RUMEN8

A dairy cow nutrition model based on AFRC 1993

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IMPORTANT: The values used in this document are a guide only to highlight how to use Rumen8. Do not assume they are suitable for your farm or client. Example target ranges have been found to be useful on a small number of Australian farms and cannot be assumed to be suitable for other properties. A nutritionist with local knowledge should be used to set the base parameters for a particular farm and then Rumen8 can be used to adjust diets with expert advice.

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What does Rumen8 do?

Rumen8 is a nutrition model for formulating a least cost diet from selected feed components which permits the user to:

- Select up to 10 different diet components
- Specify many of the constraints under which the optimisation occurs
- Store and compare two or three different optimised diets.

What do you need to do?

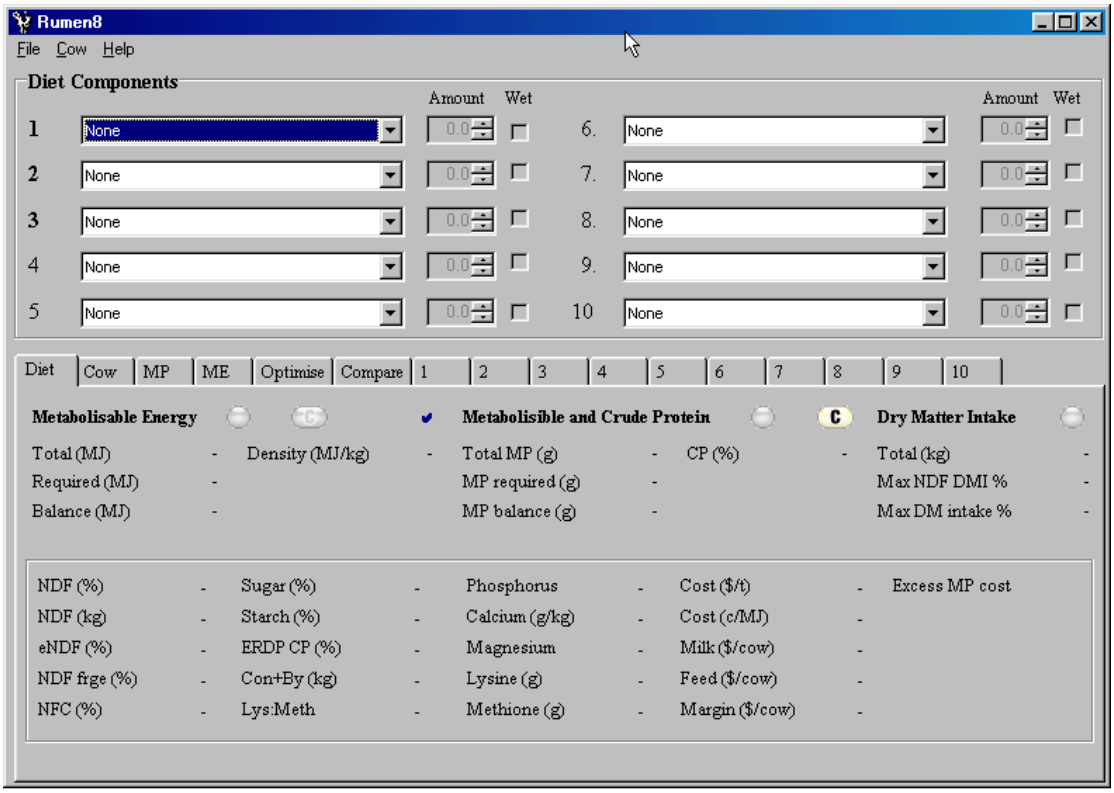
Rumen8 requires the user to:

- select diet components
- select optimisation constraints
- enter cow details

How do you do it?

The Rumen8 Main Screen (figure 1) will be the first to appear displaying the selected Diet Components in a box above a number of tabs (Diet, Cow, MP, Optimise, Compare, 1 – 10). Diet Component number 1 will be highlighted with blue.

Figure 1



Rumen8 Main Screen

Main commands

File

Open – Allows you select previously saved diets and cow descriptions

Save As – Allows you to save current diet & cow description

Edit Feeds – Allows you to edit existing feeds and create new feeds (see more detailed explanation below)

Copy Diet to Clipboard – Allows you to copy an existing diet for pasting into Word or Excel

Optimiser Set Up – Activates the optimiser function (requires additional setup and Microsoft Excel). This allows for basic least cost formulations. Is not used in a typical farm visit

Preferences – Set milk production in litres or kg. Milk composition as mv% or mm%. Enter milk price in cents per litre (a guide to see if feeding decisions are likely to increase the income over feed costs [IOFC]).
Suggest you set fasting metabolism correction to 1.2 and MP requirement correction to 1.25
Warning light accuracy sets the sensitivity of the warning light system. Default is 2%
Use defaults for all others, unless you have a specific need and valid reason for changing these.

