The objective of this study was to investigate how well cows drink the PROPELLER® calcium drink, and to evaluate its effect on blood calcium concentration. Drinking was tested in 120 cows immediately following calving, before cows drank anything else. Sixty cows each were offered 20 liters of calcium drink or 20 liters of water. Cows drank the calcium drink as readily as water. Some 72% of all cows drank all 20 liters; 18% drank on average 8.2 liters and 10% drank less than one liter. Blood calcium concentration was studied in 16 cows following calving. Eight cows each were offered 20 liters of calcium drink or no calcium drink. Blood calcium significantly increased ten minutes after intake and stayed significantly elevated for 24 hours. Without calcium drink, blood calcium levels decreased significantly. The advantage of the new calcium drink over calcium gels or boluses could be that cows now drink calcium themselves.

Oral calcium may lower the risks of hypocalcemia and parturient paresis (milk fever). Oral administration of 1.25 – 2.5 mol (50 - 100 g) calcium from calcium chloride or calcium propionate was shown to increase blood calcium. Calcium propionate lasted longer than calcium chloride, while calcium carbonate was not effective. Calcium chloride is often administered orally as gel from bottles or cartridges. Each cow was given four doses of 1.35 mol (54 g) calcium as follows: immediately before calving, immediately after calving, 12 and 24 hours later. This procedure lowered the risk of parturient paresis by 42 and 49%, respectively. However, calcium chloride
is an irritant, which has been reported to cause salivation, poor appetite, diarrhea, and ulcers in the forestomachs and abomasum. Many cows refuse oral administration, and in 4% of the cows calcium chloride gel entered the lungs, and caused pneumonia. Calcium chloride boluses also lowered the risk of parturient paresis, however, they were reported to cause fatal forestomach ulcers. Administering boli via applicator may injure mouth and pharynx.

Less labour-intensive than administering four doses of gel or bolus per cow, and less risky to the safety of farm personnel and cows would be if the cow consumed calcium voluntarily. Recently, a new calcium drink for cows became available in Europe. The PROPELLER® calcium drink (www.propeller-calcium-drink.com) comes as a powder that is dissolved in water (1.8 kg in 20 liters). The drink is offered to the cow within one hour after calving, before the cow drinks anything else. One drink of provides 2 mol (80 g) calcium from calcium lactate. This calcium drink is for cows at second calving or older.

The objective of this study was to investigate how well cows drink the PROPELLER® calcium drink, and its effect on blood calcium concentration. It was hypothesized that cows drink the calcium drink as readily as water (first research hypothesis), and that the calcium drink increases blood calcium concentration (second research hypothesis).

Materials and Methods

This study was performed in the Holstein herd of the Saxonian Milk Production Cooperative in Quersa, Saxonia, Germany.

Drinking

Drinking was studied in 120 cows at second calving or older. Only healthy and not pretreated cows were enrolled. Age (number of lactations), milk yield in the preceding lactation (kg), days in milk in preceding lactation (n), and period between calving and offering the drink (min) were recorded in each study cow. 1.8 kg calcium powder were dissolved in 20 liters of water. Within one hour after calving, 60 cows each were offered 20 liters of calcium drink (cases) or 20 liters of pure water (controls), lukewarm in a bucket. Cases and controls were selected on a systematic random basis. The following parameters were measured: volume (liters) and proportion (%) of drink consumed, drinking duration (min:sec), number of sets (n) and sips (n). Set separation was marked by a cow removing the nose from the drink. The following parameters were calculated: drinking velocity, i.e. volume consumed/drinking duration (liters per minute); volume per set, i.e. volume...
consumed/number of sets (liters); volume per sip, i.e. volume consumed/number of sips (liters),
and sips per set, i.e. number of sips/number of sets (n).

All data were transformed using a natural logarithm. Findings were described using
geometrical means 10 for calcium drink and water groups. Analysis of variance 11 was used to test
for differences between calcium drink and water groups. Statistical Analysis Systems 16 was used
for computation. P was limited to 10% (P < 0.10).

Blood Calcium Concentration

Blood calcium concentration was studied in 16 cows at second calving or older. Only
healthy and not pretreated cows were enrolled. Age (number of lactations), milk yield in the
preceding lactation (kg), days in milk in preceding lactation (n), and period between calving and
start of the study (min) were recorded in each study cow.

