Bas-Saint-Laurent
&
Côte-du-Sud
Regions

Assessment of Milk Quality and Dairy Herd Health under Organic Management

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PREAMBLE

Upon creating the *Envol – Lait biologique* Technical Support Club in 2001, the members established several objectives, including the improvement of the quality of milk on the farm. It seems quite conceited for an organic milk producer to say that his milk is better than another's since there is still no distinctive test which can verify this. On the other hand, most people agree that the quality of milk on the farm should be defined otherwise than by the absence of antibiotics, pathogens, pesticide residues and an acceptable somatic cell count. What if we went further in the definition of quality milk? It is a food product which:

- can be oriented towards a wider range of transformed products;
- as cheese, can mature in different manners;
- is very bio-available, both for calves and humans who drink it;
- can demonstrate the quality of a farmer's agricultural practices.

Prevention being a key to success in all organic productions, the organic milk producer must specifically develop this aspect in order to avoid health problems for his herd. Metabolic difficulties, problems relating to reproduction, digestion, udder's health, animal discomfort, etc., can result in onerous milk extraction stemming from the use of conventional remedies (as a last resort).

Therefore, the members agreed to provide themselves with various means to meet their objective: innovative tools and training from people who have a different perspective compared to that of the conventional sector.

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During such a training session, in November 2002, Mr. Bernard Berthet[1] told Club members that he was very familiar with the cheese factory in his alpine village in Haute-Savoie (France) and mentioned the way in which the milk producers were paid for their product. When each producer delivered his milk cans, a sample would be taken and placed in an incubator with those of the other producers. The incubator was then double-locked, and one key was given to a producer (a different one each week) and the other kept by the cheese maker. After 36 hours, a natural lacto-fermentation had occurred, and both the cheese maker and the producer would open the incubation chamber, assess the quality of the curd and determine:

- the most appropriate transformation process for the milk: butter, ripened or unripened cheese, aged cheese, etc;
- the price for each producer's milk based on the quality of his curd.

This know-how was passed down orally in France from one generation of cheese makers to another and is still used in places such as in Franche-Comté where the milk is assessed prior to producing the renowned (and labelled) "Comté" cheese.

Bernard Berthet taught us that today, in France, pasteurized drinking milk no longer keeps its shelf life in grocery stores and that the milk for consumption is therefore almost always UHT milk.

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1 Bernard Berthet has received training in: pharmacology, plant and botanical physiology with an ecological view, microbiology in hospital sciences and microbiology in food analysis.

Furthermore, it is now impossible for milk to be transformed into ripened, aged cheese in the Netherlands, as the curd quality is no longer adequate to direct the milk towards this market. Over the past ten years, the Dutch industry has been able to adapt and has developed a multitude of unripened cheeses.

The curd quality is directly related to the biogenic bacteria population (lactobacilli and lactococci) naturally present in the milk sample, as well as the biochemical composition of this environment. In fact, the biogenic bacteria have the properties of a bacteriocin – they eliminate germs when present in sufficiently large numbers – therefore they have an important bio-protection role.

In comparison, a milk of mediocre quality contains little biogenic bacteria since the quality of the biochemical environment is inadequate for their development. Therefore, pathogenic germs are capable of establishing their dominance; their presence indicates a disturbed or pathological state of the product (milk, cheese) or the organism (cow).

Therefore, this test indicates to the producer if their herd is in good health and/or if their practices and management favour the production of quality milk. Of course, one must consider the situation with an overall view since everything is inter-related. The herd environment (building, comfort, management, etc.), the sanitation level of equipment and material, the quality of feed provided and thereby the fertilization of fields, etc., have an impact on the final products.

It may therefore be possible to use this tool to assess and improve the quality of milk in Quebec, based on a qualitative diagnosis.

PROJECT OBJECTIVES

Assess the quality of organic milk produced on farms affiliated with the *Envol-lait biologique* Club, and provide tools to maintain and /or improve the quality of organic milk in Quebec.

The Valacta organic advisor and the producer shall develop new expertise in the field of milk quality for organic production. To do so, the Club has retained two means:

1. The natural lacto-fermentation test;
2. The expertise of Lawrence Andres, long-time organic milk producer from Ontario

MEAN # 1

Natural lacto-fermentation test

SUB-OBJECTIVES

1. Establish a tool for Quebec farmers to enable them to:

1.1 Determine the quality of milk produced under organic management;
1.2 Find means by which to improve/maintain this quality;
1.3 Suggest leads for identifying the source of the problem when quality is substandard;
1.4 Maximize the herds' health and by extension the health of people consuming the resulting products.

2. Verify the validity of the lacto-fermentation test as an additional observation tool:

Through statistical studies, check for possible correlations between the lacto-fermentation results and various factors related to management, nutrition, health, etc…

METHODOLOGY

1. Establish a tool for Quebec farmers: the natural lacto-fermentation test

After Ms. Sonia Gosselin (*Lait biologique du Centre-du-Québec* TSC) provided a half-day training session for *Envol* TSC advisors on the natural lacto-fermentation test, the project began.

- Sixteen herds participated in the project in 2004, 14 of which continued the data-gathering process in 2005. At the time of their monthly milk control with Valacta, the producers took 2 milk samples per cow instead of only 1. One sample was sent to the Valacta lab for the usual analysis, the other was entrusted to their Club's organic advisor who placed it in an incubator bought for this purpose by the Club (Quincy Lab, model 12-140). Another milk sample was taken from the cooler in order to assess the overall health status of the entire herd. Valacta provided the second set of specimen bottles (transparent and non-reusable) and ensured their monthly renewal in order to standardize the hygiene conditions required for these tests.

- After 36 hours of incubation, a reading of the results was done and their interpretation was noted and transmitted to the producer.

- Establishment of a file for each farm, for the purpose of compiling data. An Excel file was prepared to that end, and the monthly files were compiled, once from January 2004 to September 2004, and a second time from November 2004 to June 2005. Below are listed the parameters gathered by the advisors:

  - date of sampling
  - herd #
  - cow # (if cow/cow sampling)
  - age of cow
  - ranking (interpretation) of the sample after an incubation of 36 hours at 37°C
  - sample's condition in terms of keeping after 7 days and other observations (if there was a change compared to the previous ranking)
  - curd % of sample
  - odour
  - relevant notes (unusual things) on the farm on the day of the sampling i.e. mould in feed, damp silage, improperly washed reservoir, etc.
  - health status of cows (notes those in heat, with a health or leg problem, etc.)
  - days in milk (lactation phase) of herd, of each cow
  - lactation # of cow
  - ssc of herd/ of each cow
  - total bacteria of herd
  - various

  The cow/cow sample was kept for up to 1 week, which of the herd was kept longer, for future reference.

- Validation of the collected data: one month after the organic advisors started the lacto-fermentation process, there was a half-day meeting hosted by Sonia Gosselin in order to standardize the information.

- Sampling:
  A “briefing” was done by the agents on the minimal hygiene conditions required from farmers who wished to participate in this project. The samples taken for this purpose (incubator) had to be placed in a refrigerator until the agent’s visit. To be statistically valid, the project had to collect at least 2,000 milk samples.

- Summary results of the lacto-fermentation process were presented to the member each month. The trends became more visible with the addition of new monthly reports. Therefore, the farmer was able to establish, in collaboration with his organic advisor, additional correlations between the health status of each cow and/or the herd, and make the necessary corrections in terms of both management and feeding, eliminate those subjects presenting consistently substandard lacto-fermentation results, etc…, or simply continue the good work!

