Supplementary Material

Title: Review of feeding conserved forage to horses: recent advances and recommendations

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Supplementary Material S1

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### Example of the range in chemical composition of forages produced and fed to horses in some European regions

<table>
<thead>
<tr>
<th>European Region</th>
<th>Forage type</th>
<th>Botanical composition</th>
<th>DM (%)</th>
<th>CP (%DM)</th>
<th>Fibre CF (%DM)</th>
<th>NDF (%DM)</th>
<th>ADF (%DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nordic and Baltic countries (a)</strong></td>
<td>Hay</td>
<td>Grasses</td>
<td>85 - 88</td>
<td>6.3 - 18</td>
<td>31 - 36</td>
<td>61 - 63</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Haylage</td>
<td>Grasses</td>
<td>43* - 85</td>
<td>6.1 - 20</td>
<td>26 - 35</td>
<td>50 - 64</td>
<td>27 - 41</td>
</tr>
<tr>
<td></td>
<td>Silage</td>
<td>Grasses</td>
<td>25 – 55*</td>
<td>10 - 16</td>
<td>26 - 37</td>
<td>54 - 63</td>
<td>29 - 34</td>
</tr>
<tr>
<td></td>
<td>Straw</td>
<td>Cereal</td>
<td>85</td>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hay</td>
<td>Grasses</td>
<td>84 - 86</td>
<td>4.8 - 19</td>
<td>24 - 38</td>
<td>54 - 72</td>
<td>27 - 40</td>
</tr>
<tr>
<td></td>
<td>Mixed i, ii</td>
<td>Grasses</td>
<td>85 - 94</td>
<td>6.3 - 20</td>
<td>25 - 46</td>
<td>53 - 75</td>
<td>28 - 53</td>
</tr>
<tr>
<td><strong>Central Europe countries (b)</strong></td>
<td>Hay</td>
<td>Grasses</td>
<td>84 - 86</td>
<td>4.8 - 19</td>
<td>24 - 38</td>
<td>54 - 72</td>
<td>27 - 40</td>
</tr>
<tr>
<td></td>
<td>Haylage</td>
<td>Grasses</td>
<td>55 - 82</td>
<td>6.1 - 16</td>
<td>24 - 35</td>
<td>55 - 74</td>
<td>31 - 48</td>
</tr>
<tr>
<td></td>
<td>Mixed i</td>
<td>Grasses</td>
<td>55</td>
<td>9.6 - 21</td>
<td>27 - 35</td>
<td>53 - 60</td>
<td>30 - 37</td>
</tr>
<tr>
<td></td>
<td>Mixed ii</td>
<td>Grasses</td>
<td>34 - 44</td>
<td>9.1 - 19</td>
<td>24 - 33</td>
<td>48 - 63</td>
<td>28 - 35</td>
</tr>
<tr>
<td></td>
<td>Silage</td>
<td>Mixed i</td>
<td>34</td>
<td>12 - 21</td>
<td>25 - 33</td>
<td>51 - 59</td>
<td>28 - 35</td>
</tr>
<tr>
<td></td>
<td>Straw</td>
<td>Cereal</td>
<td>84 - 90</td>
<td>3.2 - 4.9</td>
<td>40 - 45</td>
<td>76 - 80</td>
<td>47 - 50</td>
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<tr>
<td></td>
<td>Hay</td>
<td>Grasses</td>
<td>84 - 95</td>
<td>5.2 - 8.9</td>
<td>26 - 37</td>
<td>59 - 68</td>
<td>32 - 43</td>
</tr>
<tr>
<td></td>
<td>Mixed iii</td>
<td>Grasses</td>
<td>83 - 90</td>
<td>6.2 - 8.9</td>
<td>32 - 38</td>
<td>61 - 66</td>
<td>38 - 45</td>
</tr>
<tr>
<td><strong>Southern countries (c)</strong></td>
<td>Hay</td>
<td>Grasses</td>
<td>59 - 65</td>
<td>8.3 - 16</td>
<td>27 - 31</td>
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<td></td>
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<tr>
<td></td>
<td>Haylage</td>
<td>Grasses</td>
<td>59</td>
<td>9.4</td>
<td></td>
<td>61</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Silage</td>
<td>Mixed i</td>
<td>59</td>
<td>9.4</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>Straw</td>
<td>Cereal</td>
<td>85 - 91</td>
<td>2.7 - 5.5</td>
<td>36 - 44</td>
<td>75 - 77</td>
<td>46 - 53</td>
</tr>
</tbody>
</table>

*NB from our consensus definition the forages included here as haylages with a DM <50% would be considered silages and DM >50% haylages.

