R.J. Jorgensen – Reducing the risk of milk fever (parturient hypocalcaemia) by supplementing dry cow rations with zeolite (synthetic sodium aluminium silicate)

Reducing the risk of milk fever (parturient hypocalcaemia) by supplementing dry cow rations with zeolite (synthetic sodium aluminium silicate)

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ABSTRACT

About 6 years ago dairy farmers within the European Union (EU) were given an alternative to the ration dietary cation-anion difference (DCAD) principle in order to reduce the risk of milk fever (parturient hypocalcaemia) when the Commission of the European Communities (CEC) amended its list of accepted Additives and Products or Substances used in Animal Feed (Part B of the Annex to Directive 94/39/EC) by allowing "synthetic zeolite" (synthetic sodium aluminium silicate) with the purpose of reducing the risk of milk.

This was the result of CEC’s review of published and unpublished research based on the Danish invention of using zeolite for this particular purpose. Over a period of several years the Commission formed its opinion with regard to the intended effect of using zeolites, and to any potentially adverse side-effects on the cow, its calf, milk as a food, and the environment, before it finally accepted this novel use of zeolite in January 2008.

The rationale for the underlying research was the belief that short-term binding of calcium by zeolite would mimic that of low calcium intake during late pregnancy, leading to the activation of the dairy cow’s natural defence mechanisms against hypocalcaemia, and the objective was to develop this prevention strategy for use on commercial dairy farms.

There are no indications that ration DCAD needs to be considered when applying the zeolite principle because feeding acidifying rations, as is intended with the DCAD concept, is not part of the principle.

The benefits of zeolite feeding are primarily improved cow welfare by preventing clinical and subclinical parturient hypocalcaemia and associated production diseases. Under commercial farming conditions the preventive success of zeolite supplementation was more than 80 percent.

After its introduction in the EU market, its popularity has increased steadily due to its strong preventive effect, and due to many EU dairy farmers’ difficulties in managing to achieve recommended DCAD with traditional rations. Two main zeolite containing products and a few related products are now available commercially. One is in the form of a concentrate pellet and one in a formulation containing 80 percent zeolite. Market information from the two European manufacturers shows an estimated annual turnover of more than 600 metric tonnes for 2014.

In conclusion, zeolite supplementation to prevent milk fever is now widely used in the EU.

Keywords: Milk fever prevention; parturient hypocalcaemia; synthetic zeolite

INTRODUCTION

The idea of using a calcium binder to mimic the preventive effects seen after feeding a low-calcium diet to dairy cows in late pregnancy was first promoted by the Cattle Production Medicine Research Group in Copenhagen in 1998. A first attempt to provide proof-of-concept was presented two years later (Jorgensen and Thilsing-Hansen, 2000), followed by a study on the effect on calcium homeostasis of zeolite drenching, compared with the known effect of zinc oxide drenching (Jorgensen et al. 2001). Almost simultaneously Wilson (2001) suggested the use of vegetable oil as a calcium binder.

A series of published and unpublished studies were conducted with synthetic zeolite A over the next 10 years to develop the use of zeolites in reducing the risk of milk fever. This research included optimising the dose rate and duration of the supplementation period (Grabherr et al. 2008), as well as ascertaining that there were no unwanted side effects on milk yield, health of the cow and calf, and its safety with regards to milk as a food, and the environment.

MATERIALS AND METHODS

Most of the research was conducted using controlled studies with dry cows during late pregnancy, where cows were allocated either to a treatment group or to an untreated control group. In addition, a major efficacy field study, performed on commercial farms, was carried out with a more manageable design, involving historical controls. Briefly, observations were initiated and recorded on a number of control cows during the first period, followed by a similar number of treated cows during the second period. A total of 22 dairy farms participated in the efficiency study (Table 1).
Table 1: Effects of zeolite supplementation on the prevention of milk fever among cows (≥ 2nd parity) in a field study on commercial farms (Thilsing et al. 2006).

