Feeding behaviour and weaning of milk-fed dairy calves

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In North America, dairy calves are typically:
- Separated from their mother at birth
- Raised in individual housing until weaned off milk
- Fed milk or milk replacer at 8-10% BW/d in two meals from a bucket
- Weaned off milk at 6-8 weeks of age
- Mortality rate 8-12% before weaning
Issues

1. Early care of calves: colostrum intake, heat lamp
2. How much milk to feed
3. Predicting illness with automated milk feeders
4. Weaning off milk
Sucking motivation of the newborn and colostrum intake

- Sucking motivation of newborn and colostrum intake
- No effect of time since birth (2h versus 6h) or of heat lamp
- Effects of body weight and calf vigour
Motivation to ingest colostrum at first meal varies between calves and is related to birth weight. 

\[ r = 0.39 \quad p = 0.003 \]

Calves with low colostrum intake.
High calf vigour at birth led to increased colostrum intake and drinking speed.

High vigour >=55% of first hour after birth standing

Low vigour <55% of first hour after birth standing

P<0.05
Do calves need an external source of heat?

Low temperatures

- Increase mortality
- Increase protein degradation
- Impair absorption of IG from colostrum
- Increase pneumonic lesions
Do calves recognize and use an external source of heat?

Preference test layout

Calves prefer heat

Calves use heat source more as they age.

An external source of heat could help identify ill calves

Even well fed calves (30% BW) show a strong preference for an external source of heat.

Temperature recording

How much milk should we feed?

What is “natural”, biological?
**Conventional feeding**
- fed milk at 4-6L/d
- grow about 0.5kg/d
- weaned off milk at 6-8 weeks of age

**Nursing from cow**
- drink 8-12L/d of milk,
- grow about 1kg/d
- are weaned at 8-10 months of age

Conventional feeding during the first 3d of life leads to weight loss

Milk intake kg/3d

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Milk intake (kg / 3 d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>17.79</td>
</tr>
<tr>
<td>LOW</td>
<td>8.97</td>
</tr>
</tbody>
</table>

Weight gain kg/3d

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weight gain (kg / 3 d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>1.26</td>
</tr>
<tr>
<td>LOW</td>
<td>-1.23</td>
</tr>
</tbody>
</table>

Ad lib milk feeding of dairy calves

Compared feeding and growth of calves fed either 12L/d of milk or 4L/d of milk from an automated milk feeder.

**Borderas, T.F., A.M.B. de Passillé, and J. Rushen. 2009.** Feeding behavior of calves fed small or large amounts of milk. J. Dairy Sci.
Calves drink large volumes of milk even from an early age.

**Milk**

- **12L/d**
- **4L/d**

*Graph showing milk intake (L/d) vs. age.*
Calves fed large amounts of milk have more, smaller meals of milk but make fewer visits to the milk feeder.

<table>
<thead>
<tr>
<th>Milk meals</th>
<th>Ad lib fed</th>
<th>Restrict fed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total visits to feeder /d</td>
<td>7.4</td>
<td>26</td>
</tr>
<tr>
<td>Meal frequency /d</td>
<td>5.3</td>
<td>2</td>
</tr>
<tr>
<td>Meal Size (kg)</td>
<td>1.6</td>
<td>2.3</td>
</tr>
</tbody>
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De Paula Veira et al 2007 Applied Anim Behav Sci in press
Low milk fed calves visit around time when milk becomes available
A high intake of milk reduces intake of solid starter.

Graph showing the relationship between grain intake (g/d) and age (AGE) with two milk intake levels: 12L/d (green line) and 4L/d (red line). The graph indicates that a high intake of milk reduces the intake of solid starter.
Increased milk intake increased growth rates despite lower starter intake.
No Effects on calf health

<table>
<thead>
<tr>
<th></th>
<th>High milk fed</th>
<th>Restrict fed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gastro intestinal problems</strong></td>
<td>13/25</td>
<td>8/25</td>
</tr>
<tr>
<td><strong>Respiratory</strong></td>
<td>9/25</td>
<td>8/25</td>
</tr>
<tr>
<td><strong>Total morbidity</strong></td>
<td>15/25</td>
<td>15/25</td>
</tr>
</tbody>
</table>
Ad lib feeding reduced attempted displacements at the milk feeder

De Paula Veira et al 2007 Applied Anim Behav Sci in press
<table>
<thead>
<tr>
<th>Feeding dairy calves larger amounts of milk (12L/d or ad libitum):</th>
<th>Increases weight gain during the milk-feeding period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Improves feed conversion efficiency</td>
</tr>
<tr>
<td></td>
<td>Reduces behavioural signs of hunger</td>
</tr>
<tr>
<td></td>
<td>Does not reduce the health of the animals</td>
</tr>
<tr>
<td></td>
<td>May increase milk production during the first lactation</td>
</tr>
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</table>

How to wean calves off large amounts of milk
Group-housed calves show little cross-sucking if fed sufficient quantities of milk and have enough opportunities to suck

.......but what happens when they are weaned?
Can gradual weaning reduce the growth check observed during and after weaning in *high milk fed* calves?

