Protein Quality Dynamics During Wilting and Preservation of Grass-Legume Forage

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Introduction

- The crude protein of plants can be divided into following fractions (CNCPS; Sniffens et al., 1992; Licitra et al., 1996):
  - A: Nonprotein nitrogen
  - B: True protein
    - B1: Soluble protein
    - B2: Neutral detergent soluble protein
    - B3: Acid detergent soluble protein
  - C: Acid detergent insoluble protein
- The rumen undegraded dietary protein (UDP) at a defined rumen passage rate can be calculated from the fibre and CP fractions (Kirchhof et al., 2006, Kirchhof, 2007, Edmunds et al., 2012 (In press)).
**Introduction**

- The CP fractions change during wilting and preservation.
- Limited information exists
  - on the effects of moderate wilting during good conditions on the CP fractions and UDP of forage before ensiling.
  - on the effects of storage time and additives on the CP fractions and UDP of silage.
Objective

• To evaluate the effects of
  – wilting
  – ensiling
  – silage additive
    on the protein quality of highly digestible grass-legume forage.
Materials and Methods

Silage study at Nötcenter Viken, Falköping, Sweden

Grass (77%) – legume (23%) forage at 150 g DM/kg was mowed as a first harvest June 3, 2010 and wilted for 21 hours.
Wilted forage was chopped June 4, 2010

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>DM, g/kg</td>
<td>350</td>
</tr>
<tr>
<td>CP, g/kg DM</td>
<td>149</td>
</tr>
<tr>
<td>NDF, g/kg DM</td>
<td>375</td>
</tr>
<tr>
<td>WSC, g/kg DM</td>
<td>215</td>
</tr>
<tr>
<td>OMD, g/kg</td>
<td>917</td>
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</tbody>
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Unwilted and wilted forages were sampled (n = 3).
Harvest

*Precision-chopped forage* – Claas jaguar chopper

*Additives applied to forage on the chopper:*
Homofermentative LAB KOFASIL LIFE 400 000 cfu/g f.m.

Salt-based additive
KOFASIL ULTRA K, 2 l/ton f.m.
(ADDCON EUROPE GmbH)

UNTREATED CONTROL SILAGE
Ensiling in mini silos

- 3 silos/treatment were opened after 5, 10, 30 och 125 days.
- Silages were analysed for fermentation pattern and protein quality.
### Chemical Crude Protein Fractions (Licitra et al., 1996)

<table>
<thead>
<tr>
<th>Crude protein</th>
<th>Non-protein N (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>True protein</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Buffer insoluble protein</strong></td>
<td><strong>Buffer-soluble protein (B1)</strong></td>
</tr>
<tr>
<td><strong>ND-insoluble protein</strong></td>
<td><strong>ND-soluble protein (B2)</strong></td>
</tr>
<tr>
<td><strong>AD-insoluble protein (C)</strong></td>
<td><strong>AD-soluble protein (B3)</strong></td>
</tr>
</tbody>
</table>

UDP at a specific rumen passage rate can be calculated based on these CP fractions and fibre contents (Kirchhof et al., 2006; Edmunds et al, 2012 (In press)).
Fermentation characteristics

Statistical comparisons within storage time, n = 3.
Protein quality changes in forage during wilting for 21 hours and ensiling for 125 days

UDP8, g/kg CP (n = 3)

UNWILTED FORAGE

WILTED FORAGE

CONTROL SILAGE

UDP8, g/kg CP (n = 3)

292b

350a

210c

P < 0.0001

a

b

b

b

a

a

b

b

800

600

400

200

0

ADIP (C)

AD-soluble protein (B3)

ND-soluble protein (B2)

True soluble protein (B1)

NPN (A)
Protein quality changes in silage

Values are means over additive treatments (n=9)
No effects of additives at 5, 10 and 30 days of storage.

$P_{\text{time}} < 0.0001$

BIP (g/kg DM)
NDIP (g/kg DM)
ADIP (g/kg DM)

ND-soluble protein B2
AD-soluble protein B3
Protein quality changes in silage

Values are means over additive treatments (n= 9)
No effects of additives at 5, 10 and 30 days of storage.

$P_{\text{time}} < 0.05$
Additive effects on protein quality of silage after 125 days of storage

UDP8, g/kg CP (n = 3)

<table>
<thead>
<tr>
<th></th>
<th>CONTROL SILAGE</th>
<th>KOFASIL LIFE</th>
<th>KOFASIL ULTRA K</th>
</tr>
</thead>
<tbody>
<tr>
<td>210(b)</td>
<td>233(a)</td>
<td>232(a)</td>
<td>$P = 0.060$</td>
</tr>
</tbody>
</table>

- ADIP (C)
- AD-soluble protein (B3)
- ND-soluble protein (B2)
- True soluble protein (B1)
- NPN (A)
Effect of silage UDP on a dairy cow diet containing 12 kg DM silage and 9 kg DM concentrate

<table>
<thead>
<tr>
<th></th>
<th>CONTROL silage, 210 g UDP/kg CP</th>
<th>KOFASIL LIFE or KOFASIL ULTRA K treated silage, 232 g UDP/kg CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP, g/kg DM</td>
<td>173</td>
<td>173</td>
</tr>
<tr>
<td>RDP, g/kg DM</td>
<td>112</td>
<td>110</td>
</tr>
<tr>
<td>UDP (RUP), g/kg DM</td>
<td>61</td>
<td>63</td>
</tr>
<tr>
<td>NDF, g/kg DM</td>
<td>340</td>
<td>340</td>
</tr>
<tr>
<td>Starch, g/kg DM</td>
<td>144</td>
<td>144</td>
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The increase in diet UDP corresponds to ca 0.5 kg DM concentrate per cow and day.
Conclusions

• Moderate wilting to ca 350 g DM/kg during good weather conditions improved forage protein quality.

• NPN increased rapidly during early fermentation while the AD-soluble protein increased later during fermentation and storage.

• The decrease in UDP during silage fermentation occurred early.
Conclusions

• Effects of additives on protein quality occurred late during silage storage (>30 d).

• KOFASIL LIFE and KOFASIL ULTRA K decreased NPN production and tended to maintain more of the ND-soluble protein in the wilted forage compared to the control silage, resulting in increased silage UDP from 210 to 232 g/kg CP.

• By increasing the UDP from silage, more of the silage protein can be used in cattle diets resulting in savings of concentrate.
Acknowledgements

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Thank you!