Meadow or permanent pasture; Oats hay included; Meadow hay and consociations of grass x legume hay.

DM : Dry matter; CP : Crude Protein; CF : Crude Fibre; NDF : Neutral detergent fibre; ADF : Acid Detergent Fibre

Adapted from

(a) Finland, Sweden, Iceland, Denmark, Estonia
References: Särkijärvi et al., 2008; MTT, 2010; Saastamoinen and Hellämäki, 2012; Müller and Udén, 2007; Jansson and Lindberg, 2012; Ragnarsson and Lindberg, 2008; 2010; Luthersson, personal data; Kaldmäe et al., 2012a; 2012b.

(b) Netherlands, Germany, UK, France.
References: CVB, 2010; LUFA Nordwest, personal data; HorseHage, 2014; Tinsley et al., 2014; Dulphy et al., 1997a; Julliand, personal data; INRA, 2011.

(c) Italy, Spain, Portugal. References: Peiretti et al., 2001; Bergero et al., 2002; Bergero et al., 2005; Bergero and Peiretti, 2011; Clotet, personal data; Casamiglia et al., 2004; Dentinho et al., 2014; Fradinho et al., 2013; INIAV, not published
Summary of voluntary intake behaviour of horses fed various diets ad libitum with feed intake time over 24 hours (ADF – Acid detergent fibre; Wet Matter – WM; Dry Matter-DM; ± s.d. STB – Standardbred, TB - Thoroughbred)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Horses/Ponies</th>
<th>Feed (24 hr observations unless stated otherwise)</th>
<th>WM intake 500 kg horse</th>
<th>Average DM Intake in %BW</th>
<th>Intake* Rate (min/kg)</th>
<th>Mean Feed Intake Time (hrs/24hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Dierendonck et al. (1996)</td>
<td>Przewalsky</td>
<td>Mongolia steppe grass (18 hrs)</td>
<td></td>
<td></td>
<td></td>
<td>12 ± 3.6</td>
</tr>
<tr>
<td>Magnusson et al. (1994)</td>
<td>Icelandic</td>
<td>Iceland Grass Plains</td>
<td></td>
<td></td>
<td></td>
<td>14 ± 2.5</td>
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<tr>
<td>Berger et al. (1999)</td>
<td>Przewalsky</td>
<td>Nature Reserve, D</td>
<td></td>
<td></td>
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<td>11 ± 4.4</td>
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<tr>
<td>Ferreira et al. (2013)</td>
<td>Galiciano</td>
<td>Western Asturias, June Heathland Sep</td>
<td>5.3</td>
<td>22</td>
<td>2.7</td>
<td>12 ± 0.8</td>
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<tr>
<td>Osoro et al. (2015)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 ± 0.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean Free-ranging, semi-feral horses on grass</td>
<td>12.4 ±2.7</td>
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<td></td>
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<tr>
<td>Houbiers and Smolders (1990)</td>
<td>12 TB Trotters</td>
<td>Fresh cut summer grass (long, DM 16%)</td>
<td>80</td>
<td>2.1</td>
<td>10</td>
<td>13.37</td>
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<tr>
<td></td>
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<td>Fresh cut spring grass (short DM 14%)</td>
<td>84</td>
<td>2.3</td>
<td>8</td>
<td>11.16</td>
</tr>
<tr>
<td></td>
<td>12 Warmblood</td>
<td>Fresh cut summer grass (long, DM 16%)</td>
<td>85</td>
<td>2.1</td>
<td>10</td>
<td>14.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fresh cut spring grass (short DM 14%)</td>
<td>90</td>
<td>2.4</td>
<td>8</td>
<td>11.95</td>
</tr>
<tr>
<td>Chenost and Martin-Rosset (1985)</td>
<td>TB</td>
<td>Fresh cut hybrid ryegrass (DM 20%)</td>
<td>52</td>
<td>2.6</td>
<td>12</td>
<td>10.36</td>
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<tr>
<td>Dulphy et al. (1997a)</td>
<td>Light horses</td>
<td>Fresh forages (n=16)</td>
<td>63</td>
<td>2</td>
<td>10</td>
<td>10.57</td>
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<tr>
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<td>Mean Barn/Stabled horses with cut Fresh Forages/Grass (DM 14 – 20%)</td>