Cow

Save cow details as default values – this will save the current cow description as the default whenever you open Rumen8

Load cow defaults – returns the cow description to the default settings

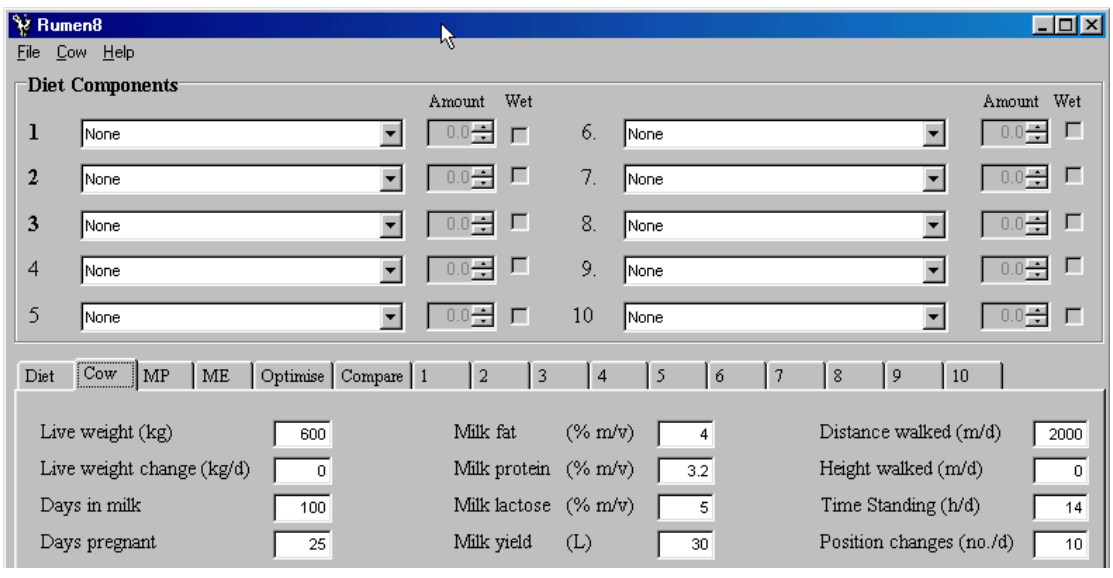
Use Standard Cow – allows you to select a standard cow 5000, 6000, 7000 or 8,000 litres per lactation at either early mid or late lactation. These should only be used for generic analyses. For use on farm, use actual milk production and composition of the herd of interest.

Main screens

Cow

Prior to selecting diet components and going through the optimisation process it would now be wise to enter the cow details. Current or default settings can be seen by selecting the "Cow" tab (Figure 2)

Figure 2



It is possible to alter these values on the "Cow" tab window and then retain them as default values by using the "Cow" pull down menu at the top of the window and selecting "Save cow details as default values". It is also possible to select other standard cows using the "Cow" pull down menu, selecting "Use standard cow". This will give the choice of 4 different production levels (5000 to 8000 litres) and 3 lactation stages (early, mid, late).It is also possible to view the ME requirements of the selected cow by using the "ME" tab on the Rumen8 Main Screen (Figure 6)

1. Live weight – mean LW of the herd of interest at the time of interest. If unknown, use the following as a guide.

    a. "North American" Holstein cows are 600-650 kg live weight

    b. Australian Friesian cows are 550-600 kg live weight

    c. Cross Bred Cows 450-500 kg live weight

    d. Jersey Cows 375-425 kg

    e. Heifers 10-20% less than their mature counterparts

    Cows that are weighed on farm are the best guide

    Culled Cows that are sold 'over the hooks'. Dairy cows typically dress out at ~40-45% of live weight Eg 200-225 kg dressed weight equates to ~500 kg live weight. Note that cull cows are (or should be) older cows, so these may not be representative of the average LW of the herd.

2. Live weight change (kg / cow / day) – this is the estimate of the amount of live weight that is being lost across the herd. Typical figures for cows with a 300-d lactation length and 365-d calving interval are given (by days in milk [DIM])

Figure 3

DIM	0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270-300	dry period
LWC kg/d	-0.8	-0.6	-0.2	0	0	0.05	0.15	0.3	0.4	0.5	0.1

Figure 4 Typical Live weight change attributed to CS

	Early	Peak	Mid	Late	Dry
Fed to Appetite on 11-12 ME pasture / crops (incl. 5.0+ kg / cow / day of concentrate)	-0.7	+0.3	+1.0	+1.0	
Fed to Appetite on 11-12 ME pasture / crops (incl. 3.0-5.0 kg / cow / day of concentrate)	-0.9	+0.2	+0.6	+0.8	
Fed to Appetite on 11-12 ME pasture / crops (incl. 1.0-3.0 kg / cow / day of concentrate)	-1.1	+0.1	+0.6	+0.9	+1.1
Fed to Appetite on 9.0-10 ME pasture / crops (incl. 5.0+ kg / cow / day of concentrate)	-2.0	-1.0	+0.3	+0.5	
Fed to Appetite on 9-10 ME pasture / crops (incl. 3.0-5.0 kg / cow / day of concentrate)	-2.5	-1.2	-0.1	+0.4	
Fed to Appetite on 9-10 ME pasture / crops (incl. 1.0-3.0 kg / cow / day of concentrate)	-2.8	-1.5	-0.3	+0.2	+0.6

3. Days in Milk (DIM) should be the weighted average of the cows in the milking herd

   Eg. 100 cows @ 100 DIM = 10,000
   200 cows @ 280 DIM = 56,000
   30 cows @ 350 DIM = 10,500
   Herd Average = (10,000+56,000+10,500) / 330 cows
   = ~230 DIM

   DIM is also required to estimate feed intake potential, as stage of lactation influences the amount of feed a cow can consume. Feed intake (kg DM/cow/d) is estimated as per NRC (2002). As an alternative you can assess intake of NDF as a proportion of LW (but beware!)

   Peak Dry Matter Intake generally occurs at 80-100 days post calving. Where cows have been exceptionally well prepared for calving and then well fed post calving without any metabolic or health issues peak DMI may occur 60-80 days.

