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1. INTRODUCTION

Rumen8 is a software application running on Microsoft Windows computers that allows farmers and consultants to easily manage dairy cow diets to improve dairy cow nutrition, improve production and/or reduce costs. It was originally developed by us while we worked for the Department of Agriculture and Food, Western Australia. We used it as an ‘in-house’ tool for managing the dairy research herds on the Vasse Research Station near Busselton, Western Australia. An emphasis on ease of use sets it apart from many other nutrition packages and it is this that makes it ideal for quickly creating or checking cow diets.

Rumen8 was released free to the dairy industry and is used in Australia on research farms, by consultants and farm managers. The nutrition model behind Rumen8 is suitable for the pasture-dominated diets common across Australia.

WHAT DOES RUMEN8 DO?

Rumen8 allows the user to design a diet from up to 15 feeds or mixes and ensure a cow’s dietary needs are met. Multiple diets can be stored and compared and if milk and feed prices are entered, the difference between feed price and return from milk is calculated.

Rumen8 uses robust nutrition models that we have found accurate enough over many years using it on farms and Research Stations. Although more sophisticated models of dairy cow nutrition exist, these require a higher level of user knowledge, they depend on less readily available and more expensive feed analyses and require more time to become experienced with. We have found that Rumen8 provides a good balance between ease and speed of use and performance that is fitting for the pasture-dominated dairy diets common in Australia.

Dairy Australia have independently evaluated Rumen8 version 1 (many years before they took on ownership) against a range of nutrition models in use in Australia at the time and it performed admirably. You can read the report yourself as it is available from the Rumen8 and Dairy Australia web sites (A review of 11 applied dairy nutrition models used in Australia, 2009). The nutrition model behind Rumen8 versions 2 & 3 is unchanged from that used in version 1.

WHAT RUMEN8 DOESN’T DO

Like most nutrition programs, Rumen8 works on a linear response to feeding. This means it assumes the same response to a kilogram of concentrate whether it is the first kilogram, or the tenth kilogram fed to the cow. Due to this Rumen8 can be misleading when asking questions such as ‘What happens if I feed another kilogram of concentrate as it presents the average response for the first diet, and then the average response for the second diet that includes the additional feed. Rumen8 cannot be used to predict the response to just the last kilogram of additional concentrate. Generally, we would suggest that marginal responses much more than 1 litre of milk per kg of concentrates should be treated with scepticism.
A WARNING BEFORE YOU START

Like any cow nutrition application, Rumen8 depends on a model of a cow that it ‘feeds’ and then estimates milk production and growth. No model is completely accurate, and it is possible to create a balanced diet in Rumen8 that will reduce cow performance or even adversely affect their health. For this reason, we recommend Rumen8 is used with your nutritionist, and depending on your level of knowledge, between their visits to adjust diets.

That statement leads us on nicely to the inevitable license agreement and disclaimer.

LICENSE AGREEMENT

End-User License Agreement (EULA) of Rumen8

This End-User License Agreement ("EULA") is a legal agreement between you and Rumen8 Nutrition Pty Ltd.

This EULA agreement governs your acquisition and use of our Rumen8 software ("Software") directly from Rumen8 Nutrition Pty Ltd or indirectly through a Rumen8 Nutrition Pty Ltd authorised reseller or distributor (a "Reseller").

Please read this EULA agreement carefully before completing the installation process and using the Rumen8 software. It provides a license to use the Rumen8 software and contains warranty information and liability disclaimers.

If you use the demonstration version of the Rumen8 software, this EULA agreement will also govern that trial. By clicking "accept" or installing and/or using the Rumen8 software, you are confirming your acceptance of the Software and agreeing to become bound by the terms of this EULA agreement.

If you are entering into this EULA agreement on behalf of a company or other legal entity, you represent that you have the authority to bind such entity and its affiliates to these terms and conditions. If you do not have such authority or if you do not agree with the terms and conditions of this EULA agreement, do not install or use the Software, and you must not accept this EULA agreement.

This EULA agreement shall apply only to the Software supplied by Rumen8 Nutrition Pty Ltd herewith regardless of whether other software is referred to or described herein. The terms also apply to any Rumen8 Nutrition Pty Ltd updates, supplements, internet-based services, and support services for the Software, unless other terms accompany those items on delivery. If so, those terms apply.

License Grant

Rumen8 Nutrition Pty Ltd hereby grants you a personal, non-transferable, non-exclusive licence to use the Rumen8 software on your devices in accordance with the terms of this EULA agreement.

You are permitted to load the Rumen8 software (for example a PC, laptop, mobile or tablet) under your control. You are responsible for ensuring your device meets the minimum requirements of the Rumen8 software.

You are not permitted to:

- Edit, alter, modify, adapt, translate or otherwise change the whole or any part of the Software nor permit the whole or any part of the Software to be combined with or become incorporated in any other software, nor decompile, disassemble or reverse engineer the Software or attempt to do any such things
- Reproduce, copy, distribute, resell or otherwise use the Software for any commercial purpose
- Allow any third party to use the Software on behalf of or for the benefit of any third party
• Use the Software in any way which breaches any applicable local, national or international law
• Use the Software for any purpose that Rumen8 Nutrition Pty Ltd considers is a breach of this EULA agreement

Liability
Licensor shall not be liable to licensee for any lost profits, lost revenues or opportunities, downtime, or any consequential damages or costs, resulting from any claim or cause of action based on breach of warranty, breach of contract, negligence, or any other legal theory, even if Licensor knew or should have known of the possibility thereof. In no event shall Licensor's aggregate liability exceed the amounts actually paid by Licensor in the 12-month period immediately preceding the event giving rise to the claim.

Intellectual Property and Ownership
Rumen8 Nutrition Pty Ltd shall at all times retain ownership of the Software as originally downloaded by you and all subsequent downloads of the Software by you. The Software (and the copyright, and other intellectual property rights of whatever nature in the Software, including any modifications made thereto) are and shall remain the property of Rumen8 Nutrition Pty Ltd.

Rumen8 Nutrition Pty Ltd reserves the right to grant licences to use the Software to third parties.

Termination
This EULA agreement is effective from the date you first use the Software and shall continue until terminated. You may terminate it at any time upon written notice to Rumen8 Nutrition Pty Ltd.

It will also terminate immediately if you fail to comply with any term of this EULA agreement. Upon such termination, the licenses granted by this EULA agreement will immediately terminate and you agree to stop all access and use of the Software. The provisions that by their nature continue and survive will survive any termination of this EULA agreement.

Governing Law
This EULA agreement, and any dispute arising out of or in connection with this EULA agreement, shall be governed by and construed in accordance with the laws of Western Australia.
ACKNOWLEDGEMENTS

Rumen8 has remained free due to the support it has received from numerous organisations and people.

Martin Staines and Richard Morris developed Rumen8 while they were employed by the Department of Agriculture and Food, Western Australia.

From 2014 and 2019 Rumen8 was owned by Western Dairy and Dairy Australia and they provided significant funding to make substantial improvements for Australian dairy farmers.

SNV Kenya worked closely with the developers along with funding improvements to Rumen8 for users in Kenya and East Africa.

The Victam foundation have provided funding to make Rumen8 more useful to users located in Africa and small consultancy teams.
Dr Steve Little provided invaluable input into the design and scope of Rumen8 version 3.0 as part of the development of the Dairy Australia Advanced Nutrition in Action course.
2. GETTING STARTED

SYSTEM REQUIREMENTS

Rumen8 requires the Microsoft Windows operating system to run. This can be Windows 7, 8(8.1) or 10. It is recommended you have run Windows Update and installed all the updates recommended by Microsoft.

If your computer can run Windows adequately, it will be enough to run Rumen8. The minimum screen resolution required to run Rumen8 comfortably is 1280 x 800 pixels.

Rumen8 requires the Microsoft NET Framework version 4 or higher to be installed. If your computer has been fully updated this will be installed automatically.

REPORT REQUIREMENTS

To create Rumen8 reports you must also install the SAP Crystal Reports Runtime Engine for the .NET framework. The installers for this software are available from the SAP website or the Rumen8 website download page. If you are running a 32-bit (x86) version of Microsoft Windows download and install the 32-bit version of the runtime software and if your copy of Windows is 64-bit (x64) use the 64-bit runtime installer.

SAP website: http://www.crystalreports.com/crystal-reports-visual-studio/

The SAP website will require your email address and country to access their downloadable files section. The files you want are the ‘SAP Crystal Reports Runtime (32Bit)’ or ‘SAP Crystal Reports Runtime (64Bit)’ depending on the version of Windows you are running.

If you are unsure whether your version of Windows is 32 or 64-Bit start Rumen8, load a few ingredients and then open the Report Designer from the File menu. Click on the ‘Create’ button and a warning will appear telling you the SAP runtime has not been installed. It will show you whether your version of Windows is 32 or 64-bit. Click on the links provided to download the correct runtime and then install it. Now the Report Preview window should appear when you create a report.

GETTING HELP

From within Rumen8 you can press the F1 key to access the User Guide. Alternatively, the User Guide is available as a PDF document from the Windows start menu applications list in the Rumen8 group.

A list of abbreviations used in this document and within Rumen8 can be found on page 144.

A Training Guide is also available from the start menu which takes you step by step through several examples of creating diets and using various Rumen8 features.

Video tutorials are provided on the Rumen8 website which cover all the main parts of Rumen8 and how to use it.

Finally, for technical support and reporting bugs please contact the developers via email at support@rumen8.com.au.

When reporting problems please provide a description of what you were doing when the issue occurred. Screen shots showing an error message are extremely useful. It is also helpful to know what version of Microsoft Windows you are using.
UPGRADING FROM RUMEN8 VERSION 2

Rumen8 version 3 can be installed on a computer that already has Rumen8 version 2 installed and they will run independently of each other and will not share library files.

Rumen8 version 3 uses a new file format for diet, feed library, milk price and preference files (the old cow.csv file is now included in the Preferences). Old diet and feed libraries can be imported into Rumen8 from the File menu and in the Feed Editor.

INSTALLATION

The Rumen8 set up file can been downloaded from the Downloads page of the Rumen8 website at http://www.rumen8.com.au

Once the executable file has been saved to your Downloads folder (the default Windows download destination) double click on the file in Windows Explorer to commence the installation process.

Figure 2.1. The Windows 10 Downloads folder with the ‘Install Rumen8’ application ready to be run.
Possible Windows SmartScreen problems with Windows 8 and 10

Microsoft has added another layer of security to try and protect their users from malicious downloads. Unfortunately, it is not obvious what to do if you trust the downloaded file. The Rumen8 download may trigger a warning because it is from a software developer Microsoft may not recognise. When you double click on the Rumen8 install executable a warning banner may appear across the centre of the screen.

*Figure 2.2. Windows 8 & 10 unknown software developer warning.*

Simply click on the ‘More info’ link and the option to run the installer anyway will appear.

*Figure 2.3. Run the installer anyway option exposed.*

Click on the ‘Run anyway’ button to continue installing Rumen8.
Windows may ask for confirmation that you want to allow the following program from an unknown publisher to make changes to this computer.

*Figure 2.4. Windows user access control during Rumen8 installation.*

Click ‘Yes’ to continue the installation and the Rumen8 Setup Wizard will appear.

*Figure 2.5. The Rumen8 setup wizard.*

Click on the ‘Continue’ button to continue to the license agreement window.
Read the Terms and Conditions and if you agree with them click on the ‘Accept’ button and move to the ‘Important Instructions’ window. This covers the limitations of nutrition software like Rumen8 and suggests it should be used alongside your nutritionist to ensure no cow health or production issues arise from its use.

