FEED/FORAGES CALCULATIONS

Equations used for generating feed and forage calculations are provided below. It is responsibility of the user the use or interpretation given to this information.

ENERGY EQUATIONS USED FOR ONTARIO FORAGES (ADF based)

<table>
<thead>
<tr>
<th></th>
<th>Legume (forage, hay, haylage)</th>
<th>Grass (forage, hay, haylage)</th>
<th>Mixed (forage, hay, haylage, balage)</th>
<th>Corn silage/fresh corn silage</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDN, %</td>
<td>88.875-(0.812*ADF)</td>
<td>98.625-(1.048*ADF)</td>
<td>92.62-(0.9093*ADF)</td>
<td>82.14-(0.577*ADF)</td>
</tr>
<tr>
<td>NEL, Mcal/kg</td>
<td>2.0575-(0.0199*ADF)</td>
<td>2.296-(0.0257*ADF)</td>
<td>2.149-(0.0223*ADF)</td>
<td>1.892-(0.0141*ADF)</td>
</tr>
</tbody>
</table>

ENERGY EQUATIONS FOR OTHER FEEDS

<table>
<thead>
<tr>
<th></th>
<th>Oatlage/barlage/misc. silages (Penn state)</th>
<th>Corn+cob meal (dry and high moist)</th>
<th>Grain corn/ HM grain corn/corn gluten meal</th>
<th>Other grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDN, %</td>
<td>88.936-(0.653*ADF)</td>
<td>99.72-(1.927*ADF)</td>
<td>92.22-(1.535*ADF)</td>
<td>92.2-(1.12*ADF)</td>
</tr>
<tr>
<td>NEL, Mcal/kg</td>
<td>2.302-(0.0271*ADF)</td>
<td>2.323-(0.0472*ADF)</td>
<td>2.139-(0.0376*ADF)</td>
<td>1.909-(0.017*ADF)</td>
</tr>
</tbody>
</table>

TMRs and miscellaneous mixed feeds

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TDN, %</td>
<td>88.936-(0.653*ADF)</td>
</tr>
<tr>
<td>NEL, Mcal/kg</td>
<td>2.302-(0.0271*ADF)</td>
</tr>
</tbody>
</table>

ENERGY EQUATIONS FOR HORSES

DE, Mcal/kg          = 4.22-(0.11*ADF)+(0.0332*CP)+(0.00112*ADF^2)

TDN, %               = (DE/4.409)*100

DIGESTIBLE ENERGY AND METABOLIZABLE ENERGY

SWINE: From NRC 1998. Noblet and Perez
DE (Kcal/kg) = 4151-(122*Ash)-(64*Fibre)+(38*Fat)+(23*CP)
DE (Mcal/kg) = DE (kcal/kg)/1000
ME (Kcal/kg) = ((DE in Kcal/kg)*(1.012-(0.0019*CP)))
POULTRY: From ANAC 2002. Fisher and McNab

\[ ME (MJ/kg) = (0.155\times CP) + (0.343\times Fat) + (0.167\times Starch) + (0.130\times Sugar) \]

\[ ME (Mcal/kg) = \frac{ME (MJ/kg)}{4.187} \]

OARDC – Weiss Summative Energy Equation

This energy calculation is a measure of the principal components in the forage that contribute to energy. Each component has a given digestion coefficient, which multiply each constituent. Finally, all the products are added together and an established value for metabolic fecal lost is deducted.

\[ TDN_{1x} = (\text{tdNFC} + \text{tdFat} + \text{tdNDF} + \text{tdCP}) - 7 \]

\[ \text{tdNFC} = 0.98 \times (100 - \text{NDFN} - \text{CP} - \text{Ash} - \text{Fat}) \times \text{PAF} \]

\[ \text{tdFat} = 0.97 \times (\text{FAT} - 1) \times 2.25 \]

\[ \text{tdNDF} = (\text{NDFD} \times \text{NDF}/100) \text{ or } 0.75 \times (\text{NDFN} - \text{LIG}) \times (1 - (\text{LIG} / \text{NDFN})^{0.667}) \]