   Where cows have had restricted energy intake through this period peak DMI is more likely to be 100-120 days.

4. Days Pregnant

   Affects nutritional requirements, which becomes significant from 140 days onwards. Days Pregnant should be the weighted average of the herd (see above example of DIM)

5. Milk fat % & Protein % - Make sure you set the correct unit in "preferences": in Australia this is almost always mv%, while in NZ it is mm%. Protein% is true protein (in some countries it is analysed as crude protein which is about 6% higher than true protein). Take the average of the latest 5 days of available factory figures. When estimating production for groups of cows within the milking herd the Milk fat and Protein %'s are likely to be significantly different to the herd average eg Early lactation cows at peak production

6. Milk Lactose % - should be left at 5.0% unless there is actual data available

7. Yield (litres / cow / day) – if milking numbers are stable should be the last 5-10 days average. Yield calculation should include all milk, including milk that is being fed to calves and other milk not suitable for human consumption.

8. Distance walked - influences the amount of energy required for maintenance

   a. Cows grazing a large farm (300 Ha) with centrally located dairy will on average walk 3500 metres to & from the dairy plus distance walked grazing ~1000 metres

   b. Cows grazing a medium sized farm (150 Ha) with centrally located dairy will on average walk 2500 metres to & from the dairy plus distance walked grazing ~750 metres

   c. Cows grazing a smaller sized farm (75 Ha) with centrally located dairy will on average walk 1750 metres to & from the dairy plus distance walked grazing ~500 metres

9. Height Walked – influences the amount of energy required for maintenance. Note that walking 1 'vertical meter' requires the same energy as walking 10 'horizontal meters'.

   a. Flat farms – 0 metres

b. Gently undulating farms – 1-5 metres

c. Rolling farms - 10-15 metres

d. Steep farms – 30+ metres

10. Time Standing – leave at 14 hours

11. Position changes – leave at 10

Diet & Tabs 1-10

The ME, metabolisable protein (MP) & DMI have warning lights that change colour. The sensitivity of the warning lights can be set under Preferences (see earlier). The default is 2%

Orange – MEI, MPI and/or DMI are more than 2% below requirements

Green – MEI, MPI and/or DMI are within 2% of requirements

Blue – MEI, MPI and/or DMI are more than 2% above requirements

Diet Components

1. Select the type of pasture available. If there are two distinct types of pasture eg irrigated & dryland then these should be Diet Components 1 and 2 (Dry Matter)
2. Concentrate or the components of the concentrate ration. These should be entered as fed (Wet box ticked)
3. Byproducts (As fed)
4. Fodder – hay or silage being fed (Dry Matter)
5. Grazed Crops – (Dry Matter)
6. The details of each feed can then be viewed on the corresponding tabs 1-10

Diet Screen

a. Metabolisable Energy

   i. Total – this is the amount of ME supplied by the diet entered

   ii. Required – this is the amount of ME required to meet the needs of the cow you have described

   iii. Balance – difference between Total & Required

   iv. Density (MJ / kg DM) – this is the average ME / kg DM consumed

b. Metabolisable & Crude Protein

   i. Total MP (g) –this is the amount of MP supplied by the diet entered

   ii. MP required – – this is the amount of MP required to meet the needs of the cow you have described

iii. MP balance – difference between Total & Required

iv. CP (%) – this is the average CP% of the diet

c. Dry Matter Intake

i. Total (kg) – this is the total DMI per cow per day

ii. Max NDF DMI % - this is % of the theoretical maximum DMI that the diet you've described represents for the cow that you've described according to the NDF intake equation DMI = 1.2% of LW (note: value can be adjusted under Preferences)

iii. Max NRC DMI% - this is the % of the theoretical maximum DMI according to the cow and the diet that have been described according to NRC (2002)

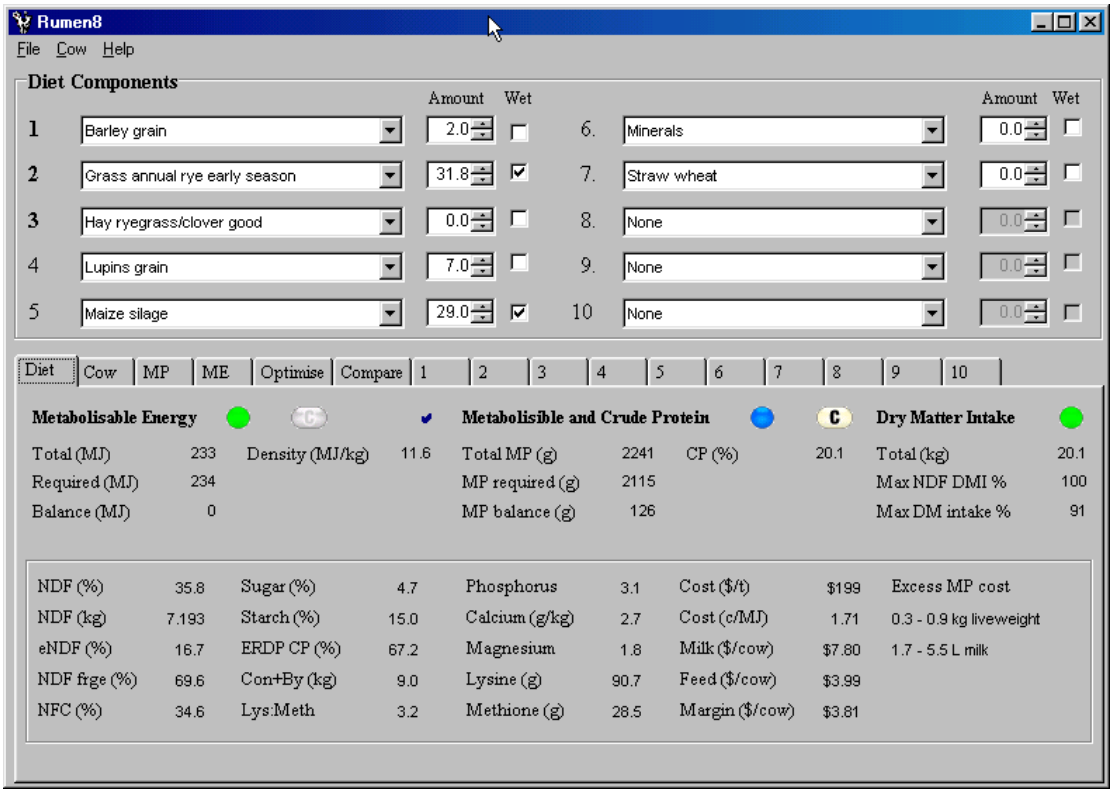
DMI=(0.372 x FCM + 0.0968xBW0.75)x(1-e(-0.192x(WOL+3.67)))

