 days, coagulase staphylococci and streptococci 3 days (*Str. uberis* 4-5 days). E. coli: 0-2 days and if the case is not puerperal, antibiotics are not necessary. *Klebsiella*: 3-5 days, in chronic cases no treatment. In chronic cases when prognosis is poor, the main objective is alleviating the clinical signs, and treatment is continued 1-3 days or no antibiotics are administered.

Supportive treatment

Oxytocin (5-10 IU) and frequent milking is recommended. In the case of endotoxin mastitis, repeated injections of oxytocin. Non-steroidal anti-inflammatory agents if the quarter is swollen or sore, also if endotoxin mastitis is suspected (flunixin, ketoprofen etc). Glucocorticoids may interfere with the defence mechanisms of the cow. Fluid therapy in serious endotoxin mastitis.

Assessment of cure

The cow owner follows up with CMT. Cell count drops to the normal level in about 3 weeks, if the infection is eliminated (in Gram-positive cases). Control sample not earlier than 3-4 weeks after treatment.

Attention

In principle it is not economical to treat subclinical mastitis during the lactation period but dry cow therapy is preferred. Exceptions: mastitis caused by *Str. agalactiae*, new infections in a former staphylococci herd where infection has been eradicated, newly calved young cows in general. A chronically infected quarter can also be prematurely dried-off. Chronic mastitis = mastitis in the same quarter more than twice during the same lactation, or infection persisting over the dry period. Record-keeping of all mastitis treatments (quarters) on cow health cards or on file is essential.

Antimicrobial treatment is only one part of mastitis control. Preventive measures are most important; treatment without prevention of new udder infections does not reduce mastitis incidence in the herd. In each herd, a mastitis control programme with a detailed treatment protocol should be established. Records of all diagnoses, treatments, etc., are essential for effective herd health programmes (computerized data management is recommended). Long systemic treatments *should be limited to S. aureus*, because evidence on their better efficacy may exist there only. In principle, mastitis due to penicillin-resistant staphylococci should not be treated,

but the cow should be culled or the quarter dried-off.

Dry cow treatment

The drug selection shall be as limited as possible in each herd. Only problem cows (episodes of clinical mastitis, high cell counts) should be treated. Dry cow preparations should be bactericidal and active against Gram-positive pathogens. If the dry period is short, lactating cow preparations can be used. First drug of choice is penicillin G, for beta-lactamase positive cases cloxacillin. There is no evidence about the superiority of injection treatment over IMM dry cow treatment (possible exception: penicillin G in mastitis due to beta-lactamase negative *S. aureus*).

In 1995, 54% of *Staph. aureus* strains tested were sensitive to penicillium and 100% to cloxacillin. The increase in penicillin resistance which has occurred in the last 20 years might have a connection to the use of cephalosporins that started in the 1980s. There seems to be a decrease in resistance to penicillin in recent years.

The strategy for therapy in Finland is as follows.

Microorganism	1st drug of choice	2nd drug of choice	Remarks
Streptococci *Str. agalactiae* *Str. dysgalactiae* *Str. uberis*	Penicillin G		Systemic (acute) or local treatment. Prevention crucial in all forms of mastitis.
Enterococci	Susceptibility testing	Usually resistant	Prognosis for bacterial cure poor.
Staphylococci *S. aureus* CNS β-lactamase -	Penicillin G		Systemic or combination treatment (acute). Prognosis for bacterial cure poor if chronic.
S. aureus CNS β-lactamase +	Cloxacillin	1st gen. cephalosporins, macrolides or according to susceptibility testing	Local and/or systemic treatment depending on drug used
Coliforms *Escherichia coli*	No antimicrobials	Fluoroquinolones or trimethoprim-sulphonamides	Antimicrobes necessary in serious cases and during puerperal period only. TMP-sulfa: high dose.
Summer mastitis *A. pyogenes* *Str. dysgalactiae* anaerobes	Penicillin G	Macrolides	Systemic treatment. Prognosis of the affected quarter poor.
Other bacteria *Klebsiella* sp.	Susceptibility testing	Fluoroquinolones	Poor prognosis
Pseudomonas sp.	Susceptibility testing	Fluoroquinolones	Poor prognosis
Corynebacterium bovis	No antimicrobials	Improve hygiene	
Bacillus sp.	Penicillin G		
Fungi, yeast	No antimicrobials		Confirm the diagnosis. Conservative treatment. Poor prognosis.

FUTURE

The short-term policy is to use antibiotics in a prudent way, to avoid antibiotic treatments when exact microbiological and economic indication are lacking and to minimize the risk of drug resistance and antibiotic residues in milk.

Now, and especially in the long term, breeding for mastitis resistance is important. Continuous education of farmers and veterinarians, advisory activities on farms to decrease the harmful effects of management and stall environment are included in the Finnish mastitis control also in the future.

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GERMANY

INTRODUCTION

The western and eastern parts of Germany were reunited in 1989. These two German regions show marked differences in agricultural structures. Generally speaking, the largest farms are in the eastern part and the smallest farms are in the west part. Therefore, mean values of the country to describe the structure and the status of dairying have little information value.

Furthermore, as in other industrial countries, the general contribution of agricultural production to the National Gross Product is of minor economic importance at less than 2%.

Due to the increased economic pressure on dairy farms there is a general trend to compensate for that by increasing the herd size and the individual yield per lactation in order to improve productivity. Despite the many interactions between the mean yield level per cow and the incidence of multifactorial diseases, more and more, dairy farmers are looking critically at the cost-benefit relationship of recommended control measures of herd related diseases.

The following description of the structure of dairying in Germany is based mainly on data published by the German Association of Cattle Breeders (2000), whereas the answers to the questions related to the mastitis control schemes and related topics are based on discussions within the German Expert Group for Mastitis (DVG, 2000) and personal experience of the author.

Table 1: Milk production in Germany 1999- global information

Parameter	West	East	Total
Herd numbers (n =)	142 900	6 100	149 000
Cow numbers (Mio)	3.8	0.9	4.7
Mean herd size (n = cows)	26.6	149.6	31.6
Max. herd size (n = cows)	1 000	3 500	-
Mean yield/cow and lact. (kg)	5 780	6 650	5 990
Mean fat (%)	4.19	4.29	4.22
Mean protein (%)	3.42	3.48	3.43
Milk delivered (Mio t)	21.0	5.5	26.5

STRUCTURE

Overall, there are around 300 dairy factories to which the milk is delivered. The global information on the structure of herds, the average production values per cow and year in the two German regions (West: Former FRG; East: Former GDR) and the amount of delivered milk/year are summarized in Table 1. The total amount of milk produced is around 27 million tons kg per year, which corresponds to around 25% of the total amount of milk pro-duced in the EU.

Table 2 gives the distribution of herd size and cows in West and East Germany based on recorded milk data, which represent around 80% of all cows in the country. It can be seen that 67% of the herds in West Germany have between 1 and 39.9 cows, whereas in East Germany 64% of the herds have more than 80 cows.

Table 3 summarizes some data on the predominant breeds of cattle and on the cull-ing rate and culling reasons. The data on culling reasons are based on information given by the dairy farmers and recorded by the

Table 2: Milk production in Germany 1999 - herd size and cow distribution based on recorded cows

Herd size	Herds (%) West	Herds (%) East	Cows (%) West	Cows (%) East
1 - 19.9	27.3	9.2	11.6	0.5
20 - 39.9	39.9	7.5	36.0	1.2
40 - 59.9	19.7	10.7	26.9	2.8
60 - 79.9	8.4	8.6	14.3	3.1
80 - 99.9	2.9	6.8	6.1	3.1
100 - 199.9	1.7	23.1	4.8	16.8
200 - 499.9	0.06	26.2	0.35	41.0
> 500	0.01	7.8	0.04	31.5
Total (n =)	84 740	4 483	2 862 714	879 971

Table 3: Milk production in Germany 1999 - cow related data and milking equipment

Predominant breed of cattle for milk production		
German Holstein	(Dairy cows)	56.6%
German Simmental	(Dual purpose cows)	25.6%
German Red Holstein	(Dual purpose cows)	7.3%
German Brown	(Dairy cows)	6.4%
Culling rate and reasons		
Mean culling rate in % of recorded cows:		36.3%
Mean culling reasons:		
Sterility		20.6%
Mastitis		15.9%
Low yield		8.9%
Hoof problems		9.1%
Breeding		8.5%
Milking equipment		
Bucket milking installation		10.2%
Pipeline milking installation		55.3%
Parlour milking installation		34.5%

milk recording institutions. From the information on the distribution of milking equipment the most common type of hous-ing can be assumed. Around 65% of all cows are kept on pasture for 6 months.

ECONOMICS

The milk price is not subsidized by the government. Nevertheless, the quota system exerts marked pressure on the economics of dairying. The most relevant data for economics are given in Table 4. Around 6% of the milk produced in the country enters the export market.

STRATEGY

The basic strategy and the basic components of mastitis control schemes in the country are detailed in Table 5. There are some differences between the GERMAN STATES in the procedure to apply the control schemes. For all states the regula-tory aspects of the MILK QUALITY ORDINANCE is valid. Very often as a first step the cow individual cell count is used to evaluate the herd problem. As a second step cyto-bacteriological examinations of quarter milk samples are performed, with different thresholds applying in the various German states.

MASTITIS CONTROL AND MILK QUALITY

Based on the MILK QUALITY ORDINANCE bulk milk delivered from every herd will be tested routinely on the following parameters: Cell count, bacterial count, fat, protein, freezing point and presence of inhibitors. For the classification of "Quality" only the bacterial count (£ 100 000 /ml) is valid. All other parameters influence only the milk price. Yet, dairies with a low milk cell count (< 400 000 cells/ml) are not always rewarded by an increased price. Milk contaminated with antibiotics is used for feeding purposes. The principal regulatory elements for mastitis control and milk quality are given in Tables 6 and 7.

CONTROL SCHEMES

There is no mandatory scheme applied to all milk producers. Institutions and people mentioned under the topic "Advice on Mastitis Control" are involved in formulating and administering the mastitis control schemes. The principal pattern of mastitis control schemes is detailed in Table 8.

Table 4: Milk production in Germany 1999 - economics

Parameter	Financial aspects		
Milk price paid to dairy producers	0.557 DM/kg (excl. VAT)		
Price for slaughter cows	3.50 DM/kg (excl. VAT)		
Mastitis losses per cow & year (285 US $)	10 % of mean yield	=	165 US $
	Treatment costs	=	20 US $
	Reduced useful life	=	100 US $
Milk price reduction by lack of quality	Inhibitors: minus 0.10 DM/kg Bacterial count (x_g: 2 months) > 100 000/ml: minus 0.04 DM/kg Cell count (x_g: 3 months) > 400 000/ml: minus 0.02 DM/kgm		

Table 5: Milk production in Germany 1999 - mastitis control strategy

- **Basic strategy:**
  Basic strategy: control of somatic cells
  Prevention of new infections; Shortening of existing infections
- **Cultural, social or economical concerns**
  No barriers to control mastitis
- **Basic components of mastitis control scheme**
  Initiation: Exceeding the thresholds of bacterial or somatic cell count due to the MILK QUALITY ORDINANCE or by private decision of the dairy farmer
  Components:
  Analysis: (milking, climate, feeding, hygiene, management)
  Diagnostics: (cow individual cell count; cell count and bacteriological examination of quarter milk samples)
  Recommendations: Therapy and changes in management
  Proposals: Future activities for the farmer

Table 6: Milk production in Germany 1999 - mastitis control and milk quality

- Mean herd bulk milk values (x_g)

** Cell count:	Total:	171 000/ml;	West:	162 000;	East:	213 000
** Bact. count:	Total:	20 000/ml;	West:	20 000;	East:	20 000

- Calculations of regulatory limits

** Cell count:	400 000/ml;	x_g: over 3 months
** Bact. count:	100 000/ml;	x_g: over 2 months

- Frequency of regulatory testing

** Cell count:	At least monthly
** Bact. count:	At least twice a month
** Inhibitors:	At least twice a month

- Exceeding the thresholds: Reinstatement of the dairy

** First step:	Three months to reduce the exceeding value
** Second step:	Double sampling with an interval of 4 days to show values below the thresholds

Table 7: Milk production in Germany 1999 - mastitis control and milk quality

- Regional variations
  - * The milk quality Ordinance is valid for all "states"
- Main mastitis pathogens
  - ** CNS
  - ** *Staph. aureus*
  - ** Streptococci
  - ** *E. coli*
  - ** Others
- Safe guards to avoid antibiotic residues in the food chain
  - ** Inhibition of application (for example Chloramphenicol)
  - ** Definition of withdrawal periods
  - ** Residue testing at the dairy factory: (MRLs)

Table 8: Milk production in Germany 1999 - mastitis control schemes

→ Mandatory Scheme
Not applied

→ Control Scheme most often applied
Pre-Dipping is not allowed (hygienic codex; EU)
Post-Dipping is recommended (90%: Iodine dips)
Dry cow therapy is used as blanket (total) therapy
Dry cows therapy formulations: Mainly penicillins
Machine testing is performed by animal health service institutions, by milk recording institutions and by milking machine manufacturers. Frequency of testing is very variable (mean: < 1 per year & dairy)
Milking time observations: No data; very seldom applied.

→ Weakness of the present approach to mastitis control
Mastitis control is initiated too late. Very often mastitis control starts after exceeding the cell count threshold of 400 000 cells/ml herd bulk milk (geom. mean over 3 months).

ADVICE ON MASTITIS CONTROL

The data given in Table 9 are based on the impression of the author, as there are no official data available. Over the last 10 years many in-stitutions involved in mastitis research and milk production have been closed (for example Institute for milk production at the FEDERAL DAIRY RESEARCH CENTER at Kiel, Institute for milk production at the UNIVERSITY at Hohenheim). The main reasons for reduction in the research activities in the public institutions are to be sought in the sur-plus production within the EU.

Table 9: Milk production in Germany 1999 - advice on mastitis control

- **Advice on mastitis control is given (estimated priority)**
  (1) Milk recording institutions (agricultural associations)
  (2) Veterinary practitioners
  (3) Dairy associations
  (4) Government paid veterinary officers
  (5) Universities
  (6) Milking machine companies, feed companies etc.
- **Services available:** see "Mastitis Control Strategy"
- **Estimate of number of people working with mastitis:**
  (1) Researchers: fewer than 20
  (2) Advisors: about 400
  (3) Veterinary practitioners: about 3000
  (4) People involved in milk recording, milk quality analyses, and advising of farmers: about 3800

RECORDS

The records systems available in the country are summarized in Table 10.

Table 10: Milk production in Germany 1999 - records

RECORDING SYSTEMS

- ***In connection with the MILK QUALITY ORDINANCE***
  +++ Determination of the bulk milk cell count at least once a month
- ***On private basis***
  +++ Around 60% of the dairy farmers (89 000) are members of the milk recording institutions. These 60% of the dairy farmers are the owners of around 80% of the cows. Monthly records consist in:
  - Yield per cow
  - Cell count in cow composite samples
  - Determination of: fat, protein, lactose, urea
  - Clinical diseases: mastitis, sterility, hoof problems
  - Culling reasons: diseases, breeding, others

THERAPY

More and more it is accepted that therapy is only one part in the strategy to control mastitis. Due to the insufficient results with antibiotic therapy the majority of the farmers recognize the need to place more importance on preventive measures. The general schedules of antibiotic use are summarized in Table 11.

Table 11: Milk production in Germany 1999 - mastitis therapy

Proportion of treatments by severity type	
Mild	<50%
Moderate	80%
Severe	95%
General route of application	
Intramammary infusion	(90%)
Combination of local and systemic treatment	(10%)
Administration of antibiotics	
Selection of antibiotics: around 60% by veterinarians	
Administration: In more than 80% by the farmers	
Antibiotic application is based on veterinary prescription	
Practical performance	
Around 30% of sub-clinical cases (increased cell count) are treated	
A resistance test is performed to select antimicrobials in 20% of all cases	
Mainly used antibiotics are: cephalosporines, penicillins	

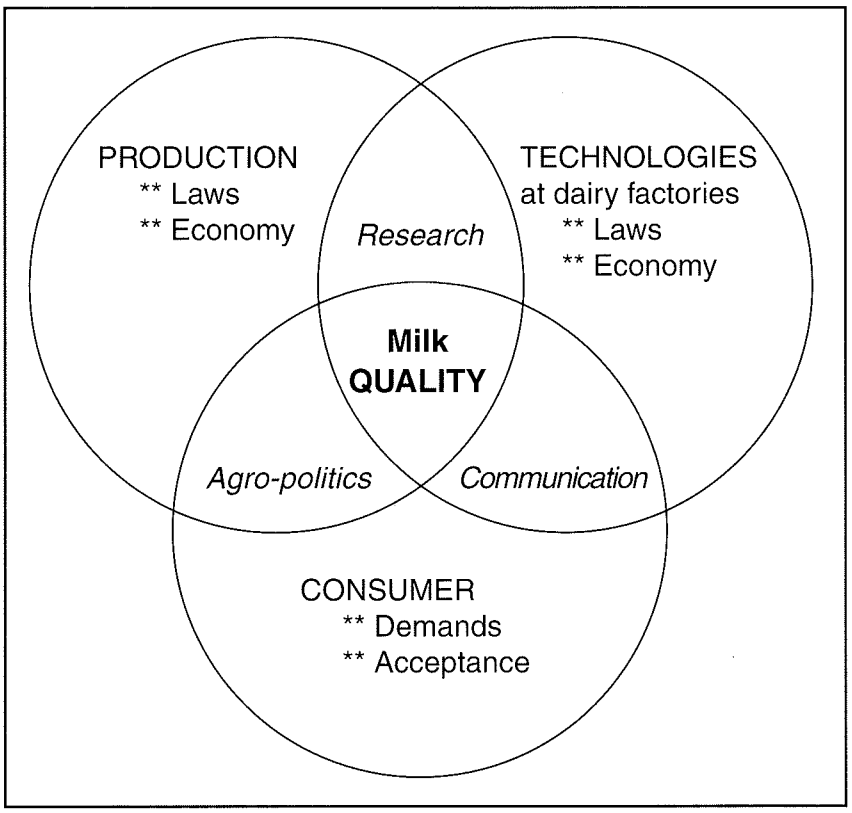

Figure 1: Basic elements of milk quality. Level corresponds to the national income.

FUTURE

In connection with the further increase in the herd size it is assumed that schemes to control mastitis which are based on more data from routine measurements will be an incentive for money to be spent on mastitis control. Schemes to regulate the milk prices depending on the health status of the herd (in terms of cell count) will drive the motivation of dairy farmers to fulfil the requirements for the maximum milk price. Moreover, the milk quality and the milk price will be influenced by the general eco-nomic development in the country (see Figure 1).

At any assumed economic level the interaction between dairy farmers, dairy factories and the consumer will define the level of milk quality. The level of milk qual-ity needed will influence the type and intensity of mastitis control.

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IRELAND

STRUCTURE

What is the structure of the Irish Dairy Industry, Co-op (farmer owned) some now PLCs

Total Milk produced – 5166 M litres (+ 350 M litres fed to farm animals), 5235 tons delivered (1997 Dept of Agric. figures)

Number of cows: 1.268 M (Dec 1997) These cows are mainly dairy cows and predominantly Friesian.

Distribution of number of:

Herd size (No. of cows)	No. of herds
>100	1 000
99-50	6 100
49 – 30	10 200
29 - 20	8 200
19 - 10	9 500
9 - 3	4 700
2 - 1	2 300

No of active producers (1997): 35 114

No of people producing milk (1997): 41 000

Average herd size: 31

Maximum herd size: 400 (estimate)

Typical culling and replacement rates for dairy herds: 16% (estimate.)

Typical yields: 4 500 kg/lact

Typical no of lactations per cow: 5

Types of winter housing: There are very few tie stall barns. Most large herds are in free stall barns and most small herds are in loose house barns. Cows are pastured for 8 months per year.

