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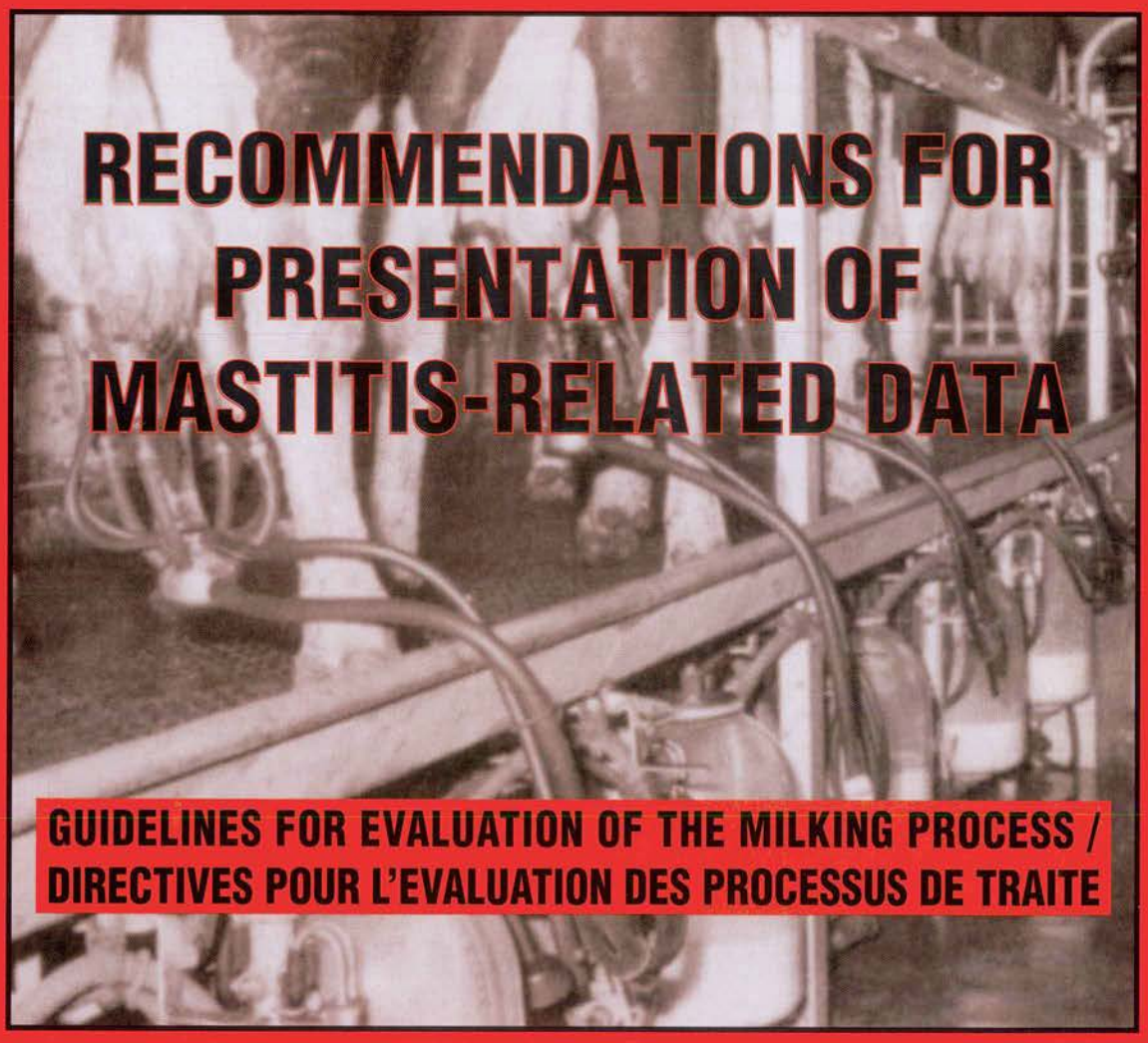

RECOMMENDATIONS FOR PRESENTATION OF MASTITIS-RELATED DATA

GUIDELINES FOR EVALUATION OF THE MILKING PROCESS / DIRECTIVES POUR L'EVALUATION DES PROCESSUS DE TRAITE

ISSN 0250-5118

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IDFnews

ANALYTICAL WEEK

LISBON, PORTUGAL
APRIL 1997

SUMMARY OF MEETINGS OF GROUPS OF EXPERTS

The 1997 Analytical Week was organized jointly by IDF, ISO and AOAC International. The "week" was attended by 125 participants from 21 IDF member countries.

The following groups of experts met and discussed the issues listed.

GROUP A7 – PRODUCTION AND UTILIZATION OF EWE'S AND GOAT'S MILK

Chairman: G. Kalantzopoulos (GR)

The group dicsussed IDF's relations with other international bodies active in the field of ewe's and goat's milk in view of seeking cooperation to maximize the scarce resources and expertise available.

The bodies in question are as follow:

CIRVAL – the international resource centre established after a proposal made at the IDF Seminar in Athens in 1985, in Corsica. IDF is represented on the scientific consultative committee of CIRVAL.

CIHEAM – international centre for higher education in agriculture in The Mediterranean region. The main function is organizing courses.

FAO – Food and Agriculture Organization of the UN. FAO is involved with both CIHEAM and CIRVAL.

Also, liaison with other IDF groups.

GROUP A19 – SPORES IN RAW MILK

Chairman: A. Christiansson (SE)

Two forthcoming monographs – 'Highly heat resistant mesophilic sporeformers' and 'Detection and enumeration of sporeformers by non-traditional methods' – were discussed.

GROUP A30 – MICROBIOLOGICAL QUALITY AND SAFETY OF RAW MILK AND RAW MILK PRODUCTS

Chairman: G. Hahn (DE)

Update of the monograph 'Methods for assessing the bacteriological quality of raw milk'. Integration of a checklist for clean milk production into a more general HACCP-system.

GROUP B12 – THE USE OF ENZYME PREPARATIONS IN CHEESE MANUFACTURE

Chairman: G. van den Berg (NL)

Nisin in cheesemaking and proteolytic enzymes in cheese manufacture. A conference on Enzymes in dairying has been organized by the Group for the IDF Annual Sessions in Iceland this year.

GROUP B52 – FACTORS AFFECTING THE YIELD OF CHEESE

Chairman: D.B. Emmons (CA)

Presentations were made on new developments in cheese yield.

GROUP E102 – PATHOGENIC CONTAMINANTS

Chairman: to be appointed

Standards for the detection and enumeration of Gram-positive pathogens – *E. coli*, coliforms, *Listeria monocytogenes*, *Bacillus cereus*, coagulase-positive staphylococci, staphylococcal thermonuclease.

GROUP E104 – LACTIC ACID BACTERIA AND STARTERS

Chairman: R. Negri (IT)

Discussion of work on bifidobacteria and *L. acidophilus*.

GROUP E201 – STATISTICS OF ANALYTICAL DATA

Chairman: H. Glaeser (CEU)

A guideline for daily quality control, software for treatment of analytical data and quality assessment in sensory evaluations were discussed.

GROUP E203 – QUALITY ASSURANCE AND PROFICIENCY TESTING

Chairman: R.L. Bradley (US)

Proficiency testing in laboratories was discussed along with a draft document on the organization and operation of an international dairy reference laboratory network to establish an international quality assurance system for routine dairy laboratories in all sectors.

GROUP E301 – FAT

Chairman: to be appointed

Standards relating to the analysis of fats and fat compounds in milk and milk products. Fat determination by Röse-Gottlieb Provisional Standards 1D, 9C, 13C, 16C, 22B, 59A, 116A, 123A will be harmonized with ISO.

GROUP E302 – PROTEIN

Chairman: D.M. Barbano (US)

Nitrogen content by Kjeldahl and the Dumas method.

GROUP E303 – INFRA-RED AND OTHER INDIRECT AUTOMATED METHODS

Chairman: G. Johnsson (SE)

Revision of standards and possible use of infrared methods for screening purposes.

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GROUP E401 – LACTOSE, LACTULOSE AND LACTATE DETERMINATION

Chairman: L. Szijarto (CA)

Reference methods for lactose determination.

GROUP E403 – ENZYMES IN CHEESEMAKING

Chairman: A. Andrén (SE)

A revised version of the provisional IDF Standard 157:1992 – Bovine rennets: Determination of total milk-clotting activity – was proposed. An IDF Standard for the total milk-clotting activity of lamb, kid, sheep and goat rennets proposed as a new work item.

GROUP E501 – ORGANIC CONTAMINANTS

Chairman: M. Cerny (CH)

The following topics were discussed in detail – General performance criteria for the use of ELISA test kits for the definition of AFM1; Replacement of chloroform in IDF Standard 171:1995; Development of a determination step using one-dimensional TLC as an extension of IDF Standard 171:1995; ISO Final Draft 14501; Review of Standards 75C and 130A.

GROUP E502 – SELECTED FOOD ADDITIVES AND VITAMINS

Chairman: to be appointed

Proposal made to prioritize revisions of existing IDF standards on additives such as benzoic and sorbic acids, natamycin, and anti-oxidants.

GROUP E503 – ANTIBIOTICS

Chairman: G. Suhren (DE)

Guidance for the evaluation of microbial inhibitor tests and preliminary confirmation tests.

GROUP E601 – WATER

Chairman: to be appointed

Provisional Standard A4:1982 dealing with moisture in cheese is to be redrafted, based on the results of Questionnaire 597/E and experimental work done in Canada, USA and the Netherlands. The aim is to obtain a more robust method. Topics to consider will be: amount of sand, pre-drying, blanks and specifications and quality of stoves.

The two main manufacturers of freezing point instruments have agreed to harmonize critical parts. Comparability of results will be checked and results incorporated in a new draft standard. Moisture, solids-non-fat and fat in butter – Results of tests carried out in the Netherlands and by an EU-working group will be used to draft three new standards which will replace Standard 80:1977.

GROUP E602 – MINERALS AND MINOR COMPOUNDS

Chairman: G. Bråthen (NO)

Consolidated standard for nitrate and nitrite in milk and milk products and determination of the salt (chloride) content in butter.

GROUP E603 – ELEMENTS IN MILK AND MILK PRODUCTS

Chairman: M. Carl (DE)

Draft standard for the determination of Na, K, Ca, Mg. The method (three procedures of sample mineralization and measuring by flame-AAS) will be tested in a preliminary collaborative study on caseins, with powder and cheese in the autumn of 1997. A new draft method for aluminium by graphite furnace AAS was presented and will be collaboratively studied early next year. In view of avoiding ozone depleting substances it was decided to withdraw IDF Standard 133A:1992 and to revise Standard 76A:1980 editorially. A new standard for the determination of Pb in milk and milk products will be developed, based on graphite furnace AAS.

GROUP F32 – INDICES OF CHEESE MATURATION

Chairman: Y. Ardö (SE)

The group continued the work on reviewing chemical methods for evaluating proteolysis in cheese during ripening.

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SCHEDULE OF FUTURE IDF EVENTS*

1997		
25 Aug.	Nutrimarketing Consultation (by invitation) (Com C & F)	Reykjavik (IS)
26–31 Aug.	81st Annual Sessions including conferences on – Risk analysis (chemical and microbiological) (Coms A & D) – Enzyme preparations in dairy processing (Com B) – International trade in dairy products Com C)	Reykjavik (IS)
17–19 Sept.	Ice Cream Symposium	Athens (GR)
3–4 Nov.	Symposium on Codex Procedures and Importance (Com D)	Chicago (US)
4–6 Dec.	Workshop on Small scale processing of milk and local dairy products (Com B)	Anand (IN)
11 Dec.	IDF and Emerging dairy markets & economies in South-east Asia	Bangkok (TH)
1998		
early 1998	Legislation Week (PC/D)	undetermined
9–11 March	Nutrition Week & Symposium on Dairy Foods in Health (PC/F)	Wellington (NZ)
1–3 April	Fouling and cleaning of heat treatment equipment	Cambridge (GB)
19–24 April	Analytical Week (PC/E) and Symposium on Food-borne Pathogens – Detection and Typing (organized under ISO auspices with IDF and AOAC International)	The Hague (NL)
18–19 Sept.	Future of dairy education Seminar (Coms F & B)	Dalum (DK)
21–23 Sept.	25th International Dairy Congress	Aarhus (DK)
24–26 Sept.	82nd Annual Sessions	Aarhus (DK)
1999		
Late 1999	Nutrition Week (PC/F)	undetermined
Candidate events		
May 1998	Seminar or Symposium (topic still to be defined) (PC/D)	Montevideo (UY)
May 1999	Membrane processing in the dairy industry	Rennes (FR)
1998 or 1999	Third Cheese Ripening Symposium	France

** Further details of these events can be obtained from the IDF General Secretariat.*

RECOMMENDATIONS FOR PRESENTATION OF MASTITIS-RELATED DATA

FOREWORD

The recommendations for presentation of mastitis-related data contained in this issue of the Bulletin were formulated by a sub-group of experts under the auspices of IDF Group of Experts A2 – Bovine Mastitis. The IDF is most grateful to the group and especially to the authors for their valuable work.

The current membership of the group is as follows:

K.L. Smith (US) Chairman, A. Saran (IL) Deputy Chairman, K. Plym Forshell (SE) Technical Secretary, W. Baumgartner (AT), D. Ryan (AU), Ch. Burvenich (BE), K. Leslie (CA), J. Hamann (DE), J. Reichmuth (DE), K. Aagaard (DK), P. Schmidt Madsen (DK), M. Schällibaum (CH), P. Casado (ES), M. Cifrian (ES), H. Saloniemi (FI), B. Poutrel (FR), J.E. Hillerton (GB), W. Meaney (IE), R. S. Singh (IN), A. Zecconi (IT), T. Kazama (JP), U. Vecht (NL), O. Østeras (NO), M. Woolford (NZ), I.-M. Petzer (ZA).

Invited member: G. Kalantzopoulos (GR) (for Group A7).

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IDF General Secretariat
June 1997

PREFACE

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 subgroup 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. The following document is the result of the subgroup's deliberations. The subgroup has included a section on presentation of clinical mastitis data 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. Group A2 hopes the document will be a useful reference for those publishing data involving somatic cell counts and/or incidence of clinical mastitis cases, and that the document will help bring clarity to an area in need of clarity.

