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Influence of somatic cell count on mineral content and salt equilibria of milk

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ABSTRACT – Aim of this research was to study the effect of somatic cell count on mineral content and salt equilibria at the level of quarter milk samples. Ten Italian Friesian cows, in which two homologous quarters (front quarters in 1 cow, rear quarters in 6 cows and both rear and front quarters in 3 cows) were characterised by a milk SCC<400,000 cells/mL (LC-milk) and milk SCC>400,000 cells/mL (HC-milk), respectively, were selected. Cows were milked at quarter level during the morning milking and a single sample was collected from each selected quarter, thus, 26 quarter milk samples were collected. Compared to LC-milk, HC-milk was characterised by a lower content of phosphorus and potassium and by a higher content of both sodium and chloride. The equilibrium of calcium, phosphorus and magnesium between the colloidal and soluble phase of milk and the mineralisation degree of the casein micelles, were not different between HC and LC milk.

Key words: Quarter milk, Somatic cell, Mineral content, Salt equilibria.

Introduction – Udder inflammations alter membrane permeability within the mammary gland and are closely followed by a marked increase in the number of somatic cells present in milk (Moussaoui *et al*., 2002). This phenomenon is associated with a wide range of related effects. For instance, total milk yield falls and marked changes occur at the level of nearly all major and minor constituents of the milk (Kitchen, 1981). Furthermore, an increase of the proteolytic activity towards caseins was observed (Urech *et al*., 1999). This leads to a worsening of the processing properties of milk and lowers cheese yield and quality (Barbano, 1994). The salt component of milk (about 8–9g/L), contains cations (calcium, magnesium, sodium and potassium) and anions (inorganic phosphorus, citrate and chloride) (Gaucheron, 2005). Colloidal fractions of these components are associated with caseins and, consequently, play an important role in the structure and stability of casein micelle. Aim of this research was to study the effect of somatic cell count (SCC) on mineral content and salt equilibria at the level of quarter milk samples.

Material and methods – Ten Italian Friesian cows, in which two homologous quarters (front quarters in 1 cow, rear quarters in 6 cows and both rear and front quarters in 3 cows) were characterised by a milk SCC<400,000 cells/mL (LC-milk) and milk SCC>400,000 cells/mL (HC-milk), respectively, were selected in two dairy herds. Selection of cows was made done according to a screening of SCC values of quarter milk samples carried out during the day previous sampling. Cows were milked at quarter level during the morning milking and a single sample was collected from each selected quarter; thus, 26 quarter milk samples were collected. On milk samples, the following analyses were performed: SCC with fluoro-opto-electronic method (Fossomatic 250); lactose by infrared analysis with a Milko-Scan

134 A/B: pH; casein nitrogen (CN) (Aschaffenburg and Drewry, 1959) from which casein (CN x 6.38); total and soluble calcium and magnesium (De Man, 1962); total and soluble phosphorus (Allen, 1940); colloidal fractions of calcium, phosphorus and magnesium were calculated as difference total - soluble; potassium and sodium with Atomic Absorption Spectroscopy according to Anon (1982); chloride according to Savini (1946). Data were analysed with ANOVA univariate (SPSS 15.0) considering as fixed factors somatic cell count (2 levels: <400,000 cells/mL and >400,000 cells/mL) and quarters-pair (13 levels, one for each pair of homologous quarters)

Table 1. SCC, pH, lactose, minerals content and salt equilibria of quarter milk samples with different somatic cell level.

		Somatic cell level (cells/mL)		SE	P value
		<400,000	>400,000		
n.		13	13		
SCC	log cells/mL	4.88	6.24	0.18	0.01
pH		6.67	6.71	0.02	0.05
Lactose	g/100g	4.69	4.45	0.04	0.01
Casein	g/100g	2.52	2.44	0.02	ns
Total calcium	mg/100g	121.01	117.74	2.39	ns
Colloidal calcium	%	75.35	74.46	0.24	ns
Total phosphorus	mg/100g	89.71	87.76	0.86	0.05
Colloidal phosphorus	%	53.37	57.72	1.61	ns
Total magnesium	mg/100g	11.45	11.62	0.26	ns
Colloidal magnesium	%	37.23	37.43	1.61	ns
Colloidal calcium/casein	g/100g	3.65	3.62	0.78	ns
Colloidal phosphorus/casein	g/100g	1.90	1.86	0.06	ns
Sodium	mg/100g	44.69	58.50	2.52	0.01
Potassium	mg/100g	146.49	137.27	1.66	0.01
Sodium/potassium		0.30	0.42	0.02	0.01
Chloride, Cl^-	mg/100g	99.43	135.17	6.19	0.01

SCC=Somatic cell count; ns=non-significant.

Results and conclusions – According to Kitchen (1981), HC-milk was characterised by a lower lactose content than LC-milk (–5.12 %) (table 1). pH values were higher HC-milk than LC-milk (+0.04). Le Roux *et al*. (1995) report an increase of pH value in quarter milk samples with high SCC. Compared to LC-milk, HC-milk was characterised by a lower content of phosphorus and potassium and by a higher content of both sodium and chloride. Udder inflammation results in an increased permeability of blood capillaries. Thus, sodium and chloride (which are high in extracellular fluid) pour into the lumen and, in order to maintain osmolarity, potassium level decreases proportionally (Kitchen, 1981).

The equilibrium of calcium, phosphorus and magnesium between the colloidal and soluble phase of milk and the mineralisation degree of the casein micelles, were not different between HC and LC milk. According to these observations, the increase of somatic cells did not alter the ratios between minerals and casein in the casein micelle.

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