

# Milk Quality & Human Health

Report from Prof. Ton Baars in cooperation with Ruth Adriaanse, Machteld Huber of the Louis Bolk Institute, Driebergen (NL) and Jenifer Wohlers, co-worker of the Department of BD Agriculture, Kassel. The report is a translation of an article published in the German biodynamic magazine 'Lebendige Erde' No. 6, 2005. Ton Baars currently holds the chair of biodynamic agriculture at Kassel University, Germany.



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## ABSTRACT:

**In Part 1 of the report Professor Baars outlines a need to consider the dynamic balance of the bovine nervous system with regard to influences of feed quality, animal husbandry and breeding management on cow health. Baars elaborates methods of assessing and measuring dynamic balance and explores the effect of human relationship upon animal health.**

**In Part 2 he discusses on-farm trials and recent research from a comparative study of biodynamic, organic and conventional dairy farms undertaken by the Louis Bolk Institute, Netherlands. Methods of quality research and their respective outcomes are explained and discussed.**

## DYNAMIC BALANCE AND COW HEALTH

Experience tells us that a good relationship between cows and their caretaker has a preventive health effect but do we know why this is so? Baars states that this health effect is regulated by the limbic system in the brain of all mammals. While the brain's neocortex controls the cognitive aspect of the animal organism, the limbic system regulates emotional function. In humans the development of the neocortex is predominant. In other mammals the limbic system is more important. The emotional brain or the limbic system controls the physiological balance of breathing, heart-beat rhythm, blood pressure, appetite, sleep, sexual drive, hormonal distribution and even the functioning of the immune system.

In general it is the condition of homeostasis which, as dynamic balance, forms the basis of life as we know it.

The brain and the heart are connected via the sub-conscious, autonomic nervous system<sup>1</sup>. The heart is continuously sensing what is taking place within the body. Emotional triggers also affect the heart's response. The heart 'speaks'

and influences the entire physiology of the organism. In so doing it uses the sympathetic and para-sympathetic nerve systems. In the rhythm of the heart beat we experience the living or dynamic balance of these two systems. Working in synchronicity, the sympathetic system governs increased heart rate associated with stress and escape while the parasympathetic works to calm and reduce heart rate. The dynamic balance between these two systems is the reason why the pause between two heart beats is never the same. We should really speak of heart rhythm rather than heart beat.

All this becomes very relevant in a practical context for animal health is a matter of dynamic balance. Therefore any prolonged stress will finally result in imbalance or loss of centre. Daily rhythm and the rhythms associated with the week and even with the years have an influence on this pattern of balance and imbalance. Not all imbalances are immediately obvious nor do they necessarily cause irrevocable damage to the animals in our care. Stress among farm animals has a variety of causes. Most are the result of husbandry which is not in conformity with the natural needs of the livestock especially when the nature of the animal is not entirely understood.

In dairy cows stress results from:

- **incorrect feeding** such as insufficient omega-3 essential fatty acids, too many concentrates, poorly structured diet, excess protein content, lack of grazing.
- **poor husbandry** resulting in stress caused by herd mismanagement, mismanagement in the milking shed, lack of shade, insufficient shelter from wind and storms.
- **incorrect herd management** such as prematurely separating calves from mothers so that not enough time is allowed for rumen development, not enough suckling allowed for, herds structured without accounting for the age of animals, the herd as an organism, the herd size, or running the bull with the herd.
- **wrong relationship of caretaker towards livestock**; not enough physical contact (brushing and cleaning),

lack of dominance by caretaker over the herd or its opposite; excessive threat, misunderstanding of the main livestock needs.

- **wrong breeding approach** whereby genotype and environment aren't synchronised with the result that the animal's body is out of balance. Examples include forced lactation being dependent on high intake of concentrates. Such conditions lead to disease in the medium to long term and potentially shorten the life span of the animals.

How can we find out if an animal is out of balance? We can measure the change in frequency of heart-beat over a 24 hour period following an induced stress or we can look at the immune response as measurable in the blood. We can also quantify it by determining the composition of fatty acids in the blood or in the milk.