K. Larry Smith,
Chairman - Group A2

RECOMMENDATIONS FOR PRESENTATION OF MASTITIS-RELATED DATA

CONDENSED VERSION

The following is a short introduction to the IDF document "Recommendations for Presentation of Mastitis-Related Data". The document presents some important considerations for international standardization of mastitis-related data and is presented for those not interested in detail. However, reading the entire IDF document will provide deeper insight into the recommended calculations and methods for presentation of mastitis-related data.

1 BACKGROUND

Milk somatic cell counts are used as a criterion of milk quality in dairy industries around the world. Individual cow somatic cell counts, as well as herd bulk milk somatic cell counts are also used in dairy research and advisory services as a complement to bacteriological findings in deciding the mastitis status in dairy herds.

For several years IDF has collected data on cell counts and mastitis status from the member countries. This information is published regularly in IDF bulletins and previously in the Mastitis Newsletter.

The principles used to analyse somatic cell counts are fairly uniform throughout the world. However, there is large variation in the methods for summarizing and presenting the cell count data. These discrepancies complicate comparisons of milk quality and mastitis data between dairy industries and make difficult the evaluation of research reports from different parts of the world.

In order to facilitate comparisons, a group of experts have developed a document with recommendations for presentation of mastitis-related data. This paper is a summary excerpt from the document. However, to understand the need for the suggested type of uniform methods for calculating and presenting mastitis-related data, the whole document should be carefully read.

2 SOMATIC CELL COUNT (SCC)

A simple arithmetic average of bulk milk SCC (BMSCC) from herds almost always has a very skewed distribution (Figure 1, page 12). The overall arithmetic mean, the arithmetic mean of the herds' geometric mean, the median, and the overall geometric mean are indicated in Figure 1. There is an obvious discrepancy between the arithmetic mean and the most common BMSCC.

Figure 2 (page 12) presents the same data as in Figure 1 after log transformation, and the distribution now approaches normality. This makes statistical calculation and evaluation of the data easier and more valid. In addition, a logarithmic scaling of somatic cell count shows linearity and correlates better than other methods to several important variables relevant to udder health.

Six different ways to combine BMSCC are presented in Table 1 (page 11) and the variation in the final result is apparent. A description of the mathematical process used is necessary in order to make relevant comparisons possible when presenting SCC data. The number of samples per month should also be given, since sampling routines vary among countries.

The following methods are recommended in order to facilitate relevant comparisons of different SCC data.

Presentations of herd BMSCC from countries or regions should be made as a true geometric mean, that is, a geometric mean of all herds' geometric means. The data should be presented as in Tables 2–4 (pages 12 and 13), using geometric means with confidence intervals, percentiles or within ranges of fixed values. The weighted arithmetic mean (weighted by milk yield at sampling day) could also be presented. Using the geometric mean for all calculations avoids herd size effects and minimizes the impact on herd BMSCC of a high SCC from a single cow in the herd.

The presentation of cow milk somatic cell count (CMSCC) and quarter milk somatic cell count (QMSCC) should follow the same principles as described above.

3 CLINICAL MASTITIS

The recording of clinical diseases, such as mastitis, is now done in many countries. Different recording principles may result in a great deal of confusion in the evaluation of animal health status among countries. Incidence rates in a population will vary depending on the principles used for the definition of a clinical case in the numerator, as well as the definition of the denominator. The results from using different numerators and denominators are presented in Table 11 (page 16). Table 11 clearly demonstrates the need for a common recommendation on calculation of clinical mastitis incidence rates if comparison among data sets is to be possible.

The incidence rate of clinical mastitis is greatly affected by stage of lactation. Thus, the distribution of cows over stage of lactation will have a significant impact on the incidence rate in the population. The number of cases of clinical mastitis per day at risk by stage of lactation is presented in Table 13 (page 19).

The fact that the incidence rate is 10–15 times greater during the first 5 days of lactation than in mid-lactation emphasizes the need to use days at risk in the presentation of clinical mastitis data. Thus, the

definition and nomenclature of a clinical case of mastitis must be very clear. The full document contains suggestions on definitions and nomenclature of clinical mastitis. Importantly, numerators and denominators used in calculation of incidence rates must be clearly defined.

An incidence rate is defined as a number of events divided by a reference population with a time factor included. The time factor is essential in order to make incidences comparable between populations, herds, cows, and studies with differing lengths of time when the events could possibly occur. An "event" of mastitis, in this context, should be either (a) cows with clinical mastitis; or (b) cases of clinical mastitis.

(a) Calculating incidences based on cows with clinical mastitis is straightforward, because each cow can only be calculated once during a recording period. The problem with using this method is that the cow-days after the first recorded case should not be included in the days at risk. The more frequent a disease, the greater the need to correct the denominator.

(b) Calculating incidences based on cases of mastitis will give the true incidence in the whole population of cows. A major problem using cases of mastitis as events is that the number of days from one event to another needs to be defined. The decision on lag time between cases should be made using principles of economics and milk quality. The length of the lag period, defined as the time between the onset of clinical signs/treatment and the onset of further clinical signs in the same quarter, is suggested to be 8 days and is strictly for use in estimating incidences of mastitis.

The unit of time may be days, months, or years at risk. The key words here are "at risk", since days when the cow is not at risk of getting mastitis must not be included in the denominator.

In conclusion, recommendations are that incidences of clinical mastitis should be reported as an incidence rate of cases (or alternatively cows) per time interval, for example cow-year at risk. Both rates should be accompanied by additional information on number of cases per treated cow.

4 GENERAL CONCLUSION

The variety of methods used for analysis of mastitis-related data can lead to confusing presentations of the data and complicate comparisons at the national and international level. Consequently, there is need for standardization of the methods for presentation of such data.

The authors recommend an international standardization of the presentation of cell count data and incidences of clinical mastitis as follows.

- The presentation of herd BMSCC, CMSCC, and QMSCC from countries or regions should be made as a true geometric mean, that is, a geometric mean of all herds' geometric means.
- The geometric means should be presented as confidence intervals, percentiles, or within ranges of fixed values.
- Incidences of clinical mastitis should be reported as an incidence rate of cases and/or cows per day, per month, or per cow-year at risk.

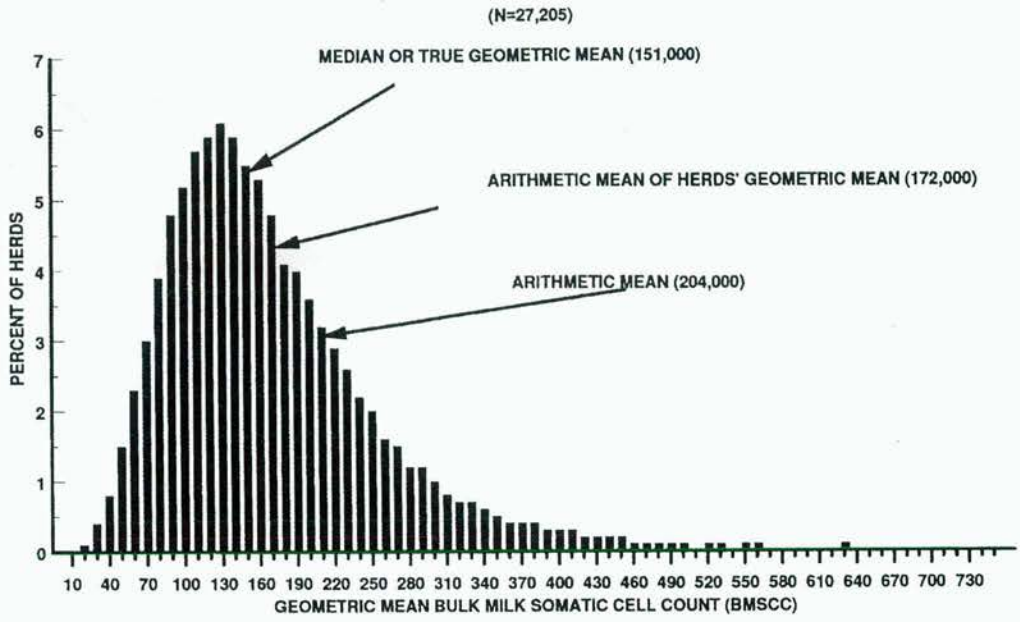

Figure 1: Distribution of herd geometric mean BMSCC for Norwegian herds in 1992. Numbers after the means refer to Table 2.

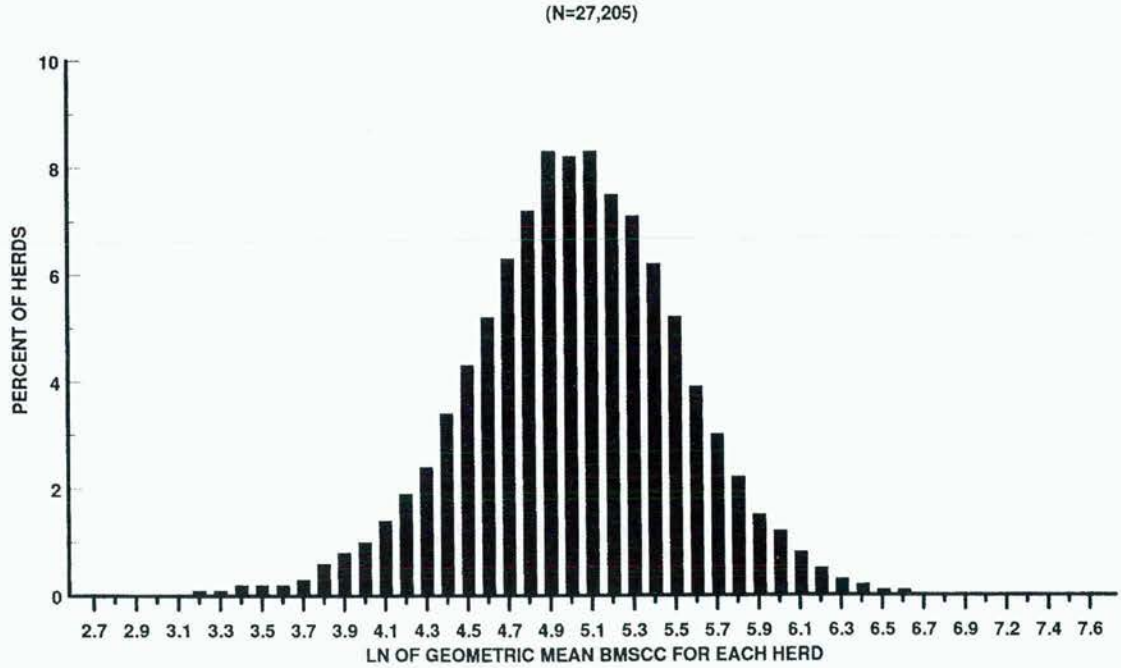

Figure 2: Distribution of ln of the herds geometric mean. Same data as in Figure 1.

Table 2: Distribution of Norwegian dairy herds' geometric mean BMSCCs (1000 SCC ml^{-1}) for the years 1992, 1993, and 1994

Variable	Value		
	1992	1993	1994
Number of herds	27 199	26 474	26 005
Mean ln of BMSCC	5.02	4.96	4.91
Std of ln BMSCC	0.51	0.52	0.51
Lower confid. interval	54	51	49
Exp. of ln BMSCC (geom. mean)	151	143	136
Upper confid. interval	420	403	379

an interpretable number. Instead, a confidence interval may be calculated on the logtransformed scale. The border values of this confidence interval can be transformed back to the original scale, and result in an intelligent interpretation.

As most pocket calculators and PC software packages use ln and e^x, the log-base with *e* would be easiest to use, and as good as base 2 according to Shook [1].

As an exception, an arithmetic mean, weighted by the amount of milk produced, might be appropriate for milk quality purposes, since the arithmetic mean would depict the quality of milk in a "would be" composite sample made up of all individual samples.

1.1.2 Horizontal and vertical calculation in subsets of SCC data

Subsets of data could be calculated over a time interval for each unit (such as the lactation mean SCC mean for each cow) as a horizontal calculation; or within specified units for each time of sampling (such as the SCC means for herds BMSCC during 1 month) as vertical calculation.

One should be very careful when mixing subsets in presentations of SCC data, where calculations are made on the basis of different subsets (time or population interval). If there is a mixture of simple arithmetic means and geometric means (using logtransformed data with base 2, *e* or 10), the results are no longer true log means, and due to the skewed distribution of data, averages will be too far to the right. **However, as long as the same log-scale (with any base) is used in all subcalculations, the final result will be correct.** If such subsets are presented and used in calculations, the subset unit should be very carefully presented.

1.2 HERD BULK MILK SOMATIC CELL COUNT (BMSCC)

BMSCC is usually analysed for quality payment schemes within regional milk marketing orders and for regulatory purposes. BMSCC is used both for payment schemes and for mastitis control. The frequency of sampling must be clarified when presenting BMSCC data. The number of samplings are important when presenting standard deviation (std), as many samples would give a smaller std. The frequency of BMSCC analysis varies from country to country, from once per month to four times per month [14].

The problem with skew distribution is also present for BMSCC. Skew distribution is more pronounced in countries with small herd sizes than in countries with large herds. In small herds, BMSCC reflects more of the problems with CMSCC.

1.2.1 Presentation of BMSCC results

The distribution of BMSCC could be presented in different ways, such as: raw figures, monthly figures, or as a distribution of herds (herd mean during a year). If monthly figures or herd average figures are presented in a distribution table, these means should always be a geometric mean illustrating the distribution of the data. If the data are being used to illustrate the total milk quality in a country, the weighted arithmetic mean should be presented to illustrate the SCC expected if all the milk from a region or a country is put together in one single tank. This weighting of means, according to milk yield, accounts for the more uneven distribution among small herds than among the large herds, and also minimizes effects of herds that produced violative BMSCC levels and were prevented from selling milk after a few months. Various calculations of BMSCC data are illustrated in Table 1.

Table 1 clearly shows that the mean for BMSCC in Norway for 1991 could vary from 157 to 204, depending upon the calculation technique chosen. In Sweden, the same figures could be any number from 198 to 258. The Table illustrates the effect of using different means, as well as the discrepancies that could arise, if figures are put together from different countries using different methods of calculation. The skew distribution of BMSCC is illustrated with data from Norway in Tables 2–4, and Figures 1 and 2. The recommended procedures to present BMSCC (that is, geometric means with confidence intervals, percentiles, and fixed ranges) are also shown in these Tables.