(FCM = fat-corrected milk, BW = body weight, WOL = weeks of lactation)

iv. Of the 2 equations the NRC equation tends to more consistently represent real situations.

Diet information

Figure 5



The bottom section of the main screen summarises other features of the diet, including NDF in the DMI (as % and in kg/cow/day), effective NDF i(% of DMI), NDF from all forages (% of DMI), NFC% (non-fibrous carbohydrates), sugar%, starch%, effective rumen degradable protein (as a % of CP), total DMI from concentrate and byproducts, P, Ca and Mg, lysine and methionine (g/cow/day and

ratio), cost of the diet ($/t DM, c/MJ ME and $/cow), milk income ($/cow), margin (milk income – feed cost in $/cow) and the cost of excreting excess ERDP (in litres of milk equivalents)

Key points on diet formulation

- NDF% - most sound dairy diets are between 30-40% NDF. Diets 30% NDF tend to be high in grain and close to sub clinical acidosis. Diets greater than 40% are usually high in forage and tend to restrict DMI due to quality
- eNDF% – reflects the physical-chemical qualities of the fibre, including initial particle size, density, and fragility or ease of particle-size reduction through chewing and digestion. The eNDF of forage not only represents its particular functionality in promoting digestive function, but also represents the character of the forage that can limit energy intake
- NDF frge% – the % of NDF in the diet from forage
- NFC% – Non Fibrous Carbohydrates are simple carbohydrates, such as starches and sugars, stored inside the cell which serve as a cellular energy source. Non-structural carbohydrates are rapidly and easily digested by the animal.
- Sugar% & Starch% – sound diets have less than 8% & 22% respectively and no more than 30% combined
- ERDP – Effective Rumen Degradable Protein
- Conc + By (kg) – is the amount of concentrate and byproducts in the diet
- Lys: Meth – the Lysine to Methionine ratio. Diets perform best when this ratio is 3:1. This is difficult to achieve in pasture based diets.
- Phosphorus (g/kg) – should be 4 to 4.5 g/kg DMI
- Calcium (g/kg) – should be 7 to 7.5 g/kg DMI
- Magnesium (g/kg) – should be around 3 g/kg DMI
- Cost ($/tonne) – is the average cost per tonne of the diet being consumed by the milking herd
- Cost (c/MJ) – energy cost in cents per MJ
- Milk ($/cow) – Gross Income per cow make sure the milk price in preferences is set correctly
- Feed ($/cow) – make sure all feeds are set at the correct price.
- Margin ($/cow) – Income Over Feed Costs. Should be used with caution when changes to feeding strategies alters the amount of pasture being consumed
- Excess ERDP cost – this is the theoretical “penalty” expressed as either weight loss or lower milk product as a result of having an excess of rumen degradable protein relative to the amount of starch / sugar in the diet. It should be stressed that this is theoretical

Feed Library

Details of each feed (ME, CP etc) can be viewed by highlighting a feed and pressing the "Edit" button (Figure 6). This also permits the modification of the details currently stored for that feed. To save alterations to existing feeds it press the "Update" button.