ECONOMICS

Milk price paid to producers: 22 pence/l

There is no governmental subsidy

What is cull cow price per kg: 150 pence/kg

There are no data on estimated losses due to mastitis

The milk price is adjusted for milk quality. There are deductions for lack of quality.

% of milk for the export market : 75%

Butter and for the home market: 15%

Liquid milk products for the home market: 10%

STRATEGY

Mastitis control is based on prevention of new infection and reducing existing infection as well a reactive approach of identifying infected quarters and treating with antibiotics. There is an individual cow SCC monitoring programme. The spring-calving, seasonal production, in Ireland gives a certain cultural dimension towards mastitis control.

Basic component of mastitis control:
Five point plan

Mastitis control implemented by:
Milk purchasers

Regulatory aspects:
EU Standards

MASTITIS CONTROL AND MILK QUALITY

Mean SCC:
300 000 cells/ml (subset of 10 500 herds)

Mean TBC:
34 000 cpu/ml (subset of 5 500 herds)

Legal limits for SCC and TBC:
EU limits

The frequency of measurement of SCC and TBC are in accordance with the EU regulations. When the limits are not followed, the milk will be rejected. Some purchasers have more stringent standards than the EU regulations.

Main cause of subclinical mastitis:
S. aureus

Main cause of clinical mastitis:
S. dysgalactiae, S. uberis, E. coli, A. pyogenes

Causes of high bulk milk SCC:
S. aureus

The bulk milk is tested at least 4 times each month for antibiotics by the milk purchasers. Moreover, the Department of Agriculture carries out random checks. If antibiotic residues are found, the milk is rejected. To ensure that antibiotics will not come into the food chain, all trucks are tested before unloading.

CONTROL SCHEMES

There is no mandatory mastitis control scheme. The existing control schemes are administered by the milk purchasers.

Pre-dipping is not recommended and post-dipping with iodine, glutaraldhyde, chlorine or chlorhexidine is recommended.

Blanket dry cow therapy is recommended.

The following antibiotics are used: cloxacillin, framycetin/penicillin, neomycin/penicillin, cephalexine, cloxacillin/ampicillin, cloxacillin/gentamycin.

It is recommended to test the milking machine at minimum once per year. Milking time observations are only carried out in problem herds and are carried out by the dairy co-operation or the Teagasc advisor.

ADVICE ON MASTITIS CONTROL

Organizatons that give advice:
Dairy co-operations, Teagasc, Veterinarians.

Primary source of advice:
Teagasc and Co-op Advisor

Services to problem herds:
Co-op, Teagasc, Regional Veterinary Laboratory

No of people engaged in Mastitis in Ireland:

Teagasc advisors	125
Co-op advisors:	40
Researchers:	8

THERAPY

Proportion of clinical cases treated:
All detected cases

Antibiotics used:
Cloxacillin, framycetin, cephalexine, neomycin, kanamycin, gentamycin-/cloxacillin

General Administration route:
Intramammary

Administered by:
Herdsman

Decision on antibiotics:
Mostly by herdsman

Are Vets only allowed to treat cows?
No

Are subclinical cases treated during lactation?
More and more resistance to 66% of *S. aureus* is resistant

Strategy for therapy in Ireland is mostly led by consumers and the overall requirement to keep the SCC within EU specifications.

FUTURE

In the future more efficient production systems will occur and the elimination of prophylactic use of antibiotics in the dry period is foreseen.

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ITALY

STRUCTURE

Italian dairy farms are currently experiencing huge changes due to the introduction of milk quotas and European directive 92/46. Immediately, farmers have to cope with a market characterized by a decreasing price of milk and a sudden increase of quality requirements. These changes make the current situation very dynamic and the following figures could change in a few years.

Number of herds

98 349 000 quintals (1996/97)
99 804 (1996) with the following distribution

Regions	Herds	(%)	Cows X 1000	(%)
North-east	29 534	(29.6)	347.2	(16.7)
North	22 741	(22.8)	948.0	(45.6)
North-west	9 520	(9.5)	242.3	(11.6)
Centre	9 085	(9.1)	152.8	(7.4)
South	25 522	(25.6)	248.1	(11.9)
Islands	3 402	(3.4)	140.6	(6.8)
Total	**99 804**		**2 079.0**	

Number of cows

2 079 000 (1996)

Distribution of herds by number of lactating cows

Herd size	Cows	% of cows	No herds	%
1- 9	252 888	12.1	64 265	56.7
10-19	271 588	13.1	20 095	17.8
20-49	530 581	25.5	17 951	15.8
50-99	492 295	23.7	7 648	6.8
>100	532 431	25.6	3 235	2.9

Maximum herd size

>2000 animals (calves included) 214 herds (1996)

Replacement rates

Estimate of replacement is 25%

Predominant breeds

Frisona Italian (Italian Holstein)
935 000 in herd book, 1 400 000 overall.

Bruna Italiana (Brown Swiss)
132 000 in herd book.

Pezzata Rossa Italiana
38 000 in herd book.

Breed milk yields

Overall 4,700 kg/305 d

(a) Frisona Italiana in herdbook: 7 813 kg/305 d with 3.54% fat and 3.22% proteins.

(b) Bruna Italiana: 5 308 kg/305 d with 3.8% fat and 3.3% proteins

(c) Pezzata Rossa: 5 098 kg/305 d with 3.8% fat and 3.3% proteins

Type of housing

Mainly loose housing, increasing number of barn with cubicles (free stall) and decrease of tie-stall barns.

Presence of pasture

Only in area close to mountains (Northeast and Northwest)

ECONOMICS

Farm price of milk

Price for 1998: 630 lit or 0.323 EURO; price 1999: 650 lit or 0.333 EURO. There are no state subsidies.

Meat price

Young bull Frisona Italiana 2 547 Lit or 1.306 EURO

Cow Frisona Italiana 1 278 Lit or 0.655 EURO

Meat (young stock) 10 167 Lit or 5.213 EURO

Meat (cows) 4.187 or 2.147 EURO

Cost of mastitis

Per cow 250 000 lit or 128 EURO (actualized data)

Per country (dairy industry) estimated 250 millions of EURO

Based on economical evaluation of direct costs, production loss, decrease of quality and increase of replacement rate

Milk quality payment

Milk quality payment is based on protein and fat content, the bulk milk TBC and SCC. The standard milk price (unit) is used as basis and depending on the milk quality, more or less is paid as stated in the schedule below (in Lit):

Export value

Overall 1.638 billions Lit or 840 millions EURO

Cheese 1.304 billions Lit or 668 millions EURO

Import value

Overall 4.768 billions Lit or 2.445 billions EURO

Cheese 2.060 billions Lit or 1.056 billions EURO

STRATEGY

Basic strategy

The basic strategy is based on the European directive 92/46. State veterinarians, dairies and producers are focused on SCC reduction.

The younger generation of practitioners and some industry (feeding, pharmaceutical and few dairies) are promoting mastitis prevention and management improvement to decrease intramammary infection frequency.

Mastitis control approach

Nobody is officially in charge of mastitis control. The task could be performed by different entities:

- private practitioners
- state veterinarians
- veterinarian of regional diagnostic labs
- advisors from local farmer organization
- advisors from industries and dairies

MASTITIS CONTROL AND MILK QUALITY

Legal limits

European directive 92/47 (In Italy milk ordinance DRP 54/97). In addition, for high quality milk (by law definition) < 300 000 SCC/ml

Consequence of exceeding the limits

Official warning, then 3 months to return to the limits

Frequency of testing bulk milk

At least once a month for SCC, twice a month for TBC. Generally more frequent (dependent on dairies)

Milk exceeding the limits sold

Used to produce foods not intended for human consumption.

How the producer gets reinstated

Having one control below the thresholds (actually). Tougher rules to be introduced

Main mastitis pathogen

Subclinical:

Staph.aureus, Environmental streptococci, *Str.agalactiae*

Clinical:

Environmental streptococci, *Staph. aureus* , *E.coli*

High SCC :

Staph.aureus, Environmental streptococci, *Str.agalactiae*

Antibiotic testing

Generally when SCC and TBC are counted, plus random samplings.

Consequences of positives

The farmer should pay a fine + the value of the whole bulk in which positive milk has been delivered

Safeguards for antibiotics

Usually HACCP implemented in each dairy

SCC class	>500	400-50	350-400	350	300-350	150-300	<150
Herds %	25.7	8.9	5.8	0.2	7.0	28.8	23.5
Milk %	19.9	11.0	7.6	0.2	9.1	37.0	15.2

TBC class	>400	300-400	200-300	100-200	100	<100
Herds %	34.6	13.0	17.9	22.4	0.2	11.8
Milk %	31.0	16.9	22.0	24.6	0.1	5.4

Proteins (g/dl)		Fat (g/dl)		TBC (*1000 UFC/ml)		SCC (*1000 cells/ml)	
<3.05	-1,3 x unit	<3.70	–0.5 x unit	<100	+6	<150	+10
3.05-3.24	-1 x unit	=3.70	0	=100	0	151-300	+5
=3.25	0	>3.70	+0.5 x unit	101-200	-2	301-350	0
3.26-3.45	1 x unit			201-300	-5	350-400	-7
>3.45	1.3 x unit			300-400	-7	>400	-10
				>400	-9		

CONTROL SCHEMES

There are no mandatory control schemes

Most frequently recommended scheme

For contagious pathogens there are 3 major schemes applied:

Scheme A (Mammary pathology centre, University of Milan)

Segregation of infected cows based on quarter milk samplings, control post-calving of all animals, dry-cow therapy and control of uninfected cows every 3 months for 1 year.

Scheme B (Regional diagnostic labs)

Segregation of infected animals based on composite milk sampling, dry-cow therapy and lactation therapy, control of all herd every 3 months up to eradication (control) of the pathogens.

Scheme C (some farmers' associations)

Segregation of cows based on SCC (different thresholds), controls every month on cow-basis, no bacteriological diagnosis.

Pre- post- milking teat dip

Post-dip frequently applied, pre-dip very seldom. Not allowed officially by the milk-ordinance (DRP 54/97).

Dry cow therapy

Applied on about 40% of cows (Pharmaceutical industry data), in Northern part of Italy, very likely more than 80% of cows are treated at drying-off, much less in the South.

Selective or blanket therapy

Mostly blanket therapy.

Weakness of the system

Individual approach to the problem, no common guidelines, no cost-benefit evaluation of the different schemes proposed.

ADVICE ON MASTITIS CONTROL

Who advises producers

Farmers' association technicians
Practitioners
Regional diagnostic lab officers
Technical advisors from companies
Universities

Primary source of advice

Technical advisors from companies and/or salesman

Services available (troubleshooting)

No organized services, local availability of technical advisors from farmers' association

Persons involved (estimated)

Researchers	10
Real advisors	50
Administrators	200
Others	??

RECORDS

Recording system available

Only for milk quality parameters (regional basis) and genetic improvement (nationwide). The systems are not mandatory.

THERAPY

Proportions of clinical cases treated

Mild:	30%
Moderate:	70%
Severe:	100%

Antibiotics for dry-cow therapy	Intramammary route	Intramuscular route
	Penicillin	Spiramycin
	Cloxacillin	Tylosin
	Oxacillin	Tiamphenicol
	Cephalosporins	
	Rifaximine	

Milking machine testing

Milking machine testing is applied, at least twice a year from local farmers' associations + private maintenance from dealers.

Most commonly used antibiotics

Tylosin
Spiramycin
Enrofloxacin
Penicillin
Cephalosporins

Route of administration

Intramammary, but intramuscular route is increasingly used

Who administers antibiotics?

The treatment is performed mainly by the milker or by the owner. Owner and/or practitioner make the decision on which therapeutical scheme should be used.

Treatment of subclinical mastitis and high SCC during lactation

Yes, to decrease SCC

Resistance to penicillin and others known

National data not available, but local data do not show any significant increase

Strategy of therapy

No national strategy, based mainly on commercial issues

FUTURE

The market will put a lot of pressure on farmers to increase their efficiency. Small herds will disappear, while large herds will increase the number of cows. Most of the changes will go in the direction showed by herd health strategies developed in the US and Canada to decrease cost and increase milk quality and safety.

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THE NETHERLANDS

Table 1: Number of dairy farms and cows 1990 – 2000 (source: CBS, NRS)

	No. of farms	No. of cows	Cows/farm	DHI	Robots
2000	29 467	1 504 097	51	82%	300
1997	34 596	1 590 571	46	80%	50
1995	37 465	1 707 875	45.6	79.7%	10
1990	46 977	1 877 684	40	74.5%	0

Table 2: Frequency distribution of herd size (source: NRS)

Class	2000	1997	1995	1990
1-20	7.5	8.5	8	9.9
21-40	23.7	29.9	28	35.7
41-60	34	34.7	34.7	32.3
61-80	20.6	16.7	17.7	13.8
81-100	8	6.1	6.8	4.9
101-150	5.1	3.4	4	2.8
151-200	0.8	0.5	0.5	0.4
> 200	0.3	0.2	0.2	0.1

Table 3: Number of calves born between 1 September 1999 and 31 August 2000 in the Netherlands (*1000), representing the percentages of breeds (source: NRS)

Breed (% purebred)	Herdbook	Non-herdbook	Total	% of total
Black & white				
HF 87.5-100%	719	47	767	65
HF 50-75%	66	63	129	11
HF total	786	110	896	76
FH 87.5-100%	3	0.5	3	0.3
FH 50-75%	1	1	2	0.2
FH total	4	1	6	0.5
Blaarkop	1	0.5	1,5	0.1
Red & white				
HF 87.5-100%	95	6	101	4
HF 50-75%	91	24	115	12
HF total	186	30	216	16
MRY 87.5-100%	16	4	19	2
MRY 50-75%	22	12	34	6
MRY total	38	15	54	9
Blaarkop	1	1	2	0.1
Others	3	1	4	0.2
Other milk type				
Jersey	1	0.5	1.5	0.03
Brown Swiss	1	0	1	0.2

STRUCTURE

Number of herds and cows

The number of farms as well as the number of cows is rapidly decreasing over the last 10 years (Table 1). On the other hand, the percentage of cows which are in a dairy herd information system increases steadily. Most cows are housed in freestall barns. The number of farms using a milking robot has increased to more than 300 in 2000.

Distribution of herds by size

The average herd size is 51 dairy cows per herd. The average herd size is steadily increasing (Table 2)

Cattle breeds

There are two main breeds in the Netherlands – Black & white and Red & white. Black and white cows are based on the Fries Holland (FH) breed and since the seventies and eighties crossed with Holstein Friesian. Red and white are based upon the MRY breed (a double purpose breed) and mostly crossed with Red HF. Besides these two major breeds there are some others. The number of calves born in 1999-2000 is given in Table 3. It is seen that the majority of the dairy cows are Holstein Friesians. The proportion of Red & white cattle is decreasing over the years.

Milk production

Milk production is still increasing and in the year 2000 was 8418 kg per cow per year. When calculated for a standard 305-day lactation, the average level was 7999 kg/cow (Table 4). The Black & white cows (mainly HF) produced more than the Red & white cows. However, the latter had a higher percentage of fat and protein.

Table 4: Milk production (305-day production) from 1990 to 2000 (source: NRS)

	Overall			Black & white			Red & white		
	kg/cow	% fat	% protein	kg/cow	% fat	% protein	kg/cow	% fat	% protein
2000	7999	4.33	3.45	8222	4.30	3.43	7277	4.45	3.53
1995	7304	4.44	3.48	7584	4.44	3.46	6661	4.40	3.55
1990	6897	4.38	3.45	7122	4.42	3.43	6359	4.27	3.50

ECONOMICS

All prices are given in Dutch Guilders. 1 Dutch Guilder (HFl) equals 0.45 Euro.

Milk payment system

Basically the milk price is a market price (demand and availability). However, the market is protected. Based on a minimum price per kg milk (3.7% fat) intervention prices are set for butter and fat-free milk powder. Dairy factories can offer these products for the intervention price to the EU. This is only done when prices for milk products are low. Moreover, there are certain import barriers for milk and milk products.

Dutch farmers are not paid per kg of milk. They are paid for delivered kg of protein and fat, and there is a very small, negative price for kg of milk

There are penalties for quality failures: SCC, total bacterial count (measured by bactoscan), freezing point, free fatty acids, spores of butyric acid, dirtiness, growth inhibition. The control schedule is given in Table 5.

Each penalty point is 1 cent per kg delivered milk of the complete payment period of a month. The penalty for growth inhibition is 50 cents for every kg of milk delivered in the shipment, which was found positive.

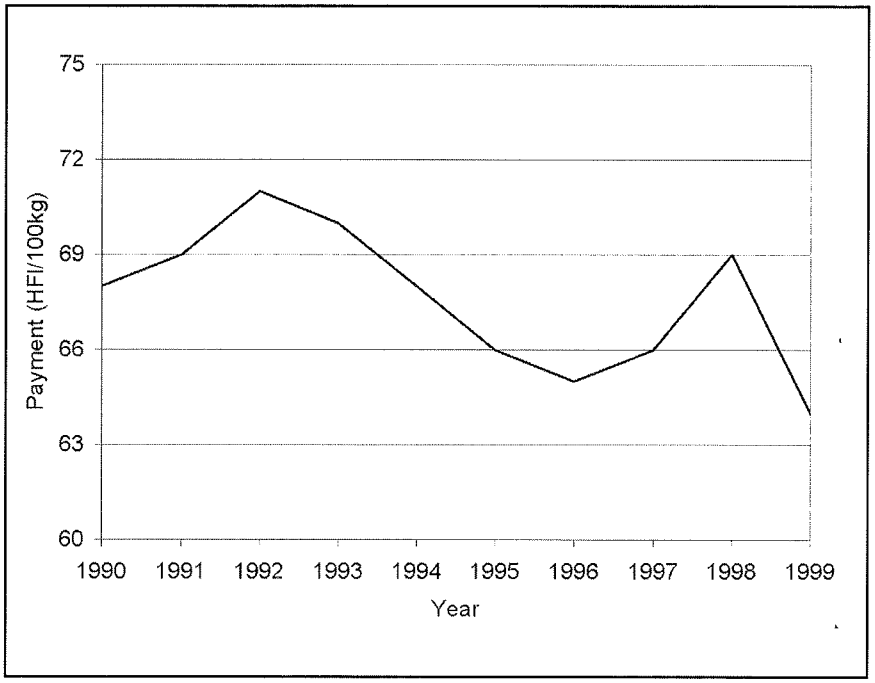

Figure 1: Dutch milk price (HFl/100 kg), standardised for 3.7 % fat from 1990 to 1999.

Table 5: Control points, frequency, thresholds and penalties of the Dutch milk quality control system.

Aspect	Frequency	Threshold	Penalty
Colony count	every 2 weeks	100 000 250 000	1 pt 2 pts
Sediment test	every 4 weeks	Poor	2 pts
Growth inhibitors 0.50/kg	each delivery	Positive	HFl
Somatic cell count	every 4 weeks	400 000 500 000	1 pt[1] 2 pts[1]
Butyric acid bacteria	6/8 times in winter	Positive	2 pts
Acid degree value	every 6 months	1.0 mmol	2 pts
Freezing point	every 6 months	-0.505° C	1 pt

[1] Only when the geometric average over a 3-month period is higher than the threshold.

Table 6: Percentage of deliveries exceeding penalty levels in recent years

Aspect	1995	1997	1998	1999	2000
TBC	1.4	1.4	1.4	1.4	0.8
Sediment test (dirt)	0.2	0.08	0.1	0.1	0.08
Growth inhibitors	0.12	0.1	0.1	0.08	0.07
SCC	7	5.6	5.3	4.7	1.6[1]
Butyric acid bacteria	2.3	0.9	1.6	1.2	1.5
Acid degree value	1.1	1.4	1.5	1.9	1.7
Freezing point	1.3	1.3	1.2	0.9	1

[1] Since 1 January 2000, the penalty system for SCC has changed. Before 2000, penalties were given when a single bulk milk exceeded the threshold. Since 2000, penalties are given whenthe geometric average over 3 months exceeds the threshold.