Table 1: Bulk milk somatic cell count (BMSCC) in Norway and Sweden in 1991 (1000 SCC ml^{-1}) (The recommended method of data calculation is indicated in bold type)

Calculation method	Norway	Sweden
1. Arithmetic mean of all samples (arithmetic sum of all analysed results divided by number of samples analysed)	204	258
2. Arithmetic mean, weighted by milk delivered to the dairy (as 1, but the analysed values are weighted by the milk delivered at sampling)	194	249
3. Arithmetic mean of all herds' geometric mean	179	233
4. Geometric mean of all herds geometric means	**157**	**198**
5. Median of all herds' geometric means	158	n.a.
6. Arithmetic mean of all herds' geometric means weighted by the amount of milk delivered to the dairy from each farm	172	n.a.

n.a. = Not available.

RECOMMENDATIONS FOR PRESENTATION OF MASTITIS-RELATED DATA

PART 1: SOMATIC CELL COUNT

ABSTRACT

Somatic cell count (SCC) data are obtained from routine examination of a huge number of milk samples. These SCC results are obtained from individual quarter samples (mostly in research), individual cow samples (as part of an animal recording scheme) or herd bulk milk (as a measurement of milk quality). SCC is one of several markers of inflammation used and as such does not indicate infection, only inflammation. SCC is currently the most frequently used indicator of inflammation throughout the world. At all three levels (quarter, cow and herd) the data should be presented following the same principles.

The IDF makes the following recommendations regarding presentation of SOMATIC CELL COUNT (SCC) data:

For calculation of **means and distributions:**

- Geometric mean or mean of natural logarithm (ln or *e*) of SCC with standard deviation (std)
- Mean and confidence interval of logarithmic transformed SCC data converted back to natural figures
- Percentage of data below fixed figures based on appropriate decimal deviation (20, 30, 40, ...,100, 200, 300...., 1000, 2000, 3000, etc.)
- The limit for data within 10%, 20%, 30%, etc., of the figures (percentiles)

For calculation of SCC **in a batch of composite milk:**

- Weighted (by milk yield for the unit analysed) arithmetic means

1.1 DISTRIBUTION OF SCC DATA

SCC data have a distribution which is skewed to the right [1]; see also Figure 1. Previous research has shown that SCC data tend to follow a lognormal distribution [1, 3–5]. In other words, the logtransformed data are normally distributed (see also Figure 2). Ali & Shook [6] have shown that log transformation is the best of all power transformations in achieving a normal distribution for SCC data. From a statistical point of view, the normal distribution is very convenient and a large number of descriptive or testing procedures assume that the data have a normal distribution.

Additionally, a logarithmic scaling of SCC shows linearity or better correlation than other methods to several important variables relevant to udder health. In other words, all types of logtransformed numbers of SCC have better correlation than raw SCC numbers to several other variables of importance for farmers. These variables include milk yield loss [7, 8], casein percentage [9], prediction of probability of positive bacterial culture results for cows in late lactation [1, 10], repeatability and heritability [11] and the prediction of BMSCC [10, 12, 13].

The problem of a few extremely right skewed-distributed quarter SCC values are biggest in small unit farms. This skew distribution is balanced by dilution from the three other quarters on CMSCC. A few cows with high CMSCC would be balanced out in BMSCC on large herds. In smaller herds, however, such high CMSCC could cause a tremendous increase in BMSCC. Likewise, one very high CMSCC at one sampling during a lactation could have tremendous effect on lactation average CMSCC. This effect would be evened out if more counts were averaged, and evened out more by using the geometric mean as an average.

1.1.1 Describing SCC data

To describe data that have a lognormal distribution, two methods are recommended.

First, the data can be described without prior transformation. In such cases, the median is a good measurement of the centre of distribution (that is, 50% of all samples are at this value or lower). Additionally, percentiles of the distribution will give an idea about the degree of skewness in the data. Alternatively, fixed cell count values may be used to define classes, and the percentage of observations within each class reported. IDF recommends the use of limits based on decimal units. These units could be broken down for every 10 units up to 100, every 100 up to 1000 and every 1000 for data > 1000. The table should start at the first class covering < 2.5%, and stop at the first class covering > 97.5% of the samples.

The second method is to transform the raw SCC data using a logarithmic transformation as described by Shook [1]. Logarithms to base 2, *e* (~ 2.71828) or 10 can be used. The mean and the standard deviation of the logtransformed data give an almost complete description of the distribution. The mean of a logtransformed SCC distribution can be transformed back to the original scale, resulting in a geometric mean. The geometric mean is easily interpreted and corresponds well to the median [6]. The standard deviation cannot, however, be transformed to the original scale to obtain

RECOMMENDATIONS FOR PRESENTATION OF MASTITIS-RELATED DATA

INTRODUCTION

High standards in hygienic milk production demand production of milk from healthy animals. For quality milk production, good udder health should be emphasized. The expression "good udder health" generally implies a low somatic cell count (SCC), and a low incidence of clinical mastitis. There is need for a standard method for calculation and presentation of SCC data and incidence of clinical mastitis. Standardized methods would make comparisons and interpretations easier.

Milk somatic cells are a product of inflammation and are one of the most widely used criteria for indicating udder health and milk quality. Milk SCC are used to monitor individual cows, herds, and national milk supplies. With increasingly more "open" trade markets and with exchange of animals and dairy products across countries, there is a growing interest in comparing SCC among countries and within regions of countries. For these reasons, the International Dairy Federation (IDF) publishes an annual overview of cell count data from different countries through its Group A2.

However, SCC can be measured in many different ways and summarized using many different statistical methods. These differences can lead to confusing results with divergent SCC summary values, as illustrated later in this document. Some of these problems were previously discussed by Shook [1] and Booth [2].

The need for standardized calculations is also obvious for statistical reasons. Much of the udder health and milk quality data have lognormal distribution (somatic cell count), Poisson distribution (clinical mastitis data) or binomial distribution (subclinical mastitis data). Many statistical methods require normally distributed data. Thus, formulating recommendations with respect to the appropriate methods for analysis and presentation of such data are important.

Although SCC has become the most common objective criterion for evaluation of subclinical udder inflammation, the severity of clinical mastitis is somewhat subjective. There is general agreement about the abnormalities that represent a clinical case of mastitis, and recommendations for recording, analysis, and presentation of clinical mastitis data are important and need to be developed. This would facilitate comparisons of these data among regions, and also serve as guidelines for countries or regions designing clinical mastitis recording schemes.

Standard recommendations for the presentation of results (tables and figures) are important for future research on antibiotic treatment of mastitis, vaccines, and other types of therapy. Standardization would make possible comparison of results from different studies. Some different methods for calculating clinical data from cases of mastitis are presented in this document. The intent is to promote the use of uniform methods for recording of clinical mastitis data, as well as for the calculation of rates.

The aim of this document is to define how to summarize, but not to interpret, udder health data, and more specifically to:

(1) standardize the **terminology** used for presentations of udder health data
(2) recommend methods for **calculating** indices of udder health
(3) recommend standard methods for the **presentation** of udder health data reported in publications.

The IDF encourages uniform methods for calculation in different countries, and a standard recommended period of 5 years for using parallel methods. At the end of such a period comparable figures would hopefully be available all over the world. A task for future research is to improve the guidelines, and adjust them to international sustainable epidemiological methods.

Definitions of terms and abbreviations used in this document are found in Appendices I–III.

Number of SCC is presented as 1000 cells ml^{-1} throughout this document.

Table 3: Upper limit values (BMSCCs in 1000 ml^{-1}) for each percentile for the years 1992, 1993, and 1994

Percentiles	BMSCC in 1000 ml^{-1} 1992	1993	1994
10	80	74	71
20	101	94	90
30	117	110	107
40	133	125	122
50	149	141	138
60	167	160	156
70	189	181	177
80	217	208	205
90	264	254	254

Table 4: Cumulative frequency distribution of herds according to their geometric mean BMSCC (1000 SCC ml^{-1})

BMSCC upper range	% 1992	1993	1994
40		1.1	1.6
50	1.8	2.5	3.4
60	3.5	4.8	6.2
70	6.0	8.0	9.9
80	9.6	12.4	14.6
90	14.0	17.4	20.0
100	19.5	23.2	25.9
200	74.0	77.3	78.4
300	94.0	94.7	94.6
400	98.5	98.7	98.5
Number of herds	27 199	26 474	26 005

The distribution of decimal range is stopped at the figure having less than 2.5% and more than 97.5% of the data (50 in 1992 and 40 in 1993 and 1994).

1.2.2 Using BMSCC in quality payment systems

The problem with skewed distribution is also important when BMSCC is used in quality payment schemes. This is most important in countries with small herds, as a single or a few cows could have a marked effect on the BMSCC. The effect is seen as a sudden rise without any clinical signs or long-term detrimental effect on milk quality for the period of payment (month). One way to compensate for such herd size effects is to use geometric averages for all calculations. Geometric averaging should also be used for samples taken within a month, in order to compensate for the variable effects of individual CMSCCs in small herds. As an example, the EU uses the geometric mean of samples analysed over a 3-month period of time.

1.3 COW MILK SOMATIC CELL COUNT (CMSCC)

CMSCC is commonly used in several countries as either an optional or a routine component of the milk production recording scheme. Thus, CMSCC is measured and computerized every month or every second month for a huge number of cows throughout the world. These data are used in quality assurance programmes, as an estimate of the inflammatory status of individual cows, and for progeny testing of bulls.

The problems relating to presentation of CMSCC data are the same as for QMSCC data. To some extent, CMSCC is a dilution of milk from the four quarters and the problems, therefore, are somewhat less severe. A simple presentation of mean values of single CMSCC ranges could well summarize the general trends of an individual cow's udder health over time. However, the use of a single CMSCC should be avoided when describing the general udder health status for an individual cow for some decision-making process such as culling.

1.3.1 Describing regional distributions of CMSCC

Summaries of CMSCCs at the herd, regional, or national level should be made bearing in mind the problems with skew or lognormal distributed data mentioned above. Calculations of means and variation should always be performed on logarithmically transformed CMSCC. Alternatively, distribution tables with fixed ranges should be used.

The skewed distribution of CMSCC is illustrated by data from Norway in Tables 5–7. The arithmetic mean of CMSCC is very much influenced by the right-hand tail; the arithmetic mean is 209, the weighted arithmetic mean 204, the geometric mean 84, and the median is 80 for the year 1992. The higher simple arithmetic mean compared to the weighted arithmetic mean (209 versus 204) illustrates a higher SCC in cows with low daily milk yield.

Table 5: Means and distribution of single CMSCC (1000 SCC ml^{-1}). The data analysed were from randomly selected Norwegian herds in the years 1991, 1992, and 1993 (data from Østeras [17])

Variable	Value 1991	1992	1993
Number of samples	137 697	135 754	133 736
Number of cows	39 147	39 114	38 420
Number of herds	2 305	2 298	2 265
Weight arithm. mean	208	204	192
Mean ln of CMSCC	4.45	4.43	4.36
Std of ln CMSCC	1.27	1.27	1.30
Lower confid. interval	7	7	6
Exp. of ln CMSCC	86	84	78
Upper confid. interval	1090	1064	1042

Table 6: Upper limit values (CMSCCs in 1000 ml^{-1}) for each percentile for the years 1991, 1992, and 1993

Percentiles	CMSCC in 1000 ml^{-1} 1992	1993	1994
10	20	20	20
20	30	30	20
30	40	40	30
40	60	50	50
50	80	80	70
60	110	110	100
70	160	160	150
80	250	250	240
90	480	470	450

Table 7: Cumulative distribution of single CMSCC (1000 SCC ml^{-1}). The data are for the years 1991, 1992, and 1993 and given as fixed interval figures at decimal limits. The data are the same as those in Tables 5 and 6

CMSCC upper limit	Percentage of samples 1991	1992	1993
20	7.2	7.0	9.5
30	17.5	17.9	21.1
40	26.3	27.5	30.0
50	33.9	35.0	37.1
60	40.0	41.0	42.8
70	45.1	45.8	47.4
80	49.4	50.0	51.5
90	53.0	53.6	55.0
100	56.3	56.8	58.0
200	75.7	74.9	76.0
300	83.4	83.1	83.8
400	87.8	87.7	88.3
500	90.6	90.6	91.1
600	92.5	92.5	92.9
700	93.8	93.9	94.3
800	94.8	94.9	95.3
900	95.6	95.7	96.0
1000	96.2	96.3	96.6
2000	98.8	98.8	99.0
Number of samples	137 697	135 754	133 736

Producers and advisors may want to use the recorded CMSCC data to estimate BMSCC. Calculating the arithmetic mean of CMSCC weighted by milk yield, using test-day CMSCC from all milking cows in the herd, could provide an estimate of an expected BMSCC. However, Danish researchers have shown that the weighted mean will not correctly estimate the BMSCC if one or more cows has a CMSCC above 1000. This is due to measuring errors at high CMSCC values [15]. The complex relationship between CMSCC and herd composite somatic cell counts is further emphasized by Fetrow et al. [16].

1.3.2 Status of the individual cow based on CMSCC

The CMSCC for a cow should be presented in a way that says something about the udder health status, and the quality of milk produced from that particular cow. However, a single CMSCC has a high degree of variation because QMSCC, and therefore also CMSCC, can change very quickly from a low value to a high value and vice versa. The work of Mattila [18], Brolund [10] and Persson [19] clearly indicates that a single CMSCC is not suitable for characterizing the udder health status of a cow. On the other hand, the SCC in healthy quarters and healthy cows is very stable. The CMSCC status of the individual cow should be based on repeated sampling over at least 1 month with an interval of 10 days between samples.

1.3.3 Prevalence of CMSCC

The prevalence of subclinical mastitis can be approximated using CMSCC. The problems with using CMSCC are discussed by Dohoo & Morris [20]. The SCC level 200 (1000 ml^{-1}) has been suggested as a limit in CMSCC to calculate prevalences. This seemed to be the best fitted level as a threshold value according to Dohoo et al. [21], McDermott et al. [22] and Dohoo & Leslie [23].

