

An incidence of acute diffuse aseptic inflammation of the corium of the hoof in dairy cows

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ABSTRACT

Herd health and production related problems were monitored on a high yield farm with 385 Holstein-Friesian cows near Ljubljana, Slovenia in 1993. At the end of August an outbreak of acute aseptic inflammation of the corium of the hoof (N=33) and retention of urine in vagina (N=37) was detected and treated in cows at pasture. The incidence of the disease in the summer months (pasture) was statistically significantly ($P<0.01$) higher than in the winter months. The analysis of intake revealed that it was markedly high in proteins and low in fibre in the summer months. A statistically significant ($P<0.001$) difference was revealed between fat, protein and urea bulk milk contents. Therefore, we may associate the occurrence of acute aseptic inflammation of the corium (sole haemorrhages) and retention of urine in vagina with protein overload (lush grass) and/or an increased urea content and some other toxic substances in the organism of dairy cows.

Key words: cow, laminitis, bovine digit, hoof, welfare, Slovenia

Introduction

Laminitis (acute diffuse aseptic inflammation of the corium of the hoof) is a metabolic disorder of the corium and germinal layer. The condition is characterized by the occurrence of excess fluid in the corium of the hoof, which may be more accurately described as excessively high blood circulation (hyperaemia), accompanied by excretion of blood or fluid from blood vessels (NILSSON, 1963; TAKAHASHI and YOUNG, 1981; MORTENSEN et al., 1986; TIUSSAINT, 1989; BOOSMAN, 1990; BLOWEY, 1993, 1995). The disease is often considered to be a herd problem

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associated with environmental, management and nutritional risk factors (GREENOUGH, 1985; DAVID, 1989).

Three forms of clinical laminitis in cattle are recognized: acute, subacute, and chronic. In all three forms the animals exhibit lameness. The onset of laminitis is most frequently observed a month before and two months after parturition (NILSSON, 1963; MACLEAN, 1965; PETERSE, 1978, 1986; NILSSON, 1982; TIUSSAINT, 1989; BOOSMAN, 1990).

Our knowledge of the origin of laminitis is still very incomplete. The acute form of laminitis has been frequently established to coincide with acute coliform mastitis, udder oedema, retention of the foetal membranes with postpartum septic metritis, rumen overload and acetonemia, indeed, the occurrence of laminitis is closely related to all locations where the production of bacterial endotoxins is increased. It has been established that nutrition, physiological state and specific digital blood circulation may lead to the development of a more or less pronounced form of laminitis (PETERSE, 1980; TAKAHASHI and YOUNG, 1981; NILSSON, 1982; LIVESEY and FLEMING, 1984; MORTENSEN et al., 1986; TIUSSAINT, 1989; BOOSMAN, 1990; VERMUNT and LEACH, 1992; BERGSTEN, 1994).

Daily ration high in proteins and/or carbohydrates (rumen overload) plays an important role in the aetiology of laminitis (TAKAHASHI and YOUNG, 1981; NILSSON, 1982; LIVESEY and FLEMING, 1984). Three factors are recognized as being responsible for the development of the disease: endotoxin, lactic acid, and histamine, which triggers an allergic reaction.

These pathogenetical products which are released mainly from the rumen, resp. intestines infiltrate the tissue of the corium of the hoof.

In the pathogenesis of laminitis, capillary thrombosis in the hoof corium and haemodynamic disturbances of the digit evoked by oedema in the corium are particularly thought to be a cause of laminitis. These processes were investigated by NILSSON (1963) and BOOSMAN (1990), while the local effect of endotoxin *E. coli* O111B4 bacteria in the corium of the hoof was studied by TAKAHASHI and YOUNG (1981) and MORTENSEN et al. (1986). They have established that endotoxin triggers a severe local Schwartzman reaction causing haemorrhagic and necrotic lesions.

Materials and methods

The present paper reviews the incidence of laminitis and results of a 1-year observational study of some milk parameters data evaluation on a high yield dairy farm in Slovenia.

The study was conducted in 1993 on one herd of 385 Holstein-Friesian cows. In the winter months the cows were housed in stalls with deep straw bedding, and pastured 24 h in the summer months.

Clinical signs of lameness and changes in the pododerm of the hoof were established by clinical examination of the digit. The incidence occurred at the end of August, mostly in cows 150±10 days after parturition.

