EFFECTS OF MONENSIN ON MILK PRODUCTION AND METABOLISM OF DAIRY COWS

JAN HLADKY1, JAN TRAVNICEK1, LUCIE HASONOVA2, ZUZANA KRIZOVA1, ROMAN KONECNY1, EVA SAMKOVA2, JITKA KAUTSKA3, ROBERT KALA2

1Department of Animal husbandry sciences
2Department of Agricultural Products Quality
University of South Bohemia in Ceske Budejovice
Studentska 1668, Ceske Budejovice 370 05
3Agropodnik Kosetice, a.s.
Kosetice 212, 394 22 Kosetice
CZECH REPUBLIC
j.hladky@seznam.cz

Abstract: The effect of monensin (intraruminal bolus, 32.4 g) was observed in Holstein cows (milk yield of 10,200 litres) in three experiments. Blood and milk was examined during 4 to 8 weeks after parturition. The positive effect of monensin resulted in lower concentration of beta-hydroxybutyrate in blood (0.60–1.31 mmol/l) and milk (0.075–0.137 mmol /l). Milk yield increased by 3.4–11.2% for the first 100 days of lactation, fat yield by 6.9–12.0%, and protein yield by 1.81–5.4%. No significant differences were found in plasma glucose, triglycerides, and urea.

Key Words: ketosis, milk yield, metabolic parameters, thyroxine, triiodothyronine

INTRODUCTION

In the relation to the energy deficit in high-production milking cows during 2nd to 6th week of lactation after parturition the occurrence of ketosis is found. The illness is connected to the increase of nonesterified fatty acids (NEFA) production, which are the cause of higher hepatic ketogenesis and rise of ketone bodies in body fluids, including milk. The result of such is a decrease in milk production and changes in qualitative parameters of milk (Duffield 2000; Litherland et al. 2011). The detection of ketosis, already in subclinical level, leads to precocious protective measures and it also preventing the clinical symptoms of diseases (Hanuš et al. 2013). The diagnosis lays in the detection of the increased keto bodies in body liquids. In blood, the increase reaches values above 1.0 mmol/l (Hofírek et al. 2004) or even 1.2 mmol/l (Šlosárková et al. 2015). In milk, the acetone level increases above 0.40 mmol/l and beta-hydroxybutyric acid (BHB) increases above 0.20 mmol/l (Geishauser et al. 2000) or 0.25 mmol/l (Hofírek 2004). From the effectivity aspect of anti-ketogenetic profylaxation the most commonly used is monensin ionophore in the form of intraruminal boluses, from which the monensin is gradually released (Šlosárková et al. 2015). Monensin positively affects ruminous fermentation for the bacteria producing propionic acid, which is a necessary substrate of gluconeogenesis.

MATERIAL AND METHODS

The effect of intraruminal bolus (Kexxtone) containing monensin (32.4 g) was validated in 3 experiments using milking cows of Holstein breed with average production of 10,200 litres of milk during lactation. Experimental group E was used in each experiment (n = 8, monensin was applied 3 weeks before parturition) as well as a control group C (n = 8). Blood and milk was examined twice during 2nd to 6th week after parturition, when the energy deficit is highest (see Introduction). The presence of BHB in milk will be determined by infrared spectroscopy (FT – MIR) method. The milk components were determined by infrared absorption analyzer Combi Foss. Production of milk was validated by yield control. Metabolic parameters and BHB of blood plasma were measured by using a metabolic analyzer Dialab. Thyroxine (T4) and Triiodothyronine (T3) in blood serum were determined by RIA methods (kits Immunotech Praha).
All data were analysed using program Microsoft Excel. Both graphs are shown in a column planar type with expressing standard deviations. In this program were determined also P – values, on tables averages with standard deviations. In the same manner was performed recalculating the absolut values to the percentage expression. Lactation persistence was expressed in percentage of index P 2:1 (2nd to 1st days of lactation).

RESULTS AND DISCUSSION

The application of monensin in the form of intraruminal bolus had in, all three experiments, positive effect on statistically significant lower content (\( P < 0.01 \) and \( P < 0.05 \)) of BHB acid in milk and also in blood plasma (figure 1, 2). Correlational coefficients between the contents of BHB in milk and blood plasma were in trial group in the range of 0.541 to 0.894 and in control group from 0.718 to 0.932. The average content of BHB in milk of trial group was in the range of 0.075 to 0.179 mmol/l and in control group (not treated by monensin) from 0.213 to 0.338 mmol/l. Concentration of BHB in milk above 0.200 mmol/l corresponding to the subclinical ketosis (Geishauser et al., 2000) was in milking cows in experimental groups from 6% (1st experiment) to 25% (2nd and 3rd experiment) and in control group from 68% to 94%.