Within one hour after calving eight cows each were offered 20 liters of calcium drink
(cases) or no calcium drink (controls). Cases and controls were selected on a systemati random
basis. Seven blood samples were collected from each cow: Case cows were sampled
immediately before offering the calcium drink and again 10 minutes, 1, 2, 3, 6 and 24 hours after
intake. Control cows were sampled at time 0, and again 10 minutes, 1, 2, 3, 6 and 24 hours later.
All blood samples were analysed for ionized calcium concentration at cow side using a portable
analyzer (Radiopoint 400, Bayer, Fernwald-Annerod, Germany).

All data were transformed using a natural logarithm. Findings were described using
geometrical means 10 for calcium drink and water groups. Analysis of variance 11 was used to test
the following hypotheses: 1. Blood calcium concentration increases after intake of the calcium
drink; 2. Blood calcium concentration decreases without calcium drink; 3. Blood calcium
concentrations are equal in calcium drink and control groups before intake of the calcium drink; 4.
Blood calcium concentrations differ between calcium drink and control groups after intake of the
calcium drink. The effect of sampling time on blood calcium concentration was studied using the
DUNCAN procedure. 11 Differences in daily milk yield between case and control groups were
accounted for by including daily milk yield as a variable. Statistical Analysis Systems 16 was used
for computation. P was limited to 10% (P < 0.10).

Results

Drinking
Drinking was studied in cows, who on average had calved for the third time. Cows offered the calcium drink had yielded less milk in the preceding lactation than cows offered water, however, they were also milked fewer days. Daily milk yield did not differ between groups. Calcium drink and water were offered lukewarm ¼ hour after calving, on average (Tab. 1). Cows drank as much calcium drink as water. In both groups drinking took equally long, was equally fast, in equal numbers of sets and sips (Tab. 2). In total, 72% of all cows emptied the 20 liters offered, 18% drank 8.2 liters on average, and 10% of all cows drank less than one liter (Fig. 1 and 2).

Blood Calcium Concentration

Blood calcium concentration was studied in cows that had calved for the second or third time on average. Cows offered the calcium drink had yielded as much milk in the preceding lactation, and were milked as many days, as cows not offered the calcium drink. Daily milk yield was, however, lower in cases than in controls. The study was initiated ten minutes after calving, on average (Tab. 3). After intake of the calcium drink, blood ionized calcium increased. Blood calcium was significantly higher from 10 minutes to 24 hours after intake than before intake (P = 0.005). Ten minutes after intake of the calcium drink, ionized blood calcium was 0.06 mmol/l higher than before intake; one hour later 0.11; six hours later 0.13; and 24 hours later 0.08 mmol/l higher than initially. Without calcium drink, blood calcium concentration decreased (P = 0.006). After 24 hours blood ionized calcium was 0.17 mmol less than initially. Blood calcium concentration did not differ initially between cows offered the calcium drink and cows not offered a calcium drink (P = 0.67). Cows having had the calcium drink showed significantly higher blood calcium concentrations from ten minutes to 24 hours after intake than cows not having had a calcium drink (P < 0.001); the difference accounted for 0.19 mmol/l ionized calcium on average (Fig. 3).

Discussion

The first research hypothesis was confirmed because cows drank the calcium drink as readily as water. It may be expected that seven out of ten cows empty a 20-liter bucket of water immediately after calving, two out of ten drink less than half of it and one out of ten cows does not drink at all. The same can be expected for the calcium drink. Not emptying the bucket may be explained by low thirst. Dairy cows drank on average 50 liters of water daily, varying from 20 to 87 liters according to feed intake and milk yield \(^3\). Heifers (primipara) drink less right after calving than cows (pluripara). This is why the calcium drink is for cows at second calving or older.
The second research hypothesis was also confirmed because blood calcium concentration increased after intake of the calcium drink. It may be expected that the calcium drink significantly increases blood calcium from ten minutes to 24 hours after intake. Other studies observed an increase in blood calcium from 30 minutes to one hour after oral administration of 1,875 mol (75 g) calcium from calcium chloride, and from 30 minutes to four hours after oral administration of 1,875 mol (75 g) calcium from calcium propionate. 4,5 Without calcium drink blood calcium concentration decreased. This is in accordance with other studies which observed decreased blood calcium after calving. 7

Calcium gels and boluses need to be administered actively, which involves more labour and puts farm personnel and cows at safety risks. 6 A benefit of the new calcium drink could be that cows now drink calcium themselves. No administration – no hassle.