Milk price

The milk price over the last 9 years is given Figure 1. This is the milk price for milk standardized at 3.7% fat. Since farmers are paid for kg of fat and protein, the actual milk price per kg of milk is higher (see also Table 3). The average Dutch milk price, not standardized, was HFl 69.67 per 100 kg milk in 1999.

Export

In 1999 a little more than 11.1 billion kg of milk was produced. Approximately 65% of total production was exported, mainly to other EU countries.

MASTITIS CONTROL AND MILK QUALITY

Milk quality

Legal limits for SCC and TBC are: 400 000 cells/ml and 100 000 cpu/ml respectively. Farmers are no longer allowed to deliver milk, when the geometric average of 3 months (monthly measurements) exceeds this limit. However, except for SCC, Dutch farmers receive penalties on each delivery they exceed the threshold. For repeated violations, the penalty increases.

Dutch milk quality (percentage of milk deliveries which exceeded the penalty threshold) in recent years is given in Table 6.

Table 7: Identified pathogens for clinical mastitis cases stratified by BMSCC class (source: Barkema et al. 1998)

Pathogen	BMSCC (1000)		
	< 150	151-250	>250
S. dysgalactiae	2.8	3.8	3.6
S. agalactiae	0.1	0.4	0.6
S. uberis	1.8	1.8	2.0
S. aureus	4.8	6.3	8.3
E. coli	6.1	5.2	4.4
Other	5.3	4.6	3.5
Negative	6.9	3.6	2.8
Total	27.8	25.7	25.2

Mastitis pathogens

Results from a large study on dairy farms in north Netherlands are given in Table 7.

Preventive measures

There is no single uniform plan that is required by legislation. Basically farmers are responsible for the implementation of mastitis control. EU legislation gives a number of requirements with regard to milk quality. For example, control of the first squirts of milk on abnormalities and cleaning of udders before milking. However, in the Netherlands it is not controlled routinely whether farmers carry out these requirements. The EU has also regulations on maximum SCC and bacterial counts. When Dutch farmers violate these regulations, the farm is visited by advisors from the milk purchaser.

In 1998 a project finished in which a health planner for mastitis was developed. In this project all Dutch organizations working on mastitis control were involved, so results of this project might be regarded as the general consensus. Advised preventive measures are:

Housing and hygiene
- Cleaning of cubicles correctly
- Prevention of lying down after milking
- Periodic control of farm hygiene
- Cleaning of barn
- Shaving cows
- Measurement of climate

Milking machine
- Yearly control of milking machine according to the Dutch standard
- Regular control of vacuum level
- Regular control of pulsation frequency
- Regular replacement of liners
- Control of second milking machine (used in the calving barn)
  - Monitoring of teat end condition

Milking method
- Teat disinfection after milking
- Correct pre-treatment
- Stripping before milking
- Milking of abnormal cows at the end
- Periodic control of milking method

Feeding
- Regular ratio calculation
- Regular control of mineral status
- Regular condition scoring

Drugs
- Bacteriological examination of cows with clinical mastitis
- Periodic adjustment of treatment plan
- Drying off according to the treatment plan
- Treatment according to the treatment plan
  - Finish treatments completely
  - Prevention of summer mastitis

Other measures
- Bacteriological examination of high SCC cows
- Control of cows bought from other farms
- Culling of chronic mastitis cows
- Use mastitis-index in bull selection
- Regular control on number of cows lying out milk

In practice the classic 5-point scheme is much applied.

CONTROL SCHEMES

There is no mandatory control scheme. However, the Dutch dairy industry has been developing a total quality system. At the end of 1999 each Dutch farmer must be entered. If not, the farmer will receive a large penalty on his milk. Part of the system is registration of diseases and applied antibiotics. Moreover, the milking machine must be checked yearly according to a standard control procedure. The persons carrying out these controls must be qualified for doing so.

Moreover, a system has been developed to help farmers with their preventive mastitis management. This system is used by all organizations working on mastitis management. These organizations have also been involved in the development of the system. The system is called health planner mastitis and is based upon a classic management planning circle (see Figure 2).

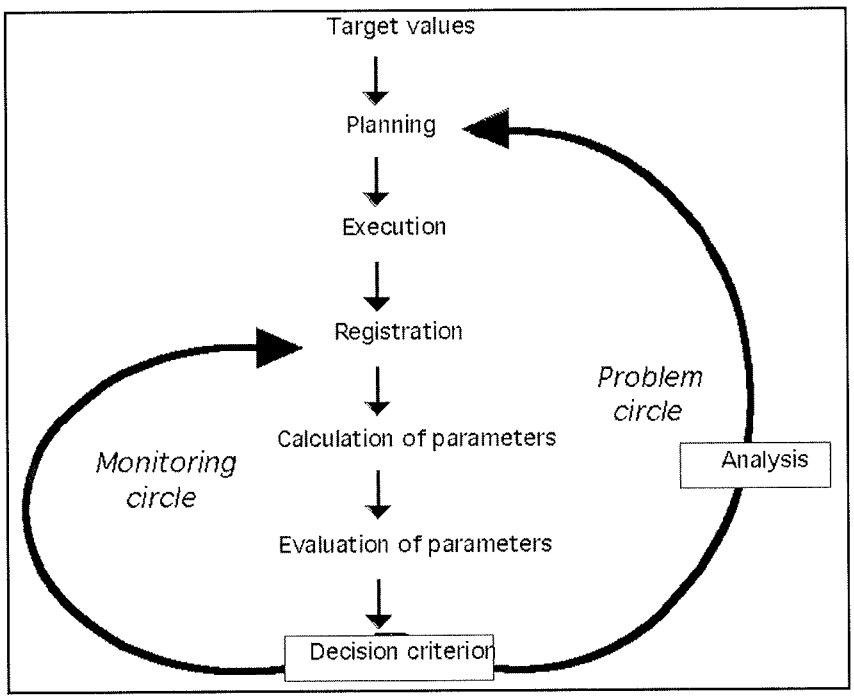

Figure 2: Basic planning circle used in the Health Planner Mastitis.

Table 8: Registered antibiotics for intramammary use (Source: FIDIN, Min. Agriculture)

Name	Company	Active compounds
Lactating cows		
Avuloxil	Pfizer Animal Health	Amoxycillin, clavulanic acid, prednisolon
Cobactan	Hoechst Roussel Vet	Cefquinome
Curaclox	Eurovet	Cloxacillin, ampicillin
Delvomast MC	Mycofarm	Natriumpenicillin-G, nafcillin, dihydrostreptomycin
Lactacure	Boehringer Ingelheim	Cloxacillin, ampicillin
Pathozone	Pfizer Animal Health	Cefoperazone
Ubrocelan	Boehringer Ingelheim	Benzylpenicillin, neomycinesulfate
Dry cows		
Kloxerate plus DC	Fort Dodge	Benzathinecloxallin, ampicillintrihydrate
Lactastop Rood	Boehringer Ingelheim	Cloxacillin, ampicillin
Nafpenzal DC	Mycofarm	Procaïnpenicillin-G, nafcillin, dihydrostrptomycin
Orbenin dry cow	Pfizer Animal Health	Cloxacillin
Orbenin extra dry cow	Pfizer Animal Health	Dynomilised cloxacillin
Prevaclox	Eurovet	Clxacillin, ampicillin
Super mastidol	Mycofarm	Kaliumpenicillin, procainpenicillin, neomycin

The management planning circle starts with the definition of goals, represented by target values. Target values are set by the farmer and his consultants based on the specific situation on the farm and the personal goals of the farmer. Given the goals, management strategy is planned and executed. From that point on, the monitoring circle starts, consisting of the recording, calculation and evaluation of monitoring parameters. Based upon a pre-set decision criterion, the monitoring circle will be continued or the problem circle will be entered. The decision criterion is set in such a way that the probability to enter the problem circle unnecessary is small. Standard, a 95% confidence interval is used. In the problem circle, an analysis protocol has to be carried out in order to find possible causes for the inability to meet the pre-set targets and, if necessary, adjust the planning. If necessary these can be adapted in time. The health planner mastitis consists of tools to obtain the current mastitis prevention status of a farm, tools to register preventive measures that were planned, a tool to monitor the mastitis status of a farm and a scheme to analyse occurring herd mastitis problems. For the monitoring of the mastitis status of a farm, new parameters were developed and tested. All tools are extensively described and much background knowledge on mastitis is given.

THERAPY

Mastitis therapy during lactation is in general only applied in cases of clinical mastitis. Most treatments use an intramammary injector. Many of these are combined with systemic treatment (parenteral). It is advised to dry cows off with antibiotics. Intramammary injectors registered for use are given in Table 8.

FUTURE

In the near future, more and more attention will go to organic farming. The minister of Agriculture has proclaimed that by the year 2010, 10% of Dutch agriculture should be organic. Within the dairy industry, more and more attention will be given to total quality management. The system which is now in use will be extended and a large part of the extensions will be directed at animal health and registration of drug use.

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NEW ZEALAND

STRUCTURE

Dairy Industry parameters in NZ for the 1996-97 production season

Total milk production	10 339 million litres
Number of herds	14 741
Number of cows	3 064 523
% herds >500 cows	3.4
% herds 100 - 499 cows	83.7
% herds 50 - 99 cows	10.9
% herds 10 - 49 cows	2.0
% herds < 10 cows	0.0
Maximum herd size	2000 cows
Typical cow replacement rate (annual)	22%
General type of cow	Dairy type rather than dual purpose

Predominant breed of dairy cow (tested herds):

Holstein-Friesian	56%
Jersey	16%
Holstein-Friesian/Jersey Crossbred	27%
Ayrshire	
1%	

Typical milk yield	3641 litres/cow/lactation
Typical lactation length	250 days
Typical number of lactations per cow	4.5

Barns are not used. All cows are kept on pasture year around.

% total cows herd tested	89.6

ECONOMICS

Price of milk paid to dairy producers NZ $3.63 /kg (based on milk solids)
Cull cow prices NZ $180 - 240 (1998)

Estimated economic losses due to mastitis in New Zealand

1990:
Average SCC = 400 000/ml giving an estimated loss of NZ $ 212 million per annum, NZ $14 620 per herd, NZ $81.23 per cow

1998:
Average SCC = 180 000/ml giving an estimated loss of NZ $ 67 - 123 million per annum, NZ $ 4600 - $8500 per herd, NZ $ 23 - 42 /cow

Proportion of milk produced for the export market: 90%

STRATEGY

Basic control strategy

The motivational driver for farmers is the somatic cell count.

Approach to mastitis control

A mix of therapy and prophylaxis which varies widely across farms. There is a clear move towards prophylactic strategies as SCC levels decline.

Barriers to control schemes

All parties accept the milk quality and animal health motivations for controlling mastitis.

The general economics of the process are a limiting factor as there is no incentive paid for low SCC milk. Penalty above 400K only. Also, the wider use of antibiotics required to get SCC levels down is of concern to both product safety and on-farm costs.

Basic components of the mastitis control scheme in New Zealand

Follows the set of recommended control activities laid out on a seasonal basis in the SAMM Plan [2].

Who implements mastitis control?

Ultimately it is an individual farmer decision.

Farmer motivation is a mix of complying with limits on SCC for the milk supplied (potential $ costs) and reducing the costs and time involved in treating clinical mastitis.

Regulatory aspects of mastitis control

All New Zealand Dairy Companies impose a $ penalty on milk tested to have SCC > 400 000 cells/ml. The penalty strategies and levels vary among companies.

Approximately 75% of NZ herds are now tested for SCC on every milk collection and are at risk of penalties from calving to drying off (approx 90% of NZ herds are seasonal producers).

MASTITIS CONTROL AND MILK QUALITY

Complete national statistics are not currently available, but estimates are available from about 50% of the NZ dairy cow population.

Mean bulk milk SCC across the seasonal supply scenario: 177 706 cells/ml (arithmetic mean), (from 1.46 million tests across season for approximately 6000 herds).

Standard plate count: 12 000 cfu/ml (Bactoscan), from 205 000 tests across 1997-88 season.

There are no national legal limits for either SCC or plate count levels. The milk quality criteria are decided and imposed by the individual dairy companies

CONTROL SCHEMES

There is no mandatory control scheme which applies to all producers. The SAMM plan is most often recommended. Post0milking spraying is recommended. For spraying, the following active compounds and emolients are used:

Actives

Iodophors	most common
Chlorhexidine	moderate use
PVP Ioodine	low use
Anionic surfactants	low use

Emolients
Glycerine
Sorbitol

Virtually all herds apply therapeutic dry cow therapy. This means that approximately 28-30% of all cows receive dry cow therapy. Moreover, approximately 4.5% of the herds during 1997-1998 used a prophylactic teat sealer.

Most common antibiotics

Dry cow therapy: cephalosporin, then cloxacillin.

Lactational therapy: Pen/Strep combo, then cloxacillin.

The milking machine is tested at least once a year, carried out by trained and certificated testers from

MAF, milking machine companies, private specialists.

Milking time observations are only carried out when there is a problem situation. Those observations are usually carried out by specialist private milking machine advisers.

Strengths of the NZ approach

Cohesive research backed recommendations targeted for seasonal dairy production along which have widespread backing. Widely adopted nationally.

ADVICE ON MASTITIS CONTROL

Sources of advice on mastitis control in NZ:

- Veterinarians
- Specialist milking/mastitis advisers
- Mastitis Advisory Committee (via SAMM)
- Dairying Research Corporation scientists
- Livestock Improvement Corporation field officers

Veterinarians are the primary source of advice. Practicing veterinarians can be assisted by specialist veterinarians and advisers for trouble shooting. Additional SCC on suspect cows may be measured.

There are 10 active researchers in the field of mastitis control, at varying levels of time commitment. There are 3 full time researchers and 7 part time researchers. There are no full time mastitis advisors. Practicing veterinarians are part time advisors and there are 3 part time specialist advisors.

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NORWAY

STRUCTURE

The dairy industry in Norway is characterized by relatively small herds with a mean herd size of 14 cows. However, 91% of the herds are members of the animal recording system and thus have a very co-ordinated advice service run by the dairy organization.

The total amount of milk produced according to the animal recording is 6160 (ECM) per cow-year. For 285 744 cow-years this will add up to 1760 million litres of milk. The milk delivered to the dairies in 2000 was 1454 million litres, from all herds, including those not member of the animal recording.

In Norway for 2000 there was a total of 20 530 dairy herds of which 18 723 were members of the animal recording system. The total number of cows was 285 744 and 270 028 were in herds which were members of the animal recording. The mean herd size in animal recording herds was 14.4 and in those herds not members, 8.7. The distribution of herd size is illustrated in Table 1.

The maximum herd size is 129 cows. Most of the herds above 100 cows are managed by more than one farmer as a co-operative.

The typical culling rate is 0.44 per cow-year (incidence rate) and with a replacement rate at 0.36 per calving. The culling rate corresponds to a risk rate of 0.37 per cow during one year.

Table 1: Distribution of herd size in Norway in 2000 (only herds in animal recording scheme)

Herd size	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1-4	245	1.3	245	1.3
5-9	4 310	22.7	4 555	23.9
10-14	7 253	38.1	11 808	62.1
15-24	6 109	32.1	17 817	94.2
25-49	1 055	5.5	18 972	99.8
50-99	41	0.2	19 013	100.0
100-499	6	0.0	19 019	100.0

The cows used for milk production are mainly (approximately 100%) for 'dual purpose'.

The predominant breed is the Norwegian Red Cattle (98.2%), Local breed 1.1% (of these 0.2% Telemark and 0.9% Black sided), Jersey (0.7%). Numbers are from 1996/97.

The typical milk yield is 6159 (ECM) litre per cow-year, which has been fairly constant in recent years. From data in 2000 the 305 days lactation yield was 5318 for 1st lactation, 6097 for 2nd lactation, 6483 for 3rd lactation, 6601 for 4th lactation, 6593 for 5th lactation. The maximum 305-day yield is around 13 000 litre. The distribution of milk yield per cow-years is illustrated in Table 2.

Table 2: Milk yield per cow-year in 2000 for all Norwegian herds within animal recording system

Milk per cow-year	Frequency	Percent	Cumulative Frequency	Cumulative Percent
< 4 000	545	2.9	545	2.9
4 001- 5 000	1681	8.8	2 226	11.7
5 001- 6 000	6262	32.9	8 488	44.6
6 001- 7 000	7828	41.2	16 316	85.8
7 001- 8 000	2395	12.6	18 711	98.4
8 001- 9 000	279	1.5	18 990	99.8
9 001-10 000	26	0.1	19 016	100.0
10 001-11 000	3	0.0	19 019	100.0

The mean age of a Norwegian cow is 47.3 months. The distributions of lactation are: 40.2% in 1st, 26.8% in 2nd, 16.6% in 3rd, 9.0% in 4th, 4.4% in 5th and 3.1% in higher than 5th lactation.

The most common type of stalls are tie stalls; however, 6% are free stalls. Most of the new buildings put up in the last 15 years are free stalls.

ECONOMICS

The price of milk paid to the dairy producer in 1999 (second half of the year) was 3.13 NOK, corresponding to 0.35 US$. Additionally comes a price added according to geographic position (south - north, height above sea level and the shape of landscape) dividing the country into 10 different zones.

The meat price for mean quality standard is approximately 30.00 NOK per kg meat (3.33 US$). This will correspond to a value of 7500 NOK per cow (833 US$). A corresponding value of a heifer ready for calving (replacement animal) would be approximately 11 000 NOK (1222 US$).

The total mastitis loss in 2000 is estimated at approximately 260 million NOK (28 900 million US$) for the whole country (only those herds in animal recording); 13 900 NOK per herd (1544 US$) or 967 NOK per cow-year (107 US$) or 0.18 NOK per litre milk produced (0.02 US$).

The supposition for the estimate is based on a complex formula taking into account the quality payment scheme (different proportion of milk prices according to quality price at BTSCC limits of 230, 300, 350 and 400), milk price (milk minus feed) for milk not produced according to milk loss (220 litre per ln-unit increase in BTSCC above 100 000) due to BTSCC, discarded milk (8 days of milk yield for full price) and veterinary salary and antibiotics (550 NOK) for mastitis treatments and replacement costs (3500 NOK per culling due to mastitis). Of the total mastitis cost 13.4 mill NOK is due to quality withdrawal, 34.8 mill NOK to production losses, 60.0 mill NOK to discharged milk after treatment, 58.3 mill to veterinary fees and medicine, and finally 95.5 mill NOK is due to replacement of mastitis cows.

STRATEGY

The basic strategy for mastitis control is to control new intramammary infections. An important tool to do so is the newly developed Herd Health Status Report. This report is able to report "new inflammation rate" at herd level periodically for the last 12 months. A new report is made every second month. The report will also present some figures for SCC status, treatment rates, duration of infection as well as total mastitis costs. Despite this the goal has always been to fight new infections; in principle the mastitis preventions have so far been too focused on BTSCC and CMSCC as those figures have been very easily available and the loss due to quality payment scheme have been very much in focus from the farmers' point of view.

The country's approach to mastitis control is very much based on prevention of new infections by correcting risk factors at farm level and also reducing the duration of infections by the same tools as well as a very selective culling and dry cow treatment strategy.

According to the strategy of reducing the use of antibiotics (from 1995 to 2000 by 25%) we had a strategy by identifying infected quarters and treating those with antibiotics at drying off. This strategy has just started to be implemented at herd level.

The reduction in the use of antibiotics and avoidance of broad spectrum antimicrobials are a national goal which are set by the veterinary as well as the farmers' association, and the government. Some farms are practising organic farming and would use more of the therapy like homeopathic and acupuncture. Some few farms use colostrums for human food. The principles of organic farming have some interest and are also adapted in other farms so as to avoid "the misuse" of antimicrobials.