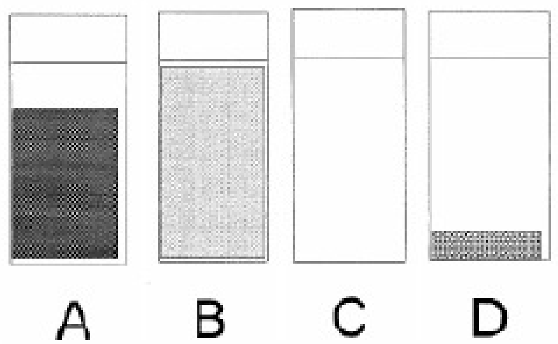
- Time allocated per member by the advisors for this project: 65 minutes were planned

The lacto-fermentation tests were conducted over two years (winters of 2004 and 2005).

2. Verify the validity of the lacto-fermentation test as an additional observation tool:

René Lacroix, Eng., along with Bruno Gosselin, P.Ag., both from Valacta, have compiled close to 2,000 samples gathered from January to September 2004 in 16 farms that are Club members. Through statistical studies, they sought correlations between the various data collected and the lacto-fermentation results.

RESULTS AND DISCUSSION



Bacteria and milk are a reflection of each other:

Incubated milk can present various aspects depending on the microbial families that "contaminated" the milk at the time it was extracted from the udder and on the biochemical or toxicological composition of the milk:

A: **homogeneous curd;** 40-50% of the volume
B: homogeneous **gel** (yoghurt) occupying the entire volume
C: milk remaining **liquid**
D: limited **curd; 1**0% of the volume or flaky, washed or totally digested curd

Figure 1 Natural lacto-fermentation of a milk sample incubated at 37°C for 36 hours

Compilation and discussion of lacto-fermentation data – Envol T.S.C., winter 2004

After a few months of tests on the farm but before compiling results, the advisors had already observed that:

- Feed has a considerable impact on lacto-fermentation results: substandard hay or silage (mould, dust, etc.) often produces lacto-fermentations in the "D" category and/or which explode (due to gas forming inside which indicates the presence of undesirable micro-organisms);
- Cows tested positive for *Staphylococcus aureus* often have inferior lacto-fermentations, especially when the feed is not well adapted;
- Certain families of cows often produce better lacto-fermentations than others, and vice-versa (and this is an indication for selecting cows whose calves should be set aside for breeding);
- The sanitary conditions of dairy equipment has a direct impact on "lactos". Specific cows in a herd may produce good "lactos", but if the cooler sample is graded "D", this clearly indicates to the farmer that there is some problem in the transfer of milk from the cow to the cooler. Without the lacto-fermentation test, the producer would not have known this!

The overall compilation of lacto-fermentation data for the 16 herds enrolled in the project in 2004 is presented in Appendix 2: "Preliminary analysis report on lacto-fermentation data".

Mr. Bernard Berthet was asked for his comments on this preliminary report, and these are included in Appendix 3.

Following the conclusions of these two reports, the farmers were determined to complete the experiment and chose to pursue the lacto-fermentation tests during the winter of 2005 while compiling the results for each herd. They then asked Mr. Bernard Berthet to interpret the results.

Compilation and discussion of lacto-fermentation data – Envol T.S.C., winter 2005

Below are a number of basic concepts presented in order to provide readers with a better understanding of test results.

It is acknowledged that milk contained in the cow's udder is sterile and is contaminated at the time of milking by the microbial flora responsible for the lacto-fermentation. This flora comes from three sources, all related to milking:

- Teats: This is a major source of potential contamination. The teat surface (which is in contact with the liners) harbours a great diversity of microbial groups with a strong prevalence of lactic groups. Their level is, on average, 100 times higher than that of microbial groups responsible for spoilage (coliforms, moulds, yeasts or anaerobics). Samples demonstrated that the microbial load on the teat surface varies from one season to the next (housing conditions of the animals). Also, in winter, straw bedding is associated with teat surfaces having higher flora levels with higher concentrations of microbes favourable for cheese production.
- Milking material: The microbial groups are not very diversified and present in relatively low concentrations. The levels of microbial groups responsible for spoilage were similar to that of microbial groups of interest for transformation.
- Ambient air in milking site: Intermediate reservoir, both in terms of diversity of the microbial groups detected and with regards to relation between interesting flora and flora responsible for spoilage. However, in winter there is a significantly higher level of mould in air samples.

Bernard Berthet provided a lot of basic information on the lacto-fermentation test, which will be used to explain the observations made by the advisors in 2004 and interpret those made in of 2005. Appendix 4 outlines the detailed description parameters of:

- ✓ Reference values for rating lacto-fermentation results
- ✓ Reference criteria for rating herd quality

Below are presented highlights of these basic notions:

The ***"A" quality*** rating is given to milk presenting a typical lactic odour. It is of high quality and optimal for all uses, namely for:

- ✓ Fine and long-ripened cheese
- ✓ Raw milk for consumption

…because sanitary quality must be certified. Indeed, when biogenic bacteria ("bio" meaning "life") are present in optimal numbers, they produce enough bacteriocins to eliminate pathogens ("pathos" meaning "disease") that could be deposited on food surfaces or attempt to develop within the food. Biogenic bacteria literally sterilize the food on which they live in perfect symbiosis. *Consequently, this food will present the characteristics of substances called "prebiotics".*

It is from this category of animals that individuals should be selected for dairy production and others be set aside for reproduction. The objective here is to identify animals that will be perfectly adapted to their living conditions, who are in optimal health and whose milk corresponds perfectly to the biological needs of the consumer.

Milk quality varies based on the various physiological phases of the lactation cycle: Quality A (or B) is obtained during maximum production and should also correspond to ideal physiological conditions for the animal. The quickness with which maximum quality is reached and its duration both:

- within a single lactation (therefore early into the lactation cycle and for a long time after the cycle has started),
- and during the animal's life span (therefore in the 1st and 2nd lactations and during several lactations)

are good signs for selecting breeding animals.

The ***"B" quality*** rating refers to milk that may contain low levels of enzymatic-reaction inhibiting substances (traces of antibiotics, sanitizers, pesticides…). This type of milk is inherent to certain races. The race is the optimal adaptation to feeding possibilities and the climate of the region.

This grade of milk can be used as fluid milk, for food formulations and for processed products that are destined to be consumed immediately. This grade of milk is therefore not suitable for long-term ripening because the stability of the processed product is not guaranteed (possibility that undesirable germs could develop due to the non-optimal number of biogenic bacteria).

The ***"C" quality*** rating represents milk of intermediate quality (sluggish milk with moderate deficiencies) and likely to evolve either into B or A grade, or D grade for those milks that exhibit limited lactic potential and marked deficiencies (these are often deficiencies in the animals' feed). The absence of lactic flora is common. Enzymatic-reaction inhibiting substances can also be present. Sanitation measures on the farm may be excessive.

These milks are vulnerable to any microbial contamination or technological processing. They are likely to result in intolerances, allergies…since they are unfavourable to the intestinal flora of the consumer.

The ***"D" quality*** rating is given to problematical milk. In this case, agriculture practices should be (re)assessed. The cause of the problem must be identified and stems either from:

✓ The animal:

  ▪ Animals who consistently produce "D" grade milk should be monitored for:

    - their lactation number (during the 1st lactation, the animal's physiology is adapting);
    - the stage of the lactation cycle at the time the lacto-fermentation test was conducted (the animal's physiology is different at the beginning and at other stages of the lactation cycle);
    - specific pathological problems (ketosis, undesirable germs such as *E. coli*, enteropathogenic agents, *Staphylococci*, *Salmonella*, *Listeria*).

