What impact does animal husbandry and management have on animal health?

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Livestock Production Systems
Department of Animal Science
Overview

- What is animal health?
- Husbandry, management and health in
  - Laying hens, small ruminants, cattle
- Influence of the production method
- Conclusions
Beforehand:

The heritabilities of health traits range between 0 and 30%.

The majority of the characteristics are environmental!

Environment: - Feeding
- Husbandry
- Pathogen pressure
- ....
Influence factors on animal health

- Husbandry
- Feeding
- Infections
- Genetics
Influence factors on animal health

- Husbandry
- Feeding Level
- Frequency
- Structure
- Over-/Undersupply
- Indigestion

Genetik

Infections

Gauly
Influence factors on animal health

- Husbandry
- Feeding
  - Vaccination
  - Cleaning/Desinfection
  - Treatments
- Infections
- Genetics
Influencing factors on animal health

- Husbandry
- Feeding
- Infections
- Genetics

Animal Health

- Immunity/Resistence
- Immunity/Resistence
- Immunity/Resistence
- Immunity/Resistence
What is animal health?

• SCHLEGEL (1999): Health is the freedom from diseases.
• SCHLEGEL (1999): Disease is any disorder of health by endogenous or exogenous factors.
• SMIDT (1996): Health means that the animals are morphologically and functionally intact, and have the ability to compensate husbandry- and performance-related stress.
What is animal health?

• ANTONOVSKY (1997): Health is a continuum on which an individual is situated at a certain time, and therefore the animal is not healthy or sick, it is healthy on a certain level.

• WHO (1946): ‘Health is a state of complete physical, mental and social well-being and not merely the absence of disease and infirmity’.

• New Common Animal Health Strategy of the EU (2007): ‘Animal health covers not only the absence of diseases in animals, but also the critical relationship between the health of animals and their welfare’.
Overview

• What is animal health?
• Husbandry, management and health in
  • Laying hens, small ruminants, cattle
• Influence of the production method
• Influence of group and herd sizes
• Conclusions
- EU Directive for the protection of laying hens -

⇒ Since 1.1.2012 ban of conventional cages for laying hens throughout the EU (40 % of hens in EU still in cages; Betz et al., 2012)

⇒ ‘Alternative’ production systems
Health problems in „alternative“ housing systems
Expected impact on animal health

Increase of:
• Bacterial and viral diseases
• Parasitic diseases
• Foot pad dermatitis
• Rank order problems
• Feather pecking and cannibalism
• Mortality

Decrease of:
• Adiposis hepatica
• Bone fractures
## Bone fractures in dependence of the housing system (Sandilands, 2008)

<table>
<thead>
<tr>
<th></th>
<th>Conventional cage</th>
<th>Enriched cage</th>
<th>Free-range system</th>
<th>Floor housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farms (N; 100 hens/farm)</td>
<td>8</td>
<td>4</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Fresh fracture (%)</td>
<td>23</td>
<td>13</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Healed (old) fracture (%)</td>
<td>26</td>
<td>30</td>
<td>45</td>
<td>53</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>43</td>
<td>54</td>
<td>68</td>
</tr>
</tbody>
</table>

53 % of the animals with bone fractures !!!!

Gauly
Prevalence of gastrointestinal helminths in relation to production system (in %)

<table>
<thead>
<tr>
<th>Author</th>
<th>Housing system</th>
<th>Ascaridia galli</th>
<th>Heterakis gallinarum</th>
<th>Capillaria obsignata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gayer et al., 2004</td>
<td>Cage</td>
<td>2.2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Floor</td>
<td>54.8</td>
<td>37.0</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Free-range</td>
<td>50.7</td>
<td>42.2</td>
<td>4.8</td>
</tr>
</tbody>
</table>
Infections cause...

... indirect costs:
- Behavioural changes (e.g. feed intake)
- Reduced performance and quality
- Increased disease susceptibility
- Secondary infections

... direct costs:
- Medication
- Animals losses

Suffering, harm and pain!
Effect of an *Ascaridia galli* – infection on the rank order (≥ 3 places) of laying hens

% Changes in rank order

(Gauly et al., 2007. Vet. Parasitol., 146, 271-280)
Approaches to reduce parasite infections

• Antiparasitics/Vaccines/Alternative products
  ➞ Limited availability, development of resistency
  ➞ Effects on product quality, problems for organic farms

• Animal-friendly design of the environment
  ➞ Minimize stress factors
  ➞ Adapted management