Figure 6: Feed library or Edit Feeds screen

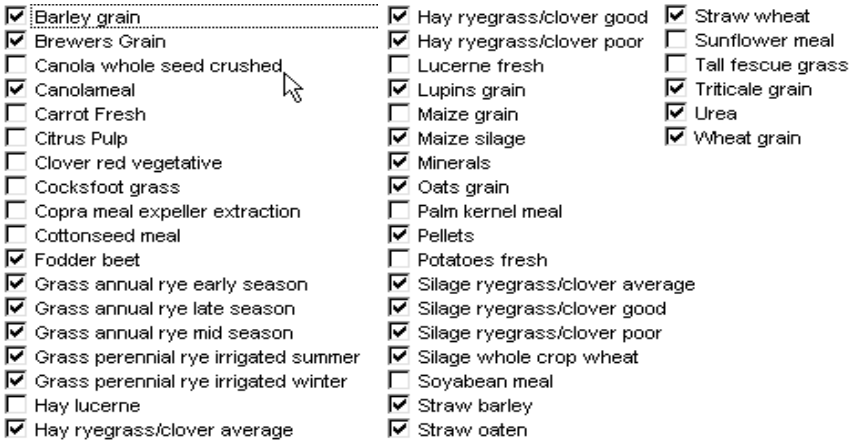
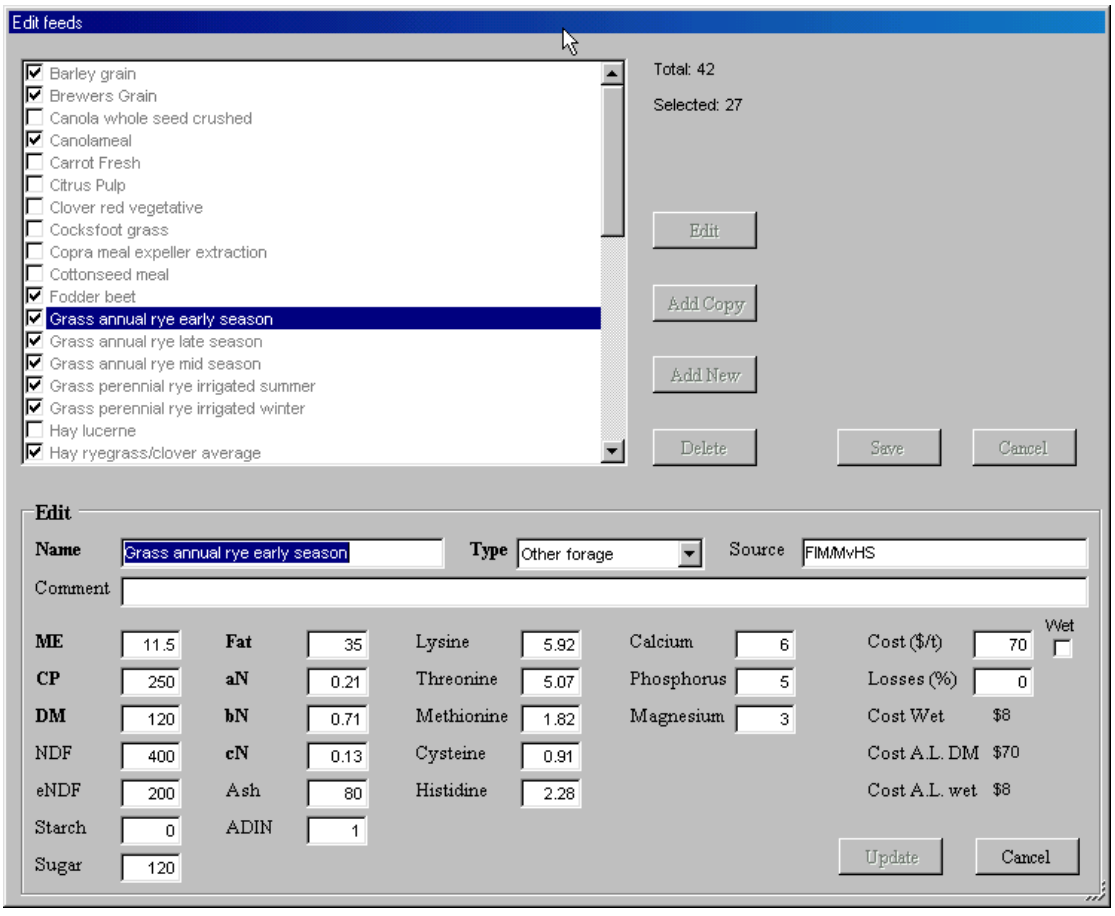


Figure 7: Current Feed library



If none of the feeds match one or more of your components, it is possible to add in completely new feeds using the "Add new" button. Once all selections or alterations are complete you have the option of saving changes or exiting the Edit Feeds window without saving using the "Save" or "Cancel" buttons. Closing the Edit Feeds window will take you back to the Rumen8 Main Screen.

1. Access the feed library by selecting File, Edit feeds
2. Only those feeds that are ticked can be seen in the library
3. Existing feeds can be altered by selecting the feed and clicking on edit
4. New feeds can be create from scratch (Add New) or by copying an existing feed (Add Copy)
5. Edit or Create New

   NOTE THAT MOST NUTRIENTS ARE ENTERED AS g/kg DM NOT AS %. Eg A FEED THAT IS 12% CRUDE PROTEIN SHOULD BE ENTERED AS 120 g/kg

   a. ME – Metabolizable Energy (MJ kg / DM)
   b. CP - Crude Protein (g/kg DM). Crude protein is a measure of the amount of nitrogen contained in a feed multiplied by a conversion factor of 6.25
   c. DM – Dry Matter (g/kg)
   d. NDF – Neutral Detergent Fibre (g/kg DM). NDF is used as one method of estimating potential intake (see Diet Assessment for more details).
   e. eNDF – effective Neutral Detergent Fibre (g/kg DM)
   f. Starch – (g/kg DM)
   g. Sugar –(g/kg DM)
   h. Fat – (g/kg DM) this is also known as Ether Extract, Lipid, Oil
   i. aN – is the proportion of the feed N that is water soluble
   j. bN – is the potentially degradable part of the feed N (excl the water soluble N)
   k. cN – is the fractional rumen degradation rate of bN. It is expressed in %/hour and indicates how fast bN can be degraded in the rumen. NOTE: The actual degradation of bN depends on its residence time in the rumen. This is inversely related to feed intake: a high feed intake results in a short residence time which reduces the actual extent of degradation of bN
   l. Ash – (g/kg DM) is the portion of the feed that is inorganic
   m. ADIN – Acid Detergent Insoluble Nitrogen; which is not available to the animal
   n. Lysine – one of the main limiting amino acids (only used in diets for very high producing cows or diets particularly low in lysine eg maize grain)
   o. Threonine – one of the main limiting amino acids
   p. Methionine – one of the main limiting amino acids in microbial protein (only used in diets for very high producing cows)