  ▪ Dairy cows producing this grade of milk should:

    - profit from an improvement in their feeding conditions and be monitored to assess their reaction to this change (see below);

- be culled and removed from the genetic bank because their phenotype is not capable of producing milk with adequate biochemical properties for the development of biogenic bacteria.

✓ And/or the feed. The presence of coliforms, yeasts, etc. is frequently found in "D" quality milk, which is often the case in the following situations:

- too much grain in feed produces milk with excessive development of lactic bacteria and yeasts in milk, resulting in a "D" rating;
- too much soluble nitrogen (legumes) in feed;
- green feed given to animals during their rapid-growth period (too much soluble nitrogen) – the consumption of green feed should be restricted;
- moulds in plants (excess of organic matter in the soil vs. actual needs of the plant);
- non-mature silage (less than 6 weeks; silage is not stabilized with regards to microbial and biochemical levels);
- over-mature silage (loss of microbial and biochemical stability);
- excessive proportion of silage in ration (over 60%).

Another important consideration: Freezing will not destroy the intrinsic qualities of the silage, but will bring out its original flaws when the product's temperature rises to reach that of the animal's rumen.

✓ And/or an important biochemical imbalance in the milk. For example, milk containing too much biogenic bacteria tends to produce lacto-fermentation results that start with a "B" grade than moves quickly to an "A" rating, then to a "D" rating, which is typical of digested milk.

Microbiological and/or chemical analysis is recommended to identify the deficient components of this type of milk in order to better understand the observed phenomenon:

- quantitative chemical composition (casein, lactose, calcium, phosphorous…);
- qualitative testing of the milk (ratios such as protein/fat, casein phenotype, bound water/free water[2], soluble/total nitrogen compounds…);
- presence of enzymatic-reaction inhibitors;
- undesirable and/or pathogenic microbial flora.

Another important consideration: If the production volume exceeds by 20% the average value admitted for any given race, the milk's biochemistry will become unstable (insufficient casein, mostly free water, inexistent or scarce original lactic flora or other desirable parameter) and result in milk that is more vulnerable to ambient microbial flora.

"D" QUALITY MILK IS NOT ACCEPTABLE FOR CONSUMPTION

In conclusion, the quality of milk or any related food product is closely related to its ability to allow the development of lactic flora, including in humans.

[2] Free water, bound water: Water is more than just a diluting agent. Water is also involved in the structuring of all living matter. This can be observed when comparing plants or animal by-products from either organic or conventional systems. A higher level of bound water will promote the acid-fermentation process by lactic bacteria, whereas a higher level of free water will promote the alkaline putrefaction process by anaerobic bacteria.

The compilation of lacto-fermentation test results by Bernard Berthet provided the Club with quality ratings for each participating herd. This quality rating was attributed essentially based on the percentage of “A” + “B” herds.

According to this expert, the desired value of herds is > 85% in “A” + “B”, and < 7% in “C” + “D”.

Below are the results of 4 herds that stand out compared to the average results obtained:

Herd # 5: Average

%		Dec.	Jan.	Feb.	Mar.	Apr.	May	Avg.		
%	A	32.1	33.3	6.9	23.8	79.3	57.7	39		
%	B	0	3.3	0	0	0	0	1	40	82
%	C	46.4	43.3	79.3	71.4	13.8	0	42		
%	D	21.4	20	13.8	4.8	6.9	42.3	18		
%	Total	100	100	100	100	100	100	100		
%	Bulk	A	A	A	A	A	A			

B. Berthet’s assessment:

1. A + B: 40%, average C: 42%, very high D: 18%, high
2. Based on feeding conditions, 82% of the herd can produce good results (A+B+C).
3. The problem stems from the feed because there is a clear improvement of “D” grade milk from December to April and an increase in “C” grade milks from December to March. This means milk is sluggish but exhibits no dominant pathogen. May results are mitigated.
4. A deficiency seems clear and is due either to irregular forages or a change in the feed.

Observations in the field:

1. Though ranked high, the average result in “D” is the lowest of all herds within the project.
2. A+B+C = 82, the highest result of herds enrolled in the project. This potential should be explored.
3. The sample from the cooler was consistently rated “A”, a reassuring fact because this is the milk that is actually delivered.
4. No feed deficiency was identified, as we did not know where to look.

Herd # 8: Average to Good

%		Jan.	Mar.	Avg.		
%	A	50	77.8	64		
%	B	0	0	0	64	67
%	C	6.7	0	3		
%	D	43.3	22.2	33		
%	Total	100	100	100		
%	Bulk	n.d.	C			

B. Berthet’s assessment:

1. A + B: 64%, average to good C: 3%, low D: 33%, high
2. Based on feeding conditions, 67% of the herd can produce good results (A+B+C).
3. The problem stems from the feed because there is a clear improvement from January, with low grade feed (more “D” grades) to March where grade values tend towards “A”, demon-

strating better quality. This is a high-performance herd (vitality) because it reacts quickly to changes in quality of feed.

Observations in the field:

1. Of all the herds enrolled in the project, this herd has the best milk biochemistry for the development of lactic bacteria.
2. Ration has more dry hay than other herds in the project (not herd with best forage milk).
3. The sample from the cooler was rated “C” in March despite good overall results.

Herd # 10: Average

%		Dec.	Jan.	Feb.	Apr.	May	Avg.		
%	A	20.7	13.0	29.6	60.9	80	41		
%	B	0	0	0	0	0	0	41	65
%	C	27.6	43.5	33.3	8.7	5.0	24		
%	D	51.7	43.5	37.0	30.4	15.0	36		
%	Total	100	100	100	100	100	100		
	Bulk	A	n.d.	n.d.	n.d.	A			

B. Berthet’s assessment:

1. A + B: 41%, average C: 24%, high D: 36%, very high
2. Based on feeding conditions, 65% of the herd can produce good results (A+B+C).
3. The problem stems from the feed because there is a satisfactory improvement of results after January. May results are satisfactory. What event related to animal husbandry could have occurred in February to produce this variation?

Observations in the field:

1. In terms of reproduction, scc. and Giboudeau observations, this herd is doing very well.
2. The “D” rating obtained in February can be attributed to primiparous heifers and staph-infected cows. Between February and May, test results of young heifers improved (due to physiological adaptation? adaptation to their social ranking within the herd?)
3. The sample from the cooler was rated “A” twice (test was not done during the other months).

Herd # 13: Poor

%		Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Avg.		
%	A	40	38.5	4.0	12.5	24.0	8.3	22.2	3.7	19		
%	B	4.0	30.8	0	0	4.0	0	0	0	5	24	25
%	C	0	0	0	4.2	0	4.2	0	0	1		
%	D	56.0	30.8	96.0	83.3	72.0	87.5	77.8	96.3	75		
%	Total	100	100	100	100	100	100	100	100	100		
%	Bulk	n.d.	n.d.	n.d.	n.d	n.d.	n.d.	n.d.	n.d.	n.d.		

B. Berthet’s assessment:

1. A + B: 24%, poor C: 1%, low (desirable) D: 75%, excessive
2. Based on feeding conditions, 25% of the herd can produce good results (A+B+C).
3. The problem stems from the feed, as illustrated by the deterioration of results from November to June. The overall average of 25% is clearly insufficient and indicates one of

the following: feed does not provide adequate nutrition, milk production is excessive, herd is too old and/or sanitary conditions are inadequate. To be noted in this case, the variation beginning in December and presumably indicating the poor quality of the feed.