1.4 QUARTER MILK SOMATIC CELL COUNT (QMSCC)

QMSCC numbers vary considerably, with examples ranging from a few thousand to several million [24, 25]. QMSCCs also represent a very skewed distribution [24–26]. Thus, presentation of arithmetic averages is inadequate for QMSCC data. Doggweiler & Hess [27] presented the median value for FQMS. The median value in healthy quarters was identified for cows of various breeds: 23 for Braunvieh, 19 for Simmentaler Fleckvieh and 24 for Schwarzfleckvieh. They concluded that in healthy heifers the normal value is approximately 20 000 cells ml^{-1}.

1.4.1 Presentation of QMSCC results

An example of presentation of QMSCC results is presented in Tables 8 and 9. This distribution could be presented as geometric means with confidence intervals only. However, using percentiles and/or fixed ranges may be more informative. Only distributions within fixed ranges have so far been found in the literature.

Data on QMSCC should be presented with limits for every 10 percentile units to provide a detailed distribution of the data (see Table 9).

The alternative way of presenting QMSCC is with fixed ranges based on decimal units, as mentioned earlier. An example of such a presentation, putting together four different studies, is shown in Table 10. At least two common limits (500 and 1000) could be identified in the four studies.

This type of presentation could be applied when presenting results from different stages of lactation (as in Tables 8 and 9), different breeds, different countries, therapy trials and different studies (Table 10), etc.

Table 8: Analysis of QMSCC (1000 SCC ml^{-1}) obtained from Switzerland. Samples were obtained at drying off and calving. One sample was obtained at each time point and calving samples were obtained between calving and < 7 days postpartum (pp) [28]. ln = Natural logarithm, Exp. = Exponential function

Variable	Value	
	At drying off	Calving to < 7 days pp
Number of samples	1172	1159
Mean ln of QMSCC	6.13	4.95
Std of ln QMSCC	1.42	1.43
Lower confid. interval	27	8
Exp. of ln QMSCC	459	141
Upper confid. interval	7811	2458

Table 9: Upper limit values (QMSCCs in 1000 ml^{-1}) for each percentile and group of samples obtained at drying off and calving

Percentiles	Upper value of QMSCC	
	At drying off	Calving
10	73	30
20	129	44
30	211	58
40	287	75
50	426	97
60	614	136
70	957	226
80	1851	444
90	3573	1186

Further research is necessary in order to verify how appropriate these ranges (Table 10) are in the 1990s and beyond. In milk samples with SCC above 10 000 (that is, > 10 million SCC ml^{-1}), the measuring instruments are not precise enough without diluting the samples. Values as high as 13 000 (in thousands) were recorded for subclinical mastitis and > 20 000 for clinical cases [29].

If QMSCC is used to estimate CMSCC, the simple arithmetic mean is as close an estimate as one could get, unless a quarter milker is used. Due to lower production in inflamed quarters and the possibility of compensatory production in healthy quarters in the same udder [30], such an estimate of CMSCC would tend to be an overestimate, unless the measurement of SCC in inflamed quarters is not an underestimation due to a very high SCC.

1.5 CONCLUSION

These recommendations for summarizing and presenting SCC data serve as guidelines, and are intended to be useful for future research and development. Any scientist should still have the freedom to use his/her own principles for calculation, though preferably following the IDF recommendations in parallel. Regardless of the methods of calculation used, they should be clearly stated and described.

Table 10: Cumulative distribution of QMSCC data from three different studies and presented as fixed interval figures with decimal limits (1000 SCC ml^{-1})

QMSCC upper limit	Study 1	Study 2	Study 3	Study 4
20	2.3			
30	8.9			
40	16.7			
50	23.2			
60	30.9			
70	37.5			
80	42.2			
90	47.5			
100	50.8	19.8		
200	68.0	57.2		
300	**75.2**	**72.0**	**57.6**	
400	79.0	79.8		
500	**81.7**	**84.6**	**72.6**	**84.3**
600	83.6	87.5		
700	84.7	89.5		
800	86.5	91.0		
900	87.7	91.9		
1000	**88.6**	**93.0**	**85.8**	**91.7**
2000		97.1		
3000		98.1		
4000		98.6		
5000		99.1		
10 000				99.3
Number of samples	1159	6560	109 160	41 344

Study 1: Casura [28], from fresh milk (< 7 days postpartum).
Study 2: Poutrel & Rainard [25].
Study 3: Wilson & Richards [24].
Study 4: Vecht et al. [26].

Continuity in a country's animal health data presentations is important as is relevance over longer periods of time. However, the IDF encourages uniform methods for calculation in all countries, and a standard recommended period of 5 years for using parallel methods. At the end of such a period, comparable figures would hopefully be available world-wide. A task for future research is to improve the guidelines, and adjust them to international sustainable epidemiological methods.

IDF makes the following recommendations regarding presentation of SOMATIC CELL COUNT (SCC) data (in ranked order):

Calculations recommended are:

(1) Geometric mean or mean of natural logarithm (ln or *e*) of SCC with standard deviation (std).
(2) Mean and confidence interval of logarithmic transformed SCC data converted back to natural figures.
(3) Percentage of data below fixed figures based on appropriate decimal deviation (20, 30, 40, ..., 100, 200, 300...., 1000, 2000, 3000, etc.).
(4) The SCC limit for data below 10%, 20%, 30%, etc., of the figures (Percentiles).

For calculation of **SCC in a batch of composite milk:** Weighted (by milk yield for the unit analysed) arithmetic means.

RECOMMENDATIONS FOR PRESENTATION OF MASTITIS-RELATED DATA

PART 2: CLINICAL MASTITIS

ABSTRACT

The records of clinical mastitis data derive from routine reports of treatments of clinically affected cows. These data do not usually include bacteriological examination, and only report events of clinical events over a certain time interval.

IDF recommends the following form of data presentation.

Clinical mastitis incidences should be reported as the true rate representing:
- Cases of clinical mastitis per day at risk (or other appropriate time units)
- Cows with clinical mastitis per day at risk (incidence of first case)
- Cases and cows could, alternatively, be further subdivided into severe or mild, defined in accordance with general or only local clinical signs.

2.1 INTRODUCTION

The recording of cases of clinical diseases has attracted more and more interest internationally. Several countries are now using clinical mastitis data for statistical analyses. Accompanying the decrease in SCC in several countries will likely be an increase in the importance of clinical mastitis and its effects on production of quality milk. Clinical diseases have been recorded, together with other records in the milk production recording systems, since 1975 in Norway [31], 1982 in Finland [32], and 1984 in Sweden [33]. Such records are also described from Canada, the USA [34], Denmark and the UK [35], etc. Presently, different types of records and calculations, emanating from such data, are used in the different countries. These different principles for recording and calculation may result in a lot of confusion in the evaluation and comparison of the animal health status between countries. This problem could be more severe than is the case for somatic cell counts as described in Part 1.

2.2 VARIATION DUE TO CALCULATION METHOD

An example from Norway is presented in Table 11 and illustrates how different methods of calculation can produce widely variable estimates of clinical mastitis incidence. During 1992, there were 409 012 cows recorded in the cow health card system. There were 336 767 calvings recorded within the milk recording system, as well as 283 326 cow-years (365 days at risk). Not less than 12 different incidence rates could be calculated with all possible combinations of numerators and denominators. The lowest incidence (0.164) would be the total number of cows treated for acute clinical mastitis divided by number of cows. The highest incidence (0.458) would be cases of clinical mastitis divided by number of cow-years. This means that we could present any figure for mastitis incidence between 0.164 and 0.458 in Norway.

The need for a clear recommendation on how to present clinical mastitis data is obvious.

Table 11: Incidence rate of clinical mastitis using three possible denominators in the calculation. The data are from the Norwegian animal recording scheme and the year 1992. The recommended method of calculation is in bold type

Type of mastitis incidence	Number (x)	Incidence rates (x/y) based on:		
		Total number of cows in population during a year (y1 = 409 012)	Total number of calvings (y2 = 336 767)	**Total number of cow-years (days at risk/365.25) (y3 =283 326)**
Cows with acute clinical mastitis	66 904	0.164	0.199	0.236
Cows with clinical mastitis	97 634	0.239	0.290	**0.345**
Acute clinical mastitis cases	81 173	0.198	0.241	0.287
Clinical mastitis cases	129 820	0.317	0.385	**0.458**

2.3 DISTRIBUTION OF DATA

The clinical occurrence of a disease in dairy cattle tends to follow a Poisson process within herds. This has been shown for clinical mastitis data [36, 37]. The Poisson distribution is especially suited to deal with relatively rare occurrences. When clinical mastitis incidence is expressed as a rate, such as cases per cow-days at risk, then clinical mastitis is indeed a rare occurrence. The variability of a Poisson process is a function of the mean. The standard deviation of the observed number is actually equal to the square root of the number of cases observed. This allows a rapid calculation of the variability of the incidence of clinical mastitis occurrence in a population. Observational studies have shown that the variability between populations, such as between herds, may be substantially larger than expected. Thus, there would appear to be considerable overdispersion present in these data [37, 38].

2.4 IMPORTANCE OF CASE AS A TERM

A new case in a clinical mastitis recording system is, by definition, quite different from the definition for new infection, as often used in research. The diagnosis of clinical mastitis does not require special diagnostic tools, such as bacteriological sampling. Under practical conditions, defining a real new infection with respect to a clinical case is impossible. A new case would be the change of a cow from a healthy status to a clinically abnormal status. This status change is of economic importance to the farmer, because the status change is followed by a period of withdrawal of milk from the saleable bulk milk supply if the cow is treated with antibiotics. In this regard, clinical mastitis is quite different from a new infection, which frequently exists in the subclinical state, and therefore does not always need withdrawal time of milk. **These recommendations are made for continuous surveillance recordings under practical farming conditions.** Therefore, from the farmers' and the processors' point of view, it is the economic and quality impact of a case of mastitis that is of utmost importance.

2.5 LAG TIME FOR A NEW CASE

Different days of lag time, allowed prior to recording a new case, are used throughout the world. Examples are 9 or 4 days in Norway, 21 days in Sweden, 8 days in Denmark, 8 days in the UK, 9 days in Canada, 14 days in the USA, and in some countries even 30 days. To illustrate the effect on the incidence rate of varying lag time between clinical cases, a data set from Norway consisting of 285 herds with a total of 7 901 966 total lifetime cow-days from 15 days prior to first calving to culling or the end of the 4-year observation time, was used. The results are shown in Figure 3.

Figure 3 illustrates that there is no large effect on the calculated incidence of cases of mastitis by increasing the lag time beyond the second day. The decision of lag time between cases should be made using principles of economics and milk quality. In that way, the total withdrawal time (medication time plus residual time for the most common antibiotic used) is important. This withdrawal time could vary from medication to medication – and from country to country. However, for practical purposes a lag time of 8 days is recommended. However, this discussion of length of lag time is strictly from the point of view of estimating incidences of clinical mastitis, not the true new infection rate.

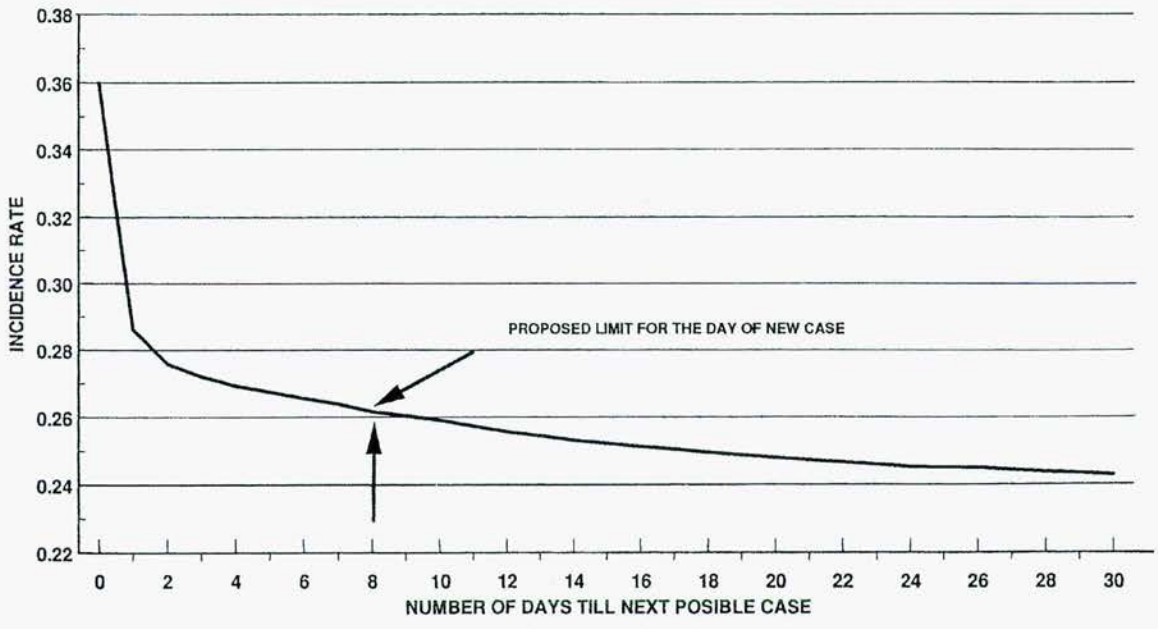

Figure 3: The incidence rate of clinical mastitis cases as influenced by the number of days from the onset of a case until a new case can be declared.

2.6 INCIDENCE RATE OF COWS WITH CLINICAL MASTITIS

Calculating incidences based on cows with clinical mastitis is straightforward, because each cow could only be counted once during a recording period. Using cows with clinical mastitis also makes easy the use of statistical methods such as Cox models. The problem with incidence of cows with clinical mastitis is that the cow-days after the first case should not be included in the days at risk. From our experience, correcting the denominator becomes more important as disease frequency increases.

The denominator (days at risk) can be easily calculated by having accurate information on the calving day, culling day and the day of disease (see Figure 4). In many data sets, such figures are not easy to achieve. An approximate estimate of days at risk could be determined by counting every cow still at risk once a year (example at 1.7. in Figure 4), or better once a month. These approximations of cow-years or cow-months are true, assuming that culling and calving days of heifers occur at random. Due to different milk quota and payment systems, this approximation might not always be true. However, the approximation is generally close enough for the purposes for which the information is required.

