How technologies can improve the welfare of transported livestock

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University of Queensland
## Worldwide live export of agricultural animals

<table>
<thead>
<tr>
<th>Species</th>
<th>Number exported per year (million)</th>
<th>Proportional increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1961</td>
<td>2013</td>
</tr>
<tr>
<td>Chickens</td>
<td>0.08</td>
<td>1.6</td>
</tr>
<tr>
<td>Pigs</td>
<td>2.6</td>
<td>38.6</td>
</tr>
<tr>
<td>Sheep</td>
<td>6.5</td>
<td>16.4</td>
</tr>
<tr>
<td>Cattle</td>
<td>4.9</td>
<td>11.0</td>
</tr>
</tbody>
</table>

Source: FAOSTAT, 2016
The quality of the transport is in the hands of the operator.
Key livestock transport issues

- better loading and unloading facilities
- stocking densities
- suitable floors and bedding
- provision of food and water during the journey
- noise and vibration
- sufficient ventilation
  - accumulation of heat from the livestock
  - humidity and ammonia from excreta
Loading in Port Perak, Surabaya, Indonesia

Courtesy of World Animal Protection
Live export from Australia

MV Ocean Drover
(www.dieselduck.net)
Live export stages (21-86 days)

- Mustering: 0.5-1 days
- Holding in yards: 0.5-1 days
- Trucking to assembly depot: 1-2 days
- Assembly depot: 1-7 days
- Trucking to port: 0.1 days
- Enter ship: 0.1 days
- On ship: 7-25 days
- Discharge to truck: 0.1 days
- Hold at feedlot: 10-50 days
- Truck to abattoir: 0.1 days
- Unload and hold in lairage: 0.5 days
- Slaughter: 0.05 days
Feedlot preparation
Loading onto a ship
Loading ramps

- 15-20° maximum
- Use bedding or batons to allow animals to grip
- Minimise slip by handling gently
Slip minimisation, ship entry
National standards

- Australian Maritime Safety Authority
  Marine Orders Part 43
- Specifies pen size, deck loading capacity, rail strength and spacing, passageway width, ceiling height
- Based on ‘best practice’
Heat stress

- Temperature/humidity
- Ventilation rate
- Emergency wetting
- Heat Stress Risk Management Model
Processing the information

- Algorithms to predict developing problems
- On board alarms for high temperatures, humidity and ammonia
- Stability monitoring
News

Cattle euthanised after truck rolled on highway

13th Oct 2016
Heat Stress Risk Management Model

Uses:

– Weather at destination and on route
– Acclimatisation
– Coat and condition
– Ventilation characteristics of ships
Ammonia accumulation on ships

Deck 9 (open)
Deck 6 (open)
Deck 5 (closed): fore, mid & aft
Deck 1 (closed): fore & aft

Fore
Aft
Port
Starboard

engine block

Legend

<table>
<thead>
<tr>
<th>Value</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.000</td>
<td>purple</td>
</tr>
<tr>
<td>11.063</td>
<td>blue</td>
</tr>
<tr>
<td>13.125</td>
<td>blue</td>
</tr>
<tr>
<td>15.188</td>
<td>blue</td>
</tr>
<tr>
<td>17.250</td>
<td>green</td>
</tr>
<tr>
<td>19.313</td>
<td>green</td>
</tr>
<tr>
<td>21.375</td>
<td>green</td>
</tr>
<tr>
<td>23.438</td>
<td>yellow</td>
</tr>
<tr>
<td>25.500</td>
<td>yellow</td>
</tr>
<tr>
<td>27.563</td>
<td>yellow</td>
</tr>
<tr>
<td>29.625</td>
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</tr>
<tr>
<td>31.688</td>
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</tr>
<tr>
<td>33.750</td>
<td>orange</td>
</tr>
<tr>
<td>35.813</td>
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</tr>
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<td>37.875</td>
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</tr>
<tr>
<td>39.938</td>
<td>red</td>
</tr>
<tr>
<td>42.000</td>
<td>red</td>
</tr>
</tbody>
</table>

© OIE
NH₃ concentration (ppm) vs. day of voyage

- **NH₃ concentration**
  - Open (gray squares)
  - Closed (black triangles)

- **Day of voyage**
  - 2 to 13

**Graph Details**
- Y-axis: NH₃ concentration (ppm)
- X-axis: Day of voyage
- Error bars indicate variability in data points.
Effects of ammonia on ships

• Mucosal secretions:
  – nose, eyes, throat
  – Increased macrophage activity

• Reduced feed intake and weight loss
Sheep feed consumption in different ammonia concentrations.

![Bar chart showing daily dry matter consumption per wether (kg) for different ammonia concentrations: control, 15 ppm, 30 ppm, and 45 ppm. The control group shows the highest consumption, followed by 15 ppm, 30 ppm, and 45 ppm. There is a significant difference (*).](image-url)
Potential solutions

- Increase ventilation rate on closed decks
- Wash pens to remove excreta
• Add gypsum to diet
• Reduce protein in ration
• Provide bedding to absorb excreta
Do livestock get seasick?

Main ship movements

Effects of ship movement on sheep behavior and physiology

Source: Eduardo Santurtun
## Effects of movement on stress

<table>
<thead>
<tr>
<th>Behavior, s/30 min</th>
<th>Roll</th>
<th>Heave</th>
<th>Pitch</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Looking at companion</td>
<td>152</td>
<td>309</td>
<td>193</td>
<td>140</td>
</tr>
<tr>
<td>Head under/above</td>
<td>1.2</td>
<td>2.3</td>
<td>1.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Leaning on crate</td>
<td>169</td>
<td>408</td>
<td>190</td>
<td>131</td>
</tr>
<tr>
<td>Lying</td>
<td>574</td>
<td>212</td>
<td>743</td>
<td>910</td>
</tr>
<tr>
<td>Ruminating</td>
<td>809</td>
<td>166</td>
<td>839</td>
<td>941</td>
</tr>
<tr>
<td>Number of steps/30 min</td>
<td>2.3</td>
<td>2.0</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Heart rate, bpm</td>
<td>84</td>
<td>84</td>
<td>81</td>
<td>79</td>
</tr>
</tbody>
</table>

Conclusion

In simulated ship transport, Roll and Heave stress the sheep.
Conclusions

Antiemetic reduces the amount of balance correction by sheep during roll motion

Therefore sheep potentially experience seasickness as a result of the rolling motion of the ship
Potential solutions

1. Stabilise the ship against roll
   - Bilge keel
   - Stabiliser fins
   - Antiroll tanks
   But reduce speed and increase fuel use

2. Include antiemetic in feed
   But high cost and feed intake variable

3. Reroute to avoid high seas
Provision of feed and water

Source: Navarro, Gallo and Phillips
Air transport

Rapid growth in Australia.
Mainly cattle

Source: Avalon Airport: Victoria’s Live Animal Freight Centre (business case)
Conclusions

• Worldwide long distance transport of livestock is increasing
• Much is in developing countries where advanced technologies are not available
• The greatest concerns - heat stress, ammonia, inappetence, seasickness – are now better understood
• This should lead to improvements in the welfare of livestock transported long distances
Thank you

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