Figure 2.7. The Rumen8 ‘Important Instructions’ window.
If you agree click the ‘Continue’ button to choose the installation folder.

*Figure 2.8. The installation folder window.*

Use the ‘Browse’ button to change the installation folder if required. The default folder will be suitable for almost everyone.

Click on the ‘Install’ button to confirm installation. You may get a window open asking you to confirm the creation of the installation folder. Just click on ‘Yes’ to continue.

*Figure 2.9. Rumen8 is installing.*
Installation of Rumen8 is complete, click on the ‘Finish’ button to exit the installer and run Rumen8 for the first time. The installer also creates a Rumen8 icon on the Desktop so you can start it from there or in the Applications list of the Windows Start button.
STARTING RUMEN8 FOR THE FIRST TIME

Rumen8 can be started from the Start Menu of Windows 7 and 10 in the ‘All programs’ list. The Windows 7 start menu is shown in Figure 2.11. Options to Pin the Rumen8 icon to the Taskbar, Start menu or Send a shortcut to the Desktop can be accessed by right clicking on the Rumen8 icon.

Figure 2.11. Starting Rumen8 under Window 10.

For Windows 8 users, type ‘Rumen8’ while in the Modern tiled interface and options to install, run and read the Rumen8 User Guide will appear in the search window down the right of the screen.
Figure 2.12. Starting Rumen8 for the first time in Windows 8.

To pin an icon to the tile interface and the Desktop so you can start Rumen8 without typing its name in the future, right click on the Rumen8 icon. Select ‘Pin to Start’ and/or ‘Pin to Taskbar’ to place the Rumen8 icon in these locations.

Figure 2.13. Pin the Rumen8 icon to the Start bar and Taskbar.

Finally, left click on the Rumen8 icon to start the application.
When Rumen8 starts for the first time it will ask you the location to create a Rumen8 folder into which will be placed a Libraries folder with your copy of the feed library, Preferences and milk prices files. Copying these files may take a few minutes so the first time you run Rumen8 it will take a little longer to get to the main window than normal.

*Figure 2.14. Choose the location of the Rumen8 folder.*

Your Documents folder is the recommended location as this is easy to access and is more likely to get backed up. If you are happy with the default location click the ‘Yes’ button but if you would like another location for the Rumen8 folder click ‘No’. This will take you to a folder browser where you may specify the location yourself.

Rumen8 will then create a folder called ‘Rumen8’ at the chosen location and within it another folder called ‘Libraries’. In this folder will be copied a feed library, Preferences and milk prices file used by the application for this user. If multiple users use the computer, each user will have their own copy of the Rumen8 library files and can tailor Rumen8 for their own requirements.

If a folder called ‘Rumen8’ already exists in the location you have chosen it will be used and no files will be deleted. If a ‘Libraries’ folder already exists within the Rumen8 folder it will also be used. If you already have the library files from a previous installation in the Libraries directory they will be left untouched and the defaults not copied from the application folder. In this way you can remove and reinstall Rumen8 manually and your feed library and settings will remain.

If you wish to revert to the default original version of any of the library files just delete them and then start Rumen8 and it will offer to copy a new file as a replacement.

The Rumen8 folder is the recommended location for your saved diet files.

The main Rumen8 window will now open ready for use.
REGISTERING RUMEN8

When Rumen8 is run for the first time it will start in trial mode. This allows you to use all the functions of the application but you are restricted to diets with only four ingredients. To get full access to all the diet ingredients please register, which is free. We ask you to register so we have an estimate of the number of people using the application. This information will be used for future funding applications for further development. By not registering or if you share your registration name and number you may reduce the chance of future improvements to Rumen8.

To register send an email to support@rumen8.com.au specifying your
First name:
Last name:
Email:
Country:
Role in dairy industry:

Your information and email will only be used to contact you for registration purposes and very infrequently for matters concerning Rumen8 in the future. It will not be passed on to any other person or group. You should receive a registration email within 48 hours containing a registration code that is linked to your name.

If you go to the Registration option under the Help menu you can enter your name and registration number exactly as specified in the email from Rumen8 support. The best way to be sure you have entered them exactly is by using copy (control-c on the keyboard) and paste (control-v) to copy them from the email and then paste them into Rumen8. Click the ‘Register’ button and all the feed ingredients will become available.

Figure 2.15. Entering registration details.

REMOVING YOUR RUMEN8 REGISTRATION

If you plan to give you computer to someone else, before uninstalling Rumen8 go to the Registration option under the Help menu and click the ‘Deregister’ button. Your name and registration code will be removed from the machine and Rumen8 will revert to trial mode.
3. QUICK START GUIDE

Start Rumen8 and the main window will open. The application can be used in one of two modes. If this is the first time you have installed Rumen8, it will start in Compact mode which reduces the window down to the essentials. The other layout is Standard mode which provides access to all the functions Rumen8 provides. Compact mode is recommended for learning how to use Rumen8, and for many users, will be enough.

Switching between modes is easy and can be done in the File menu.

Figure 3.1. Use the File menu to switch between Standard and Compact modes.

If you are unsure what something within Rumen8 is, hover your mouse over it and for most objects a tool tip will appear providing a more detailed explanation.
USING RUMEN8 IN COMPACT MODE

The main Rumen8 window when in compact mode is shown below. The Diet Ingredients section is where you specify the animal diet (1). The tabbed section is where you can specify the cow details, evaluate the current diet, adjust feed costs and milk payments. The summary section at the bottom right reports feed costs, milk income and margin (3).

*Figure 3.2. The sections of the main Rumen8 window in compact mode. Diet ingredients (1), detail tabs (2) and diet costs and efficiencies (3).*

Click on the ‘Animal/Diet’ tab to show the cow description.

DESCRIBE A COW

Using the entry sliders or typing a number in the entry box describe the cow you wish to feed, or the average cow that represents your herd or sub-herd. You can adjust live-weight, growth rate, milk yield and components, stage of lactation and pregnancy status on the left side of the Animal/Diet tab. You may also adjust the activity level of the cow with distance walked and if you have a flat or hilly farm. Leave the DMI (dry matter intake) estimation method set to standard for the time being.
To quickly overwrite a value in the entry box, double-click on it. The current value will be selected and then type in the new value to replace it.

Figure 3.3. The Animal/Diet tab.

![Animal/Diet tab screenshot](image)

The right of the ‘Animal/Diet’ tab shows how well our diet will feed the cow. It doesn’t show anything as we have not added any ingredients to the diet yet.

**ENTER A DIET**

Ten ingredients can be added to a diet using the drop-down lists on the top-left of the window. Click on ingredient 1 and select ‘Barley grain’ as our first feed in the diet. If you want an ingredient further down the list once the list has dropped down, you can type a letter on the keyboard to jump to the first ingredient starting with that letter.
Select ‘Lupins grain’ for ingredient 2 and ‘Ryegrass ann. – Dry – Spr – Low quality’ in ingredient 3 (Dryland annual ryegrass of low quality). The diet should now look like Figure 3.5.

Figure 3.5. Three ingredients in the diet.

Now let’s feed our cow. Enter the amount of each ingredient fed to the cow using the ‘DM’ entry box to the right of their name. Enter 6 kilograms of barley grain, 1 kilograms of lupins grain and 10 kilograms of ryegrass. The window should now look like Figure 3.6. Notice that while you have entered the amount fed as kilograms of dry matter Rumen8 automatically shows you the amount as fed in the column to the right and you can adjust the amounts with either quantities.
EVALUATE A DIET

The ‘Diet’ tab shows six of the parameters you need to consider when formulating a diet for dairy cows. For this example, we will consider the first three. With the current diet, we can see there is insufficient metabolisable energy (ME 87%) and protein (MP 90%) for the cow we described earlier. However, while the cows’ dry matter intake progress bar is green, it is only 90% of her potential so this means she can physically eat more food if it is presented to her.

Increase the amount of barley grain to 9.2 kg, decrease the lupins to 1.9 kg and decrease the ryegrass to 7.0 kg. Now you will see both ME and MP are at 100% of the cow requirement and intake potential is still below 100% so she can eat this amount of feed. Your screen should look like Figure 3.7.
This brings us to a very important point that is true of all nutrition models. The application tells us we have a diet that meets the ME, MP and intake requirements of our cow, but a nutritionist is unlikely to recommend this particular diet. The starch content and the proportion of the diet that is highly digestible concentrate are high (31% and 61% respectively) leading to a risk of acidosis (note the warnings in red alongside the starch and forage concentrate ratio as the bottom of the tab). That is before we consider the cost of this diet.

Rumen8 is a tool that will assist someone with nutritional knowledge to better and more cost effectively feed their cows, but in the hands of someone without that knowledge it can create diets that appear balanced on paper but may decrease cow performance or adversely affect their health.

We recommend Rumen8 is used with your nutritionist. Depending on your level of knowledge it can be used to adjust diets between visits by them.

This diet is now balanced for energy and protein and the cow should be able to physically eat the feed when it is presented to her. This demonstrates the start of the process when designing a diet for your cows, and you can now further refine the diet by looking at other important parameters such as starch and NDF content.

The remaining tab allows you to change milk payment and the cost of the feeds in the current diet. With feed costs and milk price Rumen8 can show you diet costs and margins to better compare alternatives.

**Diet Margin**

Click on the Cost/Price tab. On this tab the top section allows you to enter the feed costs for each ingredient of the diet. In the bottom section you can enter the price you are paid for your milk. Enter the prices for
the barley grain and lupin grain on an as fed basis as $300 and $350 respectively. Enter the cost of the ryegrass as $100 per tonne of dry matter so your values should be the same as in Figure 3.8.

**Figure 3.8. Feed costs and milk payment price can be entered on the second tab.**

At the bottom of the tab you can see the milk price is already entered based on a price for each kilogram of fat and protein, and a discount for volume. Changing the 'Payment by' button to 'Yield' allows you to enter a milk price per litre.

Once Rumen8 has a cost for the feeds and a milk price it can calculate a margin in the bottom left Summary section. In this example the cow is eating $4.59 of feed each day and producing $10.03 worth of milk giving a margin of $5.44. This provides a simple way to compare the financial performance of different diets even when they influence milk production.
USING RUMEN8 IN STANDARD MODE

The main Rumen8 window when in standard mode is shown below. The Diet Ingredients section is where you specify the animal diet (1). The tabbed section is where you can specify the cow details, evaluate the current diet, adjust feed costs and milk payments, compare alternative diets and keep notes (2). The costs and efficiency strip at the bottom reports feed costs, milk income, feed efficiency and margins (3).

Figure 3.9. The sections of the main Rumen8 window. Diet ingredients (1), detail tabs (2) and diet costs and efficiencies (3).

Click on the ‘Animal’ tab to show the cow description.

DESCRIBE A COW

Using the entry sliders or typing a number in the entry box describe the cow you wish to feed, or the average cow that represents your herd or sub-herd. You can adjust live-weight, growth rate, milk yield and components, stage of lactation and pregnancy status. You may also adjust the activity level of the cow with distance walked and if you have a flat or hilly farm.
To quickly overwrite a value in the entry box, double-click on it. The current value will be selected and then type in the new value to replace it.

Figure 3.10. The Animal tab.

Now click on the ‘Diet’ tab to the right of the ‘Animal’ tab to view how well our diet will feed the cow. It doesn’t show anything as we have not added any ingredients to the diet yet.

Figure 3.11. The Diet tab.
ENTER A DIET

Fifteen ingredients can be added to a diet using the drop-down lists on the left of the window. Click on ingredient 1 and select ‘Barley grain’ as our first feed in the diet. If you want an ingredient further down the list once the list has dropped down you can type a letter on the keyboard to jump to the first ingredient starting with that letter.