• Optimized nutrient composition

• Use of resistant/tolerant genotypes
Approaches to reduce parasite infections

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- Animal-friendly design of the environment
  - Minimize stress factors
  - Adapted management

- Optimized nutrient composition
- Use of resistent/tolerant genotypes
Proportion of herds treated with antibiotics and antiparasitics during the laying period in different housing systems (Gayer et al., 2004)

<table>
<thead>
<tr>
<th></th>
<th>Free-range</th>
<th>Floor</th>
<th>Cage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotics</td>
<td>35.7 %</td>
<td>35.0 %</td>
<td>0.0 %</td>
</tr>
<tr>
<td>Antiparasitics</td>
<td>25.0 %</td>
<td>20.0 %</td>
<td>0.0 %</td>
</tr>
</tbody>
</table>
Antibiotic residues in eggs in relation to management system
(Hafez et al., 1988; Friedrich et al., 1985)

<table>
<thead>
<tr>
<th>Antibiotic, concentration</th>
<th>Days of treatment</th>
<th>Residues in egg after treatment (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cage</td>
</tr>
<tr>
<td>Nicarbazin (2 mg/kg feed)</td>
<td>29</td>
<td>16</td>
</tr>
<tr>
<td>Tetracycline (500 mg/l water)</td>
<td>7</td>
<td>26</td>
</tr>
<tr>
<td>Enrofloxacine (50 mg/l water)</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>
Excretion time of flubendazole (µg/kg) via the egg in dependence of the production system

(ungpublished, 2010)
Approaches to reduce parasite infections

• Antiparasitics/Vaccines/Alternative products
  ➞ Limited availability, development of resistency
  ➞ Effects on product quality, problems for organic farms

• Animal-friendly design of the environment
  ➞ Minimize stress factors
  ➞ Adapted management

• Optimized nutrient composition
• Use of resistant/tolerant genotypes
Worm burden of LSL hens after artificial infection with 250 embryonated *A. galli* – eggs in dependence of the age

(Gauly et al., 2005. Vet. Parasitol., 128, 141-148)
Overview

• What is animal health?
• Husbandry, management and health in
  • Laying hens, small ruminants, cattle
• Influence of the production method
• Conclusions
Example: husbandry intensity, health management and performance
Influence of feeding level on animal health and performance

• Merinoland lambs (n = 248) born indoors
  ⇒ until an age of 40 days on hay and an ad libitum standard pellet diet (ME 11.5 MJ/kg, 19.5 % crude protein)
  ⇒ randomly divided into 2 groups

(Gauly et al., 2004. Small Rum. Res., 55, 159 -167)
Influence of feeding level on animal health and performance

Merinoland sheep
n = 248

Group 1
**Extensive system:**
all-hay ration, no weaning until slaughter (40 kg)

Group 2
**Intensive system:**
Hay plus concentrate ad lib, no weaning until slaughter (40 kg)

(Gauly et al., 2004. Small Rum. Res., 55, 159 -167)
Performance in relation to feeding level

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily weight gain (g)</td>
<td>180 (± 25)</td>
<td>450 (± 58)</td>
</tr>
<tr>
<td>Age at slaughter (days)</td>
<td>212 (± 32)</td>
<td>89 (± 13)</td>
</tr>
</tbody>
</table>
Mean OpG per day in Merionoland lambs in relation to different production systems (40 - 100 days of age)
Are antiparasitic treatments profitable?
Does an anthelmintic treatment indirectly effect lambs’ growth rates?

Groups (Black Head Mutton):

1. No anthelmintic treatment
2. Moxidectin (Cydectin® 1 ml/5 kg LW, Forte Dodge USA)
   → in 6-week intervals

Body weight development of treatment and control groups

Singletons: live weight of treated group was 9% higher at 12 weeks of age
- 4.32 € (4.00 €/kg SW) with approx. 0.90 €/treatment
- + labour costs and risk of resistency
Do all animals have to be treated?

Relevance of single animals on the entire parasite excretion

(Idris et al., 2012. Parasitology Research, 110, 1453-1459)
What did we do?

