MILK QUALITY IN DAIRY PRODUCTION: EFFECT OF HOUSING AND MANAGEMENT

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Introduction: To-day the largest production of milk is in European Union, India, USA, Pakistan, and China. The typical exporting countries are New Zealand, European Union, Australia, and Argentina. The consumption is expected to increase most in countries with present fast economic growth, like Chine, Russia, etc and due to increasing demand as population worldwide increased (FAO 2010). As markets are competing with each other consumers put effort on price as well as quality. In a surplus situation and in countries with prosperous economy, the consumers will put more and more effort on the quality of milk, as well as ethical and esthetical quality. One of these measures will be animal welfare, cleanliness of animal and surroundings within as well as around the holding unit.

Milk quality parameters: Due to animal welfare regulations the farmers in Norway at present only are allowed to build free-stalls. The milk is graded according to quality parameters as protein and fat percentage, bulk milk somatic cell count (BMSCC), bacterial count (BC), free fatty acids (FFA), freezing point (FP), and freedom of growth inhibitors like antibiotics (AB). A large project aiming at identifying the optimal design of free-stalls regarding production, milk quality, animal welfare and economics started in 2005. This paper will try to sum up information about milk quality and effect of housing and management at present.

Risk factor associated to milk quality: Each of these parameters has different risk factors. BC is caused by lack of cleanliness in the milking system or bacterial load from the environment. Increased FFA will be caused by metabolic stress or destroyed fat globules due to weak globule membrane or hard mechanical treatment of the milk during harvesting and storage. High FP is an indirect measure of osmotic pressure in milk or thus water mixed into the milk during milking process. BMSCC is a measure of udder health and will have several risk factors depending on the predominant agent present in the herd. In general high BMSCC is caused by chronic infected quarters and high BMSCC reflects an incorrect management strategy in udder health program. AB in milk is due to inappropriate management of withdrawal of milk for the AB used for clinical treatment of disease. It could also in rare causes be due to extra-ordinal prolonged shedding time due to diseases cows.

With increased bacterial load there is also increased risk of having pathogenic bacteria mixed into the raw milk. One example of this is contamination of raw milk with *Listeria monocytogenes*. Sanaa *et al* (1993) found these risk factors for *L. monocytogenes* contamination milk; poor quality of silage (pH > 4.0), inadequate frequency of cleaning the exercising area, poor cow cleanliness, insufficient lighting of milk barn and parlors, incorrect disinfections of towels between milking. This is an example that feed harvest, feeding, clean holding area and cows as well as the milking procedure all influence milk quality.

Goldberg *et al* (1992) identified that cows on rotational grazing system had lower BC in milk compared to herds with traditional confined herds during the grazing season. This point at some challenges in confined herds.

Ruud *et al* (in press), found that the most important factors in improving stall cleanliness on the basis of fallen faeces into the stall area in free-stalls, in ranked order, were found to be: amount of bedding > 1.0 L, diagonal stall length ≤ 1.96 m, absence of lower head rail, stall length < 2.30 m, brisket locator distance ≤ 1.83 m, stall width > 1.13 m and upper head rail > 0.70 m. Regarding manure transported into the stalls by the cows´ feet contamination, the most important preventive factors in ranked order were: amount of bedding > 0.5 L, soft stall base with > 0.5 L of bedding, brisket locator height ≤ 0.10 m, upper head rail > 1.0 m, concrete stall base and stall width ≤ 1.13 m. This study revealed that detailed construction of the free-stall bedding area is of importance for the cleanliness of the stall surface, and it points at that the cows need space in front to keep the stall clean.

Ruud *et al* (in press) identified that the cows were relatively clean on udder and belly, dirtier on thigh and the rear part of the body and most dirty on the legs. With dirty thighs as the response variable, these variable were found to be important risk factors: A high number of cows per free stall, no use of sawdust as bedding versus use of sawdust, and a low positioned (< 0.85 m above stall floor) upper head rail “enclosing” the front of the stall versus higher. Furthermore, liquid manure versus more consistent manure, less tame cows versus tame cows, a low or high indoor temperature versus 10 to 15 ºC, and high relative air humidity versus low relative air humidity were also found to be associated with an increased risk of dirty thighs.