Days at risk, corrected for days after the first case, can be estimated very precisely if the two parameters cows in population during a year and cow-years are known. In the example from Norway (Table 11), these numbers were 409 012 and 283 326, respectively. The ratio 283 326/409 012 gives us an average figure of 0.693 cow-year cow^{-1}. For example, if we have 97 634 cows treated for clinical mastitis, the number of cow-years at risk in the denominator should be approximately [283 326 – (97 634 x 0.693)/2]= 249 496. This adjustment of the total number of cow-years assumes that cows are treated, on average, half-way through the year. The approximate true incidence of cows treated for clinical mastitis in Norway in 1992 was thus 97 634/249 496 = **0.391 year^{-1}** or 0.391/12 month^{-1} = 0.0326 month^{-1}. This calculation method is in agreement with the proposal of Hurd & Kaneene [34]. The incidence would be **0.345 year^{-1}** if unadjusted cow-years were instead used in the denominator (see Table 11).

2.7 INCIDENCE RATE OF CLINICAL MASTITIS CASES

Using cases of clinical mastitis when calculating the incidence rate would give the true incidence in the whole population of cows, since earlier diseased cows are counted again.

A major problem with using "cases" of clinical mastitis is that the number of days from the onset of an incident until a new incident could occur needs to be defined. These days have to be deleted from the lifetime of a cow to find the total days at risk if true precision is required.

Nine days are used in Norwegian data, as lag time before a new case can be declared. In presentations of cases of clinical mastitis, the denominator will be [283 326 x 365.25 – (129 820 x 9)]/365.25 = (103 384 821 – 1 168 380)/365.25 = 279 853. The incidence of cases of clinical mastitis in Norway in 1992 was therefore: 129 820/279 853= **0.464 year^{-1}** or 0.464/12 month^{-1} = 0.0387 month^{-1}. If cow-years is used in the denominator, without the adjustment for lag time, the incidence would instead be **0.458 year^{-1}** (see Table 11).

As we can see from the examples above, correcting the denominator for cow-years not at risk is important when using the value for treated **cows** in the numerator. When calculations are made on **cases**, though, such a correction factor is not as important.

2.8 STARTING DAY FOR DAYS AT RISK

Another problem is the starting day for calculating days at risk for a cow calving for the first time. A close evaluation of a data set of 4113 first calvers from 285 dairy herds in Norway, having 507 cases of clinical mastitis prior to second calving, revealed that the first three mastitis cases were detected at 436, 463 and 475 days after birth. Three cases were recorded before 123 days prior to calving, four cases between 123 to 90 days before calving, one case from 89 to 60 days before calving, four cases between 59 to 30 days before calving, and 48 cases the last month before calving. The incidence rates of clinical mastitis cases are shown in Table 12.

Based on these data, we would recommended to start counting days at risk from 30 days prior to first calving, but additional evaluations of this starting day would be desirable.

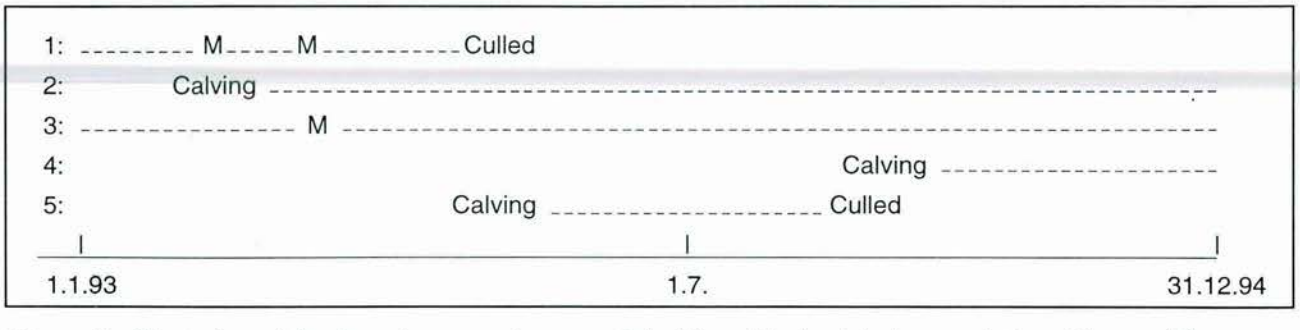

Figure 4: Illustration of the dynamic over a 1-year period of time. The herd had a population of 5 cows. There were 3 calvings, 3.5 cow-years and 1277.5 cow-days at risk (3.5 x 365 days at risk). "M"= a case of clinical mastitis.

Table 12: Time of occurrence of clinical mastitis in 4113 first calvers from 285 herds in Norway during the years 1985–1988. Total cases of clinical mastitis were 507 and a lag time of 8 days was used for a new case in an animal having a previous case

Time in lactation	Number of cases	Days at risk	Incidence rate in 1000 days at risk
365 days after birth to 31 days before calving	12	1 465 208	0.0082
30 to 15 days before calving	7	65 759	0.1065
14 to 8 days before calving	7	28 742	0.2436
7 to 1 day before calving	34	28 553	1.1908
Calving day and the day after	82	8 128	10.0886
2 to 5 days after calving	52	16 201	3.2097
6 to 14 days after calving	48	36 543	1.3135
15 to 60 days after calving	80	184 898	0.4326
61 to 120 days after calving	109	233 631	0.4665
121 to 180 days after calving	91	226 290	0.4021
181 days after calving to drying off	154	407 694	0.3777
Drying off to 15 days before 2nd calving	108	209 671	0.5151
14 to 8 days before 2nd calving	9	25 793	0.3489
7 days before to the day of 2nd calving	33	22 393	1.4736

Table 13: Incidence rate of cases of clinical mastitis per day at risk. Incidence rates are shown for various stages of lactation

Data from Rowlands & Booth [36]		Data from Østerås & Sandvik [39]	
Lactation stage	Incidence rate	Lactation stage	Incidence rate
		–30 days after drying off	0.000212
		45 to 14 days before calving	0.000155
		14–0 days before calving	0.001029
0–3 days in lactation	0.00810	0–5 days in lact.	0.011218
4–7 days in lactation	0.00461	6–15 days in lact.	0.003393
8–14 days in lactation	0.00218	16–30 days in lact.	0.002067
15–60 days in lactation	0.00073	31–60 days in lact.	0.001214
61–120 days in lactation	0.00077	61–90 days in lact.	0.000838
		91–120 days in lact.	0.000980
121–180 days in lactation	0.00050	121–150 days in lact.	0.000725
		151–180 days in lact.	0.000507
180–400 days in lactation	0.00013	181–210 days in lact.	0.000391
		211–240 days in lact.	0.000795
		241–270 days in lact.	0.000309
		271–280 days in lact.	0.000240
		Total in lactation	0.001221
Weighted mean	0.000445	Total period	0.001007

2.9 INCIDENCE DURING LACTATION

The incidence rate of clinical mastitis is greatly affected by stage of lactation [36, 39]. The distribution of cows by stage of lactation would, therefore, have a considerable impact on the incidence rate in the population. Therefore, incidence rates should be presented within defined stage of lactation intervals. Table 13 presents two studies where incidence rates were presented in different lactation stages. One survey study was from the UK [36], and one dry cow therapy trial with only subclinically infected cows was from Norway [39].

2.10 CONCLUSION

When clinical mastitis data are collected in computerized systems, and the incidence rate calculated, the numerator and denominator in the incidence rate must be clearly defined. More importantly, the definition and nomenclature of a clinical case should be very clear. IDF recommends the terminology in the Appendix for **severe clinical mastitis** and **mild clinical mastitis**. A severe case would be less affected by the farmers threshold for having the cow treated than would be evident for the mild cases.

Incidence is defined as the number of events divided by a reference populations risk time. Events of mastitis should be:

(1) cows with clinical mastitis;
(2) clinical cases of mastitis (severe and/or mild).

The reference population at risk should be days, months, or years at risk.

Using only the number of cows or lactations as the reference population should be avoided since these terms have no time scale, which is required by the definition of incidence. A term like per 100 cows per year is unclear; is the meaning number of cows at a specific time (during a year) or number of cows at time (year) of risk ? Also, cows or lactations would give incorrect estimates of the incidence, since cases of mastitis are not evenly distributed over the lactation (as illustrated in Tables 12 and 13).

Thus, IDF recommends that incidence rates of clinical mastitis primarily should be reported as:

(1) An incidence rate of cases.
(2) And/or cows treated per cow-year at risk.
(3) Both rates should be accompanied by additional information about number of cases per treated cow.

Starting time for counting days at risk before 1st calving (recommended 30 days) and lag time (recommended 8 days) should be specified. Time at risk should be corrected for lag time (in rate of case) and cows treated (in cows treated in nominator).

Clinical mastitis rates should also be presented **within lactation periods** in future research work, as well as in general presentations. Such periods should be divided into several parts, for example as in Table 12.

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Appendix I: **TERMINOLOGY**

IDF proposes a standard nomenclature and abbreviations for this subject area. For important definitions and methods referred to in this manuscript, reference is made to earlier IDF documents: Bull. Int. Dairy Fed. 211 for definition and IDF Standard 148A:1995 for recommended methods for somatic cell counting in milk. Earlier IDF publications dealing with definitions are Annual Bulletin (1967) and Annual Bulletin (Part II) (1971) and IDF Document 132 (1981) [superseded by IDF Standard 148A:1995].

Terminology used in this document and defined in earlier documents is as follows.

1 MASTITIS

2 SOMATIC CELL COUNT (SCC)

SCC is presented as **1000 SCC ml^{-1}** of milk. In presenting SCC, the following factors should be recorded: analytic method used; sampling technique; sample storage; age before analysis; storage temperature. All these procedures are described in IDF Standard 148A:1995 and this document is recommended for further reading.

3 SUBCLINICAL MASTITIS

4 CLINICAL MASTITIS (CM)

(a) Severe clinical mastitis (SCM)

(b) Mild clinical mastitis (MCM)

(c) A case of clinical mastitis

Case of clinical mastitis = An incident of clinical mastitis in one or more quarters at any one time. If a period of more than 8 days has elapsed since the first appearance of clinical signs, this is defined as a new case. A new case does not necessarily signify a new intramammary infection.

5 SAMPLE TERMS

(a) Quarter milk sample (QMS)

A quarter milk sample (QMS) represents a milk sample from one single udder quarter. The SCC should then be called quarter milk somatic cell count (QMSCC) when analysing such samples. The sample could be a foremilk sample (FQMS) [taken just before milking]; or a strippings milk sample (SQMS) [taken just after milking]; or a bucket/bulk milk sample (BQMS) [taken from pooled quarter milk]. A FQMS represents a sample taken before milking after rejection of two streams of milk. A SQMS represents a sample taken as soon as the milking machine is taken off, or a sample taken up to 1 h after milking. A BQMS represents a sample which is a mixture from the total milk from one udder quarter taken during one milking.

(b) Cow (composite) milk sample (CMS)

A cow milk sample (CMS), or composite milk sample, represents milk sampled from all secreting quarters from the cow, that is, all the quarters from which milk is produced. CMS is therefore usually a mixture or composite from four quarters. These samples are often taken during milk recording with a milk recording sampler during the normal milking procedure. The samples will usually comprise bucket milk samples – BCMS. Therefore, in presentations CMS should mean BCMS. Otherwise, if the CMS is a foremilk sample (FCMS) or a strippings milk sample (SCMS), this should be very clearly defined. The milking interval should be defined. Similarly, the sample composition relative to morning milk, evening milk or a mixture from morning and evening milk samples, should be described.

(c) Herd bulk milk sample (BMS)

A herd bulk milk sample is taken from the herd's bulk tank or when all herd milk is mixed together. SCC from these samples are called bulk milk somatic cell counts (**BMSCC**). Different time parameters should also be defined for BMSCC: the number of milking events (or days) represented in the bulk milk tank; the number of times per month BMSCC are analysed; the delay from the sampling event in the bulk tank to the analytic procedure at the lab; all data should be included. Excluded data should be documented in detail separately.

Appendix II: **STATISTICAL TERMS**

1 LOGNORMAL DISTRIBUTION

A prominent characteristic of the **lognormal distribution** is that most values are rather low, but there are a few observations with high values. Another characteristic is that the variability of the data increases when the mean of the data increases. High values tend to be variable, while low values are relatively stable. Another characteristic of the lognormal distribution is that when the data are logtransformed, the distribution will look like a normal distribution [3, 4].

2 BINOMIAL DISTRIBUTION

According to Bhattacharyya & Johnson [42]: When a fixed number n of repeated Bernoulli trials is conduced with success probability p in each trial, we consider the random variable X, which represents the count of the number of successes in n trials. The probability distribution of X is called a binomial distribution with n trials and success probability p.

3 POISSON DISTRIBUTION

According to Bhattacharyya & Johnson [42]: Poisson distributed data are to hand when X is a random variable representing the number of times S occurs in a unit time interval. Under the three postulates (independence, lack of clustering and constant rate), the probability distribution of X gives a Poisson distribution.

4 MEAN (μ)

The sum of all figures in an observed population divided by number of observations.

5 WEIGHTED MEAN

The sum of all figures multiplied by a corresponding amount figure (milk) in an observed population divided by the sum of all amount figures during the observation.

6 ARITHMETIC MEAN

The sum of all figures in an observed population divided by number of observations.

7 GEOMETRIC MEAN

The n square root of the multiplication of all numbers during an observation time. Exponentiating the arithmetic mean of the logarithm of all figures will give the same result as the n square root of all multiplied figures.

8 HORIZONTAL CALCULATION

The calculation of means (arithmetic or geometric) for each unit during a time interval (that is, mean of CMSCC for a cow during 1 year or one lactation).

9 VERTICAL CALCULATION

The calculation of means (arithmetic or geometric) for a number of individuals/herds at a specific defined time (that is, mean of CMSCC in a herd at one day).

10 STANDARD DEVIATION (std)

Usually we do not only want to describe our samples with the "most common" value, the centre of distribution, but also to give an idea about the distribution, the spread, around this average. The standard deviation (std) is then commonly used. With a normal distribution the standard deviation means that **2/3 of all samples are within ± 1 std-units of the average.**

(a) Normal distribution

Normally distributed data will give the std as square root of the sum of the powered difference of all values from the mean, divided by number of samples.

(b) Binomial distribution

Binomially distributed data will give the std as square root of the prevalence multiplied by 1 minus the prevalence, all divided by number of samples.