*Figure 3.12. Selecting a feed in the first diet component menu.*

Select ‘Lupins grain’ for ingredient 2 and ‘Ryegrass ann. – Dry – Spr – Low quality’ in ingredient 3 (Dryland annual ryegrass of low quality). The diet should now look like Figure 3.13.
Now let’s feed our cow. Enter the amount of each ingredient fed to the cow using the ‘DM’ entry box to the right of their name. Enter 6 kilograms of barley grain, 1 kilograms of lupins grain and 10 kilograms of ryegrass. The window should now look like Figure 3.14. Notice that while you have entered the amount fed as kilograms of dry matter Rumen8 automatically shows you the amount as fed in the column to the right and you can adjust the amounts with either quantities.
EVALUATE A DIET

The ‘Diet’ tab shows nine of the parameters you need to consider when formulating a diet for dairy cows. For this example, we will consider the first three. With the current diet, we can see there is insufficient metabolisable energy (ME 87%) and protein (MP 90%) for the cow we described earlier. However, the cows’ dry matter intake is only 90% of her potential so this means she can physically eat more food if it is presented to her.

Increase the amount of barley grain to 9.2 kg, decrease the lupins to 1.7 kg and decrease the ryegrass to 7.0 kg. Now you will see both ME and MP are at 100% of the cow requirement and intake potential is still below 100% so she can eat this amount of feed. Your screen should look like Figure 3.15.

This brings us to a very important point that is true of all nutrition models. The application tells us we have a diet that meets the ME, MP and intake requirements of our cow, but a nutritionist is unlikely to recommend this particular diet. The starch content and the proportion of the diet that is highly digestible concentrate are high (31% and 61% respectively) leading to a risk of acidosis (note the warnings in red alongside the starch and forage concentrate ratio as the bottom of the tab). That is before we consider the cost of this diet.
Rumen8 is a tool that will assist someone with nutritional knowledge to better and more cost effectively feed their cows, but in the hands of someone without that knowledge it can create diets that appear balanced on paper but may decrease cow performance or adversely affect their health.

We recommend Rumen8 is used with your nutritionist. Depending on your level of knowledge it can be used to adjust diets between visits by them.

This diet is now balanced for energy and protein and the cow should be able to physically eat the feed when it is presented to her. This demonstrates the process when designing a diet for your cows, and you can now further refine the diet by looking at other important parameters such as starch and NDF content. More information about the current diet is presented in the ‘Diet detail’ tab.

The remaining tabs allow you to change milk payment (‘Milk price’ tab) and the cost of the feeds in the current diet (‘Feed cost’ tab). With feed costs and milk price Rumen8 can show you diet costs and margins to better compare alternatives. Use the ‘Compare’ tab to save and compare related diets before choosing the best one and the ‘Split herd’ tab to create combined diets for herds made up of different calving groups of cows. The ‘Notes’ tab allows you to keep a description of the diet for reference in the future. How to use these functions is detailed in ‘Using Rumen8’ section of this manual.
THE PROBLEM OF MEASURING PASTURE INTAKE

It all sounds simple, choose the ingredients your cows are being fed, enter the quantities you provide and balance the diet. Easy, but what about grazed pasture? Accurately measuring how much grazed pasture a cow eats is very expensive and time consuming so may not be done on farm. To solve this problem, we ‘back calculate’ how much pasture the cows are predicted to eat by subtraction of all the feed ingredients you do know. It is easier than it sounds.

1. Enter the values that describe the average cow in your herd on the ‘Animal’ tab. Include the current milk production and yield. Rumen8 will calculate the metabolisable energy needed for the cow and this is displayed on the ‘Diet’ and ‘Diet detail’ tabs.
2. Add all the supplementary feed provided to the cows to the Diet ingredients drop-down lists. This includes grain fed in the dairy and forages in the paddock. Everything except grazed pasture.
3. Rumen8 now calculates the metabolisable energy provided by the supplements and the difference between this and the cow’s requirement must be supplied by grazed pasture. This is shown on the ‘Diet detail’ tab as the ‘Balance’ under the ‘Metabolisable energy’ section and the remaining percentage of the metabolisable energy bar on the ‘Diet’ tab.
4. Select a suitable pasture for your farm and time of year and as the next diet ingredient. Increase the quantity of this until the metabolisable energy provided by the diet is the same as the requirement of the cow.

You now have the diet that reflects the current situation with an estimate of the amount of pasture each cow is eating. With this information you can explore alternative diets that include pasture assuming you will maintain the amount of pasture on offer for the herd in the future.

RUMEN8 WARNINGS

Rumen8 will sometimes display a red exclamation mark to draw your attention to something that may be wrong with a diet or parameter you have entered. For example, if the days pregnant and days in milk values result in the cow getting back in calf within 40 days after calving a red exclamation mark appears next to the entry boxes for these parameters suggesting you should double check the values.

In Figure 3.15 you can see a red exclamation mark alongside the ingredient barley. This means the quantity of barley in the diet exceeds the recommended maximum. If you hover your mouse over the exclamation mark a tool tip will appear giving you more details about the issue.

When you see a red exclamation mark mouse over it and the tool tip will tell you what is wrong.
4. MENU COMMANDS

The menu is along the top of the main window and has five choices, File, Edit, Animal, View and Help.

FILE MENU

Figure 4.1. The File menu.

Open

Allows you to load a previously saved diet. A warning will appear if the milk price or dry matter intake parameters have changed since the diet was saved. These warnings can be disabled in the Preferences.

You can also import diet files from version 2 of Rumen8 by selecting the file type ‘Rumen8 v2 files (*.csv) in the Open dialog box.

Open with Libraries

Opens a previously saved diet similar to the ‘Open’ command but if any of the library files (FeedLibrary.db3, Preferences.db3 and MilkPrices.db3) are also present in the folder they will be opened too. See below for more information.

Save

Save the current diet. This is only available if the diet has been previously named and saved using the ‘Save As’ menu.

Save As

Name and then save the current diet. If changes to the current diet have not been saved an * will appear next to the diet name in the title bar.

Save As with Libraries

Saves the current diet in the same way as the ‘Save As’ command but also saves a copy of each of the library files (FeedLibrary.db3, Preferences.db3 and MilkPrices.db3) to the save folder. See below for more information.
Reload Feeds

This updates all the feed data from the feed library. This is useful if you have multiple instances of Rumen8 running and have made a change to a feed in one of them and wish to quickly update the others.

Reports

Opens the report designer that creates diet reports for printing or to be saved as a PDF document.

Preferences

Opens the Preferences allowing you to change Rumen8 settings. A more detailed explanation is given in the Preferences section starting on page Error! Bookmark not defined.

Standard Mode

When ticked all of Rumen8’s functions are available.

Compact Mode

When ticked the Rumen8 window is reduced to the essentials required to balance a diet based on energy, protein, fibre and starch.

Exit

Close Rumen8. You will be prompted to save an unsaved diet.

**LIBRARY FILES**

Rumen8 uses three files to store preferences, feed information and milk prices. These are called Preferences.db3, FeedLibrary.db3 and MilkPrices.db3 and are usually kept in the \Rumen8\Libraries folder in the user’s Documents folder. For most users, there will be no need to change library files and they can be left in the default location and ignored.

However, while only one of each library file can be in use at one time, you may have multiple files kept in different locations. As an example, this may be useful for a nutritionist who visits many farms as part of his role. A folder for each client could be created and by using the ‘Save As with Libraries’ command a diet file and the associated libraries are created in it. Then milk prices, preferences and feeds can be tailored for that client and do not impact on other clients with their own library files in other folders.

When returning to the farm later the nutritionist must remember to use the ‘Open with Libraries’ command for the first diet to switch to all the library files for that client.

When a library file outside of the default \Rumen8\Libraries\ folder is in use a flag appears at the bottom right of the tabbed section of the Rumen8 window. For the preferences file, a ‘P’ appears, the milk prices file will display a ‘M’ and a ‘UFL’ or ‘SFL’ for user or shared feed libraries. Normally the letter is white but if the library file is in the same folder as the current diet file it will be black. Hover the mouse over the flag and the full path of the library file will be shown in the tool tip.

Finally, if a diet file is opened with libraries from the File menu you can see which ones were found in the folder in the title bar of the Rumen8 window. After the file name in brackets will be a letter corresponding to each library, so if there was a preferences, milk prices and feed library in the diet file folder the diet name would have the suffix (PMF). This provides a fast way to double check the library files you expected in a folder with their related diet files were successfully opened by Rumen8.
Edit Menu

Figure 4.2. The Edit menu.

Edit Feeds
Opens the Feed Editor to change feeds and mixes and the ingredients available in the ingredient drop-down lists. A more detailed explanation is given in the Feed Editor section.

Copy Diet
Copy the current diet to the clipboard for later pasting into Excel or Word for example.

Copy All Diets
Copy the current diet and the three stored diets to the clipboard.

Clear Current Diet
Sets all the ingredients back to blank.

Create Mix From Diet
Opens a window that allows a new mix to be created from the current diet feeds (not mixes). Each ingredient can be removed from the mix by unticking the box to the left of the feed name. Each feed displays the quantity in the new mix on a dry matter and as fed basis, and the percentage of the mix it makes up.

To the right of the ingredient list you can select if the mix percentages are based on dry or as fed quantities and check the total mix dry matter content and number of ingredients.

Below are the normal mix parameters like those in the Feed Editor mix tab. The mix must have a unique name among existing feeds and mixes. The heading ‘Name’ will turn red if this is not the case and you will be unable to click on the ‘Okay’ button to create the mix.
Once you are happy with the mix definition, have given it a unique name and provided as many of the optional parameters as you wish, click on the ‘Okay’ button to save it to the current feed library.

Figure 4.3. The mix creation tool available from the Edit menu.
ANIMAL MENU

Figure 4.4. The Animal menu.

- **Save current animal as the default**: Save the current animal as the default that will be loaded each time Rumen8 starts.
- **Reload default animal**: Replace the current animal with the default animal.
- **Use standard animal**: Replace the current animal with a pre-defined generic cow in early, mid or late lactation for total lactation production of 2000 to 10,000 litres. These definitions should only be used for general analyses. For on-farm use actual data including cow liveweight, days in milk, milk production and composition etc. for the herd of interest should be used.
- **Dry off the current animal**: Changes the parameters for the current animal as if it had been dried off and was mid-way through a 60-day dry period.
- **Move current animal into transition herd**: Changes the parameters for the current animal to one that is 2 weeks prior to calving and has entered the transition or close-up period (i.e. last 4 weeks before calving).
VIEW MENU

Figure 4.5. The View menu.

Energy detail  Displays the details of the metabolisable energy demand calculations for the animal.
Protein detail  Displays the details of the metabolisable protein supply and demand calculations for the animal.
Minerals detail Displays the details of the calcium, phosphorus and magnesium demand and supply calculations.
Ingredient detail Displays the attributes of a diet ingredient. The submenu allows you to choose an individual ingredient from 1 to 15.
Help Menu

Figure 4.6. The Help menu.

- **Help**: Opens a context sensitive version of the Help document.
- **About**: Display information about Rumen8 such as the version number, website address and email for support.
- **Registration**: Enter your registration number and name here to no longer run in trial mode and unlock all the diet ingredients.
- **What’s new**: Opens a window listing all the changes to each version of Rumen8.
- **Check for updates**: Check to see if a newer version of Rumen8 is available. This can only be done if your computer is connected to the Internet.
5. USING RUMEN8

This section will describe the main parts of the Rumen8 window and how you use them.