\[ \text{tdCP (forages)} = \text{DCP} \times \text{CP} \]

\[ \text{DCP}_{\text{forages}} = \exp(-0.012 \times (\text{ADF} - \text{CP})/\text{CP}) \times 100 \]

\[ \text{DCP}_{\text{concentrate}} = (1 - (0.4 \times (\text{ADF} - \text{CP}))) \]

\[ \text{td} = \text{True digestible fraction} \]
\[ \text{NFC} = \text{Non-fibre carbohydrate (%DM)} \]
\[ \text{NDF} = \text{Neutral detergent fibre (%DM)} \]
\[ \text{CP} = \text{Crude protein (%DM)} \]
\[ \text{LIG} = \text{Lignin (%DM)} \]
\[ \text{NDF-CP} = \text{Protein bound to NDF fraction} \]
\[ \text{NDFD} = \text{48-h in vitro NDF digestibility (%DM)} \]
\[ \text{NDFN} = \text{NDF} - \text{NDF-CP} \]
\[ \text{PAF} = \text{Processing adjustment factor} \]
\[ \text{DCP} = \text{Digestible crude protein} \]

**RELATIVE FEED VALUE**

\[ \text{RFV} = \frac{(\text{DDM}) \times (\text{DMI})}{1.29} \]

\[ \text{DDM (Digestible Dry Matter)} = 88.9 - (0.779 \times \text{ADF}) \]

\[ \text{DMI (Dry Matter Intake)} = 120 / \text{NDF} \]

**RELATIVE FEED QUALITY**
RFQ = DMI * TDN / 1.23 (Undersander and Moore, 2002)

For legumes (alfalfa, clovers, and legume/grass mixtures)

DMI = (120 / NDF) + ((NDFD - 45)*0.374 / 1350 * 100

TDN = (NFC*0.98) + (CP*0.93) + ((FAT-1) *0.97*2.25) + (NDFn * (NDFD / 100)) -7

For grasses

DMI = -2.318 + 0.442*CPadj - 0.01*CPadj² - 0.0638*TDN + 0.000922*TDN² + 0.18*ADF - 0.00196*ADF² - 0.00529*CPadj*ADF

TDN = (NFC*0.98) + (CP*0.87) + ((FAT-1) *0.97*2.25) + (NDFN*(NDFDp / 100)) -10

Where:
CPadj = if >16, set CP=16
NDFN = NDF - NDF-CP
NDFD = 48-h in vitro digestibility of NDF (% of NDF)
NDFDp = 22.7 + 0.664*NDFD

MILK 2006

See Milk 2006 Spreadsheet for corn silage

Milk2006 for Alfalfa and Grass

POTENTIALLY DIGESTIBLE NDF (PDNDF)

PDNDF = 100 - (INDF*100)

Where:

INDF (Indigestible NDF) = (LIG / NDF) *2.4

DIGESTION RATE (KD)

KD = (1/EXP((ABS(((LN(-LN(UNIA))-(LN(24-3))))))))*100

Where:
UNIA = ((1-(24-h in vitro NDF digestibility/100))-INDF) / (1-INDF)

DIGESTIBLE PROTEIN

DP = 72.96 – (1.02*ADP*100/CP)

ADJUSTED CRUDE PROTEIN –

See "Adjusted Crude protein"

When ADP/CP ratio is between 14 and 20 then:

AdjCP = CP – (ADP / CP*100) -7 * CP
When ADP/CP ratio is greater than 20, then all ADP is considered indigestible:

\[ \text{AdjCP} = \text{CP} - \text{ADP} \]

* No adjustment is needed when ADP/CP (ratio) is less than 14. All ADP is considered digestible.

Where:

\[ \text{ADP} = \text{ADF-CP} \]

**DIETARY CATION-ANION BALANCE (DCAB)**

\[ \text{DCAB (meq/kg)} = (\text{K}\%*256+\text{Na}\%*435)-(\text{S}\%*624+\text{Cl}\%*282) \]