Acknowledgement

We thank Sigrid Raschowsky and Udo Förster from the Saxoninan Milk Production Cooperative in Quersa, Germany for good cooperation, and Philipp Sauermann from Bayer in Fernwald-Annerod, Germany for providing us with the Radiopoint 400 portable blood analyzer.
References


Table 1: Anamnestic data of 60 cows each, offered 20 liters of calcium drink or 20 liters of water. Geometric means are given. $P = \text{error probability}$.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Calcium drink (n = 60)</th>
<th>Water (n = 60)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (n calvings)</td>
<td>2.7</td>
<td>2.8</td>
<td>0.30</td>
</tr>
<tr>
<td>Milk yield in preceding lactation (kg [lb])</td>
<td>7222 [15888]</td>
<td>7947 [17483]</td>
<td>0.04</td>
</tr>
<tr>
<td>Days in milk in preceding lactation (n)</td>
<td>321</td>
<td>337</td>
<td>0.10</td>
</tr>
<tr>
<td>Daily milk yield in preceding lactation (kg [lb])</td>
<td>22.5 [49.5]</td>
<td>23.6 [51.9]</td>
<td>0.21</td>
</tr>
<tr>
<td>Period between calving and offering the drink (min)</td>
<td>15</td>
<td>16</td>
<td>0.82</td>
</tr>
<tr>
<td>Temperature of the drink ($^\circ$C [$^\circ$F])</td>
<td>27.1 [80.8]</td>
<td>26.8 [80.2]</td>
<td>0.19</td>
</tr>
</tbody>
</table>
Table 2: Drinking of 60 cows each of 20 liters of calcium drink or 20 liters of water, offered right after calving. Geometric means are given. \( P \) = error probability

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Calcium drink (( n = 60 ))</th>
<th>Water (( n = 60 ))</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume consumed (l)</td>
<td>15.1</td>
<td>12.6</td>
<td>0.30</td>
</tr>
<tr>
<td>Share of 20 l (%)</td>
<td>76</td>
<td>63</td>
<td>0.30</td>
</tr>
<tr>
<td>Duration (min:sec)</td>
<td>2:02</td>
<td>2:20</td>
<td>0.62</td>
</tr>
<tr>
<td>Velocity (l/min)</td>
<td>5.7</td>
<td>5.4</td>
<td>0.77</td>
</tr>
<tr>
<td>Set (n)</td>
<td>5.0</td>
<td>4.9</td>
<td>0.96</td>
</tr>
<tr>
<td>Volume per set (l)</td>
<td>2.7</td>
<td>2.5</td>
<td>0.71</td>
</tr>
<tr>
<td>Sips (n)</td>
<td>35</td>
<td>31</td>
<td>0.39</td>
</tr>
<tr>
<td>Volume per sip (l)</td>
<td>0.38</td>
<td>0.41</td>
<td>0.31</td>
</tr>
<tr>
<td>Sips per set (n)</td>
<td>6.5</td>
<td>6.0</td>
<td>0.68</td>
</tr>
</tbody>
</table>
Table 3: Anamnestic data of 8 cows each, offered 20 liters of calcium drink or no calcium drink. Geometric means are given. \( P = \) error probability.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Calcium drink (n = 8)</th>
<th>No calcium drink (n = 8)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (n calvings)</td>
<td>2.4</td>
<td>3.3</td>
<td>0.14</td>
</tr>
<tr>
<td>Milk yield in preceding lactation (kg)</td>
<td>6748 [14845]</td>
<td>8617 [18957]</td>
<td>0.11</td>
</tr>
<tr>
<td>Days in milk in preceding lactation (n)</td>
<td>302</td>
<td>312</td>
<td>0.76</td>
</tr>
<tr>
<td>Daily milk yield in preceding lactation (kg) [lb]</td>
<td>22.4 [49.3]</td>
<td>27.6 [60.7]</td>
<td>0.02</td>
</tr>
<tr>
<td>Period between calving and starting study (min)</td>
<td>10</td>
<td>9</td>
<td>0.79</td>
</tr>
</tbody>
</table>
Figures

Fig. 1: A cow drinking the PROPELLER® calcium drink immediately after calving.
Fig. 2: Proportion of cows and volume of calcium drink or water consumed.
Fig. 3: Ionized blood calcium before and after intake of the calcium drink or no calcium drink.