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The hygienic quality of raw reindeer milk

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Abstract: The somatic cell count (SCC) and total bacterial count (TBC) as well as the presence of major food-borne pathogens and udder pathogens in reindeer raw milk were studied. Two groups of 4 female reindeer were milked on alternate days for six weeks. A milk sample from each quarter was taken before milking and of the bulk milk at the end of milking. *Micrococcus* sp. was observed in one, *Staphylococcus aureus* in one and coagulase-negative staphylococci in five of the quarter samples (n=318). In the bulk milk (n=19) TBC varied between 700 and 1 700 000 cfu (colony forming units)/ml and SCC between 52 000 and 183 000 cells/ml. No *Bacillus cereus, S. aureus* or *Listeria monocytogenes* were detected in the bulk milk, but *Escherichia coli* and Enterobacteriaceae were found in 5 bulk milk samples. According to the bacteriological examination the udder health of the reindeer was good. Indicative information on the SCC of healthy reindeer was obtained. None of the common potential food-poisoning bacteria were found in raw milk. There was great variation in the bulk milk TBC and the average TBC was rather high (ca. 300 000 cfu/ml). The hygienic quality of raw reindeer milk makes it well suited for food manufacture. However, the results indicate that the milking conditions may be crucial for the quality of raw milk.

Key words: bacterial count, food pathogens, food safety, mastitis, *Rangifer tarandus*, somatic cell count, udder pathogens.

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Introduction

In earlier times the practice of milking reindeer was widespread in the Sami areas of Finland, Norway and Sweden and the Kola peninsula (Skjenneberg & Slagsvold, 1968). This was also the case in Finnish Lapland where reindeer were milked up until the Second World War or in parts of Enontekiö municipality as late as the 1960s (Nieminen & Pietilä, 1999). Reindeer milk and its products played a significant part in the summer and autumn diet of the Sami. Calves being born in May, milking often started around midsummer. A reindeer would yield about a coffee-cup of milk per milking. Nowadays, reindeer are still milked in parts of Siberia (Nieminen *et al.,* 1996; Aikio & Nieminen, 1998; Aikio, 2000).

Recently a new interest in reindeer milk and milk products has arisen in Fennoscandia. Co-projects among Finnish and Norwegian researchers have focused on milking technique, milk yield and composition, foreign substances in reindeer milk and technical aspects of various products made from reindeer milk, such as cheese, ice cream, soaps and lotions. Commercial milking is being set up in a Norwegian concession reindeer district (pers. comm. Holand & Maristuen[1]). So far little attention has been

[1] Lecture by Øystein Holand & Knut Maristuen at the 13th Nordic Conference on Reindeer and Reindeer Husbandry Research, Røros, Norway, 23-25 August 2004; see also Filefjell Concession Reindeer District, Norway, http://www.filefjell-reinlag.no/melking.html.

Table 1 Counts of *Escherichia coli* and Enterobacteriaceae, total bacterial counts (TBC) and somatic cell counts (SCC) in bulk milk samples of reindeer (n=8).

Date of sampling	*E. coli*[1] cfu/ml	Entero-bacteriaceae[1] cfu/ml	TBC[1] cfu/ml	SCC cells/ml
1.7.2002	10 000	10 000	130 000	79 000
2.7.2002	<1	<1	700	109 000
3.7.2002	850	1 000	37 000	108 000
4.7.2002	<1	<1	1 100	170 000
5.7.2002	<1	<1	2 500	115 000
8.7.2002	<1	<1	710 000	75 000
9.7.2002	5 700	5 300	15 000	116 000
10.7.2002	52 000	47 000	110 000	211 000
11.7.2002	320	370	11 000	74 000
12.7.2002	<1	1	560 000	114 000
29.7.2002	<1	<1	6 000 000	52 000
30.7.2002	<1	<1	100 000	76 000
31.7.2002	<1	<1	280 000	168 000
1.8.2002	<1	<1	680 000	112 000
2.8.2002	<1	<1	680 000	65 000
5.8.2002	<1	<1	1 700 000	183 000
6.8.2002	<1	<1	42 000	97 000
7.8.2002	<1	<1	240 000	183 000
8.8.2002	<1	<1	270 000	98 000
9.8.2002	<1	<1	19 000	124 000

[1] cfu: colony forming units.

given to the hygiene aspects of reindeer milk production. When launching a food product of animal origin it should be ensured that the production is up to modern standards in that it fulfils the hygiene and quality requirements expected by consumers and set by authorities (Holand *et al.,* 2002; Hänninen *et al.,* 2002; Malinen *et al*., 2002).