4. However, the “value” of the herd is low.

Observations in the field:

1. In terms of observations based on the Giboudeau method, this herd is doing well, plus it has a satisfactory percentage of serviced cows. Ration contains a lot of dry hay with high ADF. One could assume that milk production is excessive given the quantity of grains and quality of hay the animals receive. Indeed, this herd produces one of the best forage milks. So…??
2. No feed deficiency was identified, as we did not know where to look.
3. The “value” of the herd is low… Does this mean that the nutrient-absorption ability is low?

Overall results (14 herds)

Based on the compilation of results for each cow in every herd, the ratings given by Bernard Berthet for the herds enrolled in this project are as follows:

Total of A + B	Herd Quality	Number of Herds
< 20%	Very low	1
20-40%	Low	4
30-50%	Low to Average	4
40-70%	Average	3
60%	Average to Good	2
70-90%	Good	0
90-95%	Very good	0
> 95%	Excellent	0

We also compiled globally the results obtained from 1,970 lacto-fermentation tests conducted in 2005, as we did for 2004, and obtained the following percentages:

	A	B	C	D
2004	35%		34%	41%
2005	**30%**	**3%**	**17%**	**50%**

If we consider the results of milk samples taken from the cooler for 10 of the 14 herds enrolled (those where the quality of milk delivered to the market was to be verified), the following data is obtained:

Lacto-fermentation results of cooler samples/month

Herd #	Dec.	Jan.	Feb.	Mar.	Apr.	May
1	C	A	A	-	-	-
3	-	-	A	A	A	-
4	A	A	-	D	-	A
5	A	A	A	A	A	A

6	-	-	C	-	-	-
7	-	-	-	-	A	A
8	-	-	-	C		-
9	-	-	-	A	A	C
10	A	-	-	-	-	A
11	-	-	A	A	-	

A herd with several results has a more interesting profile than a herd with only 1 or 2 results.

Let's take, for example, the results of herd # 5, which has been rated as "average" (see page 12): this herd obtained 5 "A" ratings for its bulk milk samples. Can we still conclude that the quality of milk delivered to the market is more than acceptable?

In the same line of thought, could we conclude that, even if 50% of the 1,970 lacto-fermentation test results are rated "D", the bulk milk results of the 10 above-mentioned herds reflect a different image? Indeed, out of these 27 quite sporadic results, 22 are rated "A", or 81%, and there is only 1 "D" rating, and it is associated with a herd that otherwise registered only "A's". Is this a fluke?

Following recent training given by Mr. Fredi Schori, researcher at the *Agroscope Liebefeld-Posieux* Station in Switzerland (the abbey's experimental and certified organic farm), it seems relevant to study the "herd effect" of bulk samples to assess milk quality from a "delivery-to-market" perspective and analyze the individual results for each animal in order to select the best ones, with the objective, of course, of improving the herd and improving the quality of milk delivered to the market in the medium to long term. Indeed, the mixed milk of the cows in the cooler "corrected" individual results, unless they are too unfavourable and outperform the other "good" milks.

Interpreting the herd results herd-by-herd in 2005 rather than globally in 2004 will have enabled advisors and members to better understand the impact of the lacto-fermentation test as a qualitative indicator tool for milk on the farm.

One can conclude that organic milk cannot claim to be better in terms of quality. Obviously, we don't know what would be the results of lacto-fermentation tests from conventional herds. They would probably vary just as much.

We should also note that certain European countries have been working for many decades to control quality and that farmers who deliver milk for the production of cheeses with a long period of ripening have had the opportunity of selecting their breeding subjects and adjusting their husbandry according to the results of lacto-fermentation tests.

THEREFORE, IN ITSELF, THE PRODUCTION MODE FOR FOOD PRODUCTS (ORGANIC, BIODYNAMIC OR SUSTAINABLE AGRICULTURE, FARM-MADE OR "TERROIR" PRODUCT) DOES NOT NECESSARILY GUARANTEE A SPECIFIC RESULT WITH REGARDS TO THE BIOLOGICAL VALUE (BIO = LIFE) OF THE PRODUCT. This is exactly what Bernard Berthet told us in 2002.

Nevertheless, we believe that the organic production mode offers several advantages such as:

- better bound water/free water ratio
- very low level or absence of enzymatic-reaction inhibitors (antibiotics, pesticides, sanitizers)
- feed rations containing a maximum of 40% grains
- compost fertilizing of prairies
- etc.

The comments made by Bernard Berthet for each of our herds were extremely technical and somewhat beyond the level of comprehension we were hoping for. The distance and means of communication did not facilitate things. It is very difficult for us to establish connections between his recommendations and our reality, and we don't know where to start. If a Quebec-based consultant were to receive training from lacto-fermentation technicians in the Franche-Comté region, this person would return to Quebec with a considerable amount of knowledge that could be transferred to organic milk producers who wish to continue to improve or maintain the quality of their milk.

During his stay in Quebec, in 2002, Bernard Berthet had spoken about the microbial ecosystem that farmers must preserve and maintain on their farms, because all living products are associated with micro-organisms that both protect this product and allow it to exist. Reciprocally, the living product allows the microbial being to live. There is a symbiosis between the two and the quality of one is the reflection of the quality of the other. The stable health of a living product (soil, plant, animal, milk, cheese, man) is characterized by the absence of pathogens, the near absence of undesirable germs and by the presence of an optimal number of biogenes or their possible development. The health of animals and cultures, as well as the sanitation measures applied on the farm and equipment, allow well-informed farmers to optimize the selection of biogenes at the expense of pathogens.

Food must essentially be in the service of health and is a permanent factor in the balance between biogenic and pathogenic trends that coexists in all living products. Food must prevent disease. If a disease appears on the farm, changes must be made to the care given to the soil, plants, animals or humans in order to restore the deficient functions and revitalize the elements.

Bernard Berthet believes that the bacteriological quality of a food product is essential to maintain the health of consumers and is the result of multiple, point-by-point actions within the agro-food system (the farm, which is made up of the soil > plant > animal > man ensemble) in symbiosis with a common microbial entity that exhibits strong life-supporting affinities and, consequently, the desired food safety affinities.

The least that can be said is that the agro-food sector could benefit from a better understanding of the notion related to microbial ecology.

However, a recent statistical study conducted by Bernard Berthet (2006), in which more than 16,000 lacto-fermentation tests were done on 32 farms in Bretagne (France), has cast a new light and allows us to assess *the dependence of lacto-fermentation test results relative to the individual animal.*

"We don't know if all individuals (cows) produce similar milk – the development of which will only be dictated throughout the test by the state of the flora at the time of milking – or if each individual produces milk exhibiting different proprieties that affect the way in which it will be contaminated, and consequently the result of the lacto.

The conclusion of the statistical study has demonstrated that each cow produces a type of milk that probably has an effect, through its composition, on the way in which it will be contaminated by surrounding bacteria. Furthermore, the composition of bacterial flora has a lesser effect than the individual cow itself and, because the ambient microbial flora is the same for all the cows within any given herd, it is the intrinsic quality of the milk that explains the different grades of milk."

All participants in this study therefore concluded that "correlations between breeding practices, microbial diversity and the results of lacto-fermentation tests are difficult to draw. Lactos are influenced by feed, health and environmental conditions. What seems important is to be able to determine the reasons why some herds consistently produce grade milk and others produce “C” or “D” grade milks.