DIET INGREDIENTS

The left section of the main window is where you add ingredients to your diet and specify the quantity fed each day. In Figure 5.1 it is highlighted within a blue rectangle.

Figure 5.1. The diet ingredients section of the main window shown within the blue rectangle.

Clicking on the down arrowhead to the right of the drop-down lists you can choose any of the feeds available from the feed library.

If you want an ingredient further down the list once the list has dropped down you can type a letter on the keyboard to jump to the first ingredient starting with that letter.

Once a feed has been selected the ‘DM’ and ‘As fed’ entry boxes become active and you can either type the kilograms to be fed in directly or click on the up and down buttons to vary the existing amount.

You can enter the value on a dry matter basis in the ‘DM’ column and the amount will be displayed on an as fed basis in the ‘As fed’ entry box. If you prefer to enter the amount as fed the reverse works in the same manner. Internally Rumen8 always uses the value on a dry matter basis.
Up to fifteen feeds or feed mixes can be added to a diet. To see the details of a selected ingredient, right click on the ingredient number and the detail window will open. Alternatively hover the mouse over ingredient name and a tool tip will appear showing the feed or feed mix attributes.

The total diet weight on a dry matter basis and as fed are displayed at the bottom of each of the columns.

**Figure 5.2. The diet ingredient detail window.**

As feeds are added or quantities are adjusted Rumen8 recalculates energy and nutrient supply relative to energy and nutrient demand, thus showing the adequacy of your diet in meeting production objectives.

**Figure 5.3. The diet ingredient tool tip window.**
To quickly remove an ingredient from the diet, hold down the Shift key on the keyboard and right click on the ingredient number. To clear all the ingredients from the diet, select ‘Clear current diet’ from the Edit menu.
MOVING INGREDIENTS IN THE DIET

Ingredients can be dragged and dropped between the 15 feed locations to swap their positions. Amount fed is also swapped with the ingredients. To move ingredient 3 to position 8 left-click and hold on the number 3 to the left of the ingredient name. The mouse pointer will change to show a small rectangle below the pointer. Still holding down the mouse button down move the pointer over the ingredient 8’s name or number and release. The ingredients and their amounts fed will now be swapped. You can only drop an ingredient over the ingredient name or number, anywhere else will display a no entry symbol.

Figure 5.4. Starting to drag Barley grain in position 1 to position 8.
Figure 5.5. Drop the Barley grain over the ingredient position you want it to occupy by releasing the mouse click.

Figure 5.6. After the drag and drop the Barley grain and Ryegrass have swapped ingredient positions.
**ANIMAL**

The Animal details are entered on the first tab of the tabbed section of the main window. It is used to describe the cow, or the cow that represents the herd average, for the diet that is being created.

*Figure 5.7. The Animal tab highlighted in the blue rectangle.*

Using the sliders adjust live weight, growth rate, milk yield and components, days pregnant and days in milk. The value can be changed quickly by moving the slider left and right or adjusted 1 unit at a time by clicking on the – and + symbols at either end. To quickly overwrite a value in the entry box double click on it. The current value will be selected and then type in the new value to replace it.

Days pregnant and days in milk can also be set by specifying the date of conception or calving by clicking on the calendar icon.

For convenience, the milk yield is also expressed as fat: protein ratio and fat plus protein kilograms per day based on the input milk yield and components. The energy corrected values display the yield in kg corrected to the international standard 4.0% m/m fat and 3.3% m/m protein.

Additional parameters let you adjust the activity level of your cows if you have a large or hilly farm. Note that a grazing cow will typically walk 4-5 km over a day in the paddock, in addition to the distance to and from the dairy for milking.

**Breed and Maturity**

The cow breed is used to estimate mineral demand and has a relatively small influence so don’t worry too much if your actual breed is not an option. Choose the closest related breed. If you are creating a diet for young animals, choose either unmated or mated heifer.
Live weight

Mean live weight (kg) of the herd at the time of interest. Cows that are weighed on farm are the best guide, but if cow live weight is unknown, use the following as a guide.

“North American” Holstein cows are 600-650 kg live weight.
Australian Friesian cows are 550-600 kg live weight.
Cross-bred cows 450-500 kg live weight.
Jersey cows 375-425 kg.
First calvers are often 10% less than their mature counterparts.

For culled cows that are sold ‘over the hooks’, dairy cows typically dress out at ~40-45% of live weight. For example, a 260-290 kg dressed weight equates to ~650 kg live weight. Note that cull cows are (or should be) older cows, so these will not be representative of the average live weight of the herd.

Live weight change

This is the estimate of the amount of live weight that is being lost or gained across the herd (kg/cow/day). Some typical figures are shown below.
Figure 5.8. Possible estimates of live weight change during a lactation for a 600 kg cow.

<table>
<thead>
<tr>
<th>Days in milk</th>
<th>0-30</th>
<th>30-60</th>
<th>60-90</th>
<th>90-120</th>
<th>120-150</th>
<th>150-180</th>
<th>180-210</th>
<th>210-240</th>
<th>240-270</th>
<th>270-300</th>
<th>Dry period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LWC kg/d</td>
<td>-0.8</td>
<td>-0.6</td>
<td>-0.2</td>
<td>0</td>
<td>0</td>
<td>0.05</td>
<td>0.15</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Clicking on the calculator button alongside the live weight change value will open a window that assists in estimating the rate of live weight change for your animal. For cows this is based on the days in milk with the option to increase the rate if the cow is required to gain BCS over the lactation.

Figure 5.9. The live weight change calculator for cows.

To estimate live weight change for the current cow, adjust the days in milk value and you will see the estimate change below. Hover the mouse pointer over the text at the top of the window to see a graph of how a typical cow’s live weight change varies between calving assuming she returns to the same BCS in which she started the lactation.

If the cow isn’t meeting the recommended BCS for this stage of lactation or you wish her to calve at a higher BCS than previously you may add additional live weight change over and above the base. Set the amount of additional BCS gain with the top slider and the time period to achieve this with the bottom slider. This will increase the live weight change value by the appropriate amount. To see more detail on
the energy requirements of BCS gain hover your mouse over the text above the unit gain slider. Once you are happy with the live weight change estimate click on the ‘Okay’ button to return it to the Animal tab.

For heifers the calculator estimates the required rate of gain to meet mating or calving target live weights.

*Figure 5.10. The target growth rate calculator for mated heifers.*

Heifer growth rates are calculated so the herd reaches target live weight at mating or calving (55% and 94% herd mature weight respectively). Ensure the herd’s mature weight is representative of a typical animal that has completed 3 lactations. By entering the heifer’s birth date (or mean birth date for a group of heifers), a current weigh date and (mean) live weight you can see if the heifer (group) is on track. In Figure 5.10 the target weight is 46% of mature weight at 11 months and the herd is slightly above that at 49% so all is well.

To determine the target growth rate from the weigh date to mating or calving enter the date of the event. In the example above to calve on the 15th of March 2019 the heifer herd must maintain a growth rate of 0.74 kg/day to reach 611 kg live weight (94% of the mature herd weight of 650 kg live weight).

Once you are happy with the target live weight change value click on the ‘Okay’ button to return it to the Animal tab.

**Days Pregnant**

Affects nutritional requirements, which becomes significant from day 140 onwards. Days pregnant should be the weighted average of the herd (see below example of Days in milk). The number of days since conception can be entered directly with the slider or click on the calendar icon to select the date of conception.

**Days in milk**

Days in milk 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/day) is estimated as per NRC (2001). 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 at 60-80 days in milk.
Where cows have had restricted energy intake through this period peak DMI is more likely to occur at 100-120 days in milk.

Days in milk must be calculated as a weighted average for the herd. For example

- 100 cows @ 100 DIM = 10,000 cow days
- 200 cows @ 280 DIM = 56,000 cow days
- 30 cows @ 350 DIM = 10,500 cow days
- **330 cows** = 76,500 **cow days**

Weighted herd average = 76,500 cow days / 330 cows = ~230 DIM

The number of days since calving can be entered directly with the slider or click on the calendar icon to select the (mean) calving date.

Alternatively, separate diets can be calculated in Rumen8 for each calving group in the above example.

**Number of cows in the herd**

This is used only to calculate the herd margin (daily milk income minus daily feed costs in $/herd/day) and can be left set to 1 if you are more interested in daily milk income minus daily feed costs per cow/day.

**Milk yield**

(litres or kilograms/cow/day) – if milking numbers are stable this should be the last 5-10 days average milk yield per cow. Milk yield should include all milk produced per cow, including milk that is being fed to calves and any milk not suitable for human consumption.

**Milk fat and protein**

Ensure you set the correct unit in “Preferences”: in Australia this is almost always mv%, while in NZ it is mm%. Protein% as used in Rumen8 is true protein (in some countries milk protein 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 subgroups of cows within the milking herd the milk fat and protein %’s are likely to be significantly different to the herd average e.g. early lactation cows in peak production vs late lactation cows.

Below the entered milk yield and composition Rumen8 reports the Fat:Protein ratio (this can be changed to the Protein:Fat ratio in the Preferences) and the yield of fat, protein and fat + protein in kilograms per day. In addition, the yield as energy corrected milk is calculated standardised to 4% fat and 3.3% protein content (m/m).

**Dry matter intake estimation method**

Here you can set how to estimate the maximum dry matter intake for the cow. The standard method is recommended as this uses the NRC 2001 intake equation for lactating cows, the AFRC 1993 intake
equations for heifers and fixed intake values for dry and transition/close-up cows that can be adjusted in the Preferences.

As an alternative, the NDF intake method can be selected. This method estimates the cows predicted intake based on the amount of NDF eaten as a percentage of the cow’s live weight. The percentage of live weight for lactating cow, dry and transition/close-up cows and heifers can be changed in the Preferences.

**Farm terrain**

This influences the amount of energy required for maintenance. Note that walking 1 ‘vertical meter’ requires the same energy as walking 10 ‘horizontal meters’.

**Distance walked**

This influences the amount of energy required for maintenance.

Cows grazing a large farm (300 Ha) with centrally located dairy will on average walk 4 km to and from the dairy plus distance walked while grazing ~5 km. Daily total 9 km.

Cows grazing a medium sized farm (150 Ha) with centrally located dairy will on average walk 3 km to and from the dairy plus distance walked while grazing ~4 km. Daily total 7 km.

Cows grazing a smaller sized farm (75 Ha) with centrally located dairy will on average walk 2 km to and from the dairy plus distance walked while grazing 3 km. Daily total 5 km/d.

Cows kept in feedlots will on average walk only a few hundred meters a day plus the distance to and from the dairy. Often no more than 1 km/d.
**DIET**

The diet tab provides an overview of the current diet performance. It is highlighted within a blue rectangle in Figure 5.11.

*Figure 5.11. The Diet tab.*

The Diet tab has six horizontal bars representing the dry matter intake, metabolisable energy, metabolisable protein, calcium, phosphorus and magnesium in the diet. Below these are the neutral detergent fibre and starch percentage of the diet and the forage to concentrate ratio.

Metabolisable energy, protein and minerals are expressed as a percentage of the cow’s requirement so a balanced diet should have these parameters around 100%. When the cow’s requirement is not being met the progress-bar will be red. When the diet meets the cow’s requirement the bar will be green. If there is an excess of ME, MP or minerals in the diet the corresponding bar will be yellow.

The intake bar shows the percentage of the animal’s maximum intake the current diet represents. When the cow is eating close to potential the bar will be green. If the diet contains too much feed for the cow to eat the bar will turn yellow and if the cow is being very underfed the bar will be red.

How close to 100% the progress bars must be to turn green is adjusted in the Preferences.

The starch and NDF sections show the percentage of the diet made up of these components. The final value shows the ratio of forage to concentrate in the diet (with the total being 100).