### THE EFFECT OF PRODUCTION SYSTEMS ON MILK QUALITY

Throughout recent years various trials have been conducted in Europe regarding milk quality. Of particular interest is the effect upon human health of milk from biodynamic, organic and conventional production systems. Some of the questions that have been researched include human allergenic reactions, homogenization, animal diet and feed quality and the effects of dehorning. Research parameters encompassed the taste of raw milk, copper chloride crystallisation, biophoton-exchange, immune response and fatty acid composition. These parameters were recently researched in a Dutch study of milk quality undertaken by the Louis Bolk Institute; cows kept indoors on 5 organic/bd and 5 neighbouring conventional farms were fed a winter diet and their bulk tank milk samples analysed.

Taste tests conducted by a trained panel found no significant difference in the milk produced under the three systems. Organic milk and the pasteurized biodynamic milk were slightly creamier. In other studies however organic raw milk scored poorly due to oxidation of milk fat.

The content of unsaturated fatty acids, especially Omega-3, was twice as high in the organic/biodynamic milk. The content of the most valuable of the Omega-3 fatty acids, alpha linoleic acid was more than double in the organic/biodynamic milk. Other important fatty acids were also higher. Fatty acids have a major role in growth and function of the nervous system and in the alleviation of stress. The ratio of Omega-6 to Omega-3 was better in organic and biodynamic milk. Cows consuming high rations of red clover had the highest amount of Omega-3 and conjugated linoleic acid. Cows that were fed diets high in concentrates and maize silage had very low Omega-3 levels.

In Danish studies organic/biodynamic milk was found to have greater antioxidant content. Levels of vitamin E and beta-carotene were respectively 50% and 75% higher than in conventional milk.

Crystallisation images were evaluated by experienced observers in the Dutch study. The density of the crystal needles was determined with the aid of a computer programme. Organic/biodynamic milk showed superior inner structure together with better qualities of coordination, radiation intensity and overall integration of the crystallisation images. In Swiss milk studies pasteurized and homog-

enized milk suggested a marked ageing process that was not evident in raw milk.

The biophoton exchange method measures the speed and intensity of light radiated onto a food product and the emission of photons (light particles) thereafter. The higher the light emission, the better the inner structure and ordering of the milk. With all emission readings the organic and biodynamic milk recorded higher values than conventional milk.

To determine the robustness of cow health the response of immune cells was quantified. In a lymphocyte stimulation test the cell division capability of immune cells was evaluated. The cell count of the organic and biodynamic milk was higher as was the stimulation index. This points to a better reaction response to infections, possibly due to previous stimulation of the immune system.

With regard to the practice of dehorning cows Jennifer Wohlers offers results from her 2003 Masters thesis based on the University research farm, Frankenhausen. According to her research, horns had a positive influence on milk quality. The milk from horned cows appeared to be more beneficial to human health than that from dehorned stock.

In summary, the qualitative methods of research using copper chloride crystallisation and biophoton exchange demonstrated significant differences between bulk-tank milk from conventional and organic/biodynamic production systems.

Milk quality is influenced by methods of storing and processing such as pumping, cooling, heating, homogenization. Milk is of highest quality when fresh from the cow. Milk from older cows shows greater immune response. Milk from horned cows is probably best suited for human consumption.

The taste of organic/biodynamic milk is not necessarily superior to conventionally-produced milk. Milk taste is correlated with the animals' diet. It would make good sense to run some older, horned cows in the herd. It is important to store milk only for short periods of time and to ensure that its quality is undiminished by poor cooling and storage techniques.

While these studies offer positive preliminary results regarding milk quality it is necessary that a larger, more comprehensive assessment be made. Such a project is planned at Kassel for 2006-2010. ■

Summarised and translated by Andreas Welte www.EcoGrape.com and Elisabeth Alington in consultation with Ton Baars.