q. Cysteine – one of the main limiting amino acids

r. Histidine – one of the main limiting amino acids

s. Calcium – (g/kg DM)

t. Phosphorus – (g/kg DM)

u. Magnesium – (g/kg DM)

v. Cost / tonne DM

w. Losses - % of feed on that is lost in storage & feeding out. Concentrates ~2%, Hay & Silage fed in the paddock 20-30%, Hay & Silage on a feed pad 10-15%

x. Wet (tick box)

Compare Screen

1. 3 diets can be stored at any one time
2. Diets are stored by hitting the 'S' (store) button, are cleared by hitting the 'C' (clear) button and are restored by hitting the 'R' (restore) button

Using Rumen8 on Farm

1. Describe the makeup of the herd
2. Select feeds that are being fed or are being considered
3. Enter the amounts of supplements being fed, making sure they have been correctly entered as either Dry Matter or As Fed
4. Adjust the amount of pasture being fed until the diet is balanced for ME. This figure should be cross referenced with the pasture intake as described in UDDER. Large discrepancies (>2.0 kg DM / cow / day difference) warrant further investigation.
5. Check that the Diet is in sufficient for protein
6. Store the diet as Diet 1
7. If the Diet is 95% or less for the NRC equation explore options for making more feed available
8. If the Diet is at 100% for the NRC equation and additional pasture is available explore possibilities for reducing supplements and increasing pasture intake

Dry Cows

While the cow model isn't exactly designed to represent dry cow performance it is useful for predicting dry cow performance

1. Set the DIM to 310-365 days
2. Set the Days pregnant to 210-265

3. Set production to zero litres

4. Set Distance walked between zero (feedpad) to 1,000 metres for an extensive grazing situation

5. Maximum Dry Cow DMI – Will estimate the daily live weight change that the diet on offer is capable of achieving

6. Managed Condition Score change – Will estimate the Condition score change that will result for a given diet.

Nutritional Fine Tuning

Rumen8 should be used with your own and the clients observations of cow performance, CS change, grazing pressure, manure assessment. Nutrition / cow models are notoriously dangerous when used in isolation to make feeding changes however they are useful is assessing diets when combined with adherence to sound nutritional principles detailed observations .

Typical Questions

"Could / would these cows eat more if it were offered?"

"Could would these cows produce more or are they at their limit?"

"If the milkers were forced to graze harder into the base of the pasture sward what would happen to milk production?"

"How are the cows walking to & from the dairy?"

"Is there any obvious ammonia smell in the cows urine (most noticeable in the dairy)?"

"Are the cows eating all supplements on offer?"

"How stable are the fat and protein %'s?"

"How much cud chewing activity are you observing in the paddock and while the cows are waiting to be milked?"

1. Diet Quality (ME) – Rumen8 can be used to show the effect of altering the average ME value of the diet through changing pasture quality or altering the amount of concentrate being fed

2. Diet Quality (CP)

    a. Excess – is potentially an issue where there is a high intake of spring pastures (CP 25-30%) and low to moderate (0.0-4.0 kg / cow / day) of concentrates. Rumen8 can be used to test higher levels of grain feeding required to remove the theoretical excess protein and the potential increase in milk production and / or Condition Score.

    b. Shortfall – Rumen8 is useful for highlighting where crude protein is limiting milk production.

    c. Balanced – Rumen8 often highlights that mid & late lactation diets are often over formulated for crude protein.

3. NDF% - check that the diet is between 30-40% NDF. Diets 30% NDF tend to be higher in grain and closer to sub clinical acidosis. Diets greater than 40% are usually high in forage and tend to restrict DMI due to lower quality.

4. eNDF% - check that the diet contains a minimum level of eNDF to ensure there is sufficient long fibre in the diet. This is not so important with high pasture intakes (especially where cows are

typically grazing from 2500-3000 kg DM / Ha to 1300-1600 kg DM / Ha). This parameter is much more relevant where high levels of grain, and / or byproducts, and / or fine chopped silages are being fed.

5. NDF frge – is the proportion of the NDF in the diet being supplied by forages (including grazed pastures).

6. NFC%, Starch% & Sugar% - as a general rule relate to the amount of fermentable energy in the diet that contribute to rumen acidity. As a general rule diets that exceed 30% (starch + sugar) are at risk of acidosis while diets that have less than 20% (starch + sugar) limit milk production.

7. Margin ($/cow)

    a. Milk ($/cow) – litres x cents / litre. Check that the milk price expressed as cents / litre is accurate for the clients milk components and that it is the net price (excluding GST, volume & stop) charges, levies, etc).

    b. Feed ($/cow) – is the sum of all feeds being fed to the milkers. Prices should reflect the whether the feeds are being described on a AS Fed or Dry Matter basis. Should also include a wastage factor. Pastures should

    c. Margin ($/cow) – is the difference between milk income and feed costs on a cow / day basis. Margin over feed costs should be used with caution as it assumes no other changes to the cost structure of the farm eg higher feeding level of supplements that results in lower pasture intake and any subsequent changes in pasture quality or costs (silage conservation).