*Figure 1 Concentration of beta-hydroxybutyric acid in milk*

Data are expressed with +/- standard deviation
The importance of antiketogenetic prophylaxis used for stabilizing the milk production is obvious in table 1. Trial group of milking cows reached higher production of milk in the first 100 days of lactation (in 1st experiment increase of 3.4%, in 2nd experiments increase of 4.9% and in 3rd experiment increase of 11.2%) also relating to higher milk fat and proteins content (fat increase of 6.9% to 12.0% and protein increase of 1.81% to 5.4%). The increase in milk production corresponds to favorable lactation persistence. Lactation persistence was in trial group 88.9% to 96.9% and in experimental group 81.8% to 89.8%. In milking cows of control group, the increase of milk fat was also noted (trial group 3.62 to 3.77%) being linked to an increase in lipo-mobility (Hanuš et al. 2013). The average values of milk protein and lactose did not show significant differences in the first 8 weeks of lactation.

Table 1 Milk, fat and protein yield for the first 100 days lactation

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Group</th>
<th>Milk yield (kg)</th>
<th>Fat yield (kg)</th>
<th>Protein yield (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. E</td>
<td>3902.5±892.3</td>
<td>157.8±40.1</td>
<td>119.6±22.9</td>
<td></td>
</tr>
<tr>
<td>1. C</td>
<td>3772.8±845.3</td>
<td>140.8±31.6</td>
<td>117.5±24.6</td>
<td></td>
</tr>
<tr>
<td>2. E</td>
<td>3777.2±618.3</td>
<td>147.5±16.9</td>
<td>116.4±15.4</td>
<td></td>
</tr>
<tr>
<td>2. C</td>
<td>3601.5±795.2</td>
<td>137.8±25.6</td>
<td>113.8±22.7</td>
<td></td>
</tr>
<tr>
<td>3. E</td>
<td>3629.6±486.3</td>
<td>142.6±21.6</td>
<td>116.4±15.7</td>
<td></td>
</tr>
<tr>
<td>3. C</td>
<td>3264.6±518.9</td>
<td>130.8±18.9</td>
<td>110.0±18.1</td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed with +/- standard deviation
Table 2  Metabolic parameters of the blood plasma

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Group</th>
<th>Glucose (mmol/l)</th>
<th>Urea (mmol/l)</th>
<th>Total protein (mmol/l)</th>
<th>TG (mmol/l)</th>
<th>T3 (nmol/l)</th>
<th>T4 (nmol/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>E</td>
<td>2.90±0.38</td>
<td>7.54±1.84</td>
<td>79.91±2.43</td>
<td>0.29±0.01</td>
<td>1.78±0.22</td>
<td>51.43±3.1</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>2.87±0.44</td>
<td>6.52±1.42</td>
<td>81.24±1.83</td>
<td>0.28±0.03</td>
<td>1.79±0.09</td>
<td>49.93±5.1</td>
</tr>
<tr>
<td>2.</td>
<td>E</td>
<td>3.39±0.29</td>
<td>3.30±0.65</td>
<td>74.30±5.94</td>
<td>0.46±0.03</td>
<td>2.30±0.51</td>
<td>54.05±9.9</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>3.57±0.34</td>
<td>3.84±0.69</td>
<td>70.30±3.11</td>
<td>0.45±0.01</td>
<td>1.96±0.47</td>
<td>49.59±8.6</td>
</tr>
<tr>
<td>3.</td>
<td>E</td>
<td>2.82±0.53</td>
<td>4.37±0.96</td>
<td>69.69±2.69</td>
<td>0.49±0.06</td>
<td>2.37±0.65</td>
<td>51.04±9.7</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>2.60±0.39</td>
<td>4.09±0.82</td>
<td>63.29±6.86</td>
<td>0.51±0.02</td>
<td>2.48±0.28</td>
<td>47.43±8.4</td>
</tr>
</tbody>
</table>

Data are expressed with +/- standard deviation

Legend: TG - Triglycerides, T3 – Triiodothyronine, T4 – Thyroxine

The effect of monensin on selected metabolic parameters is stated in table 2. There were no statistically significant differences between the trial and the control group. Lower content of glucose and plasma protein (1st and 3rd experiment) and higher content of urea (1st experiment) relates to the energy deficit (Hofírek et al. 2004). In all three experiments the control group showed lower thyroxine concentration in blood plasma, which had no statistical significance. Lower levels of thyroxine in cows with ketosis onset are claimed by Ropstad et al. (1989). Lower content of ketone bodies (BHB) in milk and blood, or even a decrease in numbers of status corresponding to subclinical ketosis supports the significance of used anti-ketogenic prophylaxis. The positive production effect of monensin in the first period of lactation was also confirmed in experiments by Antanaitise et al. (2015), or by work of Duffield et al. (2008), Slosarkova et al. (2015) and others.

CONCLUSION

The intraruminal application of monensin (32.4 g) 3 weeks before parturition had a positive effect on the reduction of subclinical ketosis and on higher the milk production in the first 100 days of lactation.

ACKNOWLEDGEMENTS

The research was financially supported by the grant NAAR KUS QJ 510339, grand GAJU 002/2016 and GAJU 152/2014/Z

REFERENCES