Bulk milk samples were analysed weekly for fat, protein and urea concentrations. The urea content in raw milk was measured photometrically with the Cobas Mira spectrophotometer. Proteins in milk were measured by Milkoscan.

The obtained data and the disease incidence were statistically evaluated by the SPSS program (NIE et al., 1975).

Fat, protein, and urea weekly concentrations were correlated with some reproduction indexes and retention of urine in vagina and laminitis incidence.

Results and discussion

There was a marked difference between the average winter ration and diet during the disease incidence in the summer with regard to milk parameters concentration.

Table 1 shows that summer ration was high in proteins and energy and low in crude fibre content.

Table 1. Evaluation of nutritional substances in ration for examined dairy cows

| Ration | Kg | DS (kg) | CF (g) | Energy (SU/kg) | DP (g) | Na (g) | K (g) |
|-------------------------|------|---------|--------|----------------|--------|--------|-------|
| Winter * | 41.9 | 17.13 | 3.413 | 10.546 | 1.644 | 35.3 | 256 |
| During the incidence ** | 50.2 | 17.70 | 2.760 | 11.840 | 2.760 | 56.9 | 205 |

* = maize and grass silage, hay, concentrates

** = summer/pasture, alfalfa hay, concentrates

DS = dry substance; CF = crude fibre; SU = starch unit; DP = degradable proteins

We found a significant difference between fat, protein and urea content in weekly bulk milk samples with regard to winter, resp. non-winter feeding regimen.

Table 2. Average values of fat, protein and urea in bulk cow milk samples

| Parameter in bulk milk | Winter (N=27) | Summer (N=25) |
|------------------------|---------------|---------------|
| Fat (g/100 ml) | 3.806±0.16 | 3.230±0.22* |
| Protein (g/100 ml) | 3.231±0.14 | 3.078±0.09* |
| Urea (mmol/L) | 3.801±0.19 | 7.373±0.43* |

* P<0.05

During the summer a higher incidence of retention urine in vagina, acute laminitis and reproduction disorders was established. The results are presented in Table 3.

Table 3. Mean fat, protein and urea values in weekly bulk cow milk samples and reproduction indexes, and retention of urine in vagina and sole haemorrhages incidence

| Parameter | Winter (N=27) | Summer (N=25) | P |
|--|---------------|---------------|--------|
| Fat in bulk milk (g/100 ml) | 3.806 | 3.230 | *** |
| Protein in bulk milk (g/100 ml) | 3.231 | 3.078 | *** |
| Urea in bulk milk (mmol/L) | 3.801 | 7.373 | *** |
| Calving -firs AI (days) | 64.42 | 65.34 | 0.7360 |
| Calving - last AI (days) | 94.22 | 97.05 | 0.6683 |
| Number of AI | 1.58 | 1.73 | 0.1762 |
| Number of retention of urine in vagina | 16 | 37 | 2** |
| Number of acute laminitis (sole hemorrhages) | 7 | 33 | 2** |

** P<0.01; *** P<0.001

Despite a statistically insignificant difference between reproduction indexes, we are of the opinion that the data obtained during the summer demonstrated an association with higher urea content in the organism, respectively milk. Our assessment of the statistically significant higher incidence of laminitis and retention of urine in vagina is associated with protein overload (lush grass) and walking on hard roads, respectively higher urea content and coincidence of other toxins in the cows' organism.

At the end of August 1993, an outbreak of laminitis was observed among cows at grass that was particularly lush. Thirty-three severe cases of lameness and a reduced milk production (2.5 l per cow daily) were recorded. Also detected were 37 cases of retention of urine in vagina,

while urea concentration in bulk milk was above normal, between 7.21 and 9.33 mmol/l. According to our experience it should not exceed 5.5 mmol/l (ČADONIČ-ŠPELIČ et al., 1994; ZADNIK, 1995). During this period fat and protein concentrations were, in comparison to other weeks of the year, the lowest (fats 3.12% - 3.43%; proteins 1.97% - 3.09%). In our opinion, the established diseases are closely related to nutritional regime; that is to say, the animals were at pasture during that period. In this period cows were supplemented with 4.0 kg alfalfa hay and concentrates with 18% crude proteins. We believe that laminitis, lower reproduction indexes and higher incidence of retention of urine in vagina resulted from a largely pasture diet (protein overload), respectively urea content increase in the system.

