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)

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

ENERGY EQUATIONS FOR OTHER FEEDS

	Oatlage/barlage/misc. silages (Penn state)	Corn+cob meal (dry and high moist) (New York DHIC)	Grain corn/HM grain corn/corn gluten meal (New York DHIC)	Other grains
TDN, %	88.936-(0.653*ADF)	99.72-(1.927*ADF)	92.22-(1.535*ADF)	92.2-(1.12*ADF)
NEL, Mcal/kg	2.302-(0.0271*ADF)	2.323-(0.0472*ADF)	2.139-(0.0376*ADF)	0.12-(0.0245*ADF)

	TMRs and miscellaneous mixed feeds
TDN, %	95.88-(0.9111*ADF)
NEL, Mcal/kg	1.909-(0.017*ADF)

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: NRC 1998. Noblet and Perez, 1993 and May and Bell, 1971.

DE (Kcal/kg) = 4151 - (122*Ash) - (64*CF) + (38*EE) + (23*CP) - Noblet and Perez, 1993

DE (Mcal/kg) = DE (kcal/kg)/1000

ME (Kcal/kg) = ((DE in Kcal/kg)*(1.012-(0.0019*CP)) - May and Bell, 1971

Noblet, J., and J.M. Perez. 1993. Prediction of digestibility of nutrients and energy values of pig diets from chemical analysis. J. Anim. Sci. 71:3389-3398.

May and Bell (1971): May, R. W., and J. M. Bell. 1971. Digestible and metabolizable energy values of some feeds for the growing pig. Can. J. Anim. Sci. 51:271–278.

POULTRY: ANAC 2002.

ME (MJ/kg) = (0.155*CP)+(0.343*Fat)+(0.167*Starch)+(0.130*Sugar) - Fisher and McNab, 1987.

ME (Mcal/kg) = ME (MJ/kg)/4.187

Fisher C, McNab JM (1987). Techniques for determining the ME content of poultry feeds. In: Haresign W, Cole DJA (eds). Recent Advances in Animal Nutrition Butterworths, London, pp. 3-17.

OARDC – Weiss Summative Energy Equation

(National Research Council - Nutrient requirements of Dairy Cattle – 7th revised edition, 2001).

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} = (tdNFC + tdFat + tdNDF + tdCP) – 7

tdNFC = (0.98* (100-NDFN-CP-ASH-FAT)*PAF

tdFat = 0.97*(FAT-1)*2.25

tdNDF = (NDFD*NDF/100) **or**

= 0.75 * (NDFN - LIG) * (1-(LIG / NDFN)$^{0.667}$

tdCP (forages) = DCP*CP

$DCP_{forages}$ = exp (-0.012*(ADF-CP/CP)*100)

$DCP_{concentrate}$ = (1-(0.4*(ADF-CP/CP)))

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

RELATIVE FEED VALUE

RFV = (DDM) * (DMI) / 1.29

DDM (Digestible Dry Matter) = 88.9 - (0.779 x ADF)

DMI (Dry Matter Intake) = 120 / 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*$CPadj^2$ - 0.0638*TDN + 0.000922*TDN^2 + 0.18*ADF - 0.00196*ADF^2 - 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)/100 * CP

When ADP/CP ratio is greater than 20, then all ADP is considered indigestible:

AdjCP = CP – ADP

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

Where:

ADP = ADF-CP

DIETARY CATION-ANION BALANCE (DCAB)

DCAB (meq/kg) = (K%*256+Na%*435)-(S%*624+Cl%*282)