Our conclusion is yet another proof that those who wish to grasp the complexity of life in its integral scope will have to pursue their researches for many years to come.

MEAN # 2

Training for Valacta organic advisors with Lawrence Andres, Ontario organic milk producer

SUB-OBJECTIVES

Following a discussion, in 2003, with Lawrence Andres, the Club became aware of the impact of high somatic cell counts on the health of a majority of herds:

> Average scc of 300,000 = warning to the farmer that something is wrong.
>
> Average scc of 500,000 = the health of the herd is strongly compromised and the producer is under stress and could loose his or her certification.

In response to this concern, the Club decided to provide training for its organic advisors and offer the same training to members of other organic milk clubs in order to:

1. **Help organic dairy farms in Quebec produce better quality milk that will meet with all transformers' standards.**

2. **Transfer knowledge to allow advisors to "feel out" and better detect problems within a herd.**

3. **Help farmers understand what's wrong when a problem arises.**

4. **Foster the development of a prevention-based attitude among farmers and advisors.**

5. **Help advisors provide more consistent advice and members be more consistent.**

6. **Improve herd health and milk quality, in addition to other existing tools (vmem, lacto-fermentations, Giboudeau method, scc, etc.).**

7. **Motivate farmers to improve certain factors which could have considerable impact on herd health and milk quality.**

8. **Ensure short and medium-term support for producers in terms of follow-up and future improvements.**

METHODOLOGY

Four-day training seminar in the winter of 2004 (outside the PSDAB), then again in the winter of 2005 (within the PSDAB) for nineteen certified organic milk producers who are member of the Envol TSC. This training had to be given in the stable, during the herds' wintering period, to better each herd's breeding environment.

Syllabus of proposed training:

- Coaching at the farm with the producer and advisors, outlining in a step-by-step demonstration the <u>essential</u> and <u>fundamental</u> factors that make up a holistic production system. The chief objective of this initial visit is to identify the causes of such problems as:
  - various diseases (mastitis, pneumonia, acidosis -> high scc, etc.)
  - reduced life expectancy
  - injury
  - infertility
  - high/low stress levels
  - etc…

- This will be achieved by assessing and analyzing different aspects of the business, such as:
  - housing/living conditions of animals
    (i.e. type of stabling, allocated space, ventilation/air quality, animal comfort, quantity/quality of bedding, etc.);
  - feed management
    examine the feed given to animals to assess its quality, evaluate hygiene, ration, etc. with regards to type of storage used for feed;
  - herd state of health
    observe animals' overall condition, signs of distress/injury, signs of sub-clinical diseases (first signs of disease), expressions of well-being/social interaction within the herd, etc;
  - management of calves
    evaluate current methods vs. results;
  - quality of manures
    observe how manure is handled and how droppings are dealt with.

- Use of the OCPP (certification body) check-list, originally established in collaboration with Lawrence Andres (see Appendix 1) for "voluntary" winter visits of members of the Ontarbio Cooperative.

This list was then used by the advisor to support the farmer in his improvement process.

Teaching method proposed by Lawrence Andres for this training:
- sees himself as a resource person for advisors;
- avoid acting intrusively with farmers;
- avoid criticizing a farmer's practices but rather inspire them to change their attitude;
- motivate without being condescending;
- imposing standards produces fewer results than allowing the farmer to initiate changes in his practice.

During the evening, advisors exchanged notes on their visit to the farm that day. They discussed their perceptions and filled the check-list for each farm. Check-lists should not be used during the farm visit, since rating the business is not the purpose of this tool.

Below is a detailed description of the means developed to achieve each training sub-objectives:

1. Help farms in Quebec produce better quality milk that will meet with all transformers' standards.

MEANS:

Advisors from all three existing organic milk Clubs in Quebec were invited to meet in order to share knowledge of interest that can be directly applied by Club members. After the training seminar, Lawrence Andres was available in the following months to answer questions from organic advisors. During the first winter, considerable emphasis was placed on ssc, whereas calf management was more the focus during the following winter.

2. Transfer knowledge to allow advisors to "feel out" and better detect problems within a herd.

MEANS:

- After listening to the farmer and discussing his perception of the problem, take a look at the animals and breeding environment to try and detect symptoms, pick up on details that could confirm the farmer's appreciation of the specific problem;
- Encourage the farmer to see things from his animals' point of view: Are they happy to be here? To be living with us?
- L. Andres' "diagnosis"+ discussion

3. Help farmers understand what's wrong when a problem arises.

MEANS:

- Observations by other people who have a different perspective;
- Unusual observations made by people with a better sense of observation and/or more experience, knowledge;
- Analysis of the situation and discussion with the farmer;
- Lawrence Andres's notoriety produces results; also, because he is himself a farmer, he is aware of the effort required from an individual to change his or her attitude, to make decisions and stand by them.

4. Foster the development of a prevention-based attitude among farmers and advisors.

MEANS:

- Develop a global approach to dairy production management: feed, herd environment, comfort, cleanliness, feed quality, etc…
- Develop the ability to see things from the cow's point of view;
- Develop a sense of enquiry and analysis: why is there a problem with my herd? My building? See beyond the simple, "band-aid" solution to the problem (which is the method previously used in conventional systems);
- Choose to increase the proportion of dry hay in the ration, therefore:
    - Decide to put more effort into this type of conservation method for forages the following summer;
    - Perhaps even change the plant varieties grown on the farm to produce more dry hay in forages.

5. **Help advisors provide more consistent advice and members be more consistent.**

MEANS:

- Advisors have a common knowledge base;
- All farms that produce organic milk received a visit from an advisor;
- Advisors and members use the same vocabulary and members are more able to establish links between this knowledge and their own situation.

6. **Improve herd health and milk quality, in addition to other existing tools.**

MEANS:

- After the visit, a diagnosis is made, and other tools can be used to countercheck certain information or follow-up on a specific matter:
  - vmem, lactos, scc
  - Giboudeau method (ruminal stability: check the ration)
  - check conservation quality of the feed
  - take note of where forages are stored and take more forage samples related to the observed layout;

- It is easy to make a diagnosis in the case of a problem related to total bacteria, and this problem is easily solved: hygiene within milk line and cooler;
- Recommend conducting a water analysis every year;
- Recommend disinfecting the well once a year (for some members);
- Select subjects with a low ssc.

7. **Motivate farmers to improve certain factors which could have considerable impact on herd health and milk quality.**

MEANS:

Using the training method proposed by L. Andres for this training, as described above.

Motivate and promote change without being condescending:

- subsequently apply the proposed method to produce the identified change;
- if results are positive, they will motivate the farmer to make another change.

8. **Ensure short and medium-term support for producers in terms of follow-up and future improvements.**

MEANS:

- Distribute check-list to advisors;
- Provide a copy of the check-list to farmers, not as a “grading” tool for his business, but more as a guide to help identify areas to work on, priorities and follow-up in the upcoming months;
- Use the check-list to track progress since the initial visit (in particular during the fall when objectives are set out for the herd);
- Make one improvement at a time to ensure success;
- What do farmers thing of this tool?

RESULTS AND DISCUSSION

Lawrence Andres' two visits made all members aware of one thing: *they can act and produce change on their farm*. Thanks to the knowledge and sharp sense of observation of this particular organic farmer, and to his generosity in sharing his expertise with other organic milk producers, Club members became aware that they too could develop a sense of what's going on with their herd. The organic advisors of 3 TSCs also acquired new knowledge that they can apply in support of their respective members.

