Nutrition and resistance/resilience to parasitic infection

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Resistance and resilience to parasitic infection

• Cannot always be clearly distinguished but:
  
  – Resistance relates primarily to ability of hosts to affect parasite establishment, development, fecundity, etc.

  – Resilience relates to the degree the animal is able to maintain performance despite being infected
Parasites cause damage

Disrupted stomach function

Gut damage in small intestine
Parasites affect welfare and performance

- Animals feel sick and may die
• Animals feel sick and may die

• Infections reduce performance
Parasites affect welfare and performance

- Animals feel sick and may die
- Infections reduce performance
  - reduced food intake
Parasites affect welfare and performance

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- Infections reduce performance
  - reduced food intake
  - impaired food digestion
  - protein leakage (needs replenishment)
  - gut damage (needs repair)
  - immune system requires energy and nutrients
Higher infection rates, larger effects

(Coop et al., 1982)
Reduce effects by de-worming

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  - (but too expensive for some systems)
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• Negative consequences
  – Emergence of resistant parasites
  – Drug residues in animal products/environment
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• Other approaches are required
Options for non-chemical control
Options for non-chemical control

- nutrient supplementation
- bioactive forages
- vaccination
- biological control
- breeding
- grazing management
Options for non-chemical worm control

- nutrient (protein) supplementation
- bioactive forages
- vaccination
- biological control
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- grazing management
Ewe protein supplementation
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  - plays an important role in parasite epidemiology
  - ewe is a major source of infection for lambs
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  – protein scarcity during lactation increases PPRI
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- Protein scarcity is determined by supply as well as demand
  - increased protein supply and reduced protein demand both decrease the degree of PPRI
Worms and milk yield during protein supplementation

- Protein supplementation can result in more milk and reduced worm burdens

Houdijk et al 2003
A decrease in protein demand can rapidly reduce worm egg output.
Breed effects and protein supplementation

Kidane et al 2010

Ewes egg count (epg)

Days relative to parturition

MU-LP
MU-HP
BF-LP
BF-HP

Kidane et al 2010
Protein improves immune responses

Globule leukocytes

GL (nr/mm²)

Low
High

days from lambing

Houdijk et al 2005
A single lactating, under-fed susceptible ewe could be a source of infection for many lambs.
Implication for epidemiology and lamb production

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Optimal MP supply to ewes can reduce the negative effects of exposure to parasites
Ewe FEC during ewe protein supplementation (clean fields)

Kidane et al 2008
Lamb weight during ewe protein supplementation (clean fields)

Kidane et al 2008

Graph showing the comparison of Lamb BW (kg) between Control and Protein supplementation over weeks post turnout. The graph indicates a higher Lamb BW in the Protein supplementation group compared to the Control group.
Drench need during ewe protein supplementation (dirty fields)

Kidane et al. 2009

Kidane et al. 2009
Lamb weight during ewe protein supplementation (dirty fields)

Kidane et al 2009

![Graph showing Lamb BW (kg) vs. Weeks post turnout]

- Control
- Protein supplementation

Weaning

Weeks post turnout

Kidane et al 2009
• Protein scarcity may be a reason for elevated FEC in periparturient ewes
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• Protein supplementation:
  – reduced worm burdens and worm egg output
  – reduced drench use
  – increased lamb performance
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• Target most susceptible ewes:
  – thin, multiple rearing (especially gimmers)
  – single-rearing ewes may not benefit from protein
Bioactive forage: a definition

- Plants are referred to as bioactive forages if their consumption results in anti-parasitic activity
- Examples of bioactive forages
  - chicory
  - sainfoin
  - lotus
• Highly palatable
• Good nutritional value
  – Dry matter
  – Macro-nutrients
  – Micro-nutrients
• Readily grown in Scotland
• Anti-parasitic properties
Worm burdens following short term grazing on new chicory

\[ T. \text{circumcincta} \]

- Grass/clover
- Chicory

Grazing treatment

Tzamaloukas et al. (2003)
FEC during long term grazing on new chicory (pre-weaning)

Athanasiadou et al. (2006)
Gain during long term grazing on new chicory (pre-weaning)

![Graph showing lamb gain (g/day) for different treatments.](image)

- Grass/clover
- Chicory

**Ewe treatment at turnout**

- None
- Anthelmintic

Athanasiadou et al. (2006)
FEC during long term grazing on new chicory (post weaning)

Kidane et al 2009
Pasture larval counts

Kidane et al. 2009

![Bar chart showing PLC (L₃/kg) at the end of 2007 and start of 2008 for different types of pasture: Grass and Chicory.](chart.png)

Kidane et al. 2009
Drench need during long term grazing on dirty chicory

Kidane et al 2009

- Grass/clover: 2.00
- Chicory: 1.10

Kidane et al 2009
Mode of action

• Anti-parasitic plant secondary metabolites
  – direct anti-parasitic properties
Mode of action

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- **Immunonutrition**
  - improved host immune responses towards incoming and established worms
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- **Plant structure**
  - broad-leaved structure reduces larval migration and hence larval uptake during grazing
Conclusions -2-

- Bioactive forage like chicory can assist to reduce the degree of gastrointestinal nematode parasitism
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Potential benefits from chicory arise from:
- reduced worm burdens and worm egg output
- reduce drench use
- increased lamb performance
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• We need to know more to understand why it works frequently but not always
Using different approaches at the same time

- Nutritional approaches have the potential to reduce parasitism
- The use of bioactive forages has the potential to reduce parasitism
- How can they be optimally combined?
• How can they be optimally combined?
  
  – With each other?
  
  – With chemical control (drenches)?
  
  – With other measures, such as:
    
    • COWP
    
    • Breeding
    
    • Vaccination
Conclusions -3-

• There is an urgent need to develop alternatives to chemical (anthelmintic) control of gastro-intestinal parasites

• It is likely that combinations of approaches can be useful in different circumstances

• Supplementation with nutrients (protein) and the use of bio-active forages (PSM) are promising parts of strategies for parasite control in future sustainable systems
Thank you for your attention
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