<table>
<thead>
<tr>
<th></th>
<th>Control (Untreated)</th>
<th>Zeolite (550 g/d Zeolite)</th>
<th>Cases prevented per 100 cows</th>
<th>Preventive effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk fever cases (diagnosed by the farmer)</td>
<td>36/129 (27.9%)</td>
<td>9/130 (6.9%)</td>
<td>22.6</td>
<td>86%</td>
</tr>
<tr>
<td>True milk fever cases³</td>
<td>34/129 (26.4%)</td>
<td>5/130 (3.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk fever cases in high-risk cows¹</td>
<td>34/78 (43.6%)</td>
<td>5/1 (8.2%)</td>
<td>35.4</td>
<td>81%</td>
</tr>
</tbody>
</table>

¹Cases prevented/100 treated cows compared to cases per 100 control cows.
²Cows with normal blood calcium levels among the clinical cases were removed.
³High-risk cows are cows of ≥ 3rd parity.

The test product used in most of the Danish studies contained 80 percent zeolite 4A (synthetic sodium aluminium silicate) embedded in starch. Presently, the recommended dose is 500 g product per day per cow. This is equivalent to 400 g per day of synthetic zeolite. Supplementation should start 2 weeks before expected calving and should be stopped (Anonymous, 2008).

RESULTS

In 2008 the ECC adopted the use of synthetic sodium aluminium silicate (zeolite) for the prevention of milk fever in its ‘dietetic’ feed directive (Directive 94/39/EC; the directive regarding feedingstuffs intended for particular nutritional purposes). The use of zeolite was accepted based on a number of experimental studies, documenting often 100 reduction of milk fever as well as subclinical hypocalcaemia, and an absence of undesirable side-effects.

The first controlled experiment with high-risk calving cows gave encouraging results. While three control cows contracted milk fever, necessitating intravenous calcium therapy, and six out of eight control cows experienced subclinical hypocalcaemia (serum calcium levels below 2 mmol/L in one or more samples taken), none of the zeolite-treated cows showed any signs milk fever or experienced subclinical hypocalcaemia (Thilsing-Hansen and Jørgensen, 2001).

Subsequent studies, also under well controlled conditions, confirmed an efficacy level of close to 100 percent. Results of the field study are presented in Table 1.

DISCUSSION AND CONCLUSION

There has been some uncertainty regarding the optimum dose of zeolite as daily amounts higher than the recommended dose may reduce DM intake. At present 400g/day is recommended although German workers have suggested a lower dose of 23g zeolite A/kg DM (Grabherr et al. 2008). Concern about the possible detrimental effects of binding of other minerals, such as magnesium, was raised by EU expert panels. However, to date data on more than 1000 cows have shown that blood Mg levels remained within the normal range. In contrast, the effect on phosphorous is pronounced to the extent that supplemented cows become hypophosphataemic around calving followed by a sharp rise to normal or slightly above normal levels within a few days after calving. At a first sight the effect on plasma phosphorous level may be undesirable, however cows tolerate such transient hypophosphataemic levels well and it has been suggested that it may play a positive role in calcium mobilization. This view is supported by the finding that excessive phosphorous supplementation on top of zeolite supplementation appears to neutralize the preventive effect of zeolite (Pallesen et al. 2008).

Based on the documented reduction of 86 percent, or 81 percent among high risk cows, under commercial conditions it is concluded that this relatively new way of preventing milk fever is highly effective, and it is probably the most effective way of preventing milk fever and subclinical hypocalcaemia under commercial farming conditions.

To our knowledge, reduction of the risk of milk fever by the use of zeolite is not yet available in New Zealand or Australia. Although it has become increasing popular among dairy producers in the EU, the extent to which it may be accepted to the Australasian Dairy Industry, remains to be seen. Feeding acidifying rations to the dry cow is fundamental to the DCAD principle. However such acidification is not part of the zeolite concept. Dairy nutritionists should have this in mind when considering the two alternatives of preventing hypocalcaemia.
REFERENCES

Anonymous, COMMISSION DIRECTIVE 2008/38/EC of 5 March 2008 establishing a list of intended uses of animal feedingstuffs for particular nutritional purposes; ANNEX B).