The basic components in mastitis control are:

(1) Good and representative recording of disease (treatment, culling and SCC).
(2) Reporting the results at individual, herd, region level as well as is in economic terms, such that every farmer and adviser (dairy advisers and vets) can know the status of his/her herd and/or region compared with others (especially the neighbour).
(3) The Norwegian Red Breed's sires are selected according to low incidence of clinical mastitis in their daughters.
(4) Based on current knowledge give general advice on how to avoid or cope with the main risk factors for new inflammation. The main points are, in order, milking performance, milking machine, stall environment (clean and dry), replacement system and feeding strategy. As an example all herds should be presented and have the opportunity to join a milking practices course during the 5-year period 1997 to 2002.
(5) To farmers who are motivated to do some improvement to mastitis economics and reduce new infections support his/her wish with a well documented advice scheme with emphasis on correcting risk factors according to biological and economic importance in relation to the mastitis status in that specific herd. Selective dry cow therapy, advice on culling strategy and teat dipping can be advised in those herds according to the bacteriological problem to be solved.

Note that teat dipping and dry cow therapy are generally not recommended in the Norwegian Cattle Health Services.

The mastitis control in (1) to (4) are implemented in all herds in the animal recording system (approximately 22 000 herds). For (5) this should be offered to all farmers with a higher than expected new infection rate and total mastitis loss. The advisors and veterinarians are trying to encourage these farmers to buy the special service presented at (5). So far approximately 300 to 400 farmers join this special advice service each year.

This control is implied by the Norwegian Cattle Health Service which is based on an agreement between the Norwegian Dairies Association, The Norwegian Breeding Association, The Norwegian Veterinary Association, The Norwegian Meat Co-operative, The Norwegian Independent Meat Association and The State Veterinary Services. For mastitis control implementation is mainly done by the advisers in the Dairy Association, but in close co-operation with the local veterinarians and the farmers. There are no regulatory aspects other than farms having above 400 000 in BTSCC as a geometric mean for the last 3 months are not allowed to deliver milk to the dairy before they are able to demonstrate lower counts.

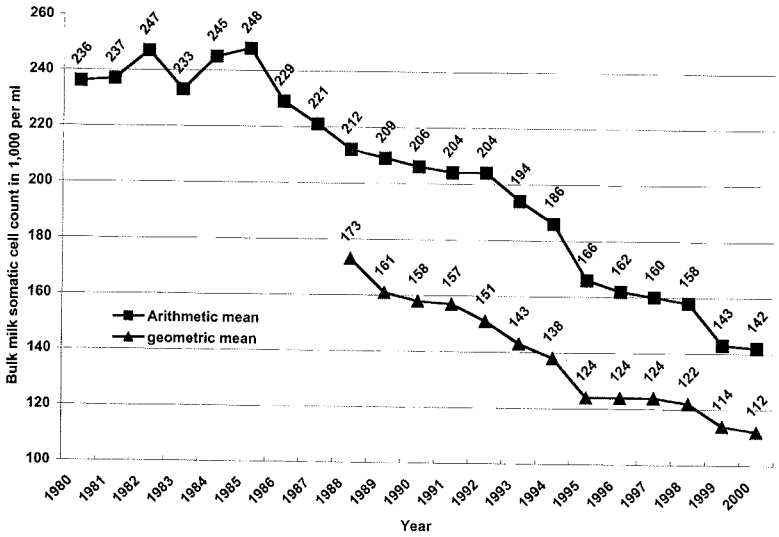

Figure 1: The arithmetic and geometric mean for BTSCC for milk delivered to Norwegian Dairies 1980 through 2000.

The results in 2000 compared to 1994 was a 44 % reduction in mastitis therapy as well as a significant reduction in BMSCC. The goal for the Norwegian Cattle Health Services from 2000 to 2005 is to further reduce the treatment rate by 5 % each year.

MASTITIS CONTROL AND MILK QUALITY

The arithmetic and geometric mean BTSCC for Norway are illustrated in Figure 1.

For BTSCC results according to the quality payment scheme 93.2% of the milk got premium quality (<230 000 in geometric mean for the last 3 months), 4.9% 1st quality (231-300), 1.1% 2nd quality (301-350), and 0.78% 3rd quality (>350).

For bacteriological quality 96.1% of the milk was paid according to premium quality (<31 000 in plate counts per ml), 2.7% s quality (32 000 – 80 000), 0.32 % 2nd quality (81 000- 300 000), and finally 0.3% 3rd quality (>300 000).

The legal limit for BTSCC is 400 000 per ml in geometric mean for the last 3 months (two samples a month), and for bacterial count (plate count) 100 000 per ml (geometric mean for the 6 last samples with two samples a month). The consequence of exceeding one of these limits is to be excluded from milk deliveries until lower figures can be demonstrated. If the producers are not able to meet these limits he/she would be out of production for human food production for sales at an open market.

There is no regional variation with regard to these official regulatory parameters; however, different dairies can have different money values for premium addition or penalties for the class premium, 1st, 2nd and 3rd quality. There is regional variation in new inflammation, BTSCC and treatment incidence between dairies in Norway. However, these differences could hardly be explained by differences in quality payment scheme.

The main intramammary infections (1999 statistics) in sub-clinical mastitis are (proportional rates of infected quarters) (1) *Staph. aureus* (57.7%), (2) CNS (21.3%), (3) *Str. dysgalactiae* (13.7%). *Str. agalactiae* has figures at 0.2% only. For clinical mastitis the same figures are: (1) *Staph. aureus* (39.8%), (2) *Str. dysgalactiae* (16.5%), (3) *E. coli* (12.7%) and (4) CNS (5.9%). *Str. agalactiae* has figures at 0.1% only.

The bulk milk is tested for antibiotics in every single tanker entering the dairy plant. For each tanker a sample of each herd is stored at the truck. If the tanker's sample shows positive results all the farms representing the tanker are additionally tested. In this way we could say that all milk entering Norwegian Dairies is tested. The testing is done by the dairy and at the dairy, however, supervised by the National Food Controls Authorities.

Milk found positive for antibiotics (mainly penicillin) would go for destruction. One way is by processing for drying to animal feed, another is to condemn the milk together with manure or other deposit places. The milk should clearly be withheld from human consumption.

In recent years, between 130 and 190 samples have demonstrated positive results for antimicrobials.

The safeguards to assure that antibiotics are not entering the food chain are several quality assurances at critical control points, first at the farm level and last at the dairy level. For example: all antimicrobial treatments have to be started by an authorized veterinarian. The veterinarians have to fill in a standard formula at each treatment having withdrawal time where he/she state the first possible delivering day for milk and meat. This sheet of paper (red) should be placed in a visible place for the milking when connecting the milking machine and should be stored in the Health Binder for 2 years. Additionally the dairy samples every tanker coming to the dairy.

CONTROL SCHEMES

There is no mandatory scheme applied to all producers except for the quality payment scheme and the disease reporting scheme linked to the animal recording. The animal recording serves the farmers and advisers with individual data at need. The control schemes, apart from the regulatory schemes, are set by the Norwegian Cattle Health Services and are as such based on the farmers' willingness to co-operate.

Pre-milking teat dipping is in principle forbidden by the dairies. The dairy industry would as far as possible avoid disinfectant residuals in milk. Avoiding predipping is important in that concept. Post-milking teat dipping is generally not recommended however, it can be recommended as a temporary tool in herds with *Staph. aureus*, *Str. dysgalactiae* or *Str. agalactiae*. Post-milking teat dipping could also be recommended in risk periods such as around drying off and calving. A survey reviled that 12% of Norwegian farmers used post-milking teat dipping regularly. The most predominant active substance is iodine. A new product based on low pH has now been introduced to the market.

Dry cow therapy is generally not recommended. In fact Norway is the only country (I am aware of) which has no dry treatments generally approved. When dry cow treatment is practised it would be typically as very selective therapy primarily aimed at *Staph. aureus* or *Str. dysgalactiae/agalactiae*. The preparation in use would be lactation formulas consisting of penicillin in combination with dihydrostreptomycin. The goal of the Norwegian Cattle Health Services is

to use narrow spectrum antibiotics. So far we have not succeeded with companies presenting only penicillin in the formulas. There is one (1 million IU) on the market. The dry cow therapy would typically be very selective aimed at cows with *Staph. aureus* at low CSCC, *Str. dysgalactiae* or *Str. agalactiae*. Healthy cows with low SCC (< 100 000) should by no means be dry cow treated and we also recommend that cows infected by CNS should not be treated. There are approximately 7000 dry cow treatments a year. Probably only 3 to 4% of Norwegian cows are dry cow treated during a year.

Approximately 1000 to 1500 herds have their milking machine tested by people from the Norwegian Dairies during a year. These are not randomly done. From these test results it could be read that at least 2/3 had a service within the last 2 years from the milking machine company.

Approximately 400 to 500 milking time observations with advice are performed annually in connection with the special service from the Norwegian Cattle Health Service. Our goal is that every farmer should be offered a practical course in milking performance during the next 5 years (from 1996). This would be done by the dairy company advisers in close connection with the local veterinarians. A random survey of milking performance was done throughout Norway in 1993. In this survey 1535 were evaluated by questionnaire and 191 by observations.

Housing environment would be evaluated during a special service visit from NCHS, which means approximately 400 to 500 a year. In 1994/95 a random selected survey was performed using the official district veterinarians to evaluate the situation in 3600 herds throughout Norway.

The strength of the mastitis control in Norway is that every farmer is a member of the data collection and general reporting part. There is also strength in that there is growing interest in formal co-operation between local veterinarians and the advisers from the dairy industry. The total data overview in Norway makes it easy to evaluate the results at country, region, district and farm level. There is also strength in that the data on clinical disease can be assessed and used for breeding purposes and for environmental evaluation. Thus all new bulls entering the population have an index for clinical mastitis. In the same way the NCHS also tries to evaluate new equipment and management systems to provide feedback of the good and the bad ones to the farmers.

The weakness so far seems to be the motivation both for farmers and advisers to deal with herds with mastitis problems other than those expressed as high BTSCC. Farmers' education in periodical reports and feedback systems seem to be critical in this.

ADVICE ON MASTITIS CONTROL

The dairy association should be the organization most likely to give dairy producers advice on mastitis. Mastitis is a problem for farmers made by the farmers' management which should also be solved by the farmers themselves. But, the association should have good support from the Universities to keep up with the current knowledge on the market, and the Universities should be very closely related to the practical problems out in the field. It is also important that the advice is closely related to the government minimum quality and safety standards set. Those standards should also have a practical approach. Other companies should be a sort of supporting team called on when needed. Companies, such as milking machine companies, feeding companies and the antibiotics industry would tend to make as much as possible. It is very rare that the milking machine company, the feeding company, or the antibiotics industry "own the mastitis problem". These problems are multifactorial at farm level and have to be solved by the farmer himself.

The primary source of mastitis control in Norway is the advisers in the Dairy Association in co-operation with the local veterinarians.

The NCHS have a special service for troubleshooting for farmers with an intensive mastitis problem. See above.

The number of people currently working with mastitis in Norway are: (a) Researchers (10 to 15), (b) advisors (local advisors in dairy association approximately 250 in connection with local veterinarians approximately 300), (c) administrators (central administration 4, regional 12) and (d) other appropriate categories (unknown).

RECORDS

All herds in the animal recording system would have results on cow SCC (CSCC) every second month for cows in milk. Results are presented for each individual cow as well as prevalence rate above 200 000 and new incidence above 200 000 (new inflammation rate) at herd level. All are presented as periodicals every second month as a rolling 12-month mean.

All Norwegian herds would have tests for BTSCC twice a month. These figures are reported as single observations as well as for geometric mean for the last 3 months (quality payment scheme).

All Norwegian farmers have to have a cow health card for each cow where all veterinary treatment and other diagnosis have to be filled in. For herds in the animal recording system the data are reported in the mainframe and results are given back as updated incidence rates in rolling 12-month periods every second month.

Cell counts for BTSCC are mandatory as well as clinical recordings. Reporting these data are mandatory for members of animal recording.

THERAPY

The treatment rate in Norway is illustrated in Figure 2.

The treatment of clinical mastitis starts typically with an intramuscularly injection of 10 000 mg (10 000 000 IU) penicillin and is followed by an intramammary injector every evening containing 300 000 to 400 000 IU penicillin and 300 mg of dihydrostreptomycin. The use of different types of antimicrobial in intramammarian injectors sold in Norway is presented in Figure 3.

In Norway all prescriptions of antibiotics to animals are by authorized veterinarians by legislation. Veterinarians can only prescribe or deliver to the farmer antibiotics for therapy of the cow at present diagnosis. The veterinarian can not sell farmers antibiotics or other types of drugs. All such drugs not intended for the presented cases have to be prescribed through the pharmacy. Thus there is a third part controlling the veterinarians' drug business.

Only an authorized veterinarian can treat cows with drugs which have to be prescribed through a pharmacy, such as antimicrobials and hormones.

Probably a lot of sub-clinical cases or high somatic cell count

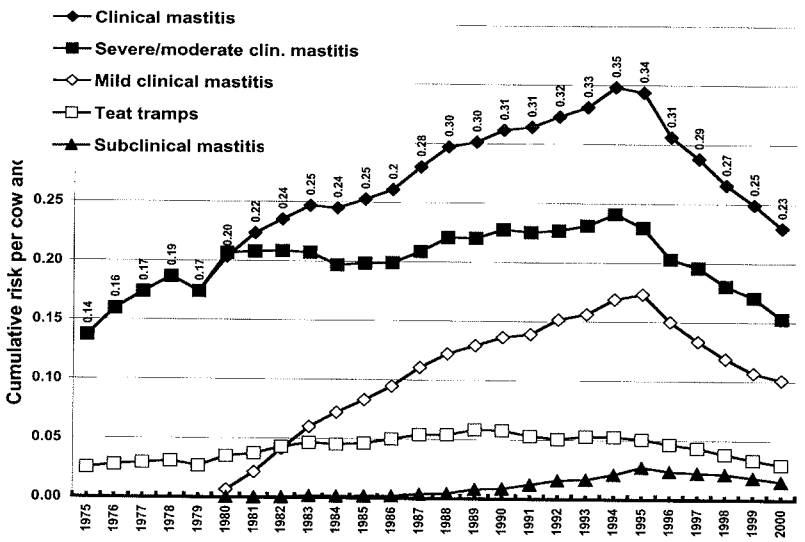

Figure 2: Estimated cumulative risk of a cow having mastitis during 1 year for different classes of mastitis 1974/75 through 2000.

cows are treated during lactation (see Figure 2, for chronic or mild to moderate cases). There is at present a goal for NCHS to minimize the use of antimicrobials for such treatment. This has partly been successful for the last 3 years (see Figure 2); however, NCHS wanted to further decrease such treatments as the economic benefit is questionable.

For samples taken from sub-clinical mastitis 88% of the *Staph. aureus* show sensitivity for penicillin-G. This figure has been quite stable throughout the last 15 years. For samples taken from acute clinical cases as high as 93.6% of the *Staph. aureus* strains shows sensitivity for penicillin. CNS strains show a lower proportion of penicillin sensitive strains; from sub-clinical mastitis 77.5% and from acute (severe) clinical cases 72.9% of strains. For *Staph. aureus* strains from acute clinical cases which show resistance for penicillin 65.6% were sensitive for streptomycin, 89.3% for tetracyclic and 98.6% for trimetoprim/sulpha. For CNS the corresponding figures were 71.4%, 91.7% and 98.8%. *Str. dysgalactiae* was 99.9 % sensitive for penicillin. For *E. coli* strains from acute clinical cases 50.3 % were sensitive for streptomycin, 57.3% for tetracyclic and 91.5% for trimetoprim/sulpha.

The strategy for therapy in Norway is:

(1) Primarily to take care of clinical diseased animals such as, if possible, they can be reintroduced for production of high quality food and in such a way that farmers and vets take care of the animal welfare aspect of diseased cows.
(2) To optimize the therapy such that further development of resistance to penicillin is avoided - there is a goal to be able to continue using penicillin as the drug of choice in mastitis therapy.
(3) Optimize dry cow therapy in such a way that cows which probably respond to therapy are treated and those not responding or need no treatment are avoided for antimicrobial use.
(4) To avoid further pressure on resistance the narrow antimicrobials should be preferred instead of broad spectrum drugs.
(5) Most of *E. coli* clinical cases do not improve their health status by using antimicrobial drugs instead of good udder drainage.
(6) Heavy mastitis problems and frequent resistance strains at herd level should be solved by environmental and management corrections and not by further use of advanced drugs which should be reserved for human medicine.
(7) Antimicrobials should be looked upon as therapy and not as a production tool.

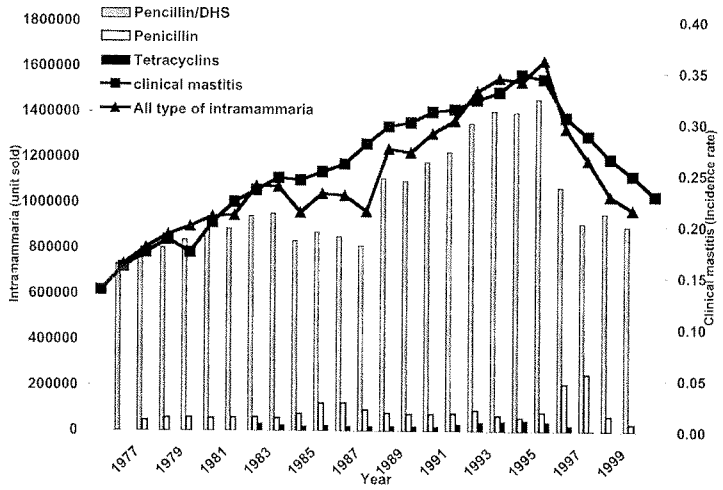

Figure 3: Different types of antimicrobials in intramammary injectors sold in Norway 1976 till 2000 compared with mastitis incidence rate.

FUTURE

In the future, more emphasis should be placed on the avoidance of non-economic treatments of sub-clinical high SCC cows in lactation, along with more pressure on more effective selective dry cow therapy. In Norway probably too many cows are treated during lactation and too few when dried off. There would be more focus on epidemiological research to truly identifying the most important and effective risk factors to be changed. Those factors seem to be identified in the milking process and can be measured during dynamic testing of the milking machine and the milker. New research is needed to identify risk factors in feeding strategy and replacement systems as clinical mastitis around calving is far too high, especially in heifers or first calvers. Breeding for mastitis resistance has been and would be important. SCC at cow level should probably be included together with clinical mastitis in the breeding index. There is and will not be any room for routinely dry cow therapy and/or regularly teat dipping in Norwegian mastitis control. Pre-milking teat dipping will also be avoided in future to avoid residuals of disinfectants in milk. Due to the low level of SCC and the continuous decrease in treatments for clinical mastitis the future for this strategy looks promising.

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SWEDEN

STRUCTURE

No. of dairy cows 1997:	455 000
No. of farms, Jan 1st, 1998:	14 720
Average herd size:	31-32
	544 (3.7%) farms have more than 75 cows
Maximum herd size:	350
There are two major breeds:	SRB - Swedish red and white
	SLB - Swedish Friesian
There are small populations of:	SJB - Swedish Jersey
	SKB - Swedish Polled "Mountain"

There are also beef breeds such as Charolais, Hereford, Simmental, Aberdeen Angus, etc. The total beef population was about 165 000 in 1997.

Culling rate in dairy cow population about 36-38% in the last couple of years.

Average lactational age:	2.5
Average milk production, ECM / 303 days:	8300 kg

Most housing systems are tie stalls - about 85% and the rest are various loose housing systems. The traditional cow house has a front gate that shuts the cows from the feeding table when the cows are not fed. Stalls are generally of the long bed type - 220 X 120 cm (230 X 130 cm for cows > 650 kg body weight; regulation effective from 1 January 1999).

The Swedish Animal Welfare Act requires that dairy cows are at pasture during summer; 2 months in the north and 4 months in the south.

The absolute majority of farms have high line milking systems. The loose housing systems have various milking parlours: herringbone, tandem, etc.

