Management Considerations Related to Hygiene, Health and Productivity

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Managing for cow behavior: “Big Picture”

Facility
- stalls
- feed area
- floors
- ventilation

Grouping

Stocking Density

Time Budgeting & Natural Behaviors

Resting ↔ Feeding ↔ Ruminating

Productivity and Health
Maintenance of time budget:
Foundation of dairy cow well-being

3 to 5 h/d

10 to 14 h/d

2 to 3 h/d

2 to 4 h/d
Maintenance of time budget: Foundation of dairy goat well-being?

2 to 6 h/d

Milking?

10 to 14 h/d
UW system as an example...scores of 1 & 2
UW system as an example...scores of 3 & 4
UW Udder scoring system

UDDER HYGIENE SCORING CHART
Score udder hygiene on a scale of 1 to 4 using the criteria below.
Place an X in the appropriate box of the table below the pictures.
Count the number of marked boxes under each picture.

<table>
<thead>
<tr>
<th>SCORE 1</th>
<th>SCORE 2</th>
<th>SCORE 3</th>
<th>SCORE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free of dirt</td>
<td>Slightly dirty</td>
<td>Moderately covered with dirt</td>
<td>Covered with caked on dirt</td>
</tr>
<tr>
<td>2-10% of surface area</td>
<td>10-30% of surface area</td>
<td>&gt;30% of surface area</td>
<td></td>
</tr>
</tbody>
</table>

DATE: ____________________
FARM: ____________________
GROUP: ____________________

Total Number of udder scores: ____________________
Number of udders scored 1: ____________________
Number of udders scored 2: ____________________
Number of udders scored 3: ____________________
Number of udders scored 4: ____________________

Percent of Udders Scored 3 & 4:
Udders scored 3 and 4 have increased risk of mastitis
as compared to scores 1 & 2.

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Focus on udder scores

- 95% agreement between observers
- Milk samples from “Dirty” cows are $1.5 \times$ more likely to contain a major pathogen

Ruegg et al., 2003
Hygiene scores highly repeatable regardless of experience with cattle

- Comparison of scores given by students and instructors
  - None = no to little experience with cattle
  - Some = grew up on a dairy; no judging experience
  - A lot = member of dairy judging team

<table>
<thead>
<tr>
<th>Area</th>
<th>None</th>
<th>Some</th>
<th>A lot</th>
<th>Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thigh</td>
<td>0.89</td>
<td>0.87</td>
<td>0.92</td>
<td>0.89</td>
</tr>
<tr>
<td>Udder</td>
<td>0.82</td>
<td>0.81</td>
<td>0.84</td>
<td>0.82</td>
</tr>
<tr>
<td>Leg</td>
<td>0.79</td>
<td>0.82</td>
<td>0.80</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Reneau et al., 2005
No data connecting hygiene and udder health in dairy goats

- No apparent scoring system for goats
- One study used cosmetic mirror to evaluate udders
- Area of future research
Relationship between cow comfort, health, and hygiene
The importance of hygiene for the health of dairy cows

Midpoint = 400,000

Ruegg et al., 2003
Stall design has a key role

As stall width increases, lying time increases

Neckrail alters stall use

Brisket board can reduce lying time and increase lameness

Tucker et al., 2006, 2009 and Bernardi et al., 2009
Considerations for bedding

- Sand – contains 100-fold fewer pathogens; must be < 5% OM
- Straw – highest strep. counts
- Sawdust – highest coliform counts
- Manure solids – must be ≥ 35% DM
- Organic beddings – 10,000-fold increase in bacteria over the first few hours

Hogan and Smith, 2012
Recently groomed sand-bedded stall and sawdust-bedded stall in need of cleaning
Sand may be the best option... if it works overall

<table>
<thead>
<tr>
<th>Area of body</th>
<th>% of cows = 3 &amp; 4</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sand</td>
<td>Mattress</td>
<td>SE</td>
</tr>
<tr>
<td>Udder</td>
<td>17</td>
<td>33</td>
<td>4</td>
</tr>
<tr>
<td>Lower leg</td>
<td>39</td>
<td>74</td>
<td>9</td>
</tr>
<tr>
<td>Upper leg</td>
<td>2</td>
<td>12</td>
<td>2</td>
</tr>
</tbody>
</table>

Cook and Reineman, 2007
### Cow response to sand...