Table 4. Frequency distribution of affected hoofs in examined dairy cows

| Haemorrhages of the sole | | Summer (N=33) |
|--------------------------|-------------|---------------|
| Front foot (N=5) | outer hoofs | 1 |
| | inner hoofs | 5 |
| Hind foot (N=29) | outer hoofs | 44 |
| | inner hoofs | 4 |
| Total hoofs | | 54 |

N = number of cows

Scandinavian researchers have also reported on distinct seasonal variations of protein levels in bulk milk samples (REFSDAL, 1984; ROPSTAD and REFSDAL, 1987). A relationship between increased urea content in blood and milk and the reproduction disorders was established by several authors (JORDAN and SWANSON, 1979a, 1979b; JORDAN et al., 1983; CARROL et al., 1987a; CARROL et al., 1987b; ČADONIČ-ŠPELIČ et al., 1994). Lush growing grass, and particularly young rye with its high protein and metabolizable energy content, has been considered important in the pathogenesis of laminitis (BOOSMAN, 1990; BLOWEY, 1993, 1995; BERGSTEN, 1994). NILSSON (1963) and MACLEAN (1971) have found that lush grass intake is high in protein and energy content, which may contribute to the occurrence of laminitis in cattle.

In our case the affected animals were lame during walking. Because of high incidence, the outbreak was initially associated with some sort of infection (e.g. digital dermatitis, interdigital necrobacillosis) or injuries. Animals were lame, particularly in hind feet. Their gait was stiff and

tender, back arched and they tried to unload the most affected hoofs. While stationary, they shifted weight frequently. Walking caused a lot of pain. Examination of the hoofs revealed haemorrhages in the horn of the sole. In some cases the haemorrhages were very extensive, often undermining the complete sole. By trimming (removal of the surplus horn) red and partly congested tissue, fluid was excreted. Beneath those haemorrhages a growth of new horn came to the surface. After cleaning, the lesion was dressed with disinfectant (povidon iodine), packed with gauze, cotton wool, and a waterproof pressure bandage was applied. The animals received 5 ml Ahistin (difenhidramin-klorid) *i/m* injection for three days (twice daily). Cows were housed in straw yards and fed 4 kg of hay in addition to their daily ration. The dressing was checked after 5 days, and 14 to 21 days afterwards lameness was no longer evident.

Our observations and the obtained results led us to conclusion that the outbreak of acute laminitis was closely associated with nutrition and with the transfer of cows from milking parlour to pasture. The cows walked to the milking parlour twice a day, covering 3 km on rough roads. Low concentrations of fats and proteins and high urea content in bulk milk samples also confirmed the incidence of acute laminitis.

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SAŽETAK

Zdravlje stada i proizvodnja mlijeka je promatrana na visoko produktivnoj farmi s 385 holštajn-frizijskih krava pokraj Ljubljane u Sloveniji tijekom 1993. godine. Krajem kolovoza je izbila akutna aseptična upala korijuma papaka (N=33) i zaostajanje mokraćne urodnice (N=37) mlječnih krava što je liječeno na pašnjaku. Učestalost pojave oboljenja u ljetnim mjesecima na paši je bila statistički značajno ($P < 0,01$) viša nego u zimskim mjesecima. Analizom korištene hrane u ljetnim mjesecima je utvrđeno da je sadržavala uočljivo više bjelančevina i manje vlaknatih sastojaka nego u zimskim mjesecima. Statistički značajna ($P < 0,001$) razlika između ljetnih i zimskih mjeseci, bila je utvrđena u količini masti, bjelančevina i mokraćevine u mlijeku istraživanih krava. Na osnovi navedenog, možemo povezati pojavu akutne aseptične upale korijuma (krvarenja u papčanom potplatu) i zaostajanja mokraćne urodnice s prevelikom količinom bjelančevina u hrani (bujnom i sočnom travom) krava i/ili povišenjem sadržaja mokraćevine ili nekih drugih otrovnih tvari u organizmu mlječnih krava.

Ključne riječi: krava, laminitis, govedi prst, papak, dobrobit, Slovenija