ECONOMICS

Milk, SEK/litre, March 1998	
Mean:	2.80 SEK, ECU: 0.33, $: 0.37
Range:	2.64 - 3.02 SEK
Meat, SEK/kg, May 1998	
Mean: steers	23.70 SEK, ECU: 2.81, $: 3.13
Range: steers	14.90 - 26.60 SEK
Live dairy cow:	8.000 - 13.000 SEK

Estimated losses due to mastitis: cow/year	1 300 SEK
Estimated losses due to mastitis: herd/year	33 000 SEK
Estimated losses due to mastitis: country/year:	600 000 000 SEK.

Milk quality payment

Price deductions at levels and according to rules laid down by the EU Milk Directive. The different dairy companies have various quality schemes paying premiums for better quality milk. Generally milk with a cell count < 200 000 receives a higher price. Other parameters are number of cows treated for mastitis, having an ecological programme, letting the calf suckle the dam, etc. "Organic milk" is paid about 0.50 SEK more/litre than conventionally produced milk.

DISEASE RECORDING SYSTEM AND MILK QUALITY

Clinical cases: lactational incidence rates of treatments per "cow control year". A control year starts 1 September and ends 31 August. The "Cow Control Programme" is the Swedish equivalent of a DHI programme.

Treatment incidences of mastitis during the control years 1997 and 1998 were 18.1 and 18.2%, respectively.

Cell counts (BMSCC) are calculated as geometric mean on the national level. Times per month and type of mean vary between dairy associations. Geometric means of national BMSCC for the control years 1997 and 1998 were 209 000 and 200 000 cells/ml, respectively.

Cow production data - CMSCC and milk production is calculated based on milk sent by the farmer to the lab once/month. TruTest and Fossomatic.

Percent of cows in cow control programme 81%

Percent of herds in cow control programme 72%

Reliability of recording of treatment of clinical cases of disease can be improved.

INFORMATION AND MASTITIS CONTROL SCHEMES

There is a monthly journal (HUSDJUR) to subscribing farmers.

The 11 different regional livestock associations have various programmes and ambitions.

Central recommendations include:

- milk low cell count cows first!
- milking routines should be evaluated if udder health investigation is initiated.

Video is used some to illustrate milking technique to farmer.

- yearly testing of milking machines (presently not done enough).
- selective dry cow Tx. About 20% of cows treated.
- most farmers practice post-milking teat dipping. Pre-dipping not practised.
- cull cows with recurrent mastitis of chronic sub-clinical mastitis

A new "holistic" herd health programme - named FRISKKO (HealthyCow) – is currently being launched by the Swedish Dairy Association (Svensk Mjölk). FRISKKO aims to place the farmer and his/her production in the focus. FRISKKO also utilizes various computer programmes to illustrate the economic and health situation on the farm.

Organizations working with udder health

- The Swedish Dairy Association - employs persons working with animal health and animal health supervision, dairy politics, marketing, sales statistics etc.
- 11 Local livestock/AI associations employing about 55 animal

health veterinarians that work with AI, fertility, udder health, herd health improvement programmes, feeding recommendations etc.

- "District veterinarians" (government employed large animal field practitioners) are starting to work preventively since a few years.
- about 50% of the cows are served by private practitioners.

Research, advice etc.

Control of mastitis - 3-4 researchers - mainly people working in the Swedish Dairy Association.

Mastitis in general - 10 (?). This figure includes persons working in different universities and institutions such as the Swedish University of Agricultural Sciences (SLU) and the National Veterinary Institute (SVA).

Advisors - about 50 udder health veterinarians in the local livestock/AI associations + 50 distr. vet.

Flops and Success

Negative experiences:

- Udder health programmes have been too inflexible and not geared to the farmer's needs and problems.
- Follow-up has been bad or non-existent.

Positive experiences are:

- Low national BMSCC without loss of much milk.
- Very low treatment incidence. World champions?
- Field practitioners practice bacteriological culturing and use mainly benzyl-penicillinprocain systematically.
- Very low rate of β-lactamase producing *Staph. aureus* (< 10%).

FUTURE

- Field practitioners will (have to) work more with preventive medicine.
- Work oriented and designed according to the farmers' needs and ambitions.
- More use of computers.

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SWITZERLAND

STRUCTURE (1997)

Number of dairy herds: 45 180
Number of dairy cows: 745 000

No. of cows/herd	% of herds
1 – 4	11.2
5 – 9	22.5
10 – 15	36.3
16 – 20	17.7
21 – 30	10.1
31	2.2

Average herd size: 15 cows/herd
Maximum herd size: 140 cows

Dairy cow population
Average culling and replacement rate: 20% per herd/year

Breeds

Most of the breeds (at least the herdbook cows) are considered as dual purpose cows.

Average production of commercial milk/cow/year: 4 475 kg
Average number of lactations: 3 -4

Types of housing
Tie stalls: 87% of herds
loose housing systems: 13%

Cows are kept on pasture during the vegetation period for at least 60 days (mandatory; regulated by the Animal Protection Act)

Milking
- 95% of the herds are milked by machine:
  - bucket milking machines 77%
  - milking pipeline machines 17%
  - milking parlours 4%
  - 2% of the herds are milked by hand

ECONOMICS

- Producers guaranteed milk price 1998 (subsidized): 0.58 USD/kg
- Cull cow prices (1998): 3.30 - 3.90 USD/kg life weight
- Estimates of mastitis losses:
  per cow/year: 120 USD
  per herd/year: 1 900 USD
  country/year: 90 Mio USD

Suppositions of the calculation:

Item	% of total loss
reduced milk production	43
cull cows	17
treatments (vet. Costs, drugs, labour, dumped milk)	28
milk price deductions for lack of quality (quality payment)	5
impairment of products (for example reduced cheese yield, product quality)	8

Export of milk products

Approx. 20% of the milk produced in Switzerland enters the export market (most of it as cheese)

Breeds	% of population	Milk yield (kg/lactation)
Herdbook cows:		
- Simmental and Simmental x Red Holstein	34.0	5 674
- Swiss Brown and Swiss Brown x Brown Swiss	33.6	5 884
- Holstein Friesian	6.9	6 651
- Race d'Hérens	0.6	3 120
Others: Montbéliarde, Jersey, Guernsey and various cross-breeds	24.9	No data

STRATEGY

The basic strategy of mastitis control is to prevent intramammary infection.

Approach

Prevention of new IMI and reduction in duration of existing IMI is strongly recommended. In praxis however the reactive approach (identifying IMI and antibiotic treatment) is still very common.

Impacts to mastitis control

"Organic" farming and milk production programmes which are

becoming more and more popular in Switzerland. These programmes prohibit the use of antibiotic dry cow therapy and teat dipping with chemicals.

Basic components of the mastitis control scheme

(1) Mastitis Prevention Programme for all herds; implemented by the dairy farmer himself.

(2) Mastitis Control Programme for problem herds; implemented by the farmer himself with the support of the Dairy Inspection and Advisory Service and the veterinarian.

Regulatory aspects

Basically there are no regulatory aspects concerning mastitis control. Certain elements of the "Ordinance on Quality control and Payment of Milk" and the "Ordinance on Quality Assurance in Milk Production" support the implementation of mastitis control measures.

For example:

- milk delivery ban if the bulk milk cell count is 5 times > 350 000/ml within 5 month
- regular udder controls (CMT or individual cow cell counts) for sub-clinical mastitis are mandatory (at least once a month)

MASTITIS CONTROL AND MILK QUALITY

Mean national SCC 1996: 101 000 cells/ml (geometric mean of all herd milk samples analysed for quality payment purposes; N=532 608)

Mean national TBC 1997: 12 500 CFU/ml (geometric mean of all herd milk samples analysed for quality payment purposes; N=500 304)

Milk Quality Payment Scheme (legal limits, methods, milk price deductions)

Quality criteria	Results	Influence on milk price [1]	Remarks
Bacterial load	< 200 000 Imp./ml	full price	1 000 000 Imp/ml count as 2 failures
	> 200 000 Imp./ml		
	1. failure within 5 month	0.01 SFR/kg	1.1 % of full milk price
	2. failure within 5 month	0.03 SFR/kg	3.4 % of full milk price
	3. failure within 5 month	0.06 SFR/kg	6.9 % of full milk price
	4. failure within 5 month	0.12 SFR/kg	13.8 % of full milk price
	5. failure within 5 month	0.24 SFR/kg	27.6 % of full milk price & MILK DELIVERY BAN [2]
Somatic cell count	> / = 350 000 cells/ml	full price	
	< 350 000 cells/ml		
	1. failure within 5 month	no deduction	Information
	2. failure within 5 month	0.03 SFR/kg	3.5 % of full milk price
	3. failure within 5 month	0.06 SFR/kg	6.9 % 0f full milk price
	4. failure within 5 month	0.12 SFR/kg	13.8 % of full milk price
	5. failure within 5 month	0.24 SFR/kg	26.6 % of full milk price & MILK DELIVERY BAN [3]
Inhibitory substances	positiv		MILK DELIVERY BAN [2]
	1. failure within 12 month	0.10 SFR/kg	11.5 % of full milk price
	2. failure within 12 month	0.30 SFR/kg	34.5 % of full milk price
	3. failure within 12 month	0.60 SFR/kg	68.9 % of full milk price
Freezing point	- 0.520°C	Information	Information

[1] *Milk price deduction for all the milk delivered in the respective month.*
[2] *Delivery ban is lifted if the dairyman can proof that his milk meets the given standards again.*
[3] *Delivery ban is lifted if the dairyman can proof that the udder health in the herd is re-established.*

Milk quality control and payment; results

Regional variation of bulk milk cell counts and prevalence of sub-clinical mastitis

There are regional variations. The Table below also shows that prevalence of sub-clinical mastitis and bulk milk SCC do not correlate in Switzerland.

Somatic cell counts in herd milk samples and prevalence of sub-clinical mastitis in Switzerland
(representative survey in 4 major dairy regions)

Region	SSC in bulk milk (samples 350 000/ml)		Prevalence of Sub-Clinical Mastitis (SCM) (CMT pos., bact. pos.)			
			1980		1994	
	1980	1994	Cows tested	SCM	Cows tested	SCM
	%	%	N	%	N	%
A	11.6	5.0	26 578	17.6	23 367	18.1
B	16.2	6.3	21 245	28.5	20 987	23.5
C	13.7	5.8	101 678	16.2	78 609	14.9
D	11.2	3.6	58 312	15.3	41 891	13.7
Total	13.2	5.2	207 813	19.4	164 854	17.6

Mastitis-pathogens isolated in Switzerland: 1987-1996
Samples taken by udder-health-service extension workers from cows with sub-clinical mastitis

Results	1987 N=54 487 %	1988 N=40 529 %	1989 N=43 628 %	1990 N=38 197 %	1991 N=28 497 %	1992 N=28 116 %	1993 N=29313 %	1994 N=31 006 %	1995 N=29 926 %	1996 N=13 443 %
Bact. negative	24.5	23.7	28.8	26.7	26.4	19.1	18.0	15.4	9.0	9.4
Bact. positive (= 100%)	75.5	76.3	71.2	73.3	73.6	80.9	82.0	84.6	91.0	90.6
Streptococcus agalactiae	7.3	7.2	5.7	5.0	5.6	3.8	3.6	2.8	2.4	2.2
"Other streptococci" (*S. uberis, S. dysgalactiae,* enterococci)	27.6	25.1	23.8	24.0	21.9	25.8	27.6	28.4	36.7	23.4
Staphylococcus aureus	41.2	43.3	41.4	42.2	41.4	45.4	45.2	41.5	37.4	39.8
"Other staphylococci" (*S. epidermidis,S. xylosus, S. hyicus,* Micrococcus sp.)	16.6	16.2	19.0	20.4	16.4	16.5	14.2	18.4	16.2	18.8
Miscellaneous (*e.g. C. bovis,* coliforms, *A. pyogenes*)	7.3	8.2	10.1	8.4	14.7	8.5	9.4	8.9	7.3	15.8

Mastitis-pathogens isolated in Switzerland: 1987-1996
Samples taken by veterinarians from cows with clinical mastitis

Results	1987 N=40 108 %	1988 N=80 604 %	1989 N=83 520 %	1990 N=96 958 %	1991 N=80 078 %	1992 N=98 293 %	1993 N=83 330 %	1994 N=99 549 %	1995 N=77 290 %	1996 N=55 296 %
Bact. negative	21.8	22.3	17.0	22.2	17.2	15.7	14.0	13.3	13.1	11.6
Bact. positive (= 100%)	78.2	77.7	83.0	77.8	82.8	84.3	86.0	86.7	86.9	88.4
Streptococcus agalactiae	2.6	2.9	2.8	2.8	2.6	2.2	1.9	1.6	1.5	1.3
"Other streptococci" (*S. uberis, S. dysgalactiae,* enterococci)	27.6	32.0	31.5	32.9	32.4	36.6	35.6	36.1	36.8	31.1
Staphylococcus aureus	33.1	30.9	31.4	26.4	25.1	28.5	29.1	27.0	24.4	26.1
"Other staphylococci" (*S. epidermidis,S. xylosus, S. hyicus,*Micrococcus sp.)	15,9	11.4	12.9	17.5	17.9	14.8	13.3	14.0	16.1	17.3
Coliforms	11.7	12.7	10.2	9.2	9.3	9.0	10.3	11.3	9.9	9.9
Actinomyces pyogenes	2.8	2.6	2.6	2.7	2.6	2.7	2.0	2.4	2.6	1.8
Yeasts	1.3	1.3	1.5	1.6	1.6	1.5	1.7	1.8	1.9	1.7
Miscellaneous (*Nocardia spp., Pseudomonas spp., Bacillus spp., C. bovis*)	5.0	6.2	7.1	6.9	8.5	4.6	6.0	5.8	6.8	10.8

Contaminated milk is usually dumped, in some cases it is used as animal feed. To assure that antibiotic contaminated milk does not enter the food chain every lot of delivered milk is tested for the presence of inhibitors by the milk processor. The Food Inspection Service is testing milk randomly for the presence of specific antibiotic residues.

CONTROL SCHEMES

Mastitis control is not mandatory. The mastitis control programmes recommended by the Dairy Inspection and Advisory Service:

Mastitis Prevention Programme (aim: maintaining a health herd)

1. Correct and hygienic milking
2. Appropriate housing and bedding to avoid teat and udder damages
3. Selective dry cow treatment
4. Immediate treatment of new infections
5. Attention when purchasing replacement cows and heifers

-Depending on the sanitary conditions on the farm teat dipping is recommended

- Control and recording of the udder health of the herd (for example CMT) at least once a month

Mastitis Control Programme (aim: control of mastitis in a problem herd)

1. Determination and elimination of mastitis causing factors
2. Treatment of infected cows in lactation
3. Dry cow treatment of all cows
4. Teat dipping
5. Culling of cows with chronic mastitis resistant to therapy and incurable teat damages

- Control and recording of the udder health of the herd (for example CMT) every two weeks

Most often used antibiotics used in dry cow product formulations:
(1) Combination of a penicillin and aminoglycoside (for example Neomycine or Gentamycine)
(2) Cloxacillin or Oxacillin

Milking machine testing
Mandatory (Ordinance on Quality Assurance in Milk Production); at least once a year; done by servicemen of the respective milking machine company.

Milking time observation
Only in problem herds or upon request of the farmer; usually done by the extension workers of the Dairy Inspection and Advisory Service.

Strengths and weaknesses of the Swiss approach to mastitis control
Strengths:
- economic pressure on the dairy farmer (severe milk price deductions if bulk milk cell counts exceed the legal limits)
- mandatory milking machine testing
- milk delivery ban and mandatory udder health controls
- the recommended control schemes are adapted to the structure of Swiss dairying (small herds, family run farms etc.)

Weaknesses:
- the reactive approach to mastitis control is still predominant. People (including the majority of the vets) are still believing that mastitis problems can be solved by antibiotic treatment of infections.
- there is no relevant mastitis research in Switzerland anymore
- there are only very few specialized veterinary practitioners involved in mastitis control

ADVICE ON MASTITIS CONTROL

Organizations/Institutions:
- Dairy Advisory and Inspection Services
- University Institutes which run "herd health improvement programmes" (only one in Switzerland concerned with mastitis)
- Specialized veterinarians
- Federal Dairy Research Station

Number of people working with mastitis:
- researchers: 3
- advisors: 18
- administrators: 9

RECORDS

Recording systems
Individual cow cell counting:
Cattle breeder's associations; optional; approximately 70% of the Swiss dairy herds covered.
Bulk milk SCC: Quality control and payment of milk; mandatory; 98% of the Swiss Dairy herds covered.
Clinical mastitis: no recording system

THERAPY

Treatments
Clinical Cases: most of the clinical cases are treated, regardless of the severity

Route of administration: usually intramammary infusion, sometimes in combination with parenteral treatment.
Administration: decisions regarding the type of antibiotic and initial treatment of clinical cases by the veterinarian; follow up treatments (only intramammary) by the dairy farmer.
Sub-clinical mastitis: treated during lactation if
- cow is in early lactation
- *Strep. agalactiae* is isolated
- in problem herds
- cow is pastured on an alp
- cow has a high breeding value

Antibiotic resistance

Antimicrobial resistance of the major mastitis pathogens in Switzerland Survey 1980-1992

Antibiotic	*S. aureus* (% resistant strains)			Streptococci (% resistant strains)		
	1980	1986	1992	1980	1986	1992
Penicillin G	47.8 *	33.3 *	9.4	0.5	0	0
Cloxacillin	0	0	0.4	5.6	9.7	10.1
Cefoperazon	0 **	0 **	0	NT	3.2	5.8
Spiramycin	0.2	0.4	0.4	1.2	6.	4.8
Chloramphenicol	5.3	2.0	2.9	1.8	4.	0.5
Neomycin	0.2	0.4	0.4	NT	NT	NT
Amoxycillin (Clavulanate potent.)	NT	NT	0	NT	NT	NT
Rifamycin	NT	NT	0	NT	NT	6.9
Gentamicin	NT	0	0	NT	1.4	3.2
Norfloxacin	NT	NT	NT	NT	N	12.7

** Penicillinase – producers; ** Cefalotin; NT: not tested*

Antibiotics	Coliforms (% resistant strains)		
	1980	1986	1992
Ampicillin	16.0	26.8	23.3
Cefoperazon	3.7*	9.8*	2.1
Chloramphenicol	12.4	14.7	6.2
Neomycin	13.4	12.9	10.4
Polymyxin	0	2.2**	2.1**
Gentamicin	0	0	0.5
Norfloxacin	NT	NT	0
Cotrimoxazol	3.7	8.9	6.7

** Cefalotin; ** Proteus; NT : not tested*

Strategy for therapy: "Don't let an infection become chronic. The sooner a new infection is treated, the better the chances for bacterial cure".

FUTURE

The use of antibiotics will be reduced.
Reasons:
- Consumer's awareness. The public opinion in Switzerland is against the use of antibiotics in animal production (residues, increase of resistance in human pathogens)
- more dairy farms will change to organic milk production where the use of antibiotics for mastitis treatment is very limited
- economics

Preventive measures become in practice more important.
Reasons:
- see above
- changes in the structure of dairying (larger farms, larger herds)

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UNITED KINGDOM

STRUCTURE

Milk quotum (1997/8) 13 922.55 million litres
Milk production (1997/98) 13 925.04 million litres
Milk production, corrected for butterfat (1997/98) 14 073.87 million litres
Number of cows (1996) 2 587 000
Number of herds (1995) 38 100
Maximum herd size is unknown, probably >500

Distribution of herd size (no.cows) - % herds, 1995

	3-9	10-19	20-29	30-39	40-49	50-59	60-69	70-99	100-199	>200
E&W	0.3	1.4	2.8	5.0	6.9	7.2	7.5	22.3	35.6	11.0
Scotland	0.3	0.5	0.8	2.0	4.1	5.5	6.2	25.2	44.6	10.8
NI	0.8	4.9	8.7	11.5	12.4	1.05	9.7	21.0	20.6	

Cow type - predominantly dairy breeds (approximate %)

	UK
Black and white	94.3
Ayrshire	2.9
Channel Islands	2.6
Others	0.2

Milk yields (February 1998 from recorded herds only - 54% total) - 6700 l/cow

Number of lactations - average 3.4

Culling rate - target is 22%
- actual is 26-29% (23.8% in DAISY herds)

Housing
- cubicles 70% cows
- yards 28% cows
- tie stalls 1-2% cows

Pasture - 5-9 months varying geographically and with weather (April – Oct./Nov.)