<table>
<thead>
<tr>
<th>Response</th>
<th>Sand</th>
<th>Mattress</th>
<th>Benefit of sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield</td>
<td>25,926</td>
<td>24,260</td>
<td>+1,666</td>
</tr>
<tr>
<td>SCC, × 1000</td>
<td>298</td>
<td>373</td>
<td>-75</td>
</tr>
<tr>
<td>Mastitis rate (%)</td>
<td>45</td>
<td>62</td>
<td>-17</td>
</tr>
</tbody>
</table>

- Comparison of 62 freestalls herds in WI visited due to udder health issues

Cook, 2012
But, all sand is not equal...

- Fine sand replaced with coarse, washed mason sand – Feb. 2006
- SCC decreased by 50%

Cook and Reineman, 2007
The best designed stalls only work if they are used...
Considerations for bedding

- Sand – contains 100-fold fewer pathogens; must be < 5% OM
- Straw – highest strep. counts
- Sawdust – highest coliform counts
- Manure solids – must be ≥ 35% DM
- Organic beddings – 10,000-fold increase in bacteria over the first few hours

What about pasture?

- Pathogen load generally lower
  - Increases occur when closely grazed or overstocked
  - Areas around feed & water troughs and lanes can be similar to confinement housing
- Access important
  - Cows with access were 3.75 × less likely to be “dirty”

Hogan and Smith, 2012; Nielsen et al., 2011
Use of alley scrapers improves udder hygiene

- Automated alley scrapers run every 2 or 3.5 h
- Reduced DM on floors
- Increased udder hygiene

Magnusson et al., 2008
Effects of management on productivity
Stocking density can lower milk yields

**Milk yield = 20.4 + 7.5 x stall/cow**

Bach et al., 2008

- Similar relationship between resting time and milk production (Grant, 2005)
### Stocking density and cow performance

<table>
<thead>
<tr>
<th>Variable</th>
<th>100%</th>
<th>113%</th>
<th>131%</th>
<th>142%</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI, lb/d</td>
<td>53.4</td>
<td>53.7</td>
<td>54.8</td>
<td>55.2</td>
</tr>
<tr>
<td>Meals/day</td>
<td>7.2</td>
<td>7.2</td>
<td>6.4</td>
<td>6.3</td>
</tr>
<tr>
<td>Minutes/meal</td>
<td>44.5</td>
<td>46.9</td>
<td>42.5</td>
<td>43.0</td>
</tr>
<tr>
<td>Milk fat, %</td>
<td>3.84</td>
<td>3.77</td>
<td>3.77</td>
<td>3.67</td>
</tr>
<tr>
<td>SCC, x 1000/ml</td>
<td>135</td>
<td>114</td>
<td>169</td>
<td>236</td>
</tr>
</tbody>
</table>

Milk fat (%) significantly reduced and tendency for increased in SCC when stocking density increased

(Hill et al., 2006)
Clinical mastitis events per 305-day lactation: Preliminary Results

- Not statistically different!
- Similar hygiene score (<2)
Are behavioral changes the key to explaining?
Earlier research on spatial needs...

- Stall stocking density = 100, 120, 150, 200, and 300%
  - Lying reduced by $\geq 4$ h above 150%
- Feed bunk stocking density = 20 in, 16 in, 12 in, 8 in, and 4 in
  - Feeding time only reduced at 4 in
- Results should be interpreted with caution

(Friend et al., 1977)
Effect of under- vs. overcrowding

- Stocking densities of 67 vs. 113%
- No effect of lying behavior
  - 10 h lying per day
  - 5 h lying and ruminating per day
  - 15 h of total stall occupancy
- Fewer aggressive interactions at 67%

(Fregonesi and Leaver, 2002)
# Overstocking and lying time

<table>
<thead>
<tr>
<th>Variable</th>
<th>100%</th>
<th>109%</th>
<th>120%</th>
<th>133%</th>
<th>150%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lying, h</td>
<td>12.9</td>
<td>12.1</td>
<td>12.0</td>
<td>11.5</td>
<td>11.2</td>
</tr>
<tr>
<td>Latency to lie, min</td>
<td>39</td>
<td>34</td>
<td>38</td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td>Displacements, n/5 h</td>
<td>0.7</td>
<td>0.9</td>
<td>1.6</td>
<td>2.1</td>
<td>1.9</td>
</tr>
</tbody>
</table>

- Overstocking creates illusion of good stall comfort
- May represent increased risk of environmental mastitis