According to the limited data available on the hygienic quality of reindeer milk TBC in bulk raw milk was from 1300 to 4000 cfu/ml and SCC from 4000 to 52 000 cells/ml. In samples from individual animals TBC was 50-300 000 cfu/ml and SCC 1000-2 058 000 cells/ml (Aikio & Nieminen, 1998; Aikio, 2000; Aikio *et al.,* 2001; Holand *et al.,* 2002).

No specific requirements for TBC or SCC of raw reindeer milk destined for human consumption are laid down in EU legislation. However, with the new EU legislation entering into force in 2006, the criteria for raw milk TBC (1 500 000 cfu/ml or 500 000 cfu/ml for manufacture of unpasteurised products) will apply to reindeer (European Parliament and Council, 2004).

The aim of our study conducted at the Finnish Reindeer Research Station at Kaamanen was to examine the microbiological quality and somatic cell count of raw reindeer milk and gain information on the presence of udder pathogens in reindeer milk.

Material and methods

Animals and routines

The study was conducted on eight female reindeer (*Rangifer tarandus*) kept at the research station, born between 1991 and 1997 and having calved in May 2002. Apart from one animal, all had been exposed to machine milking for 1-5 years. Two groups of four reindeer were machine milked on alternate days. The calves were removed from their dams four hours prior to milking. In the period between July 1st and August 9th, 2002, the reindeer were milked on 20 days, *i.e.* each animal was milked 10 times. Quarter milk samples and bulk milk samples were taken at each milking.

Sampling

Before milking the teats were cleaned and disinfected, the foremilk was discarded and quarter samples were taken aseptically from each animal. The four reindeer were milked into a common bucket, its contents were thoroughly mixed and two bulk samples were aseptically taken. The milker recorded any abnormalities noted at milking, such as health and cleanliness of reindeer, sensory characteristics of milk and deviations in sampling procedure.

Quarter and bulk samples were frozen and dispatched chilled to the Veterinary and Food Research Institute, EELA, Helsinki. Microbiological tests started at EELA on the day after arrival. Bulk samples were also transported chilled to the Valio laboratory at Seinäjoki, where SCC was analysed 2-6 days after sampling.

The analyses

The quarter samples (n=318) were analysed for aerobic udder pathogens using accredited methodology based on National Mastitis Council standards (1999) and procedures described by Honkanen-Buzalski & Seuna (1995). The bulk samples (n=20) were analysed for TBC, Enterobacteriaceae, *Bacillus cereus, Escherichia coli, Staphylococcus aureus* and *Listeria monocytogenes* using routine methods (FIL-IDF, 1991; ISO, 1993, 1996, 1999; NMKL, 1996; Johansson, 1998). Glucose fermentation was used to verify Enterobacteriaceae. *E. coli* was identified according to indole and gas formation and using the API 20E test (Bio-Merieux,

France). SCC of bulk samples was determined by the fluoro-optic method (FIL-IDF, 1995).

Results

Bacterial growth was detected in seven of the 318 quarter samples. The micrococci found in one sample are not considered udder pathogens and probably derive from the teat skin. Staphylococci were isolated from six samples of three reindeer. In one sample *S. aureus* was detected at 1100 cfu/ml, which was considered an infection and in five samples coagulase-negative staphylococci were isolated at 300-900 cfu/ml.