(c) Poisson distribution

Poisson distributed data will give the std as square root of the number of cases divided by number of animals studied.

11 MEDIAN

The value that divides the analysed population in two equal parts. In normally distributed data, the median would be equal to the mean, but the mean would be far to the right with skewly distributed data as SCC.

12 QUARTILES

Alternative measures of the spread, analogous to the median, would be quartiles or percentiles. The low quartile is a threshold at which 25% of all observations are lower than the value, and the high quartile is a threshold at which 25% of all observations are higher than the value.

13 PERCENTILES

Percentiles are defined in the same way as quartiles, but at 10% intervals.

14 DECIMAL RANGE OF DATA

Another related way to present skew distributions could be by giving frequency distributions within fixed ranges. Such ranges should be well defined and possibly standardized. A drawback with such a procedure is that the ranges necessary to give sufficiently accurate descriptions vary over time and between environments.

15 CONFIDENCE INTERVAL

A standard deviation can be calculated on logtransformed values, but it should be noted that the std can not be exponentiated to obtain a std on the actual scale. Instead, a confidence interval is the upper and lower limit of data which takes 95% of the data in a sample between them. For example, the average of the natural logarithm of CMSCC in an example above is

4.42, the std is 1.27, so the lower 95% confidence limit would be about 1.88 (4.42-2×1.27) and the higher about 6.96 (4.42+2×1.27). Transformed to the actual scale they are 6550 and 1 053 600, respectively, meaning that 95% of all observations fall within that range. In this example it is also made obvious that the spread, represented by the confidence interval, is not symmetrical around the geometric mean. An alternative to calculate geometric means with confidence limits would be always to use a logarithmic scale. Averages and standard deviations would then be directly interpretable. However, such a procedure may take time to get adjusted to and may seem confusing since there are several "bases" that the logarithm can be based on [for example natural *e* or ~2.718282, 10 or 2) and thus give different (although translatable) results.

16 PREVALENCE

Prevalence is a frequency of disease at a specific time. Prevalence is used when diseased animals are calculated as a result of sampling at a given time.

17 INCIDENCE

Incidence is a rate of diseased animals over a period of time (days at risk).

18 DEFINITIONS RELATED TO INCIDENCE RATE

In calculation of incidence rate a numerator and a denominator are needed. These two figures are often not very well documented. The importance of the definition of these two figures is highlighted below.

(a) Incidence numerator

Incidence numerator is the number of diseased units used when calculating an incidence rate.

Cows with clinical mastitis = Number of cows in a time interval with at least one recorded case of clinical mastitis.

Cases of clinical mastitis = Number of cases of clinical mastitis within the recorded time.

Case = An incidence of a clinical mastitis which occurs after a certain lag time period from the onset of a series of treatments in the same cow.

Lag time = The time period from the start of an incidence till a new case can be allowed. IDF recommends that the lag time is defined as 8 days. A new case could be counted on the 8th day after the first incidence of mastitis. The argument to use 8 days as the lag time is that 8 days is a common withholding time of milk during a mastitis treatment. The argument for this is that a case very often is used to calculate the economic loss of mastitis. An important factor in economic loss is the withholding time period.

(b) Incidence denominator

Days at risk = Sum of number of days each cow is at risk. If this is divided by 30.4 we get cow-months at risk, or, divided by 365.25 we get cow-years at risk. Days at risk, using **cows** with clinical mastitis as the numerator, is defined from the starting day until the event occurs or the end of the recording period. Days at risk, using **cases** of clinical mastitis as numerator, is defined from the starting day until the end of the period or slaughter day minus number of cases multiplied by lag time in days (see numerator definition). Days at risk should be the only incidence denominator used when presenting incidence rate.

Other denominators in use throughout the world are also presented below.

Lactation at risk = Number of lactations within the same time interval as for the disease frequency. This could give a good indication of the incidence of diseases which are strongly related to calving period (that is, postpartum diseases such as milk fever). The denominator is not so useful for diseases occurring all over the lactation period, as different lactations can have quite different lengths in each cow. Use of this denominator is not recommended for cases of clinical mastitis.

Cows at risk = Total number of cows present during a certain time interval. This means that for cows at risk during a year, a cow with 365 days carries the same weight as a cow with only 1 day during that year. The time factor is not taken into account, and this denominator should therefore not be used in calculating incidences. However, number of cows counted at **a specific day** could be a good estimate of number of days at risk if the number of cows is evenly distributed throughout the year. Alternatively, cows could be counted several times and a mean number could be calculated.

off before removing the unit is necessary to avoid air ingress, vacuum instability and the related increase in rate of new infection.

2.1.6 Postmilking disinfection and hygiene measures

2.1.6.1 *The teats*

The teats should be disinfected with an effective product immediately after unit removal. The critical element is coverage of all of the teat skin. An emollient, of a type and at a level, appropriate to the environmental conditions is recommended as part of the disinfectant formulation.

2.1.6.2 *The milking unit*

Milking unit sanitation between cows can be performed by disinfection, pasteurization or backflushing and may help to reduce the spread of pathogens between cows. It is only recommended for particular problem herds because of a poor cost–benefit relationship.

2.1.6.3 *Cleaning the parlour*

The parlour should be cleaned after milking of each group of cows to maintain the milking facility in a clean state throughout the milking operation, and very carefully at the end of milking.

2.1.6.4 *Feeding of fresh ration*

It is recommended to keep the animals standing after milking for 1–2 h. This will help to avoid contamination of the teats when the teat canals are still relatively open after milking. It should help to reduce the new infection rate.

2.2 Animal factors and behaviour

2.2.1 Uniformity and conformation of udder and teats

Proper milking unit alignment my not be possible when milking animals with grossly abnormal teat placement or poor udder attachment such that there is insufficient space under the udder for the milking unit to hang free. Animals so affected will milk poorly and may have a higher rate of infection. Where the cause is anatomical or pathological, the animals should be culled. A few animals may present a short-term problem near to peak lactation and must be managed carefully.

2.2.2 Animals and behaviour

Any clinical signs of poor health should be recorded. Abnormal animal behaviour may indicate a stray voltage problem [2]. During milking the number of units kicked off, any nervousness and hyperactivity of the animals, etc., should be observed.

2.2.3 Milking characteristics

2.2.3.1 *Completeness of milking*

After sufficient premilking udder preparation and milking with a correctly designed and well maintained milking unit the amount of milk obtained by "machine stripping", that is, the strip yield, is typically less than about 0.3 kg/cow. Milking problems can be supposed if strip yields average more than 0.5 kg/cow [3]. The most common causes, after poor stimulation, of incomplete milking are inappropriate type or poor condition of liner, incorrect milking unit position, milking unit weight too low or milking vacuum too high. On commercial farms completeness of milking can be determined either by hand-stripping or by machine-stripping of about 10 cows. Hand-stripping offers the advantage of determining the ratio of strip yield between quarters. Another test for the completeness of udder evacuation is to measure the fat content of strippings compared with bulk milk [4].

2.2.3.2 *Milking duration*

Field data show that on average, cows giving 10 kg milk per milking will have a milking unit attachment time of some 5 min, and cows producing about 15 kg will need about 6 min. This means that if the addition of 1 min to the mean milking time per cow for each 5 kg increase in mean milk yield per milking is not sufficient, there may be problems with the milking equipment or operation of the milker [3]. Similar calculations can be made for other dairy animals.

2.2.3.3 *Frequency of slipping or falling teatcups*

Flooded milking units and milklines, mainly due to insufficient capacity or a blocked air vent, are the main factors causing slipping or falling of teatcups soon after attachment. The most common causes towards the end of milking are poor milking unit alignment and uneven weight distribution in the milking unit. The problem is greatest on the first quarters to milk out. The frequency of slipping or falling teatcups can be assessed by systematic observation. Milking problems may be indicated by a frequency of > 10 slips or falls per 100 animals milked.

2.2.3.4 *Teat conditions before and after milking*

The major machine factors predisposing to teat damage are high vacuum, pulsation failure such as insufficient collapse phase, and poor liner characteristics such as too hard, wrong tension or insufficient length. The type of teat reactions to milking can be categorized in: (i) appearance and clinical signs; (ii) changes in tissue structure and composition; (iii) changes in physiological activity [5]. Often a visual check and palpation, or testing by use of a spring-loaded calliper (cutimeter) are sufficient to assess teat condition immediately after milking. External teat lesions can be checked easily by visual observation and categorized in relation to a scoring scheme, that is, Normal, Smooth chronic rings (very mild, moderate, severe), Rough chronic rings (very mild, mild, moderate, severe), Acute, Traumatized [6]. Other, internal, teat lesions resulting from congestion and oedema can be inferred by the use of the cutimeter. The instrument is applied just before and again just after milking and if the percentage changes in thickness of the teat end exceeds 5% this indicates an sufficient pulsation. From practical experience it appears sufficient to examine 10–20% of the herd or 10–20 cows [5].

2.3 Milking machine characteristics

2.3.1 Description of the teatcup

The following parameters of the liner should be recorded: bore, length, wall thickness, shore hard-

Table 1: Criteria to be considered during the evaluation

Operator action and behaviour	Observation and measurements on animals	Machine characteristics	Herd status and management
Preparation of the animal	Uniformity and conformation of udders and teats	Type of teatcup	Education and motivation of the operator
Machine preparation	Animal status and behaviour before, during and after milking	Type of liner	Interaction between operator and animals
Milking unit attachment	Completeness of milking	Interval of changing liners	General hygiene
Supervision of milking	Milking duration	Milkline position	General aspects (housing/ feeding conditions)
Milking unit detachment	Frequency of slipping or falling teatcups	Tube size	Cell count
Postmilking disinfection and hygienic measures	Teat condition before and after milking	Vacuum recordings	Bacterial content of milk
		Pulsation characteristics	
		Type and intensity of static testing	

2 PROPOSED GUIDELINES FOR THE EVALUATION OF THE MILKING PROCESS

2.1 Operator action and behaviour

2.1.1 Preparing the animal for milking

2.1.1.1 *Teat cleaning*

The cleanliness of the teats at milking time determines the type of cleaning necessary. Dry cleaning is preferred – wiping each teat with clean paper. If the teats have to be washed, they should be dried with an individual paper towel before attachment of the milking unit. Water used for teat cleaning should be of drinking water standard. Premilking teat disinfection, using disinfectant entrained in wash water or a premilking teat dip, can be recommended if adequate wiping off is performed.

2.1.1.2 *Foremilking and manual stimulation*

A strip-cup should be used to examine the foremilk prior to each milking. If teat cleaning and foremilking are done carefully a sufficient premilking stimulation is provided.

2.1.2 Machine preparation

2.1.2.1 *Function and equipment control*

Simple checks are necessary at each milking. The vacuum level of the farm milking system should be checked after reaching the full performance. Gross air leaks and the operation of the pulsators can be heard.

2.1.2.2 *Hygiene check*

The cleanliness of the milking equipment should be checked visually during setup.

2.1.3 Milking unit attachment

The milking unit should not be attached before milk letdown but should coincide, if possible, to avoid milking of empty teats. Anyway, the milking unit should be attached at least within 1.5 min of the start of stimulation [1]. Careful handling of the milking unit is necessary to prevent excessive air from entering the teatcups and to avoid contact at the teatcup with contaminated material. This will minimize spread of bacteria between quarters and impairment of milk quality. In order to minimize air leaks during milking, unit attachment short milk tubes can be kinked in a "Z" fashion and only opened up when a teat is reaching into the liner mouthpiece.

2.1.4 Supervision of milking

2.1.4.1 *Milking unit/teatcup position*

Proper alignment of the milking unit is necessary for proper milking action and complete milk removal.

2.1.4.2 *Vacuum stability and level*

Only a correctly positioned teatcup can help to prevent ingress of air and liner slip which may contribute to an increased new infection rate.

2.1.4.3 *Determination of end of flow and avoidance of overmilking*

The determination of low flow and end of flow is preferably done by automatic devices. Overmilking should be avoided if possible. However, a short period of overmilking (1–2 min) is preferable to undermilking and is not associated with an increased level of infection. Automation of milking unit removal minimizes overmilking time.

2.1.4.4 *Machine stripping*

There is no need for machine or hand stripping if there is sufficient milk letdown before attachment of the milking unit and a properly functioning unit is applied.

2.1.5 Milking unit detachment

The degree of udder evacuation should be checked before milking unit detachment. Vacuum shut

GUIDELINES FOR EVALUATION OF THE MILKING PROCESS

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FOREWORD

The milking process is critical to the production of quality milk free of contaminants. Research has clearly established that the milking process is associated with a period of high risk for new intramammary infections that can lead to increased incidence of mastitis in herds. Mastitis is one of the major factors associated with reduced milk quality. In addition, contamination of the milk with bacterial pathogens, organic matter, and chemicals can occur during milking. The milking machine is clearly the major focus of the milking process but many other elements are important to the efficient milking of cows and the production of quality milk.

The following document provides an important set of guidelines to be used to evaluate the entire process of cow milking and not just the mechanical elements of the milking installation. Milking machines are generally evaluated as a mechanical test of the equipment during the intermilking interval and is often referred to as static or "dry" testing. In contrast, dynamic or "wet" testing is performed during the milking of cows and involves all aspects of the milking process, not just the milking equipment. The guidelines presented are the product of the IDF Machine Milking and Mastitis Subgroup A2D of Group A2. Subgroup A2D is under the Chairmanship of Prof. J. Hamann (DE) and Prof. Hamann assumed the leadership role in the preparation of the document. Group A2 believes that the guidelines presented will provide for a systematic evaluation of the milking process that includes the interaction among machine, milker, environment, and cow.

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Chairman, Group A2

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ABSTRACT

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 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.

1 INTRODUCTION

A mechanical test of the milking installation known as static or "dry" testing is done between milkings to describe the potential technical capacity of a farm milking system (for example operating vacuum, air flow rate, pulsators). The main purpose is to determine operation according to specification and to identify deterioration and mechanical faults for repair or replacement of components. However, this is insufficient to determine the quality of the work done in milking.