If ‘Recommended Levels’ are set for NDF, starch and forage: concentrate a traffic light will appear and show whether the current value is under, within or above the recommended range. See the Preferences section for how to set ‘Recommended Levels’. Independent of the ‘Recommended Levels’ a warning may appear next to each of these parameters if the dietary level suggests the cow may be in danger of ruminal acidosis.
For further information about each parameter, hover your mouse over the progress bar and a tool tip will appear showing the actual values. For example, the tool tip for the dry matter intake bar in Figure 5.11 displays ‘Supply 18.0 kg. Maximum intake 18.9 kg. Balance -0.9 kg’.

In the bottom right of the tab a red exclamation mark will appear if a monitored diet parameter not shown on this tab is outside the recommended level set in Preferences. See the section on Recommended Levels in the Preferences for how to set suitable ranges for important diet parameters.
**Diet Detail**

The ‘Diet Detail’ tab is used in a similar way to the ‘Diet’ tab but contains much more information about the diet performance.

*Figure 5.12. The Diet Detail tab shown within the blue rectangle.*

The diet detail tab is divided into several sections covering metabolisable energy, metabolisable protein, dry matter intake, fibre, rumen protein, starch, fat, enteric methane production, minerals and the dietary cation anion difference. In addition, the active set of Recommended Levels can be changed in the bottom left corner of the tab.

**Metabolisable energy**

This section shows the total ME supplied by the diet, demand from the cow and the consequent balance. Below is the energy density of the diet.

The ‘traffic light’ to the right is red when ME from the diet is insufficient, green when it meets the cow’s demand and yellow when it exceeds the cow’s needs. Clicking on the title ‘Metabolisable Energy’ (or the menu option View, Energy detail) will bring up the detail window that provides more information about how ME demand is calculated. The detail window can remain open while the diet and cow is adjusted so the influence on components of the total ME demand can be seen.
Metabolisable protein

This section shows the total MP supplied by the diet, demand by the cow and the subsequent balance. Below is the diet’s crude protein content. Crude protein content of the total diet is only provided for reference. The ‘traffic light’ to the right is red when MP from the diet is insufficient, green when it meets the cow’s requirement and yellow when it exceeds the cow’s needs. Clicking on the title ‘Metabolisable protein’ (or the menu option View, Protein detail) will bring up the MP supply and demand detail window that provides more information about how metabolisable protein supply and demand are calculated by Rumen8. The detail window can remain open while the diet and cow is adjusted so the influence on components of the total MP supply and demand can be investigated.

As with the rest of the Rumen8 application, hovering the mouse over each parameter will provide additional explanatory information. If you hover over the text ‘MP system flowchart’ on the detail window a chart will appear that shows the path protein takes through the animal that corresponds to the values Rumen8 calculates when estimating MP supply.
Intake

The ‘DM intake estimate’ section shows the percentage of maximum predicted intake the current intake represents for the two methods of calculating potential available on the Animal tab. It is recommended you refer to the Maximum DMI%, as we suggest this is more reliable than determining intake potential by calculating NDF intake as a percentage of live weight for lactating cow diets that contain concentrates and quality forages.

The ‘traffic light’ is red when the diet constitutes less than the cow can eat, green when the cow is eating as much as she can, and yellow when the diet exceeds the cow’s ability to eat it. The current intake estimate method linked to the traffic light is shown in black text and the inactive method is shown in grey. The sensitivity of the traffic light and parameters used to adjust intake estimation can be adjusted in the Preferences.

Dry matter intake as a percentage of liveweight is also provided as an alternative method to evaluate the animal’s current intake potential.
Fibre, rumen protein, starch and fat

The four sections in the top right of the diet detail tab reports a range of diet parameters for the current diet. These cover things like NDF, starch and sugar through to rumen degradable protein and forage concentrate ratio. If you are unsure what one of the abbreviations means hover your mouse over the text and a tool tip will appear with a more detailed explanation.

The ‘Excess protein’ section shows the effect of having too much protein in the diet. There is a metabolic cost to remove excess protein and this is expressed as forgone milk production or live weight growth. The calculation can be adjusted in the Preferences.

If Recommended Levels have been set for some of these diet parameters a small traffic light appears next to the value and shows if it is below, within or above the recommended range. In addition, the NDF, starch and forage concentrate ratio may show a red exclamation mark if the current value may result in the animal being at high risk of ruminal acidosis.

Methane

The amount of methane produced by the cow from the intestines is shown as a total and as how much per unit of milk production (intensity). Methane (CH4) is a greenhouse gas emitted from livestock mainly through enteric fermentation and manure decomposition. Methane produced in the intestine (enteric) is a natural by-product of microbial fermentation of nutrients in the digestive tract of animals.

Minerals

The bottom right section of the diet detail tab displays supply and demand for the diet’s calcium, phosphorus and magnesium levels. A traffic light for each show if the current level is below (red), equal to (green) or above (yellow) the animal’s requirement. If all the feed ingredients have a DCAD value the dietary DCAD is calculated and compared with a recommended level depending on whether the cow is lactating, in the early dry period or the ‘transition or close-up period’ (last 4 weeks before calving).

Clicking on any of the titles ‘Calcium’, ‘Phosphorus’ or ‘Magnesium’ (or the menu option View, Minerals detail) will bring up the Minerals supply and demand detail window that provides more information about the animal demand and diet supply of each of the minerals. The detail window can remain open while the diet and cow is adjusted so the influence on mineral supply and demand can be investigated by adjusting cow or dietary parameters.
Figure 5.15. The minerals detail window.

Recommended levels

The section in the bottom left of the diet detail tab shows which set of Recommended Levels has been selected, if any, and allows the user to change between sets. In Figure 5.15 a set of Recommended Levels that applies to early lactating cows has been selected and the small traffic light adjacent to NDF (%DM) is linked to this. See the Preferences section for how to turn on and off and adjust the Recommended Levels. Rumen8 can also automatically switch between sets of Recommended levels based on the cow’s number of days in milk.
**MILK PRICE**

The price of milk is used to calculate milk income and margins of milk income over feed costs. Each milk price set contains a total of 24 milk prices, twelve prices entered as payment by volume or twelve prices entered as payment for components.

Use the ‘Payment’ box to the right of the tab to select if you wish to enter you milk prices by volume or components. Click on the ‘Components’ button to use the 12 payment prices entered as payment for fat plus protein minus a volume discount, or the ‘Volume’ button to select the 12 volume prices entered as cents per litre.

*Figure 5.16. The milk price tab with payment by volume selected.*
If the payment is entered by volume, the equivalent value expressed as payment for components is shown alongside it, and if by components, the equivalent shows the price calculated by volume. The calculation of equivalent price uses the current milk components entered on the Animal tab.

Each of the 12 prices are entered in the entry box/s alongside the numbers 1 to 12. The current price is selected with the button to the left of the number.

If you do use the 12 milk prices to represent months of the year, Rumen8 will not switch between them automatically as the date changes.

By expanding the ‘Sets and library files’ panel (click on the downward pointing arrows) up to ten sets of milk prices can be defined and given a name in Rumen8 using the drop-down menu on the right side the tab and the name edit box below it.

For example, a farmer may select ‘Milk price set 1’ in the drop-down menu and rename it ‘Milk prices 2019’ in the edit box below. He is paid by volume so he selects Volume’ in the Payment box below and then can enter up to 12 milk prices he expects to receive over the course of 2019. The current milk price can then be selected by clicking on the small button to the left of it.

A neighbouring farmer visits and they wish to check a few of her diets in Rumen8 against her milk prices. By selecting ‘Milk price set 2’ and giving it a suitable name, a completely new set of milk prices can be entered without losing the information used on the host farm.

A new MilkPrices.db3 library file can be created by clicking on the ‘New’ button. An existing milk prices library file can be opened with the ‘Open’ button. The path of the current milk prices file is displayed below. If it is too long to see all of it hover the mouse over the text and the full path will be shown in the tool tip.
FEED COST

The feed cost tab allows you to quickly adjust feed prices and losses for feeds in the current diet without returning to the feed library. This is useful for comparing groups of feed sources at different prices without having to create a new feed for each.

*Figure 5.18. The feed costs tab.*

For each of the current diet feed ingredients you may change the cost on a dry or as fed basis and the losses that occur before the cow eats it. The final cost is expressed on a dry matter basis, and then after losses for both dry and wet weights.

The new values are changed in the feed library so if you are investigating the influence of feed price changes don’t forget to put the actual feed cost back when you have finished.

Losses are not applied to the amount of feed eaten by the animal but represent the amount of feed lost between when it was costed (usually at delivery or harvest) and when it is eaten. This means the losses only influence the feed cost, not the feed amounts. For example, if the barley grain in Figure 5.18 costs $250/ton DM delivered to the farm and losses are set to 2%, it means the loss occurs after the grain was delivered to the silo and before the cow eats it. The actual cost per kg of barley grain consumed is now $255 /ton DM. The cow still eats 8.30 kg/day of barley grain.

The diet ingredient amounts are always the amount the animal eats, regardless of losses.
The ‘Compare’ tab allows you to build a diet and then save it for comparison with other diets. Think of it as three slots where you can put away a diet while you experiment with other feeds in the main window and then compare them before recalling the best one.

*Figure 5.19. The compare tab.*

There is room for three diets numbered 1, 2 and 3 from left to right. To store the current diet, click the ‘S’ button (store) for one of the diet slots. The 15 ingredients that make up the diet will appear in the slot along with important parameters below. You can make changes to the current diet, store an additional two versions, decide which offers the best solution and then recall that one to the main window by clicking the ‘R’ button (recall) for that slot. Clicking the ‘C’ button (clear) will clear the slot.

When a diet is recalled you have the option to also restore the animal parameters to the values when the diet was stored.
**SPLIT HERD**

The Split herd tab allows you to create a combined diet based on specific diets for sub-groups within a larger herd. For example, you may be running a single milking herd of 200 cows consisting of 150 cows that calved in autumn and 50 cows that calved in spring. While it would be preferable to run the two groups separately so they could receive a diet tailored for their requirements, logistically that may not be possible. The Split herd tab allows you to calculate an ‘average’ diet for the herd.

1. Create a diet for the 150 autumn calved cows and using the Compare tab store it in slot 1.
2. Create a diet for the 50 spring calved cows and on the Compare tab store it in slot 2.

Ensure when you create the diets for the sub-groups you set the number of cows in the herd correctly on the Animal tab.

*Figure 5.20. The Compare tab with diets stored for spring and autumn calving sub-herds.*

3. Change to the Split herd tab. You will see a column for each of the three Compare storage slots. As we are only using two slots there is only a diet name and cow numbers for columns 1 and 2.
Figure 5.21. The Split herd tab showing the two diets from the Compare tab’s slot 1 and 2.

4. To create an average diet weighted by cow numbers turn on the slots 1 and 2 by checking the include box under the Compare diet number as shown in Figure 5.22.

The combined diet is now listed showing amounts fed of each ingredient per cow and per herd on a dry matter and as fed basis. To see what the ‘average’ cow looks like hover the mouse pointer over the text ‘Note the average cow is only an approximation’ at the bottom of the tab.

5. If the combined diet is acceptable it needs to be ‘copied back’ into the ingredients list along with the new animal definition. To do this click on the ‘Replace current diet and cow’ button and the bottom left of the tab.

Now you can fine-tune this diet or print a report like any other Rumen8 diet.
Figure 5.22. The Split herd tab showing a combined diet about to be copied back into the main Rumen8 diet.
The notes tab allows you to write anything about the current diet you may wish to remember when looking at it later. This is often useful if you save diets by date and then refer to them in later years for guidance. The notes can also be used to communicate with your nutritionist if you save the diet file and email it to them for comment or adjustment.