ECONOMICS

Milk price

Standard litre May gross price: 18.2 p/l.

Range of gross prices according to contract (16.09 - 21.65 p/l).

Price is declining, 35% lower over the last year.

Based on 100 cow herd (600 000 litres/year), 4.1% butterfat, 3.35% protein, SCC 150 000 cells/ml, Bactoscan 50 000 cells/ml. Net of transport, seasonality and levy charges.

Organic milk may get a premium up to 50%.

There are no subsidies in these prices subject to the EU intervention price.

Losses

Market prices:

in-calf heifer	£750-900
good quality cow	£650-800

Cull cows values come from the Over Thirty Months Scheme only - £250-300

Estimated losses from clinical mastitis - country >$290M
excluding cost of prevention
- herd
- case $293

Estimated losses from all mastitis: country >$1000M
70% cases mild,
29% severe,
1% fatal,
Suppositions include drug cost, time, discarded milk, increased culling rate.

MILK QUALITY

There are various adjustments to milk price for quality varying between buyers.

Typically there are bonuses and penalties for SCC and Bactoscan and penalties for antibiotics and water.

Price structure for Milk Marque (May 1998)

Fat:		1.88 p/%
Protein:		3.18 p/%
Bactoscan:	<50	+0.2 p/l
	51-100	nil
	101-500	-0.5 p/l
	>500	-8 or 10 p/l
SCC:	<150	+0.2 p/l
	151-250	nil
	251-400	-0.5 p/l
	>400	contract cancelled
Seasonality		- 2.0 p/l
Every day collection		- £13.50/day
Size of collection		e.g. +£2.00/day

Market
- self sufficient in liquid milk - overall balance
- export 33% all creams
- import 33% butter
- import 30% cheese
- export 80% milk powder
- export 33% all other processed products

STRATEGY

Basic mastitis control strategy

To prevent new infections and to reduce the duration of infections. There are only political objections to components of mastitis control leading to a growth in organic production.

Basic control method

This remains the Five Point Control Plan.

(1) Treat all cases of clinical mastitis, recording all cases
(2) Disinfect all teats after every milking
(3) Use dry cow treatment on all cows to re-calve into the herd
(4) Test the milking machine at least annually and ensure it complies with relevant standards of operation
(5) Cull persistently infected cows

Mastitis control is entirely the responsibility of farmers. They are increasingly influenced by pricing according to milk quality and by contractual 'farm assurance' schemes from milk buyers dictating methods of management and operation.

MASTITIS CONTROL AND MILK QUALITY

Most recent estimates of SCC are

Milk Marque (England & Wales)

3 month geom. mean in March - 135 000 cells/ml

Scotland
3 month geom. mean in March – 165 000 cells/ml

Northern Ireland
weighted arith. mean in Feb – 162 000 cells/ml

Best estimate of annual average is 160-180 000 cells/ml

Most recent estimates of Bactoscan or TBC are:
Milk Marque (England &Wales)
March – 15 000 cells/ml (bactoscan)

Scotland
March - ??cells/ml

Northern Ireland
February – 13 000 cells/ml (TBC)

Legal limits are EU Directive limits
- SCC 400 000 cells/ml
- TBC 100 000 cells/ml

Counts are made by milk buyers based on sampling of bulk tank at every collection and analysis of one sample at random each week. Values are 3 monthly geometric means (n=12). If a producer exceeds the legal limit there is usually separate collection and daily testing with a maximum of one month to achieve the threshold. If still in contravention contract is revoked. The parameters should be applied nationally but certain milk buyers may lack diligence !

Bulk milk is tested for antibiotics by the buyer. All supplies are sampled at each collection. At least one sample is tested weekly and up to three may be tested. Contaminated milk must be discarded. Producers suffer a price penalty with increased severity for a further offence (maximum is payment of 1 p/l). A third offence in 6 months may revoke the milk contract. Generally producers are insured for the effect on tankers and silos.

CONTROL SCHEMES

There is no mandatory scheme except that all medicines used must be recorded. The Five Point Plan is recommended. Post milking disinfection is always recommended. Pre-milking cleaning is common but not use of pre-milking teat dipping except on problem farms.

The commonest disinfectants are:

Pre-milking	*Post-milking*
Iodophores	Iodophores
Chlorous acid	Chlorhexidines
QAC	

Blanket dry cow therapy is recommended. The commonest antibiotics are cephalonium, cloxacillin, penicillin, framycetin, amoxycillin, ampicillin.

Machine tests are recommended 6 or 12 monthly. Most are static tests and most are carried out by Axient (who also do 200+ dynamic tests per year), then dealers. Problem machines are dealt with by ADAS - all independent companies.

There is an annual farm inspection system carried out by government inspectors and increasing numbers of inspection on behalf of milk buyers usually by vets or consultants.

The strength of mastitis control has been the near eradication of *Strep agalactiae* and the 80% reduction of clinical mastitis caused by *Staph aureus*.

The weakness is the failure to control *Strep. uberis* and *E.coli*. This is in part lack of rigour in mastitis management.

ADVICE ON MASTITIS CONTROL

In descending order of importance advice is sought/given by:

- Vets
- Commercial services
- Independent advisors
- Training groups
- Pharmaceutical companies
- Milking machine/feed companies and suppliers
- Universities/research

Troubleshooting help comes from:
- Vets
- Specialists - certain vets, State Vet Service, certain companies (Axient and ADAS),
- The retired (!)
- Researchers

This resource if made up from:

	Number working
Research leaders	5
Good advisors	10
Administrators	half
Others	too many

RECORDS

There are no mandatory record systems other than for medicines usage and animal transport.

54% cows are yield and milk composition (including cell count) recorded. Most by National Milk Records.

Bulk milk records are kept by buyers, individual farmers receive these and the Intervention Board as monitors.

Clinical case records are kept by most farmers and some vet groups. They be kept on paper (methods from a diary to recording forms) or on computer(spreadsheet to commercial health recording system).

It is estimated that 50% farmers keep 'adequate' records.

THERAPY

Treatment of cases

Type	Proportion cases treated with antimicrobials
Mild	60% (Rest milk withhold etc)
Moderate	100%
Severe	75%

The commonest antibiotics are amoxycillin/clavulanic acid, novobiocin/neomycin/penicillin/ streptomycin, penethamate/streptomycin/ framycetin, cloxacillin, pen/strep.

Over 90% cows are treated solely with intramammary syringes. Farmers administer treatment except for peracute cases. Decisions on overall protocols should be on vet advice, that is, a farm policy agreed in advance.

Mastitis in the UK - estimates

Main pathogens	Infections		Clinicals	High SCC
Staph. aureus	10%	15%	75%	
Strep. agalactiae	2%`	2%	3%	
Strep. dysgalactiae		2%	3%	2%
Strep. uberis	10%	30%	10%	
E. coli 5%	40%	0%		
CNS 30%	3%	5%		
C. bovis 30%	3%	5%		
Others 15%	5%	5%		

Infection prevalence	12-15% cows and 3.5-4.5% quarters
Clinical incidence	40 cases/100 cows/ year (1.6 cases/cow)

It is rare to treat sub clinical cases but increasingly high SCC cows are treated.

Antibiotic resistance is:

	Penicillin	Cloxacillin
Staph. aureus	68%	0%
Streptococci	nil	nil

This has not changed for 30 years.

The treatment strategy has **been** to achieve a clinical cure and return to saleable milk as quickly as possible. This attitude is changing and extending milk withhold time is increasingly common to manage cell count hence milk price. This is allowing progress on persuading farmers to attempt to cure infection and not simply disease.

FUTURE

Short term

Improve detection and diagnosis

Intervene earlier and aggressively to maximise cure rates and limit prevalence and recurrence giving an overall reduction in use of lactating cow antibiotic preparations

Use additional therapy to reduce pain and treat other signs e.g use NSAID for analgesia, Ca/Mg supplements.

Maximize welfare for minimal cost

Medium term

Extend availability of vaccines and improve management

Long term

Multivalent vaccines

Breeding for resistance at invasion, infection and disease levels.

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UNITED STATES OF AMERICA

STRUCTURE

No. of cows	9 190 000
No. of replacement heifers	3 980 000
No. of dairy farms	116 000
Mean cows per farm	78.8
Maximum herd size	10 000 cows

Distribution of herds by size

Parameter	1- 9 cows	30-49 cows	50-99 cows	100-199 cows	181
No. farms	33 420	26 300	34 810	14 900	7 250
% of cows	3.5	11.5	26.0	20.0	39.0
No. cows (x 10^6)	.32	1.06	2.39	1.84	3.58

Milk production (Hoard's Dairyman, 25 March 1998)

Parameter	lbs of milk	kg of milk
Total milk produced	156 603 000 000	71 183 181 800
Average yield/cow	16 916	7 689
Maximum state average (AZ)	20 976	9 535
Minimum state average (LA)	10 312	4 687

Cattle breeds (NAHMS 1996)

Breed	% of Cows
Holstein	93.7
Jersey	4.0
Guernsey	0.8
Brown Swiss	0.5
Other	0.6

Milk production by herd size (NAHMS 1996)

No. Cows/herd	kg Milk/cow	lbs Milk/cow
<100	7 640	16 809
100 – 199	8 341	18 350
>200	8 985	19 768

Culling rates (NAHMS 1996)

Herd size	%
<100	23.9
100-199	22.1
>200	25.1
All	24.1

Housing type (NAHMS 1996)

Housing type	% of Farms
Tie stall of stanchion	61.4
Pasture	59.6
Dry lot	47.2
Free stall	24.4
Multiple animal area	17.9
Individual animal area	2.3

Farms pasturing 3 or more months (NAHMS)

Region	% of Farms
West	43.3
Midwest	54.0
Northeast	70.1
Southeast	74.5

Other parameters of interest (NAHMS 1996)

Parameter	Number
Lactations/cow	2.5
Days dry	61.7
Calving interval (months)	13.0
Age at first calving (months)	25.5

ECONOMICS

Milk price (1997)

Producers	$/100 lbs	$/kg
All	$13.10	$.29
Low (Idaho/E.Oregon)	$11.89	$.26
High (Tampa, Florida)	$15.05	$.33

The milk price to producers is based on domestic supply and demand. The governmt provides an effective support price (floor price) of $9.95/100 lbs or $.219/kg.

Milk price adjustment for quality

The milk price is in some areas adjusted for components. It is also adjusted for quality parameters (SCC, SPC, inhibitors, freezing point). The adjustment for quality can be either bonus payment of deduction, depending on the cooperative or processor purchasing the milk.

US export market: 2-3 % of total production.

STRATEGY

Basic components of the US mastitis control program. There is no single uniform plan that is required by legislation. The basic components of mastitis control that are most often recommended are listed below.

- post-milking teat disinfection
- dry cow therapy
- proper maintenance of the milking equipment
- culling of problem cows
- therapy of clinical cases
- environmental maintenance
- milking time hygiene
- nutrition
- vaccination (Gram negative vaccine)

Basic strategy

Implement procedures to control contagious pathogens and then implement procedures to control environmental pathogens. Factors that contribute to mastitis control program implementation are:

- regulatory limit for SCC
- the prohibiting of antibiotics/ drugs in milk
- economic incentives

The producers alone are responsible for the implementation of mastitis control in their herds.

The basic strategy that is promoted by professionals is that the fundamental principal is to control intramammary infection which will lead to low SCC and improved milk quality. The approach to intramammary infection control is to prevent new infection from occurring and to reduce the duration of existing infections. The latter is generally achieved by antibiotic therapy or by improved resistance of the cows through nutrition, vaccination and reduced stress.

The cultural, social, or economical idiosyncracies that impact the strategy of mastitis control are that milk should be free of drugs and other chemicals. Also, mastitis control is not mandatory. Animal welfare issues and organic milk production are not significant factors at this time.

MASTITIS CONTROL & MILK QUALITY

There is no national statistic showing the average somatic cell count for the US dairy herd. A good estimate is 350 000 cells/ml and comes from the work of Wells (Proc. NMC 1998). Somatic cell counts are influenced nationally by season (higher in summer than in winter) and by herd size (higher in smaller herds than in larger herds).

Legal limits in the US for SCC and SPC are:
SCC = 750 000 cells/ml
SPC = 100 000 cfu/ml

Calculation of SCC to determine if the legal limit has been exceeded. All aspects of the production, transport and processing of Grade A milk in interstate commerce are governed by the Pasturized Milk Ordinance (PMO). The PMO is the product of the US Department of Health and Human Services, Public Health Service, Food and Drug Administration in cooperation with the National Conference on Interstate Milk Shipments. During any consecutive six months, at least four samples of bulk or can milk from all licensed Grade A milk producers must be tested for SCC. The majority of milk is tested monthly by regulatory agencies. Producers are notified of the results of all tests regardless of whether or not the count exceeds 750 000 cells/ml. When 2 of 4 consecutive samples exceed 750 000 cells/ml the producer is sent a warning letter and notified that an additional sample will be taken within a 21-day period of time. If the SCC of that sample exceeds 750 000 cells/ml (3 of 5 consecutive samples now exceed 750 000 cells/ml), the producer is notified immediately that the sale of his milk for consumption as a human food is prohibited (the producer loses his Grade A milk license). To regain his license the producer must reapply for a Grade A milk license and demonstrate that his milk SCC is equal to or under 750 000 cells/ml. If the milk sample is under 750 000 cells/ml the producer is reinstated but all milk samples are retained historically and if the next sample is above 750 000 cells/ml the producer will again loose his license because 3 of 5 consecutive samples are greater than 750 000 cells/ml.

The same system described for SCC would apply to SPC violations.

Presence of inhibitory substances in milk. All milk tankers are tested for the presence of antibiotics at the processing plant before the milk can be unloaded. If the tanker is found to be positive, milk samples from the individual processors comprising the load are tested and the origin of the antibiotics is determined. The guilty producer is responsible for the disposal of the contaminated milk or may be forced to buy the contaminated load or both depending upon the coop or processor purchasing the milk. For a first violation within a 12-month period the producer is not permitted to ship milk for two days. If there are two violations within a 12-month period the producer is not permitted to ship milk for a 4-day period. Following a third violation within a 12-month period the producer is not permitted to sell milk for 4 days and the state regulatory agency initiates proceedings to revoke the producers.

Pathogens responsible for subclinical intramammary infections in the US

The order is meant to reflect relative prevalence. There is no absolute national survey and no national data:

- Coagulase negative staphylococci
- *Staphylococcus aureus*
- *Streptococcus uberis*
- *Streptococcus agalactiae*
- *Corynebacterium bovis*
- *Streptococcus dysgalactiae*
- *Serratia* spp.
- *Klebsiella* spp.

Pathogens responsible for clinical mastitis in the US

The order is meant to reflect relative prevalence. There is no US data base:

- *Escherichia coli*
- *Streptococcus uberis*
- *Klebsiella* spp.
- *Serratia* spp.
- *Staphylococcus aureus*
- *Coagulase negative staphylococci*
- *Streptococcus agalactiae*
- *Streptococcus dysgalactiae*

Pathogens responsible for high bulk milk SCC

The order is meant to reflect relative importance as a cause of high bulk milk SCC. No national US data base exists:

- *Streptococcus uberis*
- *Staphylococcus aureus*
- *Streptococcus agalactiae*
- *Streptococcus dysgalactiae*
- *Serratia* spp.
- *Klebsiella pneumoniae*
- *Escherichia coli*

Milk quality (NAHMS 1996)

Herd size

Cells/ml X 1000	<100 cows	100 - 199 cows	>199 cows	Total
<100	4.7%	3.3%	3.3%	4.4%
100 - 199	24.5%	26.5%	33.2%	25.4%
200 - 299	33.0%	38.3%	41.4%	34.4%
300 - 399	19.9%	24.7%	13.4%	20.2%
400 - 499	11.4%	5.0%	6.3%	10.1%
>499	6.5%	2.2%	2.4%	5.5%

Herd size

Cells/ml X 1000	<100 cows	100 - 199 cows	>199 cows	Total
<400	82.1%	92.8%	91.3%	84.4%

CONTROL SCHEMES

There is no mandatory control scheme in the US. The basic control scheme recommended by most experts is the five-point plan plus attention to the environment. Pre- and post-dipping of teats is recommended by most experts.

Use of pre- and post-dipping in the US

	Herd size		
Practice	<100 cows	100 - 199 cows	>199 cows
Pre-milking wash pen	4.7%	4.9%	35.5%
Pre-milking teat dip or spray	54.2%	72.9%	70.6%
Post-milking teat dip or spray	86.9%	95.1%	97.2%

Practice	All Herds
Pre-milking wash pen	7.0%
Pre-milking teat dip or spray	58.3%
Post-milking teat dip or spray	88.9%

Teat dip products used in the US

Iodine (0.1% - 1%)
Chlorhexidine (0.35% - 0.5%)
Linear dodecyl benzene sulfonic acid (1.94%)
Lauricidin, caprylic, capric, lactic and lauric acids
Quaternary ammonium (0.5%)
Nicin
Sodium chlorite
Sodium dichloro-s-triazene-trione
Sodium hypochlorite
Sodium chlorite plus lactic acid

Pre-dipping products used in the US

Iodine (0.1% - 0.35%)
Chlorhexidine (0.35%)
Iodophor (0.55%) plus linear dodecyl benzene sulfonic acid (1.9%)
Sodium chlorite (0.64%) plus lactic acid
Sodium hypochlorite

Bedding types used in the US

Bedding type	% of Herds
Straw/hay	66.9
Wood products	27.9
Rubber mats	27.0
Corn cobs/stalks	12.8
Sand	11.2
Shredded newspaper	6.7
Mattresses	4.7
Composted manure	2.4
Rubber tires	1.0
Other	3.7

Machine testing

Frequency of testing is:

- At the discretion of the producer
- Every 6 months recommend by most advisors
- May be monthly in large herds
- When problems occur

Testing is conducted by:

- Equipment dealers
- Veterinarians
- Extension
- Consultants

Milking time observations

Frequency of milking time observations is:

- At the discretion of the producer
- When problems occur

Milking time observations are conducted by:

- Equipment dealers
- Extension
- Consultants

Strengths of control schemes

Prevention is emphasized
When applied properly:
(a) herd SCC < 200 000
(b) clinical cases < 2% of cows per month

Weaknesses of control schemes

- Voluntary program
- Extensive use of chemicals and antibiotics
- No single uniform program recommended by all advisors

Use of dry cow therapy (NAHMS 1996)

% of Herds by size

Method of use	<100 cows	100-199 cows	>199 cows	All herds
All quarters of all cows	73.3%	88.1%	87.2%	76.5%
Selected cows	16.8%	7.7%	5.5%	14.6%
No dry cow therapy	9.9%	4.2%	7.3%	8.9%

ADVICE ON MASTITIS CONTROL

Sources of advice:
- Private veterinary practitioners (No. 1 source)
- Milk cooperative/processors fieldmen
- Consultants
- Extension
- Peers

Services available for mastitis problem solving:
- Veterinary practitioners
- Diagnostic laboratories
  - Veterinarians
  - Government
  - Private
  - University
- Consultants
- Extension

Numbers of people working in mastitis control

Research workers: Approximately 50
States with active research programs: Approximately 20

RECORDS

There are no mandatory recording systems in the US. Recording systems available are listed below.

Individual cow SCC recording:
- Dairy Herd Improvement Association
- Private laboratories

Bulk milk SCC recording:
- Cooperatives and processors
- State regulatory agencies

Clinical cases of mastitis
- None

THERAPY

Severity of clinical cases (these estimates are based on Hogan et al. 1989).