No *B. cereus,* coagulase-positive staphylococci or *L. monocytogenes* were detected in the bulk milk samples. Five samples had bacteria of the family Enterobacteriaceae (370 - 47 000 cfu/ml) as well as *E. coli* (320 - 52 000 cfu/ml).

TBC of bulk samples varied between 700 and 1 700 000 cfu/ml (average 290 000, median 110 000 cfu/ml). One exceptionally high count (6 000 000 cfu/ml), possibly due to outside contamination, was discarded from these calculations. The same sample had a low SCC and none of that day's samples showed bacterial growth.

SCC of the bulk samples (n=19) varied between 52 000 and 183 000 cells/ml (average 111 000, median 109 000 cells/ml). These calculations exclude one high count (211 000 cells/ml), which was considered indicative of mastitis and connected to bacterial growth in the quarter samples of that day (table 1).

Blood on the teats of reindeer, probably a result of insect harassment, was recorded at five milkings. The reindeer were recorded to be muddy on four occasions.

Discussion

This study was the first closely concerned with milk hygiene and udder health aspects of reindeer milk production. The udder health of the reindeer in this study was good. Coagulase-negative staphylococci were isolated in low counts. The one reindeer harbouring *S. aureus* was not clinically ill. This case was possibly reflected in the high SCC of the bulk milk. The data on SCC are indicative of the counts to be expected in bulk milk of healthy machine-milked reindeer.

The TBC of bulk raw milk is known to reflect the hygiene of milking and handling of milk. The average TBC in this study, 300 000 cfu/ml, can be considered high. Counts of total bacteria, Enterobacteriaceae and *E. coli* correlated with observed muddiness of reindeer at milking. High counts of Enterobacteriaceae and *E. coli* were observed regardless of TBC counts, which should be borne in mind in food safety surveillance, where TBC is used as a hygiene indicator.

The common food-borne pathogens were not found in reindeer milk. Reindeer milk has potential as a raw material of good quality in the production of food commodities. A high standard of hygiene is essential to prevent contamination of raw milk with microbes from the production environment. Milking a semi-domesticated animal is no easy task and warrants more attention.

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Abstract in Finnish / Yhteenveto:

Tutkimuksen kohteena oli poron raakamaidon solupitoisuus ja kokonaispesäkeluku sekä tärkeimpien elintarvike- ja utarepatogeenien esiintyminen raakamaidossa. Kaksi 4 vaatimen ryhmää lypsettiin vuoropäivinä 6 viikon ajan. Ennen lypsyä vaatimista otettiin vedinkohtaiset näytteet ja lypsyn päätyttyä näyte yhteismaidosta. *Micrococcus* sp. todettiin yhdessä, *Staphylococcus aureus* yhdessä ja koagulaasinegatiivisia stafylokokkeja viidessä vedinkohtaisessa näytteessä (n=318). Yhteismaitonäytteiden (n=19) kokonaispesäkeluvut vaihtelivat välillä 700-1 700 000 pmy (pesäkkeitä muodostava yksikkö)/ml ja somaattisten solujen määrät välillä 52 000-183 000 kpl/ml. Yhteismaitonäytteissä ei todettu *Bacillus cereus-, S. aureus-* eikä *Listeria monocytogenes* -bakteereita, mutta viidessä näytteessä todettiin Enterobacteriaceae-heimon bakteereita ja *Escherichia coli* -bakteereita. Bakteeriviljelyjen perusteella vaadinten utareterveys oli hyvä. Terveiden vaadinten maidon solupitoisuudesta saatiin suunta-antavaa tietoa. Raakamaidossa ei todettu yleisimpiä potentiaalisia ruokamyrkytysten aiheuttajia. Yhteismaidon kokonaispesäkeluvuissa esiintyi suurta vaihtelua ja niiden keskiarvo oli melko korkea (n. 300 000 pmy/ml). Poron raakamaito on hygieeniseltä laadultaan hyvää elintarvikkeiden raaka-ainetta. Tulokset antavat kuitenkin viitteitä, että itse lypsytapahtuma on porollakin avainasemassa raakamaidon laatuun vaikuttavana tekijänä.