(Fregonesi et al., 2007)
# Space allocation changes lying behavior in goats

<table>
<thead>
<tr>
<th></th>
<th>Horned</th>
<th>Hornless</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Distance</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Lying, %</td>
<td>72.5</td>
<td>79.6</td>
</tr>
<tr>
<td>Aggression, n/h</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Importance of rest to dairy cows

- Deprivation of lying = ↑ cortisol and ↓ GH (Munksgaard and Simonsen, 1996)
- Priority over other resources (Munksgaard et al., 2005)
  - Rest ↑
  - Feeding ↓
  - Social behavior ↓
  - DMI ↔
- Lameness ↑ as CCI ↓ (Espejo and Endres, 2007)
Benefits of adequate rest

- Reduced stress on the hooves (Cook, 2002)
- Greater blood flow to uterus (Nishida et al., 2004)
- Lower cortisol (Munksgaard and Simonsen, 1996)
- Increased bGH (Munksgaard and Lovendahl, 1993)
- Greater milk yield
  - ~3.5 lb/d for each additional hour
Effect of management on Feeding Behavior
Impact of increasing bunk space per cow

- Comparison of 20 vs 40 in

- 40 in/cow resulted in:
  - 57% fewer aggressive interactions while feeding
  - 24% increase in feeding during 90 min after fresh feed delivery
  - Especially subordinate cow

(DeVries et al., 2004)
Cows have aggressive feeding drive …

- Cows willingly exert >500-lb pressure against feed barrier while eating
  - 225 lb causes tissue damage

- Defines “aggressive feeding drive”
Delivery of fresh TMR stimulates feeding behavior

DeVries and von Keyserlingk, 2005
Frequency of feeding alters feeding behavior

DeVries et al., 2005
Effect of increasing competition at the feed bunk

- Stocking densities of 75, 100, 150, 300%
  - Headlocks and post-and-rail
- As stocking density increased:
  - Feeding time decreased curvilinear
  - Aggression increased curvilinear
  - Inactive standing increased linearly
  - Shift in feeding times
- Greater effect for post-and-rail

(Huzzey et al., 2006)
Behavior from midnight to 4:00 am (Hill et al., 2006)

<table>
<thead>
<tr>
<th>% of cows:</th>
<th>100%</th>
<th>113%</th>
<th>131%</th>
<th>142%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resting</td>
<td>71.1</td>
<td>70.0</td>
<td>63.7</td>
<td>58.7</td>
</tr>
<tr>
<td>Feeding</td>
<td>11.8</td>
<td>12.6</td>
<td>14.6</td>
<td>15.4</td>
</tr>
<tr>
<td>Standing in alley</td>
<td>3.9</td>
<td>5.4</td>
<td>8.7</td>
<td>12.6</td>
</tr>
</tbody>
</table>

Cows wasting time at 142%; 1:00 am
Feed barrier design affects goat behavior
Feed barrier design used

Effects evident or most pronounced in hornless goats

Types of feed barriers

- Neck rail
- Wooden palisade
- Metal palisade
- Diagonal fence

Lowest stress
Fewest displacements
Easiest exit

Acceptable alternative

Nordmann et al., 2011
More on feed barriers for goats

Both increased feeding response....but

Platform decreased aggression and increased simultaneous feeding to a greater extent

Aschwanden et al., 2009
Overcrowding and rumination

- 100 vs 130% (Batchelder, 2000)
  - 28% of cows ruminating at 130%
  - 38% of cows ruminating at 100%

- 67 vs 113% (Fregonesi and Leaver, 2002)
  - Rumination unaffected
  - ~8 h per d
Summary of where we stand...

- **Established effects:**
  - Stall design and management alter use
  - Feed barrier design changes behavior and stress response
  - Amount of space per animal affects behavior and, likely, productivity
  - Hygiene key for udder health in cows

- **Need to know more:**
  - Decreased rumination
  - Less milk
  - Lower milk fat
  - Greater SCC
  - *More on goats overall*
Take home messages…

- Stalls and management need to allow 10-14 h/d rest with all postures
- Manage for 5 h/d feeding; reduced aggression and slug feeding
- Stocking density should not exceed ~120%
- Further research needed
  - Confirm relationship among milk quality, behavior, and stocking density
- Stocking density, grouping & social interactions interact with facilities to determine cow & goat well-being, productivity, health, and herd profitability
SQMI: Objectives

1. Why (or why not) practices adopted?
2. What practices are effective in the SE?
3. Tools & services to help make informed decisions.
4. Education programs for current & next generation

Research * Extension * Education
Questions or comments?

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