       Margin ($/cow) is of most use when pasture is in limited supply and supplementary feeding decisions do not impact on pasture intake.

       Margin ($/cow) can be used to highlight potential gains from

        i. Changes in pasture management ie higher quality pastures result

        ii. Changes in the type of supplements being fed eg forages v's concentrates

        iii. The amount of supplements being fed eg reducing supplements when pasture supply is not limited or increasing supplements when milkers are clearly not at capacity

abbreviation	units	description	menu/tab
A	MJ/d	activity allowance	ME (Other)
ADIN	g/kg DM	acid detergent insoluble nitrogen	Edit feeds
aN		proportion of water soluble N in the total N of the feed	Edit feeds
Ash	g/kg DM	Ash	Edit feeds
Balance (MJ)	MJ	the difference between metabolisable energy requirements and supply	Diet
bN		proportion of degradable N, other than water soluble N, in the feed	Edit feeds
Calcium	g/kg	concentration of calcium in the diet	Diet
Calcium	g/kg DM	Calcium	Edit feeds
CI	MJ/d	plane of nutrition correction factor in calculating ME requirements	ME (Other)
cN		Fractional rumen degradation rate per hour of the b fraction of the feed N with time	Edit feeds
Comp. 1	kg	the amount of component 1 must fall within specified minimum and maximum values	Optimise
Comp. 2	kg	the amount of component 2 must fall within specified minimum and maximum values	Optimise
Comp. 3	kg	the amount of component 3 must fall within specified minimum and maximum values	Optimise
Con+By (kg)	kg	concentrate and byproduct in the diet	Diet
Conc. + ByPr.	g	the total amount of concentrate + byproduct in the diet must fall within specified minimum and maximum values	Optimise
Conc. + ByPr.	g/kg	the concentration of concentrate + byproduct in the diet must fall within specified minimum and maximum values	Optimise
Cost	$/cow and c/MJ	diet cost ($/cow and c/MJ) and margin ($/cow)	Compare
Cost	$/tonne	cost to produce or buy 1 tonne of feed (nominate if wet or dry)	Edit feeds
Cost ($/t)	$/tonne	diet cost per tonne	Diet
Cost (c/MJ)	c/MJ	diet cost on a metabolisable energy basis	Diet
Cost A.L. DM	$/tonne DM	cost after losses on a dry matter basis	Edit feeds
Cost A.L. wet	$/tonne wet	cost after losses on a wet or fresh basis	Edit feeds
CP	g/kg	the concentration of CP in the diet must fall within specified minimum and maximum values	Optimise
CP	g/kg DM	crude protein	MP (supply)
Cysteine	g/kg DM	Cysteine	Edit feeds
Days in milk	d	number of days the cow has been lactating	Cow
Days pregnant	d	number of days the cow has been pregnant	Cow
Distance walked	m/d	distance walked each day by cow	Cow
DM	g/kg	dry matter	Edit feeds
DMI	kg and %	dry matter intake (kg) and % of maximum intake (NDF/NRC methods)	Compare
DMTP	g	digestible microbial true protein	MP (supply)
DUP	g	digestible undegraded protein	MP (supply)

abbreviation	units	description	menu/tab
Ec	MJ/d	net energy retained in concepta	ME (Detail)
El	MJ/d	net energy secreted as milk	ME (Detail)
Em	MJ/d	net energy for maintenance	ME (Detail)
eNDF	g/kg	the concentration of effective NDF in the diet must fall within specified minimum and maximum values	Optimise
eNDF	g/kg DM	effective neutral detergent fibre	Edit feeds
eNDF (%)	%DMI	effective NDF in the diet	Diet
ERDP	g	effective rumen degradable dietary protein	MP (supply)
ERDP CP	%	percentage of the CP that is effective rumen degradable dietary protein	Diet
ERDP CP%	%	percentage of the CP that is ERDP	MP (supply)
Excess MP	g	MP in excess which will require ME to remove	MP (supply)
Excess MP cost	$??	the metabolic cost to remove excess metabolisable protein expressed as forgone weight change or milk production	Diet
F	MJ/d	fasting metabolism	ME (Other)
fat	g/kg	the concentration of fat in the diet must fall within specified minimum and maximum values	Optimise
Fat	g/kg DM	Fat	Edit feeds
Feed ($/cow)	$/cow/day	feed cost	Diet
FME	MJ	fermentable ME of the diet	MP (supply)
Height walked	m/d	height change during walk each day	Cow
Histidine	g/kg DM	Histidine	Edit feeds
Intake (kg)	kg	the maximum DMI cannot excede 100% as determined by liveweight, milk yield and week of lactation	Optimise
Intake (max. NDF)	g	the maximum DMI cannot excede 100% as determined by NDF intake and liveweight	Optimise
Kc		efficiency of utilisation of ME for growth of the concepta	ME (coefficients)
Kg		efficiency of utilisation of ME for weight change when lacting	ME (coefficients)
Kl		efficiency of utilisation of ME for lactation	ME (coefficients)
Km		efficiency of utilisation of ME for maintenance	ME (coefficients)
Kt		efficiency of utilisation of mobilised tissue for lactation	ME (coefficients)
L	MJ/d	level of feeding as a multiple of MJ of ME for maintenance	ME (Other)
L		level of feeding as a multiple of MJ of ME for maintenance	MP (supply)
Limited by		factor limiting MP supply	MP (supply)
Live weight	kg	the cows liveweight	Cow
Live weight change	kg/d	cows daily liveweight change	Cow
Losses	%	dry matter loss from feed after costing	Edit feeds