1. Faeces sample of every animal
2. Number of eggs in distinctive amount of faeces (4 g) diagnosed
3. Total number of eggs excreted by the herd
4. Proportion of single animals on total egg excretion calculated
Proportion of animals involved in total egg excretion (example sheep herd 1, n = 82)

Number of animals (%)

Total egg excretion by 80% of the herd

50% of the total egg excretion by 17% of the herd

10% of the total egg excretion by 1% of the herd
Proportion of animals involved in total egg excretion (example sheep herd 2, n = 173)

Number of animals (%)

Total egg excretion by 91% of the herd

50% of the total egg excretion by 19% of the herd

10% of the total egg excretion by 2% of the herd
Disadvantages of selective treatments

- Additional labour costs for selection of treated animals
- Potential laboratory costs
Advantage of selective treatments

- Savings of anthelmintics
Advantage of selective treatments

• Savings of anthelmintics

Example Moxidectin: approx. 0.90 € / ewe (n = 100) (5.24 €)

only 80% of the herd is treated → + 18 € (+ 105 €)

only 50% of the herd is treated → + 45 € (+ 262 €)

only 20% of the herd is treated → + 72 € (+ 419 €)
Advantage of selective treatment

- Savings of anthelmintics
- Savings of labour costs
- No residues (product quality?) – organic farms!
- Delayed development of resistancy – longer effectiveness of the compounds
Overview

• What is animal health?
• **Husbandry, management and health in**
  • Laying hens, small ruminants, **cattle**
• Influence of the production method
• Conclusions
Effect of management system on health of beef calves

- Keeping animals indoors on straw during winter period (n = 181)
- Pasture based management system (n = 23)

Percent prevalence of *Cryptosporidium parvum* in beef calves

![Bar graph showing prevalence of Cryptosporidium parvum in beef calves across different ages and environments.](image)

- **Prevalence %**
- **Age in weeks**
- **Pasture**
- **Indoors**

- **p < 0.05**
Percent prevalence of *Eimeria sp.* in beef calves

<table>
<thead>
<tr>
<th>Age in weeks</th>
<th>Prevalence %</th>
<th>Pasture</th>
<th>Indoors</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

* p < 0.05
Intensity of *Eimeria sp.* infections in beef calves

OpG

![Bar graph showing the intensity of *Eimeria sp.* infections in beef calves. The graph compares the intensity between calves raised outdoors and indoors. The x-axis represents the age in weeks, ranging from 5 to 9, and the y-axis represents the intensity, ranging from 0 to 1200. The graph indicates a significant difference (p < 0.05) in the intensity of infections between the two groups.]
Factors influencing the incidence of diarrhoea in dairy calves
Comparison of the incidence of diarrhoea in calves with and without contact to other animals

(Girnus, 2004)
Comparison of the incidence of diarrhoea with different staff

(Girnus, 2004)
Associations between production system and isolation of *Salmonella* in dairy cattle

\[ n = 20,089 \text{ dairy cows}, n = 4,673 \text{ pre-weaned calves}, n = 129 \text{ farms} \]

- 4.9 % of the fecal samples from cows, 3.8 % from calves were *Salmonella* positive.

(Fossler et al., 2004)
Factors associated with increased odds for *Salmonella* shedding

- routine feeding of medicated milk replacer,
- use of calving pen as a hospital area for sick cows > once a month,
- open storage of all purchased concentrate or protein feeds,
- cow access to surface water,
- disposal of manure in liquid form on land and
- eating or grazing roughage by cows from fields having surface application of manure during the growing season.
Factors not associated with increased odds for *Salmonella* shedding

- Herd size and
- farm type (organic/conventional).
Weaning management in beef cattle:

What impact does age and weaning method have on health and performance?
Weight gain (g/day) in dependence of the weaning age in Angus calves

<table>
<thead>
<tr>
<th>Weaning age</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5 months</td>
<td>879 g</td>
</tr>
<tr>
<td>7 months</td>
<td>1273 g (+ 45 %)</td>
</tr>
</tbody>
</table>
Two-Step-Weaning
Two-Step-Weaning
- Behaviour of calves -
Two-Step-Weaning
- Behaviour of cows -

Vocalizations/day and animal after weaning

[Bar chart showing vocalizations per day for Traditional and Two-Step weaning methods over five days (Day 1 to Day 5).]
What impact does barn climate have on the health in dairy cows?
Distribution of veterinary-treated cases (n = 5,547) in 8 farms (2003 and 2005) and THI (yearly average)

(Sanker et al., 2013, Animal, 7, 316-321)
What impact does the production system have on the barn climate in dairy cows?
Temperature-humidity index (THI) and milk yield (Brügemann et al., 2011)
Husbandry system, climate and performance

- 88 farms in 4 husbandry clusters:
  - Cold loose-housing with and without pasture
  - Warm loose-housing with and without pasture