Figure 5.23. The notes tab.
The Optimise function within Rumen8 is difficult to setup unless you have a good knowledge of Microsoft Windows and Excel. It requires Microsoft Excel and the Solver add-in to be installed (versions 2010, 2013 or 2016) and configured for use with Rumen8. See the Optimiser Installation section for step by step instructions on page 118. If you use the Optimiser regularly it is recommended to use the latest version of Excel as the Solver add-in optimises diets more successfully than earlier versions.

The Optimise tab and button will only be available if it is enabled in the Rumen8 Preferences. Optimising allows you to fine tune a diet to minimise cost. The Optimiser will vary the amount fed of each ingredient to find the cheapest diet that meets the constraints you have chosen. Using the Optimiser requires all feeds have costs entered in the fed library or the feed costs tab.

You should first add your feeds to the diet in the approximate quantities required. For the first run of the Optimiser enable the ME and MP constraints to ensure it is possible to calculate a diet from the feeds selected that meets the cow’s requirements. Once a feasible diet has been found progressively add additional constraints starting with your preferred intake estimate until you have a diet that meets your needs, or the Optimiser cannot find a feasible solution. This step-by-step approach is far more likely to result in an optimised diet than simply turning on all the constraints immediately. This is because if a feasible diet cannot be found you know it was the last constraint that is the issue and you can then either exclude that or relax other constraints until a feasible diet can be found.

Remember, the Optimiser simply treats the diet as a mathematical problem to solve and has no nutritional awareness. It can find a feasible diet that minimises cost and meets the constraints but that may harm your cows. Evaluate each feasible diet carefully based on your knowledge of the cows and the diet. If in doubt consult with a qualified nutritionist!

Figure 5.24. The Optimise tab.
You can add constraints to control the diet content of NDF, eNDF, NDF supplied by forage, crude protein, forage concentrate ratio, kilograms of concentrate, starch, sugar and fat. For each of these constraints you must specify the minimum and maximum levels that are acceptable using the left and right sliders. The actual values will be displayed to the left of the slider. The more constraints are activated, the more expensive the diet is likely to become. Also, the narrower the range the less likely it is that a feasible diet can be found. To make the constraint active click the box to the left of the constraint name to put a tick in it.

To the left of the constraint ranges are the current diet value for each parameter. If the constraint is active (ticked) and the diet value is outside the constraint range it will turn red. A parameter such as ME or MP may be close enough to the cow demand to have a green traffic light on the Diet detail tab and still be displayed in red on the Optimiser tab. This is due to a wider margin for the traffic lights (set in the preferences, default is 2%) and rounding differences between Rumen8 and the spreadsheet calculations.

The last four ingredient constraints refer to diet ingredients 1 to 15. Using these you can restrict the amount of each of four feeds in the diet. The drop-down list allows you to select the ingredient you wish to constrain, and the two entry boxes specify the range of kg DM fed that is acceptable. The ‘Current value’ button lets you to quickly fix an ingredient at the amount currently entered. This is useful when the amount of pasture available has been previously determined and needs to be fixed at a certain level. Then the remainder of the diet ingredients will be changed to optimise the diet.

The light on the right of each of the ingredient constraint will turn green when that constraint is active. To be active it must be ticked, specify an ingredient number that has a feed or mix and have a valid range of DM fed.

*Figure 5.25. The Optimiser has been unable to find a feasible diet.*
When a feasible diet cannot be found check the diet values to see how close the Optimiser was to the specified level. You can see in Figure 5.25 the ME and sugar constraints are highlighted red and are outside the desired range, preventing optimisation. The ME value can be ignored as it is only slightly greater than the cow demand, so the issue here is high sugar content in the diet. You can then either add additional feeds or relax a constraint until a feasible diet is found.

The number shown in brackets at the end of the message from the Optimiser (under the ‘Optimise’ button in Figure 5.25) is the return code from the Solver add-in in Excel. You can find more information about these return codes in the Solver documentation provided with Excel.

*Figure 5.26. Successful optimisation after relaxing the sugar constraint.*

![Optimisation Example](image.png)

Figure 5.26 shows a successful optimisation with a feasible diet found. The values are ME and MP are still highlighted in red as they are mathematically outside the constraints but not by a biologically significant amount.

The Solver add-in provided with Excel has improved with more recent versions of Excel so if possible, upgrade your copy of Excel to the latest version if you use the Rumen8 Optimiser regularly.

The constraint ranges on the Optimiser tab can be quickly set to the recommended levels (set in preferences) by clicking on the ‘RL’ button which opens the ‘Apply recommended levels to the optimiser’ window. Up to 5 sets of recommended levels for a range of diet parameters can be set in the preferences providing quick feedback on the suitability of a diet on the Diet tabs.
Figure 5.27. Apply previously set recommended levels to the optimiser.

To set the optimiser constraint range to the same as the recommended range first select which set to use at the top of the window. In Figure 5.27 set one has values for early lactation cows and three of the parameters are active and available to be used in the optimiser. Initially all the ranges are from the Optimiser tab so all the ranges under the ‘Current Optimiser’ column are in bold. To change ranges simply click on them. For example, to use the NDF% range from the recommended levels set one click on the ‘28 to 30’ text and it will be bolded signifying it is now active.

Figure 5.28. Diet parameter ranges from recommended level set one have been selected for NDF and sugar.

Click ‘Okay’ to return to the Optimiser tab and the constraint ranges for NDF and sugar will be updated.
COSTS, INCOME, EFFICIENCIES, AND MARGINS

The bottom of the Rumen8 window displays a range of parameters that allow you to evaluate the financial performance of the current diet. All feeds in the diet must have a feed cost entered and a milk price is also required.

*Figure 5.29. The costs, income, efficiency and margin measures.*

These parameters are divided into four groups. From left to right they are feed costs, milk income, feed efficiencies and margins. The first two of the feed efficiency measures and the feed as a percent of income measure may also have a recommended level set in Preferences to quickly show if they are within the recommended range via a small traffic light.

The current milk yield can also be adjusted in the bottom right of the window allowing the animal performance to be fine-tuned while the Animal tab is not visible. But note our warning about marginal milk yield responses on page 5.
6. THE REPORT DESIGNER

The report designer can be accessed via the File menu. In it you can create several reports based on the current diet and customised for your business.

Note that reports require additional software to be installed. See the Getting Started section of the User Guide for details.

When the report designer window first opens it will have no entries for the farm name, diet name and who prepared the diet. This information will be printed at the top of the report, so it is useful to include it for your business. It only needs to be entered once and Rumen8 will remember it for future reports.

The report type is selected in the top drop-down menu.

THE DIET REPORT

The diet report presents all the information about a completed diet including the animal details, ingredients list, animal performance, diet performance, efficiencies and margins.

Figure 6.1. The Report Designer window highlighting the ingredients list (1) and the mixes list (2).

Once the farm name, diet name, prepared by, contact details, notes and disclaimer have been completed you may also include a business logo on the top right of the report. Click on the ‘Select’ button in the Logo section of the Report Designer (top right) and choose an image file. The image file can be either jpeg, tiff, png or bmp format and will look best if it is between 600 x 300 and 300 x 300 pixels in size (W x H). If the logo is very wide (aspect ratio > 2) it may cover some of the farm detail text.
The order the ingredients are listed on the report is determined in the ‘Ingredients listed in order’ box. It is labelled with a 1 in Figure 6.1. The numbers alongside each ingredient are their ingredient number in the main Rumen8 window so will not change as you change the list order with the arrow buttons alongside them or by dragging and dropping with the mouse.

You can also control if mixes are listed as a single ingredient (their mix name) or broken down to their constituent ingredients. Mixes checked in the ‘Mixes to list as their ingredients’ box labelled 2 in Figure 6.1 will be shown as their ingredients. Figure 6.2 shows the report created with mixes listed by name, not ingredients.

Below the mixes ingredients box you can choose if common ingredients from mixes that are being listed as their ingredients should be combined with the same ingredient already in the diet. For example, Mix Demo above contains barley grain, lupins grain and wheat grain. If it was checked in box 2 to list as it’s ingredients and common ingredients ‘Keep separate’ was selected the final report would list barley and lupins grain twice, once as an ingredient added by the user and once as part of the Mix Demo ingredient. Figure 6.3 shows the report created with these settings.

If Common ingredients ‘Combine’ was selected only a single entry for barley and lupins grain would be included on the report and they would be the combined amount from the user added ingredients and the barley and lupins in the mix. See Figure 6.4 to see the report created with mix ingredients combined.
Figure 6.2. The Report Preview window showing a diet report with the Mix Demo ingredient listed as a mix.
Figure 6.3. The Report Preview window showing a diet report with the Mix Demo ingredient listed as its ingredients and common ingredients kept separate.
Figure 6.4. The Report Preview window showing a diet report with the Mix Demo ingredient listed as its ingredients and common ingredients combined.
THE DAILY FEEDING SHEET REPORT

This report allows you to create a PMR/TMR sheet from the current diet for the number of cows to be fed. For this report you must provide additional information beyond that for the Diet Summary report. In Figure 6.5 can see there are 150 cows to be fed (1) and the target dry matter content of the PMR/TMR mix is 52% (2). You must also specify where the ingredients will be fed. When the Report Designer opens all the feeds are listed in the left most TMR/PMR box. You should drag and drop (or use the arrow buttons) the ingredients to be fed in the dairy (3) and elsewhere (4). This is usually the paddock and includes grazed forages. The ‘Mixes to list as their ingredients’ works in the same manner as in the Diet report described in the section above.

You can see in Figure 6.5 the Mix Demo ingredient is being fed in the dairy (3) and the Ryegrass is listed as fed elsewhere (4) as it is grazed in the paddock.

If the dry matter content of the TMR/PMR is higher than the target (2) then the report will show the quantity of water to add to the TMR/PMR to reduce it. If the dry matter content is already below the target water will not be added.

Figure 6.5. The Report Designer window showing a Daily Feed Sheet. In this report you must specify the number of cows (1), the target dry matter for the TMR/PMR mix (2) and ingredients fed in the dairy (3) and elsewhere (4).
Figure 6.6. The Report Preview window showing a Daily Feeding Sheet report with diet ingredients listed fed in a TMR/PMR, in the dairy and fed elsewhere (grazed in the paddock in this case).
**THE BATCHING SHEET REPORT**

This report allows you to create a batching sheet from the current diet for a batch size in tonnes (fresh weight). In this report you can add a mix name below the contact details of the person who prepared the diet.

For this report you must provide additional information beyond that for the Diet Summary report. In Figure 6.7 can see the batch size will be 2.5 tonnes fresh weight (2) and the target dry matter content of the PMR/TMR mix is 52% (1). You must also specify which ingredients will be fed in the batch and elsewhere. When the Report Designer opens, all the feeds are listed in the left most batch box (3). You should drag and drop (or use the arrow buttons) the ingredients to be fed elsewhere (4). This is usually the dairy and paddock and includes grazed forages. The ‘Mixes to list as their ingredients’ works in the same manner as in the Diet report described in the section above.

You can see in Figure 6.5 the Mix Demo and Ryegrass ingredients are being fed outside of the batch (4) and the barley grain, lupins grain and barley hay make up the batch (3).

As for the Daily Feed Sheet report, if the dry matter content of the batch is higher than the target (1) then the report will show the quantity of water to add to reduce it. If the dry matter content is already below the target water will not be added.