It is necessary to evaluate the milking process. Such a study has the main purpose of describing the interactions between machine, milker and dairy cows during milking and is concerned with the efficiency of milking, milk removal and any risk of new infection of the mammary gland. The appraisal may include a dynamic or "wet" test made on the machine during milking of one or more cows. The details of technical measurements made during a dynamic test will be described in an IDF Document by Group A32 (Milking Machines) on 'Dynanmic testing of milking machines', in preparation. The main criteria of evaluation of the milking process cover aspects of action of the operator, animal status and behaviour, machine characteristics and herd status and management (Table 1) and guidelines to good practice are described here. Assessment of the practices when milking should include determination that all of these standards are being met.

Appendix III: **ABBREVIATIONS**

The abbreviations used for relevant terminology are as follow:

SCC = Somatic cell count
QMSCC = Quarter milk somatic cell count
CMSCC = Cow (composite) milk somatic cell count
BMSCC = Bulk milk somatic cell count
QMS = Quarter milk sample
CMS = Cow milk sample
BMS = Bulk milk sample
FQMS = Foremilk quarter milk sample
SQMS = Strippings milk quarter milk sample
BQMS = Bucket milk quarter milk sample
CM = Clinical mastitis
SCM = Severe clinical mastitis
MCM = Mild clinical mastitis

ness, tension, effective length. A transparent shell may be used to check liner wall movement. Further details can be found in IDF Bulletin No. 297 [7] and ISO 5707 [8].

2.3.2 Interval of changing liners

The manufacturer's recommendation in terms of number of milkings between liner changes should be followed. As a minimum requirement, irrespective of how few milkings are done, the liners should be exchanged every 6 months.

2.3.3 Vacuum

Accurate recording of vacuum during milking provides the best means of measuring the adequacy of any milking system. Appropriate technology and methods are described in an IDF Document by Group A32 (Milking Machines) on 'Dynamic testing of milking machines', in preparation. The equipment is expensive, the methods require precision, and interpretation of the data requires significant fundamental knowledge of milking systems. Such machine testing requires specialist skills and training. A properly functioning system should have a stable vacuum such that there are fluctuations less than 2 kPa in the receiver throughout all milking operations. Nominal milking vacuums of 40–45 kPa for lowline milking, or 45–50 kPa for highline systems, will result in a mean claw vacuum within the range 35–42 kPa during the period of peak milk flow for a representative group of cows. Lower values may be caused by excessive milkline height, restrictions in the milk tubes, or excessive vacuum drop across ancillary components. Fluctuations in the claw vacuum should not exceed 7 kPa in lowline systems, and 10 kPa in highline systems [3].

2.3.4 Pulsation

The vacuum level, pulsation rate and pulsator ratio can easily be monitored by a suitable instrument. The measured values should correspond to the international standard [8]. However, the correct pulsator ratio does not guarantee proper liner wall movement and so effective pulsation. This is described in an IDF Document by Group A32 (Milking Machines) on 'Dynamic testing of milking machines', in preparation.

2.3.5 Type, intensity and frequency of static testing

It is best to conduct the static and the dynamic test on the same visit. If this is not possible, the records of the static test should be used for appraisal of the milking installation and the related milking efficiency.

2.4 General conditions of housing and management

2.4.1 Interaction between the operator and the dairy animal

The level of education, information and motivation of operators determines their capabilty to manage dairy animals and to apply modern techniques to the process [9]. The attitude of the operator with regard to the cooperation with the animals has to be seen as an important factor which may contribute markedly to the stress imposed on the animals. The interaction between operator and the herd is very complex and the animals will perceive mainly the following cues: human hand and arm, and human voice. Furthermore, holistic empathetic factors that have received only limited research, for example olfactory agents from the operator, level of electromagnetic "forces" created by the operator or a certain air of "calm and confidence", contribute to the human–animal interaction [10]. The nature of the operator interaction significantly influences animal wellbeing and productivity. Therefore, type of action and behaviour of the operator should be recorded.

Additionally, factors such as noise from milking equipment, motorbikes, or from in parlour feeding stations as well as dogs are elements determining the stress level imposed on operator and animals.

2.4.2 General hygiene with and without respect to milking

The general herd hygiene can be assessed in several ways, including use of information from milk hygiene records, visual examination of the milking process, questioning of the staff, evaluation of the bedding material and air bacterial counts during the milking operation. The type of bedding, for example sawdust, shavings or straw, and the frequency of renewal have a direct influence on the magnitude and type of the bacterial population. The status of the bedding material (dry, wet, organic, inorganic, clean, dirty) influences markedly the contamination risk of the teats.

Investigations on the relationship between air contamination in the milking parlour and mastitis risk have shown that there can be a significant relationship between prevalence of intramammary infections due to environmental pathogens and the degree of air contamination (total bacteria count; coliforms) [11].

2.4.3 General aspects

General environmental factors such as climate, type and standard of nutrition, and housing conditions will influence the physiological status and therefore the susceptibility to infection and severity of disease. Mastitis can be influenced by several factors, including humidity in the housing, metabolic disorders due to energy deficiency, teat lesions created or exacerbated by the beds and/or the climate. It is important that sufficient attention is paid to assessing these factors.

2.4.4 Cell count level

Data from a period of at least 6 months should be evaluated. The analysis should follow the description given by Osterås et al. (this Bulletin, pp. 10–25). If no cell count data are available, results of the California-Mastitis-Test can be used.

2.4.5 Total bacteria count

The level of total bacteria count in herd bulk milk should be less than 50 000 cfu/ml. If the values are higher, then commonly cleaning and disinfection of the plant is insufficient and/or the cooling system is defective or inadequate. Insufficient cleaning and disinfection may also increase the risk for new infections by milking with contaminated teatcups.

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suivant, et jusqu'à la fin de la traite, le phénomène est du, entre autres, au mauvais alignement de la trayeuse et au déséquilibre de la répartition du poids à l'intérieur de la trayeuse. Le problème est particulièrement crucial lors de la vidange des premiers quartiers de la mamelle. La fréquence des glissements ou des chutes de gobelets trayeurs peut être déterminée par l'observation systématique. On peut conclure que des problèmes de traite se posent si la fréquence des glissements ou chutes est supérieure à 10 pour 100 animaux soumis à la traite.

2.2.3.4 *Etat des trayons avant et après la traite*

Parmi les principaux facteurs mécaniques susceptibles d'endommager les trayons, citons l'excès de vide, la défaillance de pulsation (par exemple, phase de dépression insuffisante) ou encore l'inadaptation des caractéristiques du manchon, qui est trop dur ou présente une mauvaise tension ou une longueur insuffisante. On peut classer les réactions des trayons à la traite de la manière suivante: (i) apparition de signes cliniques; (ii) changement de la structure ou de la composition des tissus; (iii) modification de l'activité physiologique [5]. Généralement, le contrôle visuel et la palpation, ou la réalisation d'un test au moyen d'un compas de calibrage à ressort, sont suffisants pour déterminer l'état des trayons juste après la traite. Les lésions externes des trayons se contrôlent aisément et entrent dans la classifications suivante: normales, cycliques chroniques et régulières (faibles, modérées, graves), cycliques chroniques et irrégulières (très faibles, faibles, modérées, graves), aiguës, traumatiques [6]. Par contre, les lésions internes des trayons, dues à la congestion ou l'oedème, sont détectées au moyen d'un compas de calibrage. On applique l'instrument juste avant et juste après la traite. Si le volume du trayon s'est modifié, à son extrémité, de plus de 5%, on peut en déduire que la pulsation est suffisante. Sur le plan pratique, il suffit d'examiner 10 à 20% du troupeau ou 10 à 20 vaches [5].

2.3 Caractéristiques de la machine

2.3.1 Description du gobelet trayeur

Pour le manchon, il est primordial de relever les paramètres suivants: calibre, longueur, épaisseur des parois, dureté des bords, tension, longueur effective. La carcasse transparente permet de contrôler les mouvements des parois du manchon. Le Bulletin 297 de la FIL [7] et la norme ISO 5707 contiennent de plus amples détails à ce sujet.

2.3.2 Intervalle entre les changements de manchons

Il y aura lieu de suivre les recommandations du constructeur concernant le nombre de traites à respecter entre deux changements de manchon. Il est indispensable de procéder au changement de manchon au mois tous les 6 mois, même si le nombre de traites est inférieur au nombre recommandé.

2.3.3 Vide

Un enregistrement précis du vide pendant la traite constitue le meilleur moyen de mesurer l'adéquation du système de traite. Un document FIL en cours de préparation, rédigé par le Groupe A32 (Trayeuses) et intitulé 'Essais dynamiques des trayeuses', comporte de plus amples détails sur la technologie et les méthodes appropriées. L'équipement est onéreux, les méthodes exigent de la précision et l'interprétation des données nécessite des connaissances approfondies en matière de systèmes de traite. Seul les spécialistes compétents et expérimentés dans ce domaine sont habilités à procéder au contrôle des trayeuses. Tout système fonctionnant correctement doit produire un vide stable, et présenter des fluctuations inférieures à 2 kPa au niveau de la chambre de réception, durant la totalité des opérations de traite. Un vide nominal de traite, de 40 à 45 kPa pour les machines à traire à ligne basse ou de 45 à 50 kPa pour les systèmes à ligne haute, produit un vide de griffe moyen de l'ordre de 35 à 42 kPa pendant la période de débit maximum du lait pour un groupe représentatif de vaches. Des chiffres inférieurs peuvent indiquer une hauteur excessive de la conduite de lait, des étranglements dans les conduites de lait, ou une pénétration excessive de vide dans les composants annexes. Les fluctuations du vide de griffe ne devraient pas dépasser 7 kPa dans les systèmes à ligne basse et 10 kPa dans les systèmes à ligne haute [3].

2.3.4 Caractéristiques de pulsation

Le niveau de vide, la vitesse de pulsation et le rendement du pulsateur feront l'objet d'un contrôle à l'aide d'une instrumentation adéquate. Les valeurs mesurées doivent satisfaire à la norme internationale [6]. Toutefois, il est à noter que le rendement correct du pulsateur ne garantit pas la précision des mouvements des parois du pulsateur, ni l'efficacité de la pulsation. Ce point fait l'objet d'un document FIL en cours de préparation, rédigé par le Groupe A32 (Trayeuses) et intitulé 'Essais dynamiques des trayeuses'.

2.3.5 Type, intensité et fréquence des essais statiques

La meilleure des solutions consiste à effectuer les essais statiques et dynamiques lors de la même visite. Si cela s'avère impossible, les enregistrements du test statique doivent servir à apprécier l'installation de traite et l'efficacité de la traite qui en découle.

2.4 Conditions générales de logement et de gestion

2.4.1 Interaction entre l'opérateur et l'animal laitier

Les niveaux de formation, d'information et de motivation des opérateurs déterminent leur capacité à gérer un cheptel d'animaux laitiers et à utiliser les techniques modernes [9]. L'attitude de l'opérateur en matière de complicité avec les animaux constitue un facteur important susceptible d'influencer fortement le stress imposé aux bêtes. L'interaction entre l'opérateur et le troupeau est très complexe et les bêtes percevront surtout les signaux suivants: bras et mains de l'homme et voix humaine. De plus, il est incontestable que certains facteurs holistiques et affectifs, comme la perception olfactive de l'opérateur, le niveau des "forces" électromagnétiques qu'il produit ou son

2.1.4.2 *Stabilité et niveau du vide*

Seul un bon positionnement du gobelet de traite peut contribuer à réduire la pénétration d'air et le glissement du manchon qui augmenteraient les risques d'infection.

2.1.4.3 *Détermination de la fin du flux et prévention de la surtraite*

On se servira de préférence d'instruments automatiques pour déterminer la baisse du flux et la fin du débit. Si possible, on évitera la surtraite. Cependant, une courte période de surtraite (1–2 min) est préférable à une traite incomplète et n'accroît pas les risques d'infection. L'automatisation de l'enlèvement de la trayeuse réduit à un minimum le temps de surtraite.

2.1.4.4 *Egouttage mécanique*

Aucun égouttage mécanique ou manuel n'est nécessaire si la descente de lait est suffisante avant la fixation de la trayeuse et si l'unité fonctionne correctement.

2.1.5 Détachement de la trayeuse

Avant de détacher la trayeuse, il y a lieu de contrôler le degré de vidange du pis. La production de vide doit impérativement s'interrompre avant l'enlèvement de l'unité pour éviter la pénétration d'air, l'instabilité du vide et les risques de nouvelle infection qui en découlent.

2.1.6 Désinfection après la traite et mesures d'hygiène

2.1.6.1 *Les trayons*

Les trayons seront désinfectés à l'aide d'un produit adéquat, immédiatement après la traite. Il est impératif de désinfecter toute la peau du trayon. Il est recommandé d'associer au désinfectant un émollient, dont le type dépendra des conditions ambiantes.

2.1.6.2 *La trayeuse*

L'assainissement de la trayeuse entre chaque vache pourra s'effectuer par désinfection, pasteurisation et rinçage afin de réduire la propagation des agents pathogènes entre les vaches. Ceci est uniquement recommandé pour les troupeaux à problèmes, étant donné le faible bénéfice par rapport au coût.

2.1.6.3 *Nettoyage de la salle de traite*

La salle devra être nettoyée après la traite de chaque groupe de vaches pour maintenir l'installation de traite dans un état de propreté suffisant pendant toute l'opération de traite. A la fin de la traite, on procédera à un nettoyage en profondeur.

2.1.6.4 *Remplacement de la ration*

Il est recommandé de garder les animaux debout pendant 1–2 h après la traite. Ceci contribuera à éviter la contamination des trayons dont les canaux restent ouverts pendant quelque temps après la traite. Cette précaution peut contribuer à réduire le taux de nouvelles infections.

2.2 Facteurs et comportements des animaux

2.2.1 Uniformité et conformation des pis et des trayons

Un alignement correct de la trayeuse peut s'avérer impossible lorsque les animaux à traire présentent une position anormale des trayons ou un relâchement relatif du pis laissant insuffisamment de place au faisceau de la trayeuse. Les animaux souffrant de ce type de malformation donnent peu de lait et peuvent présenter un taux élevé d'infection. Si la cause est anatomique ou pathologique, il sera nécessaire d'abattre ces bêtes. Certains animaux ont des problèmes de poussée de lait à court terme et nécessitent des soins attentifs.

2.2.2 Etat et comportement de l'animal

Il est indispensable de consigner tout indice clinique de maladie. Tout comportement anormal de l'animal peut être le signe d'un mauvais réglage du voltage [2]. Pendant la traite, on observera le nombre d'unités de traite arrachées, tout signe de nervosité ou d'hyperactivité des animaux, etc.