Severity	% of Cases
Mild	38
Moderate	47
Severe	15

Antibiotics commonly used in lactating cow products available in the US:
- Cephapirin
- Penicillin
- Pirlimycin
- Cloxicillin
- Amoxicillin
- Erythromycin
- Novobiocin
- Penicillin/Novobiocin
- Hetacillin

Antibiotics commonly used in dry cow therapy products that are commonly available in the US:
- Cephapirin
- Penicillin/dihydrostreptomycin
- Novobiocin
- Cloxicillin
- Penicillin
- Penicillin/Novobiocin
- Erythromycin

Individuals administering antibiotic therapy in the US

Individual treating	% of Cases
Only veterinarian	10.9
Only dairyman/farm worker	52.8
Veterinarian plus dairyman	28.6

Route of therapy administration

Route of administration	% of Cases
Infuse quarter	90.9
Inject muscle	48.1
Inject vein	30.4
Other	6.1

Treatment of sub-clinical mastitis and/or high SCC cows during lactation is generally not recommended, but likely to be used when herd is approaching legal limit for SCC.

Antibiotic resistance of mastitis pathogens in the US:
- Nationally not known
- Pathogen dependent
- Resistance among Gram-negative bacteria is very high to commonly used antibiotics

Basic strategy of therapy in the US:
- Eliminate the clinical signs
- Reduce milk yield losses
- Reduce SCC
- Cure the infection

FUTURE

Likely changes in mastitis control and mastitis control schemes:
- Lower legal limit for SCC
- Reduced reliance on antibiotics
- Increased emphasis on vaccination and nutrition
- Increased emphasis on pathogen reductions in the cows environment and particularly cow housing

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Events & Meetings

US NATIONAL MASTITIS COUNCIL ANNUAL MEETING - 2001

The 2001 annual meeting of the National Mastitis council was held 11-14 February in Reno, Nevada. Attendance was approximately 380 individuals and among the attendees were several individuals from countries other than the US. The conference included a pre-conference symposium on Sunday, numerous committee meetings and short courses on Monday, and general sessions and poster presentations on Tuesday and Wednesday. A highlight of this year's meeting was that the President of NMC, Dr Ann Godkin, was both the first woman and the first non-US citizen to be President of NMC. Dr Godkin is from Fergus, Ontario, Canada, and is employed by OMAFRA - Health Management.

The Sunday pre-conference symposium was on somatic cell counting and was organized by Dr Godkin. Eight papers were presented and authors were from the US, Canada, United Kingdom, and Switzerland. Following the presentations there was a lively discussion of the somatic cell count standard for the US. All papers are available in the proceedings of the annual meeting.

Keynote speaker for the general sessions was Mr. Bob Franks, New Zealand Dairy Group of Companies, Hamilton, New Zealand. The topic of his presentation was "New Zealand Milk Quality - Lessons Learned". Other papers presented in the general sessions included the topics of drying off cows, antibiotic treatment during lactation and drying off, use of teat seals during the dry period, organic dairies and mastitis control, genetics and mastitis, and automated systems for milking cows in relation to milk quality and mastitis control. Papers for all presentations as well as abstracts for 46 posters presented are in the Proceedings of the Annual Meeting. A copy of the Proceedings can be obtained by contacting <www.nmconline.org> and for the first time the proceedings are available on CD-ROM. The price for the CD is $24/95 plus shipping for members and $29.95 plus shipping for non-members.

In other activities, the NMC Board of Directors has agreed to submit a proposal to the National Conference of Interstate Milk Shippers to lower the SCC standard in the US from 750 000 cells/ml to 400 000 cells/ml by 1 January 2005. It is the NCIMS Conference that establishes the rules for the production, storage, transportation and processing of milk and milk products in the US. All actions taken by the Conference must be approved by the Food and Drug Administration. The Conference meets every two years and this years meeting is in May and the venue is Witchita, Kansas. NMC submitted a similar proposal to the last NCIMS Conference and the proposal was rejected.

NMC has broadened the mission statement of the organization to become more global in its activities. There is a desire to develop programs and educational materials that have an appeal to individuals and groups from countries other than the US and Canada. To accomplish this, NMC is trying to organize the appropriate discussion groups to give direction and guidance on how best to accomplish these goals. As a first step to broaden the mission of NMC, non-US persons are being place on key committees of the organization. Examples include Dr Eric Hillerton as chair for the Milk Monitoring Committee and both Dr Hillerton and Dr Alfonso Zecconi are serving as members of the Research Committee.

Officers elected to serve for the 2001-2002 year are: President, Dr Gary Heinrich, Pharmacia Animal Health, Kalamazoo, Michigan; First Vice-President, Dr Steve Nickerson, Hill Farm Research Station/ LSU, Homer, Louisiana; Second Vice-President, Dr Andy Johnson, Veterinarian, Seymore, Wisconsin. In other action, the Board of Directors agreed to down size the Board to a more workable group.

A major activity planned for September of 2001 is the joint American Association of Bovine Practitioners/National Mastitis Council International Mastitis and Milk Quality Symposium. The symposium will be held 13-15 September in Vancouver, British Columbia, Canada. Details are available on the NMC web site. The conference should be of particular interest to veterinary practitioners and research workers. The 2002 annual meeting is planned for February in Jacksonville Florida.

All relevant information regarding future meetings, available publications, membership information and other activities of the NMC are available at the web site www.nmconline.org.

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SOMATIC CELLS IN MILK OF DAIRY COWS

Within the framework of the 3-day (26-27-28 May 1999) annual meeting of the association of veterinary practitioners "SNGTV" (Société Nationale des Groupements Techniques Vétérinaires), attended by more than 1200 persons and whose scientific progamme was this year co-organized with INRA, the subject topic of the somatic cells in milk was extensively reviewed.

The plenary sessions during the first day of the meeting, hosted in the Palais des Congrès in Nantes, were devoted exclusively to milk somatic cells, a topical subject related to both animal and public health, and which has a strong impact on the economy of dairy farming. The ambition of the chair of the scientific committee, Bernard Poutrel (INRA Tours-Nouzilly), was to realize an update on every aspect of the topic, by assembling reports on basic knowledge, technical data and applied research.

Sixteen speakers, most French but four from abroad, presented their papers:

- Cells of milk and the udder (Ph. Le Page, SNGTV).
- Phagocytic defence of the bovine mammary gland (M.J. Paape, USDA-ARS).
- Is it possible to predict the severity of acute mastitis during early lactation through the measurement of the activity of circulating polymorphonuclear cells? (Ch. Burvenich, University of Ghent).
- Effect of selenium and vitamin E on phagocytic cell function and mastitis control (K.L. Smith, Ohio ARDC).
- Kinetics of cell recruitment and bacteria multiplication after infection (C. Riollet, INRA Tours-Nouzilly).
- Cellular and molecular components involved in the recruitment of polymorphonuclears in the udder (P. Rainard, INRA Tours-Nouzilly).
- Methods for counting milk cells and quality control (O. Leray, CECALAIT, INRA-SRTAL, Poligny).
- Use of somatic cell count for the evaluation of the efficacy of mastitis treatment ? (H. Deluyker, University of Ghent).
- Simulation model and control of variation of milk cell counts of dairy cows (P. Sabatier, ENVL-INRA, Lyon).
- Influence of cells on the biochemical composition of milk and its transformation ability (I. Michelutti, ENSAIA Nancy).
- Nutrition of dairy cows and individual cell counts (J.-L. Troccon, INRA Saint-Gilles).
- Physiological factors of milk cell concentration variations (J.-B. Coulon, INRA Saint-Genès-Champanelle).
- Risk of clinical mastitis in relation to milk cell concentration: epidemiological approach (C. Fourichon, ENVN-INRA Nantes).
- Genetic relationship between cell count, clinical mastitis, milk yield and a few morphological traits (R. Rupp, INRA Jouy-en-Josas).
- Use of cell counts in selection programmes (D. Boichard, INRA Jouy-en-Josas).
- Evaluation of the economic consequences of strategies of milk somatic cell count control in dairy herds (H. Seegers, ENVN-INRA, Nantes).

All the papers on milk somatic cells are gathered in a proceedings book (188 pp), "Cellules somatiques du lait", available from the SNGTV, 5 rue Moufle, 75011 Paris.

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THE BRITISH MASTITIS CONFERENCE 2000

The thirteenth conference was held in October 2000 and comprised a programme largely inspired by the wishes of previous audiences. The meeting was the first in the series to move from a national arena closer to a traditional dairying area visiting Shepton Mallet in Somerset. Some 150 advisors, veterinarians, educators and farmers attended.

Dr Steve Oliver, University of Tennessee (USA) started from the 'beginning'. He reviewed the importance of intramammary infections introduced into the herd in first calving animals. These infections are much commoner than previously thought, perhaps up to 90% animals being infected. The infections can be long lasting affecting milk quality and quantity as well as impairing mammary development prior to parturition. Prepartum infusion of antibiotic has been proven to reduce significantly the prevalence of infection and to prevent the deleterious consequences. There is a net financial benefit from this therapy equivalent to US$175 per heifer.

Peter Orpin and Chris Watson, both specialist cattle veterinarians, gave their views on managing the high cell count herd and the high mastitis incidence herd respectively. The high prevalence problem can be tackled by quantifying the problem and its importance, investigating the specific cause of infection, studying the farm and its operation closely to identify the main intervention points. The approach then becomes a joint project with the owner, staff and veterinarian to agree the actions, responsibilities and targets. Regular thorough review and appraisal are essential to ensure sustained compliance and achievement of targets. The high incidence farm requires more targeting of the cause, and then adoption of specific plans according to the pathogens involved to prevent new infections rather than a therapeutic approach. A high incidence often means too quick a resort to antimicrobial treatments, hence the need for a preventive approach.

The research report session started with Andrew Bradley highlighting the importance of new coliform infections occurring in the dry period. He found that of all coliform clinical cases in the first 100 days after calving, some 52% arose in the dry period. This demonstrates the importance of dry period management in preventing clinical mastitis in lactation. Elizabeth Berry has re-examined the importance of dry cow therapy in preventing new infections some 35 years after its 'invention'. This is highly relevant to the organic dairying system with significantly reduced use of prophylactic antibiotic treatments. In comparison with a no

treatment group, dry cow antimicrobial treatment reduced the rate of new infections, mostly by *Streptococcus uberis*, by 80%. The milk conductivity system in an automated milking system, when set at the a threshold 17.5% change in average conductivity, was very specific in detection of infection (87%) but the sensitivity was only 50% suggesting that a high frequency of false positive indications may arise.

A series of papers was presented looking at managing mastitis as an economic problem. Liz Best, a farmer who won the UK Milk Quality Award in 1999, showed how she could produce milk with a cell count averaging 60 000 cells/ml and a Bactoscan averaging 7000 impulses largely by attention to cleanliness and to the detail of the job. This is exactly the requirement of the milk retailer as explained by Chris Brown from Marks & Spencer. High hygienic standards are essential to support and protect the high status of milk with consumers who see it as fresh, of high nutritive value and wholesome. Managing and minimizing mastitis is essential to safeguard markets.

Olav Østerås from Norwegian Dairies has looked closely at the cost of mastitis at the herd level. In the herd with a low cell count the largest loss is due to the treatment cost of clinical cases (48%) and replacement cost (27%). It is not the total loss that is most important but the proportional costs; these indicate where the emphasis on means of control should be applied. The aim is to reduce the costs and is generally a hidden benefit because the profits are not obvious. David Logue complemented this in presenting guidelines based on economic modelling for the control of Staphylococcus aureus sub clinical mastitis by culling. The decision depends on yield and individual cow cell count.

Full papers and abstracts of posters are available along with details of the 2001 meeting from margaret.carr@bbsrc.ac.uk

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SYMPOSIUM ON ROBOTIC MILKING

Held August 17-19 2000, Lelystad, the Netherlands

Automatic milking systems (AMS) have been promised by futurists for some time, and it now appears that they are no longer a promise but reality. Their growing and now widespread use on private dairy farms for the last several years confirms that for at least Europe, AMS are an important part of the future. At the moment, the most exciting developments in Europe are related to what farmers and their advisors are learning about practical AMS use.

Private Dutch dairy farmers have used robotic automated milking systems since 1992. Over 600 farms are using a milking robot now, most of them in north-western European countries. But also some farms in North America and Japan are introducing an automatic milking system. Automatic milking fits particularly in those areas with limited or expensive labour. Many of the technical engineering problems, especially those related to automatic location and attachment of teat cups, have been resolved over the last decades. The equipment works reliably. With the widespread adoption of robotic milking by private farmers, new problems have emerged, however.

An international symposium to discuss the most recent research results was held in Lelystad, the Netherlands, 18-19 August 2000. It was organized by the Research Institute for Animal Husbandry (PV-Lelystad) and IMAG-Wageningen. Around 275 people from 20 countries heard 25 presentations, viewed over 35 scientific poster presentations, visited private dairy farms using five brands of AMS being marketed and got the latest business developments during a business presentation. A short summary of the results presented is given hereafter.

Automatic milking provides the dairy farmer with more freedom, but, on the other hand, he will be more dependent on equipment. This makes a fast and accurate service in case of malfunctioning important. Much research was directed to implement the milking robot on the dairy farm as efficient and economically advantageous as possible. Although many farmers use the milking robot to increase the milking frequency of their cows, this should not be the leading principle. Optimal use should be directed at milking as many KGs of milk per robot per day. When installing an AMS on the dairy farm, adjustments in cooling are often underestimated. Because of the low milk flow per hour, traditional, direct cooled, bulk tanks do not work adequately with AMS. Several options to adjust the cooling system (use of a buffer tank, instant cooling, ice bank cooling and adjusted direct cooling) to the demands of automatic milking were discussed.

The quality of the milk produced with AMS needs attention. Reports from various countries showed that, although the quality of the produced milk was within EU limits, there were negative effects of automatic milking on the milk quality. Research into the background and causes of these effects on milk quality has not yet been carried out. Besides the quality of the produced milk, the prevention of the delivery of abnormal milk got attention. The main detection method of abnormal milk currently available is the use of electrical conductivity. By improving algorithms, the performance of electrical conductivity can be improved. However, in the future biosensors will most probably become available, for instance to measure NAGase, an enzyme that has a predictive value for mastitis.

Another important issue was the variation in milking intervals. Since cows have to come to the milking robot voluntarily, a large variation in milking intervals was seen. The effects of this variation on milk yield and (udder) health are not fully known and need more attention in the near future.

The use of a milking robot does not give more stress when compared to traditional milking. From that point of view there was no fear of decreased animal welfare. However, combination of robotic milking with grazing gave more discussion. According to some presentations, it is very well possible to combine grazing with automatic milking. Other presentations indicated that the introduction of the milking robot automatically will, almost certainly, lead to a farm system in which dairy cows will always

be kept inside. This might have implications for animal welfare, but also for public acceptance. There is hardly any knowledge on the conditions for public acceptance of automatic milking. This will be an important subject for the near future.

Finally it was stressed that the users of an automatic milking system have more and more need for individual cow data. From these data, the herdsman must be able to draw relevant information for decision making. With the current software, this information is insufficient. A good management information system needs to help the dairy farmer to take decisions on his farm, while taking a large number of aspects (welfare, production, milking frequency, capacity, economics and grazing) into account.

In summary: robotic milking is reality, it gives the dairy industry many opportunities, but new challenges in various fields of dairy farming and research have emerged.

More information about the Symposium, amongst which abstracts of all oral presentations, can be found on internet: http://www.pv.wageningen-ur.nl/roboticmilking. A bound version of the papers from the Robotic Milking Symposium is also available for order. The proceedings is over 300 pages and is an excellent reference for anyone who is considering an AMS or who advises producers making those decisions. http://www.WageningenPers.nl/bookshop/index.html

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WORLD EXPO 2000

Project "Sustainable Animal Production" with virtual and real conferences at the School of Veterinary Medicine Hanover

"Mankind – Nature – Technology" was the theme of the World Exposition held in Hanover, Germany, 1 June through 31 October 2000. The purpose of this exposition was to demonstrate that technical progress in our world has its limits at the point where the balance of nature would be irreversibly destroyed, but that mankind must employ technology to restore and maintain this balance.

In this context, the School of Veterinary Medicine Hanover realised a programme of EXPO activities covering different aspects of the theme "Sustainable Animal Production".

Among these was the formation of the Research Consortium Sustainable Animal Production, in which scientists from three other institutions in northern Germany organised a virtual conference followed by a series of real conferences covering the following topics:

- Animal Production and World Food Supply
- Globalisation, Production Siting and Competitiveness
- Product Safety and Quality Assurance
- Livestock Farming and Environment
- Health and Welfare of Farm Animals
- Advances in Biotechnology in Livestock
- Animal Breeding and Animal Genetic Resources
- Animal Nutrition: New Challenges, New Concepts
- Safeguarding Animal Health in Global Trade
- Bonds Between Animals and Humans

As a first step these ten subjects were discussed in the virtual Internet conference www.agriculture.de launched 1 October 1999 and continuing through 31 December 2001.

During the five months of EXPO 2000, nine real workshops covering the same topics were held with participation by internationally-recognised experts from 25 countries. The results of these workshops will be published as proceedings, and will also be available in the Internet (www.agriculture.de) in the second half of this year.

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IDF Publications on Mastitis

All documents listed below can be obtained from IDF Brussels as per address on cover

SUGGESTED INTERPRETATION OF MASTITIS TERMINOLOGY

K. Larry Smith (co-ordinator)

Much of the terminology used in the thousands of publications on mastitis and its control is unique to mastitis and many terms used in one English-speaking country are described by a different term in another country.

Members of IDF Group A2 have recognized these differences and the lack of guidance when trying to determine the preferred terms. It is hoped that the present document, with contributions from all members of Group A2, will be of value to all of those interested in mastitis and the production of quality milk.

INSTRUMENTS FOR MECHANICAL TESTS OF MILKING MACHINES

IDF Group of Experts A32

This document provides information about the various devices that can be used to test milking machine performance, which will help in the choice of convenient and appropriate test equipment as well as indicating the need for new and better instruments.

A proposal for test terminology is presented. All the information on the instruments listed has been provided by manufacturers or distributors.

Bulletin N°338/1997 – 1500 BEF (37,18 euro)

RECOMMENDATIONS FOR PRESENTATION OF MASTITIS-RELATED DATA

Part 1: Somatic Cell Count
Part 2: Records of Clinical Mastitis

By a sub-group of IDF Group A2 – Bovine Mastitis

Historically, somatic cell count data have been presented in a variety of ways, making comparisons of data from different sources difficult, if not impossible. Milk somatic cell counts are increasingly used to compare milk quality within regions or states of a country as well as among countries. The final number used to indicate the status of a country/region/milk cooperative can vary greatly depending upon the method used for calculation. As the demand for such comparisons increases, so does the need for a standardized method of calculation. A sub-group of A2 was organized under the leadership of Olav Østerås (Norway) with the charge to produce a document recommending standardized methods for presentation of somatic cell count data. A section on presentation of clinical mastitis data is included as these data also suffer from a lack of consistent method of presentation, and comparisons among studies or reports are very difficult.

The document is presented in the form of a condensed version for quick reading and introduction to the subject matter, and as the full text with complete detail.The document will be a useful reference for those publishing data involving somatic cell counts and/or incidence of clinical mastitis cases, and will help bring clarity to an area where it is needed.

GUIDELINES FOR THE EVALUATION OF THE MILKING PROCESS

By J. Hamann (Germany) (in conjunction with the IDF Machine Milking and Mastitis Subgroup A2D of GroupA2)

The paper describes guidelines to evaluate the entire process of mechanical milking. Application of the guidelines will result in detailed information on interactions between machine, milker and dairy cows, and the related efficiency of milking, milk removal and any risk of new infection of the mammary gland. The guidelines are based mainly on the evaluation of the following criteria:
(1) Operator action and behaviour;
(2) Animal factors and behaviour;
(3) Machine characteristics, and
(4) General conditions of housing and management.