*Figure 6.7. The Report Designer window showing a Batching Sheet report design. In this report you must specify the target dry matter for the TMR/PMR mix (1), the weight of the final batch (2) and ingredients fed in the batch (3) and elsewhere (4).*
Figure 6.8. The Report Preview window showing a Batching Sheet report with diet ingredients listed fed in the batch and elsewhere. Water has been added to reduce the target dry matter of the batch down to 52% which is shown in addition to the 2.5 tonnes of ingredients.
THE DIET COMPARISON REPORTS

This report allows you to print a comparison between three diets that have been stored in the Compare tab. Typical use might be an existing diet and then two alternatives with improving margins.

Figure 6.9. The Compare tab showing three stored diets. Diet 1 is the existing diet, diet 2 uses the same ingredients but better matches the cow’s requirements and improves the margin. Diet 3 substitutes the barley grain with a smaller quantity of slightly more expensive wheat grain to further increase the diet margin.

Once multiple diets have been stored in the Compare tab the Diet Comparison report shows the ingredients in each. Ingredient order can be adjusted using the buttons to the left of the lists or they can be dragged and dropped with the mouse.
Figure 6.10. The report designer displaying the three stored diets from the Compare tab when creating a Diet Comparison report.
Figure 6.11. The Report Preview window showing a Diet Comparison report with three diets, the current diet, an improved version of the current diet with a better margin and an alternative with barley grain replaced with wheat grain that improves the margin further.

The Diet Comparison report can also be printed with ingredient quantities show on an as fed basis if this is more suitable for the recipient.
PRINTING REPORTS

The Report Preview window has a tool bar across the top of the window with icons for

1. printing the report,
2. copying text from the report for pasting into other documents,
3. changing the report page number for multi-page reports,
4. and changing the zoom level of the report preview.

The print report button opens a standard Windows print dialog box where you can specify the printer, page size and layout.

To save the report and as a PDF document click on the ‘Save report as PDF’ button at the top of the Report Preview window. You will be asked for a name for the PDF file and where you would like to save it.
7. THE FEED LIBRARY EDITOR

The feed library is accessible from the edit menu of the main Rumen8 window. It allows you to edit all the parameters for each feed and define commonly used mixes. The feed library window is divided into three tabbed sections, the first tab (Select feeds) shows all the feeds available in the library, the second (Mixes) allows creation of feed mixes and the last (Feeds) the details of every feed.

SELECT FEEDS

Figure 7.1. The Selection tab of the feed editor.

The list of feeds in the left of the feed library window shows all the feeds and mixes available in the current library. Feeds with a tick in the box to the left of their name will be visible in the diet ingredient drop-down lists of the main Rumen8 window. This allows you to have a large feed library but only make a smaller more manageable number of feeds visible when creating diets.

To the right of the feed list the total number of feeds and the number currently visible in the diet ingredient drop-down lists are displayed. Below that the current feed library or libraries are shown. There are three types of feed library.

Default – This is the library that is provided with Rumen8 and it is in the \Rumen8\Libraries folder by default. For most users, this will be the only library type they need to use.

User – User libraries are just like the default library, just in another location. They are loaded instead of the default library. These allow you to have multiple separate specialised feed libraries and are useful for different projects, farms or clients.

Shared – These libraries are not editable and are used by project, business or consultancy teams to share common feeds and mixes to all members. For more details, see the section below.
Select feeds

The Select buttons allow you to select all, none, or invert the current selection of the feeds and mixes with a single click. Beneath those you can select all or none of just the feeds or just the mixes.

Sort feeds

The sort buttons allow you to change the order of the feeds and mixes, so they are listed in ascending or descending (reverse) order by name, category, selection (ticked) or by library if a shared library is loaded. Sorting can also be changed by clicking on the column heading row in the feed list.

Print report

Generate a report that includes all or a subset of the feeds and mixes in the library and then print or save it to a file.

Click on the ‘Print’ button and a window will appear that allows you to select all the feeds and mixes you wish to add to the report. Individual feeds can be selected by clicking on the first one and then holding down the Control key when clicking on subsequent feeds. A block of feeds can be selected by clicking on the first one, holding down the Shift key and clicking on the last feed of the group.

To include all the feeds in selected mixes, click on the ‘Mix feeds’ button. When all the feeds and mixes you wish to add to the report have been selected, click the ‘Create’ button. A report preview will appear and from here you can export to a variety of formats or print it.

User feed libraries

You may have multiple feed libraries and switch between them. When Rumen8 starts, it will load the library used last time if it is still available. If not, it will revert to the default feed library. Default and user feed libraries must be called FeedLibrary.db3 so you cannot have two libraries in a folder.

The ‘Open’ button allows you to open a user feed library from another folder. The ‘Create’ button allows you to save a copy of the current library in a new folder. The ‘Close’ button re-loads the default feed library held in the \Rumen8\Libraries folder. There must always be a default library in the Libraries folder and if it is removed Rumen8 will replace it when it starts.
Figure 7.2. A user feed library is in use as shown by the ‘User’ flag displayed under the number of feeds and mixes.

When a user feed library is open the ‘Feed library in use’ flag changes to the word ‘User’ and if you mouse over it the file name of the library is displayed in the tool tip. Back in the main Rumen8 window if a user
feed library loaded the UFL flag will also appear and the feed library file name will be shown in flag’s tool tip (hover the mouse over it to see it).

*Figure 7.3. The user feed library flag in the main window (highlighted with a blue arrow).*
Shared feed libraries

A shared feed library can be opened in addition to, not instead of, the current default or user feed library. Shared feed libraries are intended to be used by consultancy teams or several managers on a multiple farm business where it is useful to have access to common feeds and mixes. A shared feed library cannot be edited by users and is maintained by a central manager.

A shared feed library can be opened and closed from the Select tab of the feed editor using the ‘Open’ and ‘Close’ buttons at the bottom of the window under the ‘Shared feed library’ heading.

Feeds and mixes from the shared library are shown throughout Rumen8 in a lighter grey colour. The feeds and mixes from the default or user libraries that can be edited are shown in the normal black text by default.

Figure 7.4. A shared feed library is in use as shown by the ‘Shared’ flag displayed under the number of feeds and mixes. The feeds and mixes from the shared library are visible in the feed list to the left in a lighter grey colour.

As with a user or default library, if you mouse over the ‘Shared’ flag to the right of ‘Feed libraries in use’ text details of the library can be seen in the tooltip. Back in the main Rumen8 window an ‘SFL’ flag will appear below the tab section of the window to remind you a shared library is open.

On the ‘Select feeds’ tab, the visibility of shared feeds and mixes cannot be changed as this has been set by the library manager.

Shared mixes cannot be edited or deleted on the ‘Create mixes’ tab of the feed editor. When a shared mix is selected in the mix list the ‘Edit’ and ‘Delete’ buttons are not enabled. Shared mixes can be copied into the default/user library using the ‘Add Copy’ button and then the copy altered. When a mix is copied all the constituent feeds are copied with it unless they are already in the default/user library. If a feed of the
same name with different parameters is already present, the shared feed will have the mix name appended to it.

In the same manner, shared feeds cannot be deleted from or edited in the shared library, so those buttons are not enabled when one of the light grey feeds are selected in the feed list. They can be copied into the default/user library using the ‘Add Copy’ button and then edited.

*Figure 7.5. A shared feed library is in use as shown by the ‘SFL’ flag displayed under the tab section of the main window. The feeds and mixes from the shared library are visible in the ingredient list in a lighter grey colour. Feed and mixes in the default library are shown in the normal black text colour.*

Managing a shared feed library

Shared feed libraries are managed by a single user and distributed to the other users in the group. This can be done via email if the group is small and changes are infrequent. For larger groups it may be better to use a cloud drive service with sharing capability, such as Dropbox, OneDrive or Google Drive for example.

Using Dropbox as an example, the manager can create a new folder in their Dropbox folder and share it so other Dropbox users can access it. When setting up the shared folder, access can be set to ‘Can view’ to prevent editing by the users. Sharing also allows you to list the emails of group members you wish to use the shared library and modify them in the future by adding and removing members. Users must have Dropbox installed on their computer but there is a free tier that is suitable.

The manager should keep the master shared feed library in a folder other than the shared Dropbox folder. It can then be opened as a user library to prepare it or make changes. Once it is ready for distribution close
the user library and the feed library can be copied, and renamed if needed, to the shared Dropbox folder using Windows File Explorer.

The shared library should not be directly edited in the Dropbox folder as partial changes may be distributed to users while the library is being modified.

Sharing feeds and mixes

At the bottom of the ‘Select feeds’ tab of the feed editor the import and export buttons allow you to share feeds with other Rumen8 users.

The ‘Export’ button allows you to copy selected feeds and mixes to a small feed library file to transfer them between computers running Rumen8.

*Figure 7.6. The export window of the feed editor. Three feeds and a mix have been selected for export.*

Click on the export button and the window shown in Figure 7.6 will appear. Select all the feeds and mixes you wish to copy into an export feed library. Individual feeds can be selected by clicking on the first one and then holding down the Control key when clicking on subsequent feeds. A block of feeds can be selected by clicking on the first one, holding down the Shift key and clicking on the last feed of the group.

All the feeds in selected mixes will be exported automatically when you click on the ‘Export’ button. If you wish to see which feeds make up the selected mixes click on the ‘Mix feeds’ button and they will be selected in the Feeds list.

When you have selected all the feeds and mixes you wish to copy click on the export button, select the location and file name and click on the ‘Save’ button. It is recommended exported feed libraries always have the .db3 file name extension but you can change the rest of the file name to whatever you prefer.
Importing feed libraries

The ‘Import’ button allows you to

- import an older Rumen8 feed library held in a feed.csv file
- a group of feeds previously exported from Rumen8
- import complete data for feeds from a comma delimited .csv text file.

To import an older feed library click on the ‘Import’ button and select the feed.csv file to import and then the window shown Figure 7.7 will appear.

*Figure 7.7. The import window of the feed editor. Barley grain is already present in the feed library.*

Rumen8 version 3 requires two additional categories for each feed, management category and particle size classification. You can step through each feed to be imported and provide these. If they can be determined from other feed information the importer will select them for you.

Each feed must have a unique name so if the import feed name already exists the Name label will turn red and you must provide an alternative.

Once the import feed has a unique name and all three categories the ‘Add’ button will become active so you can add it to the feed library. At any stage, you can click on the Skip button to ignore the current import feed and move to the next. Pressing ‘Cancel’ will finish the feed importing. Feeds already added will remain in the feed library.

To import a previously exported group of feeds and mixes click on the ‘Import’ button and select an export feed library file with a .db3 extension. A window like the one shown in Figure 7.8 will appear listing all the feeds and mixes available in the file. In Rumen8 all feeds and mixes must have a unique name and you can see in the Figure 7.8 Wheat grain is highlighted red. This means a feed already exists in the current feed library with that name.

You select the feeds to import in the same manner as you selected feeds to export in the section above. If you select a feed or mix that has the same name as an existing feed by default it will be renamed with (imported) appended to the name. In this case ‘Wheat grain’ will be renamed ‘Wheat grain (imported)’ when copied into the current feed library.
You can change the text appended to feeds that already exist in the bottom right of the window in the ‘Name suffix’ section. You can also choose to append text to all the feeds being imported by selecting the ‘All imported feeds/mixes’ option. This might be useful if you want to keep track of feed information from a colleague or your nutritionist for example.

If ‘Use existing feeds’ is ticked Rumen8 will check each feed to be imported to see if it is identical to any existing feed in the library (other than the name). If an identical feed is found that will be used instead of importing the feed. If ‘Use existing feeds’ is unticked all feeds selected will be imported regardless, and potentially renamed as described above.