Does gradual weaning reduce cross-suckling?
Methods

Calves fed with automated milk + grain feeders
4 calves/pen
9 repetitions

Calf is recognised by the feeder, milk and grain intake are recorded and can be controlled
Treatments

1. **Abrupt weaning** - 12L/d until 41d
2. Start 19d of age reduce milk allowance by 0.5L/d for 22d weaning
3. Start 31d of age reduce milk allowance by 1.1L/d for 10d weaning
4. Start 37d of age reduce milk allowance by 2.4L/d for 4d weaning
11 Days of x-sucking observations

Day
9  All offered 12L/d of milk
18  Start 22d weaning
24
30  Start 10d weaning
36  Start 4d weaning
39
40
41  Abrupt weaned  Weaning completed – no milk
42
46
49
Gradual weaning increased grain intake during and after weaning.

Digestible energy (DE) intake estimated for milk, grain and total energy intake.
1. Gradual weaning decreases energy intake before weaning but increases energy intake after weaning.

2. Abrupt weaning leads to little cross-sucking before weaning but much cross-sucking after.

3. Gradual weaning that begins too early (22d) leads to increased cross-sucking before weaning is completed.
We measured each calf’s level of feeding motivation by the frequency of visits to the milk feeder and the grain feeder and time standing or lying down.

Time spent standing or lying was recorded by activity loggers attached to a leg.
A calf’s frequency of visits to the milk feeder and to the grain feeder and time spent standing were positively correlated, suggesting that they all reflect feeding motivation.

However, the duration of cross-sucking was not positively correlated with any of these
Conclusions:

When fed high quantities of milk from a teat feeder, calves show little cross-sucking.

Abrupt weaning results in an increase in cross-sucking.

Gradual weaning does not reduce cross-sucking after weaning.

Gradual weaning that starts too early (e.g. before 4 weeks of age) increases cross-sucking before weaning.
Conclusions:

Individual differences in cross-sucking after weaning may not be related to individual differences in feeding motivation.

Or may be an alternative way of responding to hunger (rather than visiting the dry feeders).
Can delaying the age at which calves fed large amounts of milk are weaned off milk:

- increase calves’ intake of starter before weaning
- reduce weight loss during and after weaning
- reduce behavioural signs of hunger at weaning?
Calves kept in groups of 9; fed milk and starter from an automated feeder.

3 calves from each treatment in each group;
Gradual weaning took place over 10d

Treatments:

a). Fed 6L/d milk, weaned off milk at 48d of age
b). Fed 12L/d of milk, weaned off milk at 48d of age
c). Fed 12L/d of milk, weaned off milk at 90d of age
Milk intake

Milk intake (kg)

Age (d)

- 6L/d 48d wean
- 12L/d 48d wean
- 12L/d 90d wean
Conclusions:

High milk intake reduced grain intake but later weaned calves increased grain intake more quickly when weaning began.

Calves did not eat enough starter to compensate for lost milk. Energy intake decreased at weaning. This was less for later weaned calves.

Weaning at 48d led to a drop in body weight among high milk fed calves. This did not occur when calves were weaned at 90d of age.

During weaning calves visited the feeder frequently—a sign of hunger. This increase was less for later weaned calves.
Which aspects of feeding behaviour of milk-fed calves are affected by illness.

Does the amount of milk fed influence the effect of illness on feeding behaviour?

Calves kept in groups and fed with automated feeding system.

Fed either high (12L/d or ad lib) or low (4L/d) amounts of milk or milk replacer.
Detecting illness through automated monitoring of behavioral changes

Changes in behaviour are one of the first signs that an animal is ill
Daily health checks

- General condition
- Dehydration
- Rectal temperature
- Faecal consistency
- Navel status
- Nasal/ocular discharge
- Coughing / Lung sounds
- Hair
- Muzzle humidity
Illness reduced milk intake only of calves fed high amounts of milk

High-fed calves

Low-fed calves

Milk intake / L

Days from when illness detected

* P<0.05

Healthy

Sick

High-fed calves

Low-fed calves
Effects of illness on feeding behaviour depends on feeding motivation

- **Healthy**
  - High-fed
  - Low-fed

- **Sick**
  - ns

**Milk intake (L/d)**
- Healthy: Low-fed vs. High-fed: p<0.05
- Sick: ns

**Visits to feeder**
- Healthy: ns
- Sick: p<0.05

**Visit duration (min/3 visits)**
- Healthy: ns
- Sick: p<0.05
Improving heifer welfare on farms

- A survey
- An intervention tool
1. Problems areas identified in the survey:

- Calving management
- Pre weaning mortality
- Colostrum management
- Pain control during dehorning
- Milk feeding and Weaning
Despite frequent recommendations, many dairy producers use management practices that increase the health and welfare risks of milk-fed calves.

In particular, inadequate health monitoring and colostrum management practices need to be improved.
2. On-farm intervention tool to improve rearing practices

Tested on 30 farms in Quebec

New approach of on-farm management and health data collection

A tool to improve calf and heifers rearing practices
Intervention has 2 parts:

1. Farmers’ part:  
   takes samples and records

2. A half-day visit:
   An interview to document management practices
   a check-list in the barn on housing and other environment measures

→ Observer assigns “marks” and provides recommendations on the 10 key elements of rearing practices
Farmers' part:

Farmers take samples (colostrum and blood) and records (mortality and morbidity) during a 6-months period.

Farmers tests for colostrum quality and IG transfer level in blood.
Producers measure colostrum quality

We provide colostrometer
Producers measure blood Ig levels

We provide kits

Producers take blood samples
Report and discussion

- Calving management
- Calf’s first cares
- Colostrum management
- Milk feeding
- Weaning
- Calf housing
- Heifer housing
- Heifer feeding
- General cares

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