*This and the following article originally appeared in Harvests Magazine (the Biodynamic Journal for New Zealand) and appear with their permission.*

i The autonomic nervous system is responsible for maintaining the internal environment of the body within carefully defined limits. This internal control function is called homeostasis or more precisely homeoekinesis. The latter term incorporates many dynamic processes, the equilibrium of which is so highly controlled that it would appear to be static. Both the sympathetic and parasympathetic nerve systems conduct impulses away from the central nervous system, the former from the thoracic-lumbar region, the latter from the sacro-cranial. They act as visceral flexors and extensors; both are necessary for the efficiency of the whole system. Ed (Harvests).

This article is to be read in conjunction with 'Milk quality and human health' (see pages 8-9).

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# Milk quality of horned and de-horned cows

**IN AN EXPLORATIVE PROJECT** presented for her Masters thesis at the University of Kassel in 2003, Jenifer Wohlers demonstrated that milk from horned dairy cows is of significantly different quality to that from de-horned stock. The results of her work were summarised in the Swiss biodynamic magazine 'Beiträge'.

Milk quality can be researched in many ways. The usual method is by way of analysis of primary constituents eg. fat or protein content, cell count. Sometimes research will focus on the relationship between dietary feeds and milk quality. In order to obtain a comprehensive impression however, picture-forming methods are especially valuable. Wohler's work explores the hypothesis that milk from horned cows differs significantly from that of de-horned cows. Milk samples were gathered over an extended period of time from the long-standing, partially de-horned Friesian herd on the university research farm Frankenhausen (certified Bioland and Naturland). Bulk milk samples from 25-28 horned and 21-37 de-horned cows were analysed. Age, stage

of lactation, milking performance and milk constituents of both groups were similar.

The Steigbild capillary imaging method according to WALA and the copper chloride crystallisation technique according to Pfeiffer were used to evaluate the samples.

## CAPILLARY IMAGES

In the capillary images it is clearly recognisable that milk from horned cows (H-milk) has very narrow flags of an even and upright appearance. See Fig.1.

On the other hand, the milk from dehorned cows (Deh-milk) shows wide, irregularly expressed flags which do not rise straight up but tilt sideways. The Deh-milk shows distinct silver reduction spots in the upper flag zone. The first sign of an ochre-brown strip is expressed as a broad band. In the area of the shell zone the H-milk has relatively even, almost deep, colourful slim shells while the Deh-milk differs significantly with deep, uneven shells that seem to dissipate towards the bottom.