From the same material (Østerås *et al* 2010) found that increased BC was associated with use of AMS, having separate feeding stalls, brisket board more than 183 cm into the stall, no existing brisket board, overstocking compared to number of free-stalls, no use of or excessive use of bedding material, use of mattresses, and watery consistence of the manure. Lowest BC was at relative humidity from 65 to 70 %. These founding illustrate a clear link between BC in bulk milk and the same risk factors as dirty stalls and dirty cows.

BMSCC and udder health control is a very complex area with hundreds of different risk factors. The important to keep BMSCC low is the implementation of a complex but easily managed udder health control program. The main element in such a program will be to cull chronic infected cows and at the same time reduce the new infection rate. These programs will include elements from milking technique, milking machine performance, culling policy, antibiotic treatment of the right cow at the correct time, and additionally hygiene, nutrition, housing and cow comfort, air and water quality, health monitoring, breeding policy, cow conformation and milk production level (Schukken *et al* 2003).

Soft bedding is found to be one of the most important improvements concerning udder health. According to Ruud *et al* (2010) the hazard ratio (HR) of CM was lower on rubber, multi-layer mats and mattresses respectively compared to concrete. That of teat lesions was lower on rubber, soft mats, multi-layer mats and mattresses respectively. A soft free-stall base contributed significantly to an increased milk yield and a lower incidence of CM, teat lesions, and removal of cows.

Østerås *et al* (2010) found increased BMSCC was associated with overstocking, more than one blind alley, long stalls, no use of or excessive use of bedding material, watery manure, mixed ration, more than 50 % of cows with neck lesions, and slatted floor in the alley.

Introduction of automatic milking system (AMS) on dairy farms in the Netherlands, Germany and Denmark has led to a small, but significant increase in total BC, BMSCC at least the first six months after introduction, but then it improves again (de Koning *et al* 2003). AMS was also associated with increased level of FFA. Rasmussen *et al* (2002) found installation of AMS associated with increased total BC, spores of anaerobes, BMSCC, and FP. Østerås *et al* (2010) also found increased FFA was associated with use of AMS, but also with other stall constructions like; manger height, no use of maternity pen, and feeding board entrance with vertical bars. They also found increased FFA in herds with thin cows. They also found increased FP was associated with use of AMS, and watery consistence of the manure. Some variables possibly indicating of stress were also associated with higher FP.

This paper illustrates that design and management of free-stall influence milk quality.

Key words: Milk quality, BMSCC, bacterial count, free fatty acid, freezing point.

References:

De Koning K, B Slaghuis, Y van der Vors. 2003. Robotic milking and milk quality: effects on bacterial counts, somatic cell counts, freezing point and free fatty acids. *Ital J Anim Sci* 2, 291-299

Goldberg JJ, EE Wildman, JW Pankey, JR Kunkel, DB Howard, BM Murphy. 1992. The influence of intensively managed rotational grazing, traditional continuous grazing, and confinement housing on bulk tank milk quality and udder health. *J Dairy Sci* 75, 96-104.

FAO, Food and Agriculture Organization. 2006. Food outlook. Global market analysis. June 2010. http://www.fao.org/docrep/012/ak349e/ak349e00.pdf Accessed July 2010.

Østerås O, C Kielland, LE Ruud, G Næss, KE Bøe, I Haug. 2010. Milk quality in dairy production: effect of housing and management. Poster. *World Buiatric Congress*, Santiago, Chile.

Rasmussen MD, M Bjerring, P Justesen, L Jepsen. 2002. Milk quality on Danish farms with automatic milking systems. *J Dairy Sci* 85, 2869-2878.

Ruud LE, O Østerås, KE Bøe. 2010. Soft flooring materials in free stalls and the impact on milk yield, clinical mastitis, teat lesions, and removal in dairy cows. *J Dairy Sci* 93, 1578-1586

Ruud LE, C Kielland, O Østerås, KE Bøe. 2010. Free-stall cleanliness is affected by stall design. Livestock (in press).

Ruud LE, KE Bøe, O Østerås. 2010. Risk factors for dirty Dairy Cows in Norwegian Free-stall systems. *J Dairy Sci* (in press).

Sanaa M, B Poutrel, JL Menard, F Serieys. 1993. Risk factors associated with contamination of raw milk by *Listeria monocytogenes* in dairy farms. *J Dairy Sci* 76, 2891-2898

Schukken YH, DJ Wilson, F Welcome, L Garrison-Tikofsky, RN Gonzalez. 2003. Monitoring udder health and milk quality using somatic cell counts. *Vet Res* 34, 579-596.