(Sanker et al., 2012)
### THIs above/below thresholds in the farms

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Days with THI</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>≤ 30</td>
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<tr>
<td>Warm loose-housing</td>
<td>4.5</td>
</tr>
<tr>
<td>Cold loose-housing</td>
<td>17.5</td>
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</tbody>
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Effects on the milk yield
(-0.22 kg/THI < 40; -0.26 kg/THI > 60)

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<th>Days with THI</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 30</td>
<td>≤ 40</td>
<td>≥ 60</td>
<td>≥ 70</td>
<td>≥ 80</td>
</tr>
<tr>
<td>Warm loose-housing</td>
<td>4.5</td>
<td>30</td>
<td>184</td>
<td>70</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold-loose housing</td>
<td>17.5</td>
<td>80</td>
<td>173</td>
<td>69</td>
<td>7.5</td>
</tr>
</tbody>
</table>
Influence of the cubicle floor design on the claw health

<table>
<thead>
<tr>
<th></th>
<th>Sole lesion (Score 1 - 6)</th>
<th>Sole hemorrhage (Score 1 - 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straw</td>
<td>2.9 (± 0.27)\textsuperscript{a}</td>
<td>2.3 (± 0.34)\textsuperscript{a}</td>
</tr>
<tr>
<td>Mat</td>
<td>3.8 (± 0.21)\textsuperscript{b}</td>
<td>3.4 (± 0.30)\textsuperscript{b}</td>
</tr>
<tr>
<td>Mattress</td>
<td>3.7 (± 0.30)\textsuperscript{b}</td>
<td>3.7 (± 0.30)\textsuperscript{c}</td>
</tr>
</tbody>
</table>

\textsuperscript{a, b, c} - p < 0.05

(Laven and Livesey, 2004)
Factors of the husbandry system (tie stalls vs. loose-housing) influencing the health and welfare of dairy cows

Gauly
- Acceptance of husbandry systems -
  (Consumer‘s point of view, ranking)

1. Dairy cattle
2. Sheep
3. Pig
4. Beef cattle
5. Egg production
6. Beef calves
7. Broiler

(von Alvensleben, 2003)
What causes the difference in consumer perception?

- Positive development of dairy farming (tie-stalls → loose-housing) (?)
- Dairy cattle are directly visible.
- In pigs and poultry the consumer’s point of view is committed by impressions from the media (no transparency).
- In Germany, only 1.6 % of the employed persons in the primary production (DBV, 2010) → Estrangement, no 'dependency' on the job.
- Herd sizes (‘Industrial livestock farming’) and problems of regional concentration (?)
Problems in tie-stalls - 1

• Insulated barn ⇒ reduced air volume, constant climate, accumulation of noxious gases ⇒ increased incidence of respiratory diseases
• Fixation (more or less inflexible) ⇒ amongst others injuries around the neck and chest
• Poor lying comfort and bad insulation (short beds) ⇒ technopathies such as teat injuries (leading to mastitis), pressure marks on the claws, sole ulcers (Rusterholtz ulcer) (i.e. short bed), injuries of ankle joint, secondary infections
Problems in tie-stalls - 2

- Claws (deficient abrasion)
- Mortellaro and panaritium caused by standing in faeces
- Cow trainer – 80 % of the electric shocks not due to defecation; defecation with straight back
- Reduced feeding times (medium-long bed) and feed intake in straddle position
- Species-atypical standing up and laying down behaviour
- Limited social contact

⇒ Etho- and Technopathies
Status quo: Tie-stalls
Prevalence of welfare problems in 5 dairy cattle breeds housed in tie-stalls in traditional husbandry systems

<table>
<thead>
<tr>
<th>Indicator (% of animals)</th>
<th>Italian HF</th>
<th>Italian Bruna</th>
<th>Pezzata Rossa Italiana</th>
<th>Griga Alpina</th>
<th>Pezzata Rossa d'Oropa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hairless patch areas</td>
<td>40.4</td>
<td>20.8</td>
<td>21.5</td>
<td>2.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Lesion/swelling areas</td>
<td>34.0</td>
<td>30.4</td>
<td>22.8</td>
<td>6.8</td>
<td>1.5</td>
</tr>
<tr>
<td>Overgrown claws</td>
<td>42.6</td>
<td>42.7</td>
<td>31.6</td>
<td>20.5</td>
<td>8.5</td>
</tr>
<tr>
<td>Lameness</td>
<td>39.4</td>
<td>53.2</td>
<td>40.5</td>
<td>2.3</td>
<td>1.5</td>
</tr>
<tr>
<td>„Open“ shoulders</td>
<td>40.6</td>
<td>29.2</td>
<td>33.3</td>
<td>11.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