In 2004, 3 herds within the Envol Club were prohibited from delivering milk because of a scc over 500,000 during 5 months. Lawrence Andres's visit helped these farmers understand that this situation, which they had been living with for some time, was far from normal. Two years following Lawrence Andres' last visit, the spin-offs are still materializing with regards to the quality of the milk produced by these herds: the average scc of 2 of these herds is currently under 200,000; and the 3rd herd has a stable scc of approximately 350,000.

Organic agriculture helps producers understand that they can acquire the knowledge they need to properly manage their herd and thus free themselves of many products available on the market that don't really provide real solutions.

Since 2004, all Club members have taken action and, despite the fact that there are now more herds in the Club and despite the production incentive (7 days/month), the average scc has gone down:

Year	Number of herds	Average scc
2004	20	332,000
2005	24	328,000
2006	27	294,000

Since 2004, other changes have also been made to the ventilation of farm buildings, the quantity of bedding applied under the cows, the size of stalls, the exercise offered to animals, parasite electrical power, geo-pathogenic areas, etc., thus providing a better environment and as a result, improving herd health.

Changes were also made by a majority of members regarding calf management (more milk and for a longer time, healthy milk, socialization) in order to improve overall scc in the long run. Several members changed udder washing products and teat dips.

Club advisors are now more consistent in their advice to members and stress the importance of fundamentals with regards to animal husbandry (they call it "driving in the nail"!) The credibility and attitude of Lawrence Andres during this training also had an impact on members because they assume if a farmer just like them does it, someone who understands their situation and the difficulties in making change happen, and then perhaps they can do it too.

Club advisors say they are better equipped to present in a simple and clear manner why members should trigger changes on their farms. One of the advisors in particular said he could relate to Andres' concept of "animal comfort" and concluded that the training method adopted (visits to members' farms) was a great formula and that he was ready for another training session. Most of the members who received a visit during the winters of 2004 and 2005 made considerable progress with regards to their understanding of what constitutes a good breeding environment and better quality milk.

CONCLUSION

Both components of the project conducted by the Club have increased the members' understanding of just how important the quality of their milk can be. This is a major improvement compared to the farmers' attitude when they were producing milk under conventional management. Given the current context where producers are encouraged to increase their production of organic milk, quality can be quite a challenge!

The quality of the forage given to animals and the way in which it is conserved were amended in the summer of 2004, following the results of the lacto-fermentation tests performed in the previous winter. Several farmers became aware of the importance of serving quality feed.

Club members chose to make changes one step at a time, and this constitutes in itself a change and a success, according to Lawrence Andres.

The lacto-fermentation test is an interesting tool, despite the fact that it was not used to its full potential in the course or our project. The Envol TSC was happy to bring a small contribution to this tool. We hope that it will be appropriated more thoroughly in Quebec by another organization that will have the resources needed to fully comprehend it and relate it to observations made in Europe.

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APPENDIX 1

Assessment of organic milk production systems in improving and maintaining herd health and milk quality

(From: *Livestock Inspection Check-list and Report*, OCPP inc.)

Farm: **Date:**

OK: Acceptable NI: Needs Improvement UA: Unacceptable

	OK	NI	UA	
A: SITE DESIGN				
General appearance				
Entrance and farmyard				
Building upkeep				
Manure storage				
B: MILK HOUSE				
Clean and tidy				
Condition of floor/drain				
Walls and ceiling				
Lighting				
Sink				
Hose and nozzle				
Exterior of cooler				
Location of compressor/condition of radiator				
Ventilation/air quality				
Cleaning products				
C: MILKING EQUIPEMENT				
Liners				
Liner supports (for washing)				
Claws				
Air tubes				
Milk hoses				
Reception jar				
Milk line surface – milk taps				
Milk buckets/utensils for feeding calves				

D: MILKING ROOM				
Walls and ceiling				
Floors and milking platform				
Barriers				
Drainage				
Lighting				
Ventilation/air quality				

E: STABLE				
Dimensions of the stalls*/free stalls				
Areas with accumulated bedding **				
Social interaction				
Scouring				
Aisles				
Walls and floors				
Ventilation/air quality				
Lighting (natural/artificial)				
Calving/maternity parks				
Water (clean and always available)				
Feeders				
Daily exercise yard ***				

*Enough room to move freely, groom themselves, get up/lay down, stretch their limbs
**Clean, dry and comfortable in terms of quantity and quality
*** Area, roughness, water supply, sheltered from wind

F: CONDITION OF DAIRY/CULLED COWS				
Clean				
Calm, content, alert				
Flesh/coat condition				
Feet and limbs/joints				
Clean and dry udder				
General state of health/symptoms of stress				
Consistency of droppings				

G: HOUSING OF CALVES				
Size of fence /stall/kennel				
Clean and dry bedding				
Scouring				
Lighting (natural/artificial)				
Ventilation/air quality vs. temperature humidity				
Size of group pen/ animal density				
Bottles/buckets/barrels				
H: STATE OF CALVES				
Clean				
Calm, content, alert				
Social interaction				
Flesh/coat condition				
Feet and limbs/joints				
General state of health/symptoms of stress				
Consistency of droppings				
I: HOUSING OF HEIFERS AND BULL				
Size of stall/pen				
Clean and dry bedding				
Ventilation/air quality				
Scouring				
Lighting (natural/artificial)				
Water				
J. STATE OF HEIFERS AND BULL				
Clean				
Calm, content/vigour				
Flesh/coat condition				
Feet and limbs				
Social interaction				
General state of health/symptoms of stress				
Consistency of droppings				

K: FEED				
Nutritionally balanced and complete ration				
Fodder vs. concentrate				
Dry hay – to all age groups				
Minerals – Vitamin supplements				
Probiotics				
Feed quality– Absence of mould				
Appearance/odour				
Sanitary state/cf: Manure, soil, etc				
L: OTHER NOTES/OBSERVATIONS				

APPENDIX 2

Preliminary analysis report of lacto-fermentation data

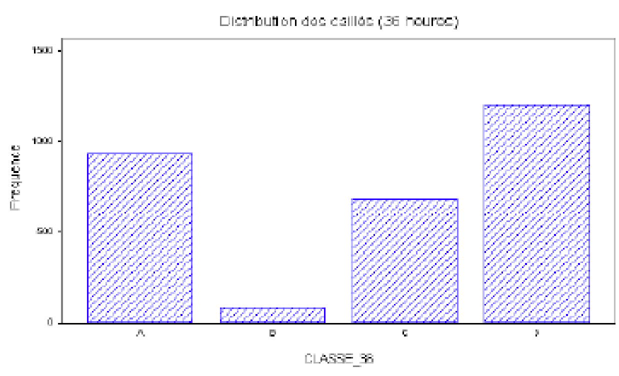
By René Lacroix, P. Eng., and Bruno Gosselin, P.Ag.