Bulletin N°321/1997 – 1200 BEF (29,75 euro)

MASTITIS CONTROL (RESULTS OF QUESTIONNAIRE 1694/A)

by IDF Group of Experts A2 – Bovine mastitis

The replies of 24 member countries to IDF mastitis control questionnaire 1694/A issued in February 1994 are tabulated. The survey shows a high degree of uniformity in recommended mastitis control measures and an increase in their application on-farm since the previous questionnaire 5 years before. There is little evidence in a reduction in infection levels, although cell counts are lower and there has been a big increase in cell count payment schemes in the countries replying to the questionnaire.

Bulletin N°305/1995 – 1400 BEF (34,71 euro)

TEAT TISSUE REACTIONS TO MACHINE MILKING AND NEW INFECTION RISK

Document prepared by the IDF Machine Milking and Mastitis Subgroup A2D working under the chairmanship of *Prof. Dr J Hamann (Germany)*

A description of the physiological status of the teat is used as a reference for the evaluation of the teat tissue reactions induced by machine milking and their impact on the new infection risk.

Bulletin N°297/1994 – 1300 BEF (32,23 euro)

MASTITIS CONTROL

by a Group of Experts

Results of questionnaire 1889/A of 16 pages with results from 23 countries: data for cow population, mastitis control schemes, monitoring procedures, antibiotic sensitivity, mastitis control measures, milk payment, progress in mastitis control.

It is part of a three-part Bulletin which also covers payment systems for ex-farm milk and the alkaline phosphatase test as a measure of correct pasteurization.

Bulletin N°262/1991 – 1400 BEF (34,71 euro)

DESIGN OF CLINICAL TRIALS FOR MASTITIS THERAPY

by Margaret A. Thorburn, Dept of Population Medicine, Ontario Veterinary College

This 8-page report covers clinical trials of therapeutic treatments; causes of mastitis and its consequences.

It is part of a five-part Bulletin which also covers: radionuclides in dairy products; distribution systems for fresh dairy products; enzymes in cheesemaking; and teat and udder cleaning.

Bulletin N°247/1991 – 1500 BEF (37,18 euro)

ENVIRONMENTAL INFLUENCES ON BOVINE MASTITIS

by a Group of Experts

Covers mastitis as a multifactorial disease, pathogenesis, sources & transmission of pathogens, environmental influences on animal health, external environment, internal environment, conclusions and recommendations.

Bulletin N°217/1987 – 1000 BEF (24,79 euro)

MACHINE MILKING & MASTITIS

by a Group of Experts

Comprises (a) recommendations concerning the use of milking machines and the incidence of mastitis; (b) review of literature on milking machine factors affecting the rate of new infections; (c) review on the effect of machine milking on teat end condition.

Bulletin N°215/1987 – 1000 BEF (24,79 euro)

BOVINE MASTITIS: DEFINITION & GUIDELINES FOR DIAGNOSIS

by a Group of Experts

This Bulletin gives new (compared to 1967) proposals for mastitis definitions, diagnosis & results of an IDF trial on the interpretation of diagnostic data.

Bulletin N°211/1987 – 800 BEF (19,83 euro)

PROGRESS IN MASTITIS CONTROL

by a Group of Experts

This survey describes in tabular form the progress made in 23 countries, on the basis of an enquiry conducted in September 1983. In a previous survey of 1977 (see Bulletin 121), many countries reported little progress; this time, 7 countries reported definitive improvement to 1983.

Bulletin N°187/1985 – 500 BEF (12,39 euro)

MASTITIS RESEARCH INDEX (13th EDITION, 1996)

MASTITIS RESEARCH INDEX AVAILABLE ON INTERNET

The 13th edition of MRI was published in January 1996. It includes 271 mastitis research projects from 71 laboratories from 28 countries.

The printed version is available from the IDF secretariat (Square Vergote 41, B-1030 Brussels, Belgium, fax +32 2 733 04 13, e-mail: info@fil-idf.org.

The index is also available on Internet. If you have access to WWW, use address : http://www.helsinki.fi/~hssaloni/. By file transport protocol you can find it at ftp.funet.fi/pub/sci/medical/vetmed/MRI96.zip. The same file is also available as MRI96.txt text file.

The next printed edition of MRI will be published in 1998. Before that the electronic form of the index will be updated, if mastitis laboratories give new research topics. Send the information to the editor by mail, fax or e-mail.

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MASTITIS NEWSLETTER N°23

General

Report of the IDF Group of Experts on Mastitis — K.L. Smith, Chairman (USA)

Research Communications

State of proficiency in counting of somatic cells – Results of latest intercomparisons — E.-H. Ubben & J. Reichmuth (Germany)

Dynamics of mastitis in Norway — O. Østerås (Norway) C-reactive protein as indicator for subclinical bovine mastitis —J. Hamann (Germany)

Characteristics of bovine mastitis caused by Listeria monocytogenes and new ELISA method for diagnosis – B. Poutrel (France)

The effect of automatic milking on bulk milk somatic cell count —H. Hogeveen, G.H. Klungel & B.A. Slaghuis (Netherlands)

Investigation on hygienic important and potential pathogens of raw milk of sheep and goats during one lactation period —L. Podstatzky-Lichtenstein, P. Winter & W. Baumgartner (Austria)

Effect of milking interval on milk yield and composition —B. O'Brien, J. O'Connell & W.Meaney (Ireland)

Milk quality and automatic milking systems (AMS) —J. Hamann (Germany)

Vaccination with ferric enterobactin receptor (FepA) to control coliform mastitis (summary of a recent PhD thesis) — J. Lin, J. Hogan & K.L. Smith (USA)

Udder health on dairy farms. A longitudinal study (summary of a recent PhD thesis) — H.W. Barkema (Netherlands)

A study of dairy herds with constantly low or constantly high bulk milk somatic cell count, with special emphasis on management (summary of a recent PhD thesis) —T. Ekman (Sweden)

Mastitis Notes from Member Countries

Switzerland:

Mastitis pathogens isolated in Switzerland, 1987–1996 — M. Schällibaum

The Netherlands:

The health planner: a new concept in mastitis control — H. Hogeveen, T.J.G.M. Lam, E.G. Grijsen & Y.H. Schukken Dutch mastitis platform —Y.H. Schukken

Events & Meetings

US National Mastitis Council – Update

British mastitis conference 1998

The IDF-A2 meeting in Oslo

Udder health at the International Conference on Production Diseases in Farm Animals

ANNOUNCEMENTS

Somatic cells in milk
IDF symposium on udder defences and immunology

IDF PUBLICATIONS ON MASTITIS

In: Bulletin No. 338/1999 – Available on request.

MASTITIS NEWSLETTER N°22

GENERAL

- Report of the IDF Group of Experts on Mastitis – K.L. Smith, Chairman (USA)
  Erratum Mastitis Newsletter No. 21

RESEARCH COMMUNICATIONS

- Differential Somatic Cell Counts in Milk – A. Saran, G. Leitner & M. Chaffer (Israel)
- Effect of Undermilking and Overmilking on Teat Tissue Condition – E. O'Callaghan (Ireland), D. Gleeson (Ireland) & F. Neijenhuis (the Netherlands)
- Effect of Various Milking Machine Systems on Free Fatty Acid Development in Milk – B. O'Brien, E. O'Callaghan & P. Dillon (Ireland)
- The Use of Lacticin 3147 in Mastitis Control – M. Ryan, W.J. Meaney, C. Hill & P. Ross (Ireland)
- Decision-Making in Clinical Mastitis Therapy programmes – K. Leslie & G. Keefe (Canada)
- Vaccination Against Coliform Mastitis: A Historical Perspective – K.L. Smith & J. Hogan (USA)

MASTITIS NOTES FROM MEMBER COUNTRIES

Italy: *Staph. aureus*: A Problem for Italian Dairy Herds – A. Zecconi & R. Piccinini

New Zealand: Daily Somatic Cell Count Testing – R. Franks

Spain: Milk Quality in Spain – E. Cifrian, J.A. Garcia, P. y. Casado & J.C. Marco

Switzerland: Evolution of Somatic Cell Counts in Bulk Milk Samples: Switzerland 1983–1996 – M. Schällibaum

EVENTS & MEETINGS

Report of the Seminar "A half Centenary of Lactation Biology Research", University of Ghent, Belgium, 20–22 November 1996 (D. Hoeben)

The Future Use of Antibiotics in Mastitis Therapy: A Report from a Nordic Seminar in January 1997 (Ch. Hallén Sandgren)

US National Mastitis Council Annual Meeting – 1997 (K.L. Smith & A. Saeman)

Subclinical Bovine Mastitis – Prevention and Therapy. Conference of the German Veterinary Association, Grub/Munich, 27–28 September 1996 (J. Hamann)

IDF PUBLICATIONS ON MASTITIS

In: Bulletin No. 330/1998 – Reprints available free of charge subject to availability.

MASTITIS NEWSLETTER N°21

GENERAL

- Report of the IDF Group of Experts on Mastitis – K. L. Smith, Chairman (USA)
- Integrated Detection Systems for Antimicrobials in Milk: The IDF Approach – W.H. Heeschen (Germany)

RESEARCH COMMUNICATIONS

- Standards for Somatic Cells in Milk: Physiological and Regulatory* – K.L. Smith (USA)
- Somatic Cells: Factors of Influence and Practical Measures to Keep a Physiological Level* – J. Hamann (Germany)
- Somatic Cells and their Significance for Milk Processing (Technology) * – A. Zecconi (Italy)
- Milk Quality Payment: Quality Assurance (QA) in Somatic cell Counting* – M. Schällibaum (Switzerland)
- Mastitis: The Disease under Aspects of Milk Quality and Hygiene* – W.H. Heeschen (Germany)
- New Systems for Somatic Cell Counts – J. Reichmuth (Germany)

MASTITIS NOTES FROM MEMBER COUNTRIES

Finland: Mastitis Prevention has Succeeded in Finland – T. Honkanen-Buzalski & V. Myllys

Italy: Mastitis Control Programme and Breeders Association – A. Zecconi & M. Nocetti

Norway: Bulk Milk Somatic Cell Count in Goat Milk (A presentation according to new standard) – O. Østerås & T. Lunder

Sweden, Norway, Denmark & Finland: Antimicrobial Drug Policy in Four Nordic Countries – K. Plym Forshell, O. Østerås, K. Aagaard & L. Kulkas

Ireland: Antibiotic Resistance Testing of *Staphylococcus aureus* Isolateds from Cases of Bovine Mastitis in Ireland – W.J. Meaney & J. Flynn

Ireland and USA: Analysis of diversity of *Staphylococcus aureus* isolates from bovine mastitis using DNA restriction fragment length polymorphisms of rRNA genes – J.R. Fitzgerald, C.J. Smyth, P.J. Hartigan, W.J. Meaney & V. Kapur

Switzerland: Mastitis Pathogens in Switzerland 1988–1994 – M. Schällibaum

EVENTS & MEETINGS

British Mastitis Conference
US National Mastitis Council Annual Meeting – 1996

IDF PUBLICATIONS ON MASTITIS

* *Summaries of papers presented at the conference on the occasion of the meeting of Commission A during the IDF Annual Sessions in Vienna, September 1995.*

Ref. N°144 – Available on request – September 1996

MASTITIS NEWSLETTER N°20

GENERAL

- Report of the IDF Group of Experts on Mastitis – J.M. Booth (United Kingdom)
- Hygienic Requirements in International Trade and the Role of Codex Alimentarius and the International Dairy Federation – W.H. Heeschen (Germany)

RESEARCH COMMUNICATIONS

- Treatment of Mastitis with Homeopathic Remedies – W.J. Meaney (Ireland)
- Mastitis Cell Count Date – J.M. Booth (United Kingdom)
- Counting Somatic Cells in Milk: International IDF Standard 148:1991 Approved as a Final Standard (1994) – W.H. Heeschen & E.-H. Ubben (Germany)

- Counting Somatic Cells in Milk: Reference material ("Kiel Standards") – W.H. Heeschen & E.-H. Ubben (Germany)
- The Importance of Coagulase-Negatice Staphylococci – K.L. Smith & J.S. Hogan (USA)
- Somatic Cell Counts in Milk of Goats – B. Poutrel (France)

Mastitis Notes from Member Countries

Finland: The Bovine Udder and Mastitis – M. Sandhol, T Honkanen-Buzalski, L. Kaartinen & S. Pyörälä (Editors)

Germany: New German Guidelines for Mastitis Control – J. Hamann

Switzerland: Mastitis Pathogens 1988 – 1993 – M. Schällibaum

Events & Meetings

The 3rd International Mastitis Seminar

British Mastitis Conference

US National Mastitis Council Annual Meeting – 1995

Symposium "Udder Health" in the Netherlands

IDF Publications on Mastitis

Ref. N°142 – September 1995 – 500 BEF (12,39 euro)

MASTITIS NEWSLETTER N°19

Report of the IDF Group of Experts on Mastitis – J.M. Booth (United Kingdom)

Research Communications

- Counting somatic cells in milk: results of IDF intercomparison trials – W.H. Heeschen (Germany)
- Studies on inflammation in the bovine teat with regard to its role in the defence against udder infections – K. Persson (Sweden)
- Cubicle designs for dairy cattle – J. O'Connell & B. Meaney (Ireland)
- Retarded Excretion of antibiotics in milk after drying-off therapy – M. Schällibaum (Switzerland)

Mastitis Notes from Member Countries

Czechoslovakia: Standardization in somatic cell counting – D. Rysánek, V. Bábák & L. Slehoferová (Czech Republic)

Finland: The status of mastitis in the Nordic countries – S. Pyörälä & T. Honkanen-Buzalski (Finland)

Israel: The national program for the control of mastitis and the improvement in milk quality – A. Saran (Israel)

Italy: Eradication and control programs – A. Zecconi & G. Vicenzoni (Italy)

New Zealand: SAMM – A new mastitis control plan – M.W. Woolford (New Zealand)

Norway: Norwegian cow milk somatic cell count – O. Østerås (Norway)

Switzerland: Mastitis pathogens 1988–1992 – M. Schällibaum (Switzerland)

Events & Meetings

IDF Publications on Mastitis

Ref. N°140 – Available on request – August/Août 1994

MASTITIS NEWSLETTER N°18

- Annual report of the IDF Group of Experts on Mastitis (1992) (J.M. Booth, Chairman, UK)
- Mastitis cell count data (J.M. Booth, Chairman, UK)
- Somatic cells in milk – aspects of quality, hygiene & mastitis control (Prof. Dr W.H.Heeschen (Germany)
- Homeopathic treatment of bovine mastitis (J. Hamann, Germany)
- Cell count interpretation (D.P. Ryan, Australia)

Research Communications

- A strategy to increase resistance in dairy cows: expression of human lactoferrin in the milk of transgenic cows (J.H. Nuijens, M. Geerts, R. Strijker, F. Pieper & H.A. de Boer, the Netherlands)
- Systemic dry cow therapy – an update (Dr A. Saran, Dr G. Ziv & Dr S. Soback, Israel)

Mastitis Notes from Member Countries

Italy: The prevention of mastitis in Italy – G. Ruffo & A. Zecconi (Italy)

Switzerland: Mastitis pathogens in Switzerland, 1988–1991 – Prof. Dr M. Schällibaum

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Ref. N°134 – Available on request – April/Avril 1993

MASTITIS NEWSLETTER N°17

Antibiotics and sulfonamides in milk-risk evaluation of residues (Prof. W.H. Heeschen, Germany), Teat dipping before milking – summary of UK field trials (S.A. Langridge, UK), What future for conductivity? (A. Zecconi, Italy), Mastitis pathogens in Switzerland (M Schällibaum, Switzerland), Mastitis events, Mastitis publications.

Ref. N°128 – Available on request – June 1992

MASTITIS NEWSLETTER N°13

Questionnaire on national herd milk mastitis cell counts – Mastitis notes from member countries.

Ref. N°102 – March 1988

MILK – ENUMERATION OF SOMATIC CELLS

Standard/Norme 148A:1995 – 500 BEF (12,39 euro)

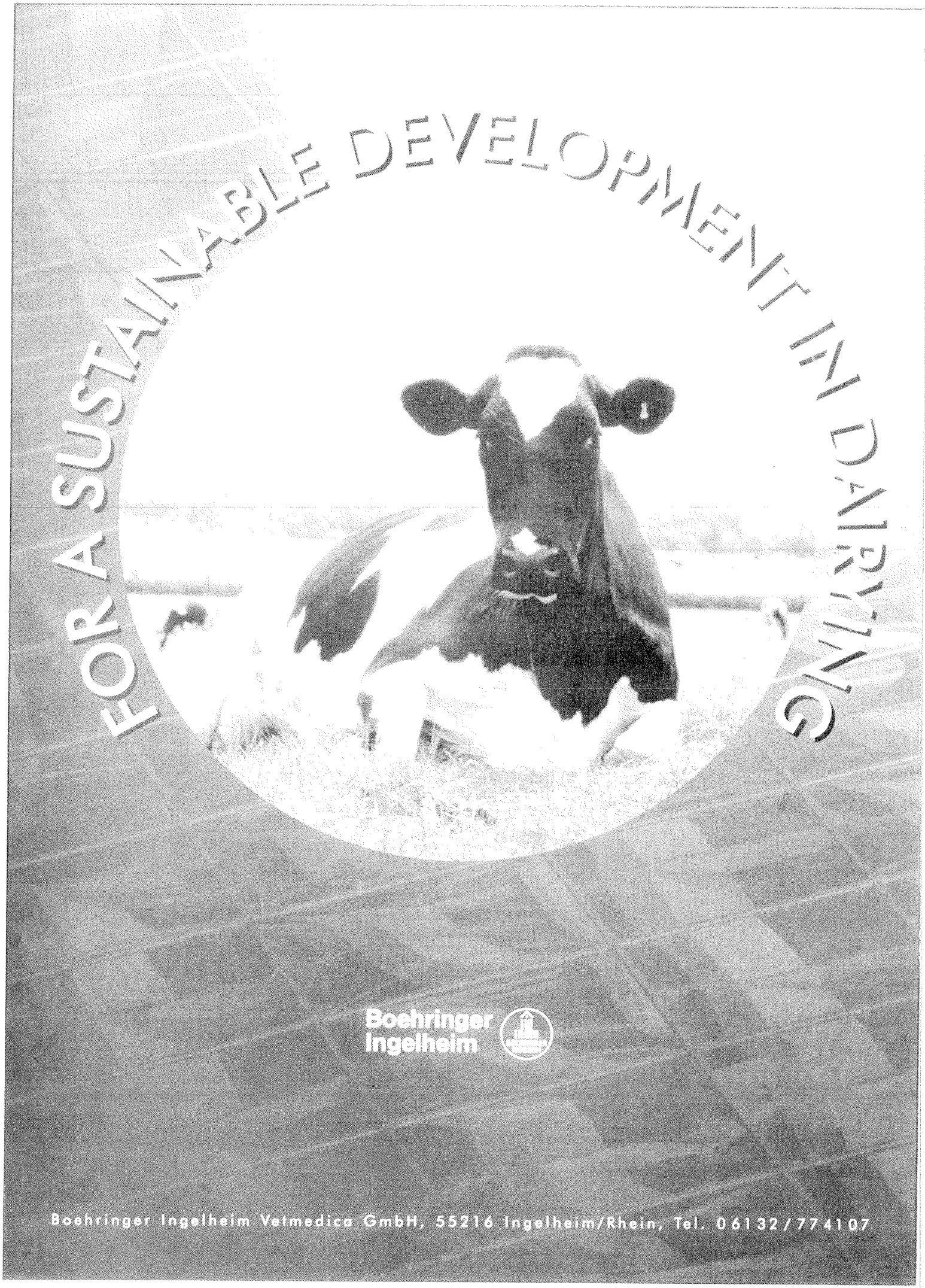
Mastitis Newsletter No. 24

IDF Publications on Mastitis

53 pp - English only

Index: animal health, automatic milking, mastitis, somatic cell count, udder health

Bulletin N°367/2001– 40 Euro (1614 BEF)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