2.2.3 Caractéristiques de la traite

2.2.3.1 *Etat d'achèvement de la traite*

Après une préparation suffisante du pis à la pré-traite, et après la traite effectuée à l'aide d'une unité de traite dont la conception et l'entretien sont suffisants, la quantité de lait obtenue par "égouttage" mécanique – ou rendement de l'égouttage – est généralement légèrement inférieure à 0,3 kg/vache. Les rendements moyens d'égouttage excédant 0,5 kg/vache sont souvent révélateurs de problèmes sous-jacents [3]. Parmi les causes les plus courantes, citons la stimulation insuffisante ou la traite incomplète, l'inadéquation du manchon ou son mauvais état, la position incorrecte de la trayeuse, le poids trop faible de la trayeuse ou le vide trop puissant pour la traite. En principe, dans les fermes industrielles, on détermine l'état d'achèvement de la traite soit par égouttage manuel soit par égouttage mécanique sur environ 10 vaches. L'égouttage manuel offre l'avantage de donner des indications sur la répartition du rendement d'égouttage entre les différents quartiers de la mamelle. Pour évaluer l'état d'achèvement de vidange du pis, on peut aussi pratiquer un test qui consiste à comparer la teneur en matière grasse des laits d'égouttage par rapport à celle du lait en vrac [4].

2.2.3.2 *Durée de la traite*

Des expériences menées sur le terrain démontrent que les vaches donnant 10 kg de lait par traite doivent rester à la trayeuse pendant environ 5 minutes, tandis que les vaches produisant environ 15 kg la gardent à peu près 6 minutes. Cette constatation permet de conclure que si le fait d'allonger la durée de la traite d'une minute par vache n'apporte pas un accroissement du rendement moyen de 5 kg par traite, le fonctionnement de la machine ou la méthode utilisée par le laitier doivent être remis en question [3]. Des calculs similaires s'appliquent aux autres animaux laitiers.

2.2.3.3 *Fréquence de glissement ou de chute des gobelets trayeurs*

Les débordements des unités et des conduites de traite dus essentiellement à l'insuffisance de capacité ou au blocage d'une soupape d'air, constituent les principaux facteurs de glissement ou de chute des gobelets de traite juste après leur fixation. Au stade

Tableau 1: Critères à prendre en considération lors de l'évaluation

Action et comportement de l'opérateur	Observations et mesures sur les animaux	Caractéristiques de la machine	Etat et gestion du troupeau
Préparation de l'animal	Uniformité et conformation des pis et des trayons	Type de gobelet trayeur	Formation et motivation de l'opérateur
Préparation de la machine	Etat et comportement de l'animal avant, pendant et après la traite	Type de manchon	Interaction entre l'opérateur et les animaux
Fixation de la trayeuse	Etat d'achèvement de la traite	Intervalles entre les changements de manchons	Hygiène générale
Supervision de la traite	Durée de la traite	Position de la conduite de lait	Aspects généraux (conditions de logement/nourriture)
Détachement de la trayeuse	Fréquence de glissement ou de chute des gobelets trayeurs	Taille du tube	Dénombrement des cellules
Désinfection après la traite et mesures d'hygiène	Condition des pis avant et après la traite	Enregistrement des vides	Teneur en bactéries du lait
		Caractéristiques de pulsation	
		Type et intensité des essais statiques	

l'opérateur, à l'état et au comportement de l'animal, aux caractéristiques de la machine et à l'état et la gestion du troupeau (Tableau 1). Le présent document contient les directives de bonne pratique. L'évaluation des méthodes a pour objectif de constater le respect de ces normes.

2 DIRECTIVES PROPOSEES EN VUE DE L'EVALUATION DU PROCESSUS DE TRAITE

2.1 Action et comportement de l'opérateur

2.1.1 Préparation de l'animal pour la traite

2.1.1.1 *Nettoyage des trayons*

La propreté des trayons au moment de la traite détermine le type de nettoyage nécessaire. Le nettoyage à sec sera préféré. Il consiste à nettoyer chaque trayon à l'aide d'un papier propre. S'il est nécessaire de laver les trayons, ils devront être séchés avec une serviette en papier individuelle avant la fixation de la trayeuse. L'eau utilisée pour le nettoyage des trayons devra répondre aux normes en matière d'eau potable. La désinfection des trayons avant la traite, par dilution d'un désinfectant dans l'eau de lavage ou dans le bain pour trayons, n'est recommandée que si elle est suivie d'un essuyage consciencieux.

2.1.1.2 *Prétraite et stimulation manuelle*

Avant chaque traite, on procédera à l'examen du premier lait à l'aide d'un récipient approprié. Le nettoyage soigneux du pis et la prétraite constituent, en principe, une stimulation suffisante avant la traite.

2.1.2 Préparation de la machine

2.1.2.1 Contrôle du fonctionnement et de l'équipement

Avant chaque traite, il est indispensable de procéder à des contrôles de routine. Il y a lieu de contrôler le niveau de vide de l'installation dès que celle-ci atteint ses performances maximales. En principe, les fuites d'air importantes et le fonctionnement des pulsateurs sont perceptibles.

2.1.2.2 *Contrôle de l'hygiène*

On profitera des opérations de réglage pour procéder à un contrôle visuel de la propreté de l'équipement de traite.

2.1.3 Fixation de la trayeuse

La mise en place de la trayeuse doit se produire, autant que possible, au moment de la descente de lait afin d'éviter de traire les trayons déjà vides. De toute façon, la trayeuse sera fixée au pis au moins 1,5 minute avant le démarrage de la stimulation [1]. Il est indispensable de manipuler la trayeuse avec prudence pour éviter la pénétration d'une quantité d'air excessive dans les gobelets trayeurs et pour empêcher que ces derniers entrent en contact avec du matériel contaminé. Cette précaution réduit autant que possible la propagation des bactéries et donc l'altération de la qualité du lait. Pour éliminer au maximum les risques de fuites d'air lors de la fixation de la trayeuse, il est recommandé de tordre les tubes à lait courts en forme de "Z" et de ne les ouvrir complètement que lorsqu'un trayon atteint l'embouchure du manchon.

2.1.4 Supervision de la traite

2.1.4.1 *Position de la trayeuse/gobelet de traite*

L'alignement correct de l'unité de traite est indispensable pour le bon déroulement de la traite et à l'évacuation complète du lait.

DIRECTIVES POUR L'EVALUATION DES PROCESSUS DE TRAITE

J. Hamann

(en collaboration avec le Groupe FIL A2D du groupe A2 sur les Machines à traire et la mammite)

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AVANT-PROPOS

Le procédé de traite est déterminant dans la production d'un lait de qualité, exempt d'agents contaminants. La recherche a clairement établi que la procédure de traite est étroitement liée à une période de hauts risques d'infections intramammaires susceptible d'augmenter l'incidence de la mammite dans les troupeaux. La mammite est l'un des facteurs majeurs liés à une réduction de la qualité du lait. En outre, la contamination du lait par des agents pathogènes bactériens, des matières organiques et des agents chimiques peut se produire durant la traite. La trayeuse mécanique est clairement le point central du procédé de traite mais d'autres éléments sont importants pour une traite efficace des vaches et la production d'un lait de qualité.

Les documents suivants fournissent un jeu important de directives à suivre pour évaluer l'ensemble du processus de traite des vaches et pas uniquement les éléments mécaniques de l'installation de traite. Les trayeuses mécaniques sont généralement évaluées lors d'un test mécanique de l'équipement pendant l'intervalle entre les traites qui est souvent appelé test statique ou "sec". Au contraire, les tests dynamiques ou "humides" sont effectués durant la traite des vaches et couvrent tous les aspects du processus de traite et pas uniquement l'équipement de traite. Les directives présentées sont l'oeuvre du Sous-groupe FIL A2D Traite mécanique. Le Sous-groupe A2D est présidé par le Prof. J. Hamann (DE) qui a aussi assumé le rôle dirigeant dans la préparation du document. Le Groupe A2 estime que les directives présentées permettront une évaluation systématique du processus de traite, incluant l'interaction entre les machines, les trayeurs, l'environnement et la vache.

K. Larry Smith
Responsable, Groupe A2

La FIL tient à remercier les membres du Sous-groupe A2D (Groupe A2) de leur contribution méritoire aux travaux de la FIL:

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RESUME

Ce document décrit les directives destinées à évaluer le procédé de traite mécanique dans sa totalité. L'application de ces directives devrait déboucher sur des informations détaillées relatives aux interactions entre d'une part la machine, le laitier et les vaches laitières, et d'autre part l'efficacité relative de la traite, l'enlèvement du lait et tout risque de nouvelle infection de la glande mammaire. Ces directives se basent essentiellement sur l'évaluation des critères suivants:

(1) action et comportement de l'opérateur;
(2) les animaux et leur comportement;
(3) paramètres de la trayeuse, et
(4) conditions générales de logement et de gestion.

1 INTRODUCTION

Entre chaque traite, l'installation de traite est soumise à un essai mécanique appelé test statique ou "sec" qui décrit les capacités techniques potentielles de l'installation de traite (par exemple vide opérationnel, vitesse de circulation d'air, pulsateurs). Le principal objectif de l'essai consiste à déterminer si l'opération répond aux spécifications et à identifier toute détérioration ou défaillance technique nécessitant une réparation ou un remplacement des composants. Cependant, ceci ne suffit pas à déterminer la qualité du travail effectué lors de la traite.

L'évaluation du processus de traite est une opération indispensable. Cette étude a pour objectif principal de décrire l'interaction entre la machine, le laitier et les vaches laitières durant la traite. Elle s'intéresse à l'efficacité de la traite, à l'enlèvement du lait et à tous les risques de nouvelle infection de la glande mammaire. L'évaluation peut aussi comporter un test dynamique ou "humide" effectué sur la machine pendant la traite d'une ou de plusieurs vaches. Les détails des mesures techniques prises lors des essais dynamiques feront l'objet d'un document FIL sur les 'Essais dynamiques des trayeuses' que le Groupe A32 (Trayeuses) est en train de préparer. Les principaux critères d'évaluation concernent les aspects relatifs à l'intervention de

comportement "calme et confiant" (les études à ce sujet sont peu nombreuses) participent à l'interaction entre l'homme et l'animal [10]. La nature des affinités qu'il entretient avec l'opérateur influence fortement le bien-être et la productivité de l'animal. Par conséquent, il est indispensable de noter le type d'actions et le comportement de l'opérateur.

D'autres facteurs comme les vibrations de la trayeuse, le vrombissement de motos, le bruit des mangeoires présentes dans la salle de traite ainsi que la présence de chiens constituent des facteurs importants qui influencent le niveau de stress imposé à l'opérateur et aux bêtes.

2.4.2 Hygiène générale liée ou non à la traite

L'évaluation de l'hygiène générale du troupeau tient compte d'éléments multiples, dont l'utilisation d'informations provenant des enregistrements sur l'hygiène du lait, l'examen visuel du processus de traite, les entretiens avec le personnel, l'examen des litières et le dénombrement des bactéries dans l'air pendant les opérations de traite. Le type de litière (par exemple sciure, copeaux ou paille) et la fréquence de son renouvellement exercent une influence directe sur l'importance et le type de la population bactérienne. L'état de la literie (sec, humide, organique, inorganique, propre, sale) influence considérablement le risque de contamination des trayons.

Des enquêtes sur la relation entre la contamination de l'air des salles de traite et les risques de mammites ont démontré qu'il existe une corrélation importante entre la fréquence des infections dues aux pathogènes environnants, et le degré de contamination de l'air (dénombrement total des bactéries, coliformes) [11].

2.4.3 Aspects généraux

Certains facteurs ambiants généraux comme le climat, le type et les normes d'alimentation, et les conditions de logement influencent l'état physiologique et par conséquent les risques d'infection et la sévérité des lésions. Plusieurs facteurs exercent une influence sur le risque de mammite: l'humidité du logement, les désordres métaboliques dus à la déficience en énergie, les lésions des trayons créées ou exacerbées par les litières et le climat. Il est important d'accorder une attention suffisante à l'examen de ces facteurs.

2.4.4 Dénombrement des cellules au niveau des quartiers de la mamelle, de l'animal et du troupeau

L'évaluation des données doit s'étendre sur une période d'au moins 6 mois. L'analyse doit observer la description donnée par Osterås et al. (voir le présent Bulletin, pp. 10-25). Si aucune donnée concernant le dénombrement des cellules n'est disponible, on peut utiliser les résultats du 'California Mastitis Test'.

2.4.5 Dénombrement total des bactéries dans le lait en vrac du troupeau

Le dénombrement total des bactéries présentes dans le lait en vrac du troupeau doit produire des données inférieures à 50 000 ctu/ml. Si elles sont supérieures à cette limite, on peut en déduire généralement que le nettoyage et la désinfection de l'installation sont insuffisants et/ou que le système de refroidissement est défectueux ou insuffisant. L'insuffisance de nettoyage et de désinfection peuvent également accroître les risques de nouvelles infections dues à la traite avec des gobelets contaminés.

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Recommendations for Presentation of Mastitis-Related Data

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 subgroup 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 that the document will help bring clarity to an area in need of clarity.

20 pp - in English only

Index: clinical mastitis, mastitis, somatic cell counts

Guidelines for Evaluation of the Milking Process

by J. Hamann (Germany) (in conjunction with the IDF Machine Milking and Mastitis Subgroup A2D of Group A2)

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 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.

5 pp - English and French

Index: machine milking

Directives pour l'Evaluation des Processus de Traite

par J. Hamann (Allemagne) (en collaboration avec le Groupe FIL A2D du Groupe A2 sur les Machines à traire et la mammite)

Ce document décrit les directives destinées à évaluer le procédé de traite mécanique dans sa totalité. L'application de ces directives devrait déboucher sur des informations détaillées relatives aux interactions entre d'une part la machine, le laitier et les vaches laitières, et d'autre part l'efficacité relative de la traite, l'enlèvement du lait et tout risque de nouvelle infection de la glande mammaire. Ces directives se basent essentiellement sur l'évaluation des critères suivants: (1) action et comportement de l'opérateur; (2) les animaux et leur comportement; (3) paramètres de la trayeuse, et (4) conditions générales de logement et de gestion.

5 pp - Anglais et français

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