abbreviation	units	description	menu/tab
Lys:Meth		ratio of lysine to methionine in the diet	Diet
Lysine	g	total lysine in the diet	Diet
Lysine	g/kg DM	Lysine	Edit feeds
Magnesium	g/kg	concentration of magnesium in the diet	Diet
Magnesium	g/kg DM	Magnesium	Edit feeds
Margin ($/cow)	$/cow/day	margin (milk income - feed costs)	Diet
Max DM Intake %	%	percentage of predicted maximum intake currently provided by the diet based on liveweight, milk yield and stage of lactation	Diet
Max MP cost	MJ	Maximum ME cost to remove exces MP	MP (supply)
Max NDF DMI %	%	percentage of predicted maximum intake currently provided by the diet based on NDF intake and liveweight	Diet
Mc	MJ/d	ME requirement for growth of concepta	ME (Detail)
MCP	g	microbial crude protein	MP (supply)
ME	MJ	metabolisable energy supplied and required	Compare
ME	MJ/kd DM	metabolisable energy	Edit feeds
ME requirement	MJ	the diet must provide the ME required for maintenance and production	Optimise
Methionine	g	total methionine in the diet	Diet
Methionine	g/kg DM	Methionine	Edit feeds
Mg	MJ/d	ME requirement for liveweight change when lactating	ME (Detail)

Milk ($/cow)	$/cow/day	milk income	Diet
Milk fat	% m/v	percentage of milk that is fat	Cow
Milk lactose	% m/v	percentage of milk that is lactose	Cow
Milk protein	% m/v	percentage of milk that is true protein	Cow
Milk yield	L	daily milk production	Cow
Min MP cost	MJ	Minimum ME cost to remove excess MP	MP (supply)
Ml	MJ/d	ME requirement for milk production	ME (Detail)
Mm	MJ/d	ME requirement for maintenance	ME (Detail)
Mmp	MJ/d	ME requirement for maintenance and production	ME (Detail)
MP	g	metabolisable protein	MP (supply)
MP balance	g	metabolisable protein balance	Diet
MP min. requirement	g	the diet must provide an MP supply at least that required for maintenance and production	Optimise
MP required	g	the amount of metabolisable protein required for the production level	Diet

abbreviation	**units**	**description**	**menu/tab**
Mpb	g/d	basal endogenous nitrogen requirement	MP (required)
Mpc	g/d	MP requirement for the growth of the concepta	MP (required)
MPd	g/d	dermal loss as scurf and hair	MP (required)
MPg	g/d	MP requirement for liveweight gain when lactating	MP (required)
MPl	g/d	MP requirement for milk production	MP (required)

MPm	g/d	MP requirement for maintenance	MP (required)
MPmp	g/d	MP requirement for maintenance and production	MP (required)
MTP	g	microbial true protein	MP (supply)
NDF	g/kg	the concentration of NDF in the diet must fall within specified minimum and maximum values	Optimise
NDF	g/kg DM	neutral detergent fibre	Edit feeds
NDF (%)	%DMI	neutral detergent fibre in the diet	Diet
NDF (kg)	kg	total NDF in the diet	Diet
NDF forage	g/kg	the concentration of NDF from forage in the diet must fall within specified minimum and maximum values	Optimise
NDF frge (%)	%DMI	NDF in the diet supplied from forages	Diet
NFC (%)	%DMI	non fibrous carbohydrate in the diet	Diet
Phosphorus	g/kg	concentration of phosphorus in the diet	Diet
Phosphorus	g/kg DM	Phosphorus	Edit feeds
Position changes	no./d	number of body position changes per day	Cow
Protein	g and %	metabolisable protein supplied and required and crude protein %	Compare
QDP	g	quickly degradable protein	MP (supply)
Qm		metabolisability of GE at maintenance	ME (coefficients)
r(fraction/hr)		rumen digesta fractional outflow rate per hour	MP (supply)
RDP	g	rumen degradable protein	MP (supply)
Required (MJ)	MJ	metabolisable energy supply required from the diet for specified production	Diet
SDP	g	slowly degradable protein	MP (supply)

Source	source of information	FIM (feed information manual) / TFD (top fodder data) / VMF (Vasse milk farmlets) / MvHS (M Staines data) / Prot (?)	Edit feeds
starch	g/kg	the concentration of starch in the diet must fall within specified minimum and maximum values	Optimise
Starch	g/kg DM	Starch	Edit feeds
Starch (%)	%DMI	starch in the diet	Diet
sugar	g/kg	the concentration of sugar in the diet must fall within specified minimum and maximum values	Optimise
Sugar	g/kg DM	Sugar	Edit feeds
Sugar (%)	%DMI	sugar in the diet	Diet

abbreviation	units	description	menu/tab
Threonine	g/kg DM	Threonine	Edit feeds
Time standing	hr/d	time cow spends standing each day	Cow
Total (kg)	kg	total dry matter in the diet	Diet
Total (MJ)	MJ	total metabolisable energy supplied from the diet	Diet
Total MP (g)	g	total metabolisable protein in the diet	Diet
Type	name	other forage / grass silage / other silage / distillery product / other non-forage	Edit feeds
UDP	g	undegradable dietary protein	MP (supply)
y	g	potential microbial protein yield in the rumen from FME	MP (supply)