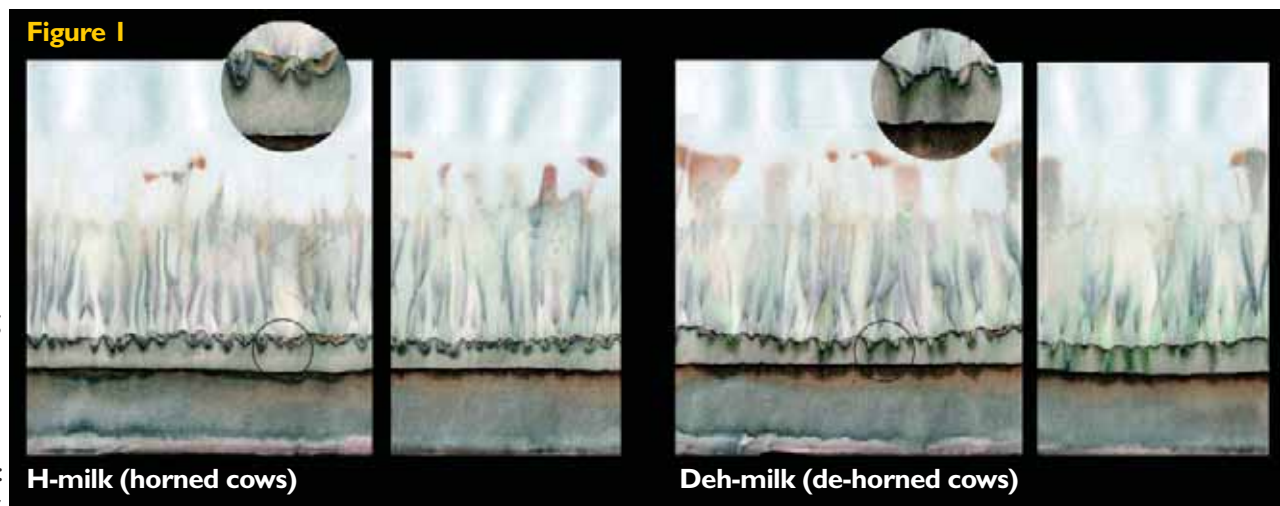


Figure 1 illustrates the ageing process in milk sampled on 26/3/03 and diluted 1 part milk: 6 parts water.

In addition to the comparative visual evaluation the pictures were assessed by computer for their formative differences upon which statistic variations were subsequently determined. The results were analysed according to standard statistical practice.

### QUALITY ASSESSMENT

In making an assessment of the pictures we must refer to a control series of dilutions regarding the aging factor of raw milk. On the basis of there being significantly more cavities and uneven shell depth it becomes obvious that milk from dehorned cows appears somewhat aged. Milk from horned cows produces images more similar to the typical raw milk pictures.

In the flag zone it is apparent that the forms widen according to the ageing process; becoming progressively less formed, more 'runny' and shorter in length. This is evident in the Deh-milk pictures. It is clear that the pictures from the dehorned samples more closely resemble aged milk than do the pictures from the horned samples.

### IMAGE FORMATION ACCORDING TO SPECIFIC DAYS

In assessing images from the picture-forming methods one must take into account the day-specific variations. Pictures formed on one day cannot be directly compared with those made on another. The typical milk quality characteristics however, are recognisable across all images at any given time.

### VISUAL IMAGE EVALUATION

The entire series of twelve pictures per sample was visually evaluated. Differentiation between images is most readily discerned according to the size of the cavities. The H-milk shows consistently larger cavity forms and more 'felty' crystal structures than the Deh-milk. The spiking, branch forms of the H-milk are more rounded and bow like while those of the Deh-milk lead straight to the periphery or even form snaking lines and appear to run in a less 'guided' way. The width of the rim is another observable criterion. The H-milk has a wider rim than the Deh-milk.

Looking at the whole, it becomes obvious that the pictures generated by the H-milk appear more differentiated, more harmonious, more evenly formed and more subtle in overall appearance than do the pictures from the Deh-milk, some of which give a much coarser and heavier impression.

To assess the difference in vitality a copper-chloride dilution series was established using different sample strengths. It was clear that, at a rate of 350 ml milk to 100 mg CuCl<sub>2</sub> the milk dominates and very subtle crystal structures are formed. The Deh-milk was able to develop a more formative picture at this concentration. This is an indication that the Deh-milk has stronger vitality forces than the H-milk but at the same time it has less ordering capacity.

### COMPUTERIZED PICTURE ASSESSMENT

A computerized assessment of the pictures led to the same conclusion. After scanning the crystal pictures according to their shades of grey in defined areas significant difference in milk quality could be ascertained.

### SUMMARY OF THE COPPER-CHLORIDE CRYSTALLISATION

In comparing the present work with results obtained by Balzer-Graf and Gallmann (2000) and by Johannson-Pieschl (1996) it is clear that forms obtained from the H-milk series are of close similarity to those produced by raw-milk images. With its relatively wide spike features the Deh-milk seems at first sight to be more vital. However these features are also characteristic of aged milk which is why Deh-milk can itself be described as aged or older. The ageing series also indicates that Deh-milk declines in quality at a faster rate than H-milk.

The results indicate that there are differences in milk quality between horned and dehorned cows. The term quality however, needs more clarification. Further investigations are needed to ascertain if it is possible to measure these differences in milk quality on a molecular level and the findings will have to be repeated in future research projects. ■

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