(Mattiello et al., 2011)
Prevalence of lameness and overgrown claws depending on access to pasture

![Table showing prevalence of lameness and overgrown claws.](https://example.com/table.png)

- **Indicator (%) of animals**
  - Use of pasture
  - Italian HF
  - Italian Bruna
  - Pezzata Rossa Italiana

<table>
<thead>
<tr>
<th>Indicator (%x of animals)</th>
<th>Use of pasture</th>
<th>Italian HF</th>
<th>Italian Bruna</th>
<th>Pezzata Rossa Italiana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lameness</td>
<td>yes</td>
<td>18.2</td>
<td>57.6</td>
<td>56.0</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>47.8</td>
<td>51.7</td>
<td>36.6</td>
</tr>
<tr>
<td>Overgrown claws</td>
<td>yes</td>
<td>18.2</td>
<td>38.5</td>
<td>52.0</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>52.2</td>
<td>55.2</td>
<td>26.8</td>
</tr>
</tbody>
</table>

(Mattiello et al., 2011)
Health and welfare of dairy cows in different husbandry systems (n = 134) in Switzerland (Regula et al., 2004)

1. Tie stalls with regular exercise in summer but minimal outdoor access during winter
2. Tie stalls with regular exercise in an exercise yard or pasture throughout the year
3. Loose-housing with regular exercise to an outdoor yard or pasture

Welfare indicators (e.g. lameness, skin alterations at the hock joints, scars of injuries at the teats) decreasing from 3 > 2 > 1
Solutions

• Extensive pasturing or at least exercise yard (Infrastructure?)
• Transformation into cubicles (behind lying area at least 2.20 m walkway)
• Bedding
Overview

• What is animal health?
• Husbandry, management and health in
  • Laying hens, small ruminants, cattle
• Influence of the production method
• Conclusions
Prevalences and worm burden in organic free-range systems
(144 hens in 11 farms)

<table>
<thead>
<tr>
<th></th>
<th>Prevalence</th>
<th>Mean worm burden (SD)</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nematodes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Ascaridia galli</em></td>
<td>66.6</td>
<td>16.0 ± 24.3</td>
<td>149</td>
</tr>
<tr>
<td><em>Heterakis gallinarum</em></td>
<td>84.0</td>
<td>97.6 ± 129.3</td>
<td>736</td>
</tr>
<tr>
<td><em>Capillaria spp.</em></td>
<td>75.1</td>
<td>45.7 ± 60.2</td>
<td>244</td>
</tr>
<tr>
<td><em>Acuaria hamulosa</em></td>
<td>1.4</td>
<td>1.0 ± 0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>92.4</td>
<td>135.7 ± 136.8</td>
<td>2-775</td>
</tr>
<tr>
<td><strong>Cestodes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Raillietina cesticillus</em></td>
<td>24.3</td>
<td>41.3 ± 45.6</td>
<td>350</td>
</tr>
<tr>
<td><em>Hymenolopis cantaniana</em></td>
<td>2.1</td>
<td>11.3 ± 5.6</td>
<td>1</td>
</tr>
<tr>
<td><em>Choanotaenia infundibulum</em></td>
<td>2.8</td>
<td>26.8 ± 34.4</td>
<td>76</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25.7</td>
<td>42.9 ± 34.8</td>
<td></td>
</tr>
</tbody>
</table>

(Kaufmann et al., 2011, Livestock Sci., 141, 182-187.)
Prevalence (%) of *Ascaris* infections in pigs in relation to production system

(Thamsborg et al., 1999)
Overview

• What is animal health?
• Husbandry, management and health in
  • Laying hens, small ruminants, cattle
• Influence of the production method
• Conclusions
Conclusions

• Animal health and welfare are multifactorial.
• Important are:
  • Husbandry (housing system, infrastructure, protection of the herd, labour, hygiene and health management),
  • Feeding (frequency, level, structure) and
  • Pathogen pressure (Cleaning, desinfection, prophylaxis, medical treatments).
• Production method (organic/conventional) has only indirect effects.
Conclusions

• Because the consumer’s acceptance of livestock farms is based mainly on animal health and welfare, the highest attention should be paid to the environmental conditions.

• A prompt modification and optimization of these factors is needed. Otherwise we will lose production shares.
Take home message!

• Improving animal health is the challenge.
• Improving production systems including management is the key.
• The future of livestock production in many European countries relies on it!
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