<td>75.6</td>
<td>2.3</td>
<td>9.67</td>
<td>12 ±1.5</td>
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<tr>
<td>Bergero et al. (2002)</td>
<td>Ponies</td>
<td>Early cut (DM 56%)</td>
<td>19</td>
<td>2.7</td>
<td>30</td>
<td>9.36</td>
</tr>
<tr>
<td></td>
<td>Maintenanc e</td>
<td>Light cut (DM 63%)</td>
<td>17</td>
<td>2.8</td>
<td>30</td>
<td>8.52</td>
</tr>
<tr>
<td></td>
<td>Light Work</td>
<td>Med. Work</td>
<td>19</td>
<td>3.1</td>
<td>30</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>Med. Work</td>
<td>Late cut (DM 65%)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Mean Stabled, Haylages /Dry Silage (DM 56-65%)</td>
<td>23.2</td>
<td>2.8</td>
<td>30</td>
<td>9 ± 0.5</td>
</tr>
<tr>
<td>Martin-Rosset and Dulphy (1987)</td>
<td>Heavy horse</td>
<td>Hay medium quality</td>
<td>12</td>
<td>2</td>
<td>40</td>
<td>7.75</td>
</tr>
<tr>
<td></td>
<td>Yearlings</td>
<td></td>
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<tr>
<td>Vermorel et al. (1997)</td>
<td>STB</td>
<td>Hay late cut</td>
<td>10</td>
<td>1.7</td>
<td>40</td>
<td>6.42</td>
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<tr>
<td>Study</td>
<td>Species</td>
<td>Type</td>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td>Value 4</td>
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<tr>
<td>Dulphy et al. (1997b)</td>
<td>Light horses</td>
<td>Lucerne hay (n=12)</td>
<td>13</td>
<td>2.2</td>
<td>45</td>
<td>9.55</td>
</tr>
<tr>
<td>from various authors</td>
<td></td>
<td>Grass hay (n=38)</td>
<td>13</td>
<td>2.2</td>
<td>35</td>
<td>7.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straws (n=6)**</td>
<td>7</td>
<td>1.3</td>
<td>50</td>
<td>5.88</td>
</tr>
<tr>
<td>Pearson et al. (2001)</td>
<td>Ponies</td>
<td>Oat straw</td>
<td>12</td>
<td>2.2</td>
<td>45</td>
<td>9</td>
</tr>
<tr>
<td>Staniar et al. (2014)</td>
<td>Quarter Horses</td>
<td>Teff Hay (40% ADF)**</td>
<td>9.1</td>
<td>1.7</td>
<td>45</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stabled: Mean Hays (DM 85%)</td>
<td>12 ± 1.4</td>
<td>2.0 ±0.2</td>
<td>40 ± 5</td>
<td>8 ±1.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stabled: Mean Straws/High ADF** (DM 88% +)</td>
<td>10 ± 3.5</td>
<td>1.7 ±0.6</td>
<td>48 ±2.2</td>
<td>7.3 ± 4.1</td>
</tr>
<tr>
<td>Argo et al. (2002)</td>
<td>Ponies</td>
<td>Total Chaff-Pellet Mix</td>
<td>25</td>
<td>4.4</td>
<td>18</td>
<td>7.43</td>
</tr>
<tr>
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<td>As above – pelleted</td>
<td>25</td>
<td>4.4</td>
<td>18</td>
<td>7.43</td>
</tr>
<tr>
<td></td>
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<td>Day 26 Max intake pelleted</td>
<td>28</td>
<td>4.9</td>
<td>18</td>
<td>8.4</td>
</tr>
<tr>
<td>Dugdale et al. (2011)</td>
<td>Ponies</td>
<td>Complete Chaff Diet</td>
<td>12</td>
<td>2.3</td>
<td>60</td>
<td>11.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean Concentrate: minimum 50% Chaff Diets</td>
<td>16.5</td>
<td>2.75</td>
<td>25-60</td>
<td>10 ± 1.8</td>
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<td>Mean Concentrate: Pellets</td>
<td>26.39</td>
<td>4.64</td>
<td>18</td>
<td>8 ± 0.7</td>
</tr>
</tbody>
</table>

*Feed Intake Time as per author or estimated according to Ellis, 2010
** High ADF content: only volume limiting forage, which if overruled by intake behaviour can lead to compaction colics
References for Table S1 and S2


Bergero D, Peiretti PG and Cola E 2002. Intake and apparent digestibility of perennial ryegrass haylages fed to ponies either at maintenance or at work, Livestock Production Science 77, 325-329.


Houbiers HJ and Smolders EA 1990. Opname van vers gras van verschillende opbrengsten (Intake of fresh grass from various harvests). In Praktijkonderzoek Paardenonderzoek 1990