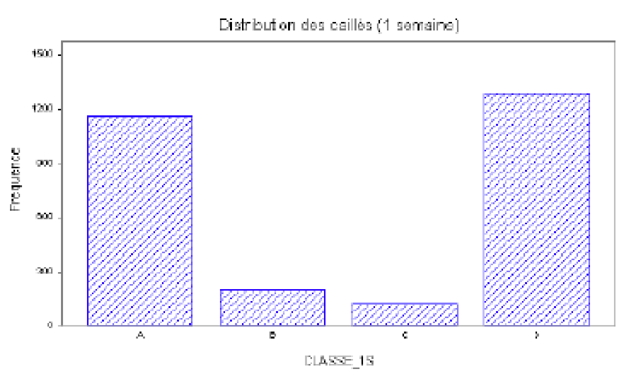
1. Introduction

In total, 2,914 milk samples were collected from individual cows between January and February 2004 among 16 Club l'Envol member clients. These samples were used for lacto-fermentations. On average, 182 data items were collected for each farm. The following data were collected: curd ranking at 36 hr, curd ranking at 1 wk, evaluation of curd %, odour rating. The data was extracted from V2K from each cow: lactation stage, parity and somatic cell count (scc). This document outlines some of the results of analysis done on these data.

2. Distribution of curd classes

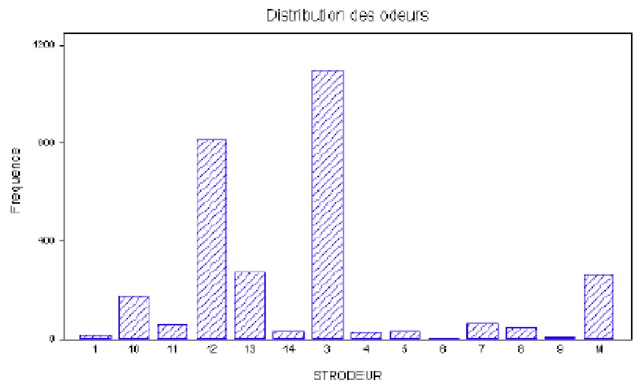
- 35% of samples had a type A or B curd after 36 hrs
- 41% of samples had a type D curd after 36 hrs
- The curd % went from 24% to 5% between 36 hrs and 1 week
- The % in each class varies greatly between herds. For example, the A % at 36 hrs varies from 8% to 54% and from 21% to 60% after one week





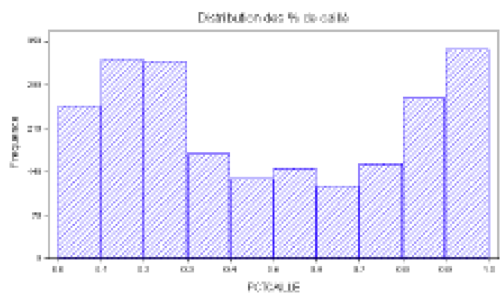
3. Distribution of odours

- Over 80% of the samples were ranked by 3 odour ratings
- 42% had a 3 rating (yeast)
- 31% had a 12 rating (lactic acid, yogurt)
- 10% had a 13 rating (vinegar)



4. Curd percentage

- A large proportion of curd percentages are less than 30% and more than 80%.
- The correlation between curd percentage and somatic cell count is very low (about 5%) and negative.
- No relation was observed with parity.
- A positive correlation of around 17% was observed with the lactation phase.



5. Lactation phase

- After analyzing the data based on 30-day stratums, we observe that the type A curd % increases with the lactation phase.
- The type D percentage reduces after about 200 days in milk.

6. Seasonal effect

- The curd percentage and the curd class percentages seem to vary from one month to another.
- The average curd percentage is higher from May to August.
- However, we should consider the herd effect in the analysis in order to identify any seasonal trends.

Conclusion

This document presented the preliminary analysis of the lacto-fermentation data. Any interpretation of this document would require a more in-depth analysis of the data, including a detailed herd-by-herd analysis. Such interpretation would also require a literature review on milk microbiology and on previous lacto-fermentation studies.

APPENDIX 3

Comments on the preliminary analysis report of lacto-fermentation tests
Envol TS Club - 2004

Laboratoire BERTHET
analyse conseil formation en agro-alimentaire

Introduction

The main principle of this method is based on a comparison between the profile obtained for the milk sample and a “reference” profile:

- if the sample is consistent with this reference, it is considered “satisfactory”;
- if the sample is not consistent with this reference, it is considered “problematical” and other investigations will be necessary to determine the deficient parameters and all the possible causes.

Some important points on the evolution of lacto-fermentation:

- Acidification transforms **the milk** that goes **through the following stages**: from liquid milk (note C), to jellified milk containing little lacto-serum (note B) within 20 hrs at 37°C, then the curd develops (note A), usually between 24 and 48 hours.
- In the event of a **major abnormality** in the physico-chemical and/or microbiological composition of the milk, the destruction of the curd leads to what is referred to as a “digested” curd (note D).
- In the event of a **minor abnormality** or special characteristics, certain milks are considered sluggish and, after one week, exhibit optimum curd characteristics (note A). This is the maximum possible delay.
- Depending on the activity of existing lactic bacteria and the biochemical composition of the milk, the curd can contract after a week, and then stabilize for several weeks. However, curd volume should never be less than 60% of the total volume for a **milk of excellent quality**. Depending on its profile, the milk will present characteristics specific to a particular type of use.

Milk is produced by the mammary gland and is meant to feed young mammals of the same species. Its nutritional composition is adapted to the growth speed of the young animal it is intended for. Because of its composition, milk can be transformed into cheese. The components come either from the feed, the metabolites formed by intestinal fermentations, or the syntheses and modifications carried out by the mammary gland cells. And this is precisely the physiological process that the lacto-fermentation test must highlight.

Comments on the preliminary report

Item No 2: Distribution of curd classes

35% of the results are favourable; therefore 65 % of the animals are in an unfavourable physiological state. These are the animals among which one should look for abnormalities: feed and/or health problems (namely among the 41%). This restricts the veterinary research and allows us to have reference animals per farm (the 35%).

The reduction of curd is normal; see this comment in the introduction.

The variation between herds is logical since the results depend on the practices which account for all the factors specific to each agricultural land base: soil, crops and agricultural practices, feed and herd behaviour.

Within 30% of favourable results (A+B), the herd presents feed and health problems. The feed quality characteristics should be examined first:

- As a reference, one must take the lactos from a specific land base and during a period that is considered to be the most favourable for the available feed and corresponding to 70% of A+B (reminder). Understanding the origin of the gaps is important; lactation period and feed quality need to be taken into account. The very beginning and end of a lactation period will produce milk with specific characteristics unfavourable to lacto-fermentation. The micro-organic qualities of the feed are also important, especially with regards to their fermentative characteristics (presence of lactic flora). Correct necessary practices.
- If the reference of 70% satisfactory is not found in the land base, perform the same analysis as above and make the necessary corrections. It is probable that animal health problems exist in this case: incorrect choice of race, of husbandry and poor adaptation to the available feed.

Item No 3: Distribution of odours

What odours are used for the study?
They are the product of microbial metabolism and provide information on the metabolic pathways and microbial families present. **Lactic aroma is the dominant aroma in lactic fermentation** but it must remain moderate. In the case of digested milk, the lactic odour can be very strong and result from excessive development of the lactics. It is very important to remember that the number of lactic bacteria must be optimal for any given environment, a lack or an excess is harmful to its integrity.

Item No 4: Curd percentage

What is the selection criteria used for first-line data?
The study does not indicate the type of curd or the number of cells (bacteria). These parameters should be determined to allow interpretation. There is a positive correlation between certain types of curds and the number of cells. One must reconsider the role, interest and function of the cells.

What does the third-line mean?

A correlation exists with the lactation phase, but the interpretation must be pushed further and it is necessary to specify this fundamental parameter in more detail since it allows one to select the best animals and the animals' reactivity to the constraints of breeding and production. One must revise the data in Item No 5 (too vague) to establish corresponding curves while taking into account the following parameters:

- based on the overall average for the period from the start to the end of lactation;
- per curd category by integrating the total lactation period;
- per agricultural land base using above-mentioned specifications.

Item No 5: Lactation phase (see above paragraph)

Item No 6: Seasonality (see comments under Introduction)

APPENDIX 4

Reference values for the determination of milk quality

3.1 Milk quality

The chemical or microbiological reference values are intended as parameters accessible by current lab analysis methods that are accepted, at a given moment, as standard values. **Bacteria and the environment are each other's reflection.**

The reference values (RV) consider the following parameters:

1. **The quantitative chemical composition** corresponds with the allowed presence of a natural component such as casein, lactose, calcium, phosphorous…
2. **The qualitative chemical composition** corresponds with certain components such as protid/lipid, calcium, phosphorous…or the distribution of variants for a category of elements like the casein phenotype, nitrogen compounds (soluble/total), free water/unfree water…
3. **The presence of enzymatic reaction inhibiting elements**
4. **The importance of the total lactic flora and the lactobacilli and lactococci ratio**: the biological value of the milk is linked to their presence and an optimal value of 15,000 cfu/ml for a ratio of 1.8. An excessively low value is correlated either to an excess of inhibitors, linked to inappropriate hygiene practices, or a biochemical imbalance of the milk and (or) the animal's feed. This deficit is generally found in all agricultural land base spaces. A high value indicates either a local infectious process or a major a biochemical imbalance of the milk. After a quick passage through B and A aspects, lacto-fermented milk tends to move towards the D characteristic of digested milk.
5. **Undesirable flora** includes alteration germs such as aerobic mesophilic germs, coliforms, anaerobics and other eventually pathogenic types, which are either yeasts or moulds. These micro-organisms develop in all environments having characteristics of biochemical imbalance.
6. **Pathogenic germs** (entero-pathogenic e.coli, staphylococci, salmonelle, listeria): product conformity is provided in relation to the absence or a maximum normative germ limit found in the analysis. The bacteria can be found at all levels of the agricultural eco-system where they could persist or even develop **(figure 4)**: The animals' digestive tract is a favourable environment for its development. The excrements will then contaminate the soil, the artesian system, the farm buildings, the fodder plants gathered after wilting or those intended for ensilage, an area with high multiplication potential, thus a new source of contamination, on plants by the presence of contaminated organic matter in the soil.

The lacto-fermentation test, a very old approach, is not part of the currently standardized methods but it is being used again by many professionals since it allows, inexpensively although qualitatively, to select the milk quality as defined in the previous chapter. The classic microbiological and (or) chemical analyses allow one to determine eventually deficient components in order to better understand the observed phenomena.

The rating leads to the following appraisals:

A RV 1 to 6 optimal. Optimal milk for all uses namely for long-ripening products since the stability of RV 6 is interesting for the consumer. Used as a beverage, with the usual precautions, its allergenic properties are limited. This food presents the characteristics of pre-biotic substances.

B RV gaps of little significance. The slight presence of RV3 can be found. This characteristic of this type of milk is inherent to certain races. The race is the optimal adaptation to the feeding possibilities and the climate of the region. Usable for beverages, food preparations and transformation products meant to be consumed “fresh”. The RV6 stability is not guaranteed in the long-term.

C Gaps that are often of little significance with RV 1, 2, 5 and 6 but the absence of lactic flora is common. The presence of inhibitors is possible. The hygiene rules can be excessive. This is often due to deficiencies in the animals’ feed. These are vulnerable products and are likely to result in intolerances, allergies…since they are unfavourable to the intestinal flora of the consumer.

D Variable and significant gaps for all RV. Micro-organic and/or chemical analysis is recommended to determine the deficient RV, to find the eventual causes and propose possible interventions. Not acceptable for consumption.

Reference criteria for the determination of herd quality

3.2 Herd quality

Herd quality is basically evaluated in relation to the percentage of milk in A or A+B. It is retained according to the following ratings:

< 20%	Very low
20-40%	Low
40-70%	Average
70-90%	Good
90-95%	Very good
> 95%	Excellent

For C and D milks, the following ratings will be used:

< 20% low
7 to 30% high
40-70% very high
> 70% excessive

The values of the used thresholds correspond with the key moments in the growth chart belonging to each microbial family in question in the considered eco-system, in this case the milk or the agricultural land base. According to the “nutritional state” of the environment, there is competition between the microbial flora and, according to the dominant flora, the result will be A, B, C or D. This activity is identical at all levels of the food chain considered as an eco-system. The agro-food eco-system is made up by relations of different spaces as well as direct or indirect links for bacterial or other contaminations (figure 4). Man, with his farming cultural, transformation and hygiene practices, must respect each space occupied by an antagonistic lactic flora able to ensure the security of the agro-food environment.

The reference criteria (RC) consider the following parameters:

1 The selection of animals: The objective is to find an animal ideally adapted to its living environment, therefore in perfect health, and producing milk corresponding entirely to the biological needs of the consumer.

2 Animal pathologies or physiological states normally observable among the animal placed in defined production or feeding conditions. At the different physiological phases of lactation, the milks are of variable quality: A (or B) quality corresponds with a production maximum, meant to correspond with the ideal physiological conditions for the animal. B (or C) quality often corresponds with extreme production periods for the animal’s age during the first lactation. The quickness with which maximum quality is reached and its duration, both during lactation and the animal’s life span, are good signs for selection. A behaviour pattern can thereby be traced for each animal.

3 Hygiene conditions practiced. Lack and excess are important parameters. The reduction of the multiplication of undesirable and pathogenic germs requires the application of hygiene measures in the breeding, milking and transformation areas. In fact, the required intervention measures integrated in the hygiene practice principles are harder to apply than curative measures, if only for the difficulty of assessing their immediate interest, but they ensure the continuity of any living system. The breeding buildings, the area and terms of compost, the fodder storage areas, relations with the cultivated areas; all are part of a whole or an eco-system and should be organized as such.

4 Quality of the animals' feed. In Phase D, the presence of coliforms, yeasts, etc. is often found. This is frequently encountered in feed having an excess of grain, soluble nitrogen (legumes), plants loaded with moulds, ensilages that are too young (less than1 month), too old or representing an excessive portion of the ration (over 60%)…Other assessment possibilities are underway. Among the criteria figuring in paragraph 2, the natural aptitude for fermentation, thus for conservation and consumption is the most accessible to experimentation.

The herd's quality ranking, values A or A +B, will lead to the following appraisals:

< 20% Very low: RC 1 to 4 not controlled at the herd level. Start research for RC3 first, meaning the hygiene conditions (could be a lack or excess), ten RC4. Wait for herd reactions before assessing RC2 per animal and then consider RC1. When the D percentage is high, there are more RC 4-related problems; especially above 70%. When the C percentage is high, there are more RC 3 or feed-related problems.

20-70% Low to average: RC4 for which insufficient control at the herd level creates major reactions for individuals requiring verification for RC1 and RC2. This is a heterogeneous herd. Monitor for RC3.

70-95% Good to very good: The RC are controlled for the animal production, specific cases should be studied individually. Specifically monitor fluctuations during feed transitions by keeping in mind that too much variation harms the stability of microbial flora not only for the animal but also for compost flora and beyond that of the soil, therefore the vegetable rhizosphere. Unbalanced organic matter favours the development of cryptogamic diseases.

> 95% Excellent: Monitor RC1 to RC4 for divergent cases.