Once you have selected the feeds and mixes to import, click on the ‘Import’ button and they are copied into the current feed library.

*Figure 7.8. The import window of the feed editor. Three feeds are available to import but Wheat grain already exists in the current feed library.*

To add feeds to the Rumen8 feed library from a comma separated text file an import file must be created in the correct format. The first line is a header and can be used for comments as it will be ignored. Subsequent lines must consist of 42 values separated by commas in the order specified. The text fields do not require quotes and cannot contain a comma. An example is shown in the Appendix along with the definitions of the values required for the category fields such as management category, protein type and forage or concentrate.

When the csv file is selected Rumen8 will attempt to import the feeds into the current library. A report will be displayed showing the number of feeds successfully imported and a list of any errors. These can include missing values, invalid values or insufficient data for each feed.
MIXES

The mixes tab lets you define commonly used mixes of feeds that can be selected as a single ingredient in a diet.

**Figure 7.9. The mixes editor in the feed editor.**

The left part of the window shows all the mixes in the feed library and the Edit section shows the details of the currently selected mix. You can use the buttons above the mix list to create, change, and delete mixes or double click on a mix to edit it.

- **Edit** Edit the parameters of the currently selected mix.
- **Add Copy** Add a new mix to the library that is a copy of the currently selected mix.
- **Add New** Add a new blank mix to the library.
- **Delete** Remove the currently selected mix or mixes from the library.

The Edit section becomes active when a mix is being created or changed. The feed list on the right shows all the feeds in the current feed library that are not in the mix. They can be added to the mix table singly or in groups by selecting them and clicking on the add (<) button. Multiple feeds can be selected by choosing the first one and then holding down the control key while clicking on subsequent ones. Groups of feeds can be moved into the mix by selecting the first feed and then holding down the shift key when selecting the last one. Alternatively, you can double click on a single feed to move it straight into the mix.

To remove a feed from the mix, click on the row header in the mix table to highlight the row and press the remove (>) button.

Once all the feeds have been moved into the mix table you then enter the percentage for each one by clicking in the cell under the ‘Percent’ column. Feed percentages can be entered on a dry weight or as fed...
(wet weight) basis. Ensure the ‘Mix percentage by’ setting above the feed table is set correctly for your feed percentages.

You cannot save the mix unless all the feed percentages add up to 100. The total at the bottom of the mix table shows the current percentage and will be red if it isn’t 100%. If the percentage is under or over 100 the difference is shown in brackets. Change each feed percent by double clicking on the value in the table.

Below the mix table are the remaining parameters needed to define a mix. The mix name must be unique among both feeds and mixes and will turn red if this is not the case. You will be unable to save the mix until it has a unique name. If you are unsure what the parameters are, hover your mouse over the name and a tool tip will appear with the full name. Abbreviations are also listed at the end of this document on page 144.

If you enter an invalid value into the entry box for any of the parameters, the parameter name will turn red.

Table 1. Explanation of feed parameters used in the Feed Editor

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max feeding rate</td>
<td>The maximum feeding rate of the mix as a proportion of the total dry matter intake. If this rate is exceeded a warning (!) will appear to the right of the ingredient name on the main Rumen8 window. Expressed as g/kg or %.</td>
</tr>
<tr>
<td>Wet density</td>
<td>The mass of the mix as fed including liquids (kg/m³).</td>
</tr>
<tr>
<td>Mix cost</td>
<td>The cost of the mix entered per tonne dry matter or as fed. This should be the cost of the ingredient feeds and additional costs incurred such as milling or mixing.</td>
</tr>
<tr>
<td>Losses</td>
<td>The proportion of dry matter lost from a feed after purchase. This in effect increases the cost of feed consumed by the animal.</td>
</tr>
<tr>
<td>Source</td>
<td>A space for the user to record the source of information for a feed.</td>
</tr>
<tr>
<td>Comment</td>
<td>A space for the recording of any other useful information for a feed. Click on the magnifying glass to the left of the comment box to open a larger editing window for more detailed comments.</td>
</tr>
<tr>
<td>Ingredients cost</td>
<td>This shows the value of the mix ingredients per tonne on a dry matter and as fed basis. If any of the ingredient feed costs are missing the value will not be calculated. The tool tip for the value shows the individual feed costs and dry matter contents.</td>
</tr>
</tbody>
</table>
FEEDS

The Feeds tab lets you edit all the parameters for each of the feeds in the current library. The currently highlighted feed has its parameters displayed in edit section of the window.

*Figure 7.10. The feeds editor in the feed editor.*

Edit  Edit the parameters of the currently selected feed.

Add Copy  Add a new feed to the library that is a copy of the currently selected feed.

You can add an blank new feed by holding down the Shift key and the ‘Add Copy’ button will change to ‘Add New’. Adding a feed this way is not recommended, always add a copy of the closest related feed and modify the parameters with the new values.

Delete  Remove the currently selected feed from the library.

To edit an individual feed highlight it in the feed list and click the ‘Edit’ button or double click on it. The entry boxes in the Edit section of the window will become active and allow you to change any of the feed parameters.

As a minimum, eleven parameters are required for a feed to be accepted as valid and their names are in bold in the edit section. These are a unique name, management category, protein type, particle size classification, ME, CP, DM, Fat, aN, bN and cN. Until valid values for these parameters are entered you will be unable to save the feed.

If you are unsure what the parameters refer to, hover your mouse over the name and a tool tip will appear with the full name and an explanation. Abbreviations are also listed at the end of this document on page 144.
If you enter an invalid value into the entry box for any of the parameters, the parameter name will turn red. Once you have entered all the feed parameters you have, or have edited an existing feed, click on the ‘Okay’ button to save your changes and return to feed selection.

Figure 7.11. Entering parameters for an individual feed.

Given the importance of the correct management category, protein type and particle size classification of a feed, and the difficulty in obtaining aN, bN and cN values for feeds, we strongly suggest you ALWAYS create a new feed in your feed library by adding a copy of a closely matching existing feed from the original Rumen8 feed library, which can then be modified for DM, ME, CP, fat and other feed values. For this reason, we also suggest you never edit feeds in the original Rumen8 feed library, but add copies of these feeds instead which can then be modified to reflect your feeds.

Although Rumen8 can function with just these eleven required parameters, to make full use of the features of the program, all feed values should be entered if possible. Entering feed costs and keeping these up to date is also important if you wish to compare diets to determine the lowest cost option.

As the aN, bN, cN and ADIN values are not easily obtained, a generic list is provided here that indicates typical values for different feed classes (AFRC 1993).
Table 2. Typical protein degradability (aN, bN and cN) and ADIN (g/kg DM) values for different feed classes

<table>
<thead>
<tr>
<th>Feed class</th>
<th>aN</th>
<th>bN</th>
<th>cN</th>
<th>ADIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh forages</td>
<td>0.24</td>
<td>0.67</td>
<td>0.12</td>
<td>1.2</td>
</tr>
<tr>
<td>Roots</td>
<td>0.25</td>
<td>0.65</td>
<td>0.41</td>
<td>1.2</td>
</tr>
<tr>
<td>Grass and legume silages</td>
<td>0.59</td>
<td>0.31</td>
<td>0.13</td>
<td>1.2</td>
</tr>
<tr>
<td>Cereal silage incl maize</td>
<td>0.69</td>
<td>0.20</td>
<td>0.10</td>
<td>2.2</td>
</tr>
<tr>
<td>Grass hays</td>
<td>0.22</td>
<td>0.60</td>
<td>0.08</td>
<td>1.2</td>
</tr>
<tr>
<td>Legume hays</td>
<td>0.20</td>
<td>0.65</td>
<td>0.29</td>
<td>2.0</td>
</tr>
<tr>
<td>Cereal straws</td>
<td>0.30</td>
<td>0.50</td>
<td>0.12</td>
<td>1.0</td>
</tr>
<tr>
<td>Cereals</td>
<td>0.47</td>
<td>0.48</td>
<td>0.27</td>
<td>0.4</td>
</tr>
<tr>
<td>Legume seeds</td>
<td>0.41</td>
<td>0.57</td>
<td>0.16</td>
<td>0.5</td>
</tr>
<tr>
<td>Cereal byproducts</td>
<td>0.36</td>
<td>0.55</td>
<td>0.09</td>
<td>1.0</td>
</tr>
<tr>
<td>Beet and citrus pulps</td>
<td>0.39</td>
<td>0.57</td>
<td>0.05</td>
<td>1.2</td>
</tr>
<tr>
<td>Oils meals, high fibre</td>
<td>0.24</td>
<td>0.69</td>
<td>0.11</td>
<td>3.3</td>
</tr>
<tr>
<td>Oil meals, low fibre</td>
<td>0.14</td>
<td>0.79</td>
<td>0.09</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Table 3. Explanation of feed parameters used in the Feed Editor

Feed management category

This is used to sort feeds into similar groups for easier access. It is not used by the nutrition model to determine nutrient supply (grazed pasture, grazed other, hay, silage, concentrate, additive, byproduct).

Feed protein type

This is used by the AFRC nutrition model to calculate the diet’s fermentable energy content and hence influences the metabolisable protein supply (grass silage, other silage, other non-forage, other forage, distillery byproduct).

Feed particle size classification

This is used to classify feeds as forage or concentrate like in terms of behaviour in the rumen. This is expressed as the ‘forage concentrate ratio’ and ‘NDF from forage’ measures on the diet detail tab. It is also used to determine the absorption coefficient for calcium, phosphorus and magnesium (concentrate, forage, other).

DM                  Dry matter content of feed in g/kg or % (depending on your choice in Preferences)
ME                  Metabolisable energy content of feed in MJ/kg DM
CP                  Crude protein content of feed in g/kg DM or % in DM
Fat                 Fat content of feed in g/kg DM or % in DM
Ca                  Calcium content of feed in g/kg DM or % in DM
P                   Phosphorus content of feed in g/kg DM or % in DM
Mg                  Magnesium content of feed in g/kg DM or % in DM
K                   Potassium content of feed in g/kg DM or % in DM
Na                  Sodium content of feed in g/kg DM or % in DM
Cl                  Chlorine content of feed in g/kg DM or % in DM
Sulphur content of feed in g/kg DM or % in DM

DCAD
Dietary cation anion difference of feed in milli-equivalents per kg DM. Can only be calculated if the K, N, Cl and S content of the feed are provided.

aN
Proportion of water soluble nitrogen (N) in the total N of the feed

bN
Proportion of potentially degradable N, other than water soluble N, in the total N of a feed

cN
Fractional rumen degradation rate per hour of the b fraction of feed N

ADIN
Acid detergent insoluble nitrogen content of feed in g/kg DM or % in DM

Ca abs
Calcium absorption coefficient for feed (% of total calcium content). Rumen8 adopts the NRC 2001 approach with constant coefficients of 60% and 30% for concentrates and forages respectively.

P abs
Phosphorus absorption coefficient for feed (% of total phosphorus content). Rumen8 adopts the NRC 2001 approach with constant coefficients of 70% and 64% for concentrates and forages respectively.

Mg abs
Magnesium absorption coefficient for feed (% of total magnesium content). Rumen8 adopts the NRC 2001 approach with constant coefficients of 16% for both concentrates and forages.

Max feeding rate
Maximum feeding rate of a feed as a proportion of the total dry matter intake. This is optional and needs to be set by the user.

Wet density
The wet density of a feed as fed. This is not used by Rumen8 per se but by associated programs.

NDF
Neutral detergent fibre content of feed in g/kg DM or % in DM

eNDF in NDF
The physically effective NDF in the total feed NDF. See tool tips for further explanation

Starch
Starch content of feed in g/kg DM or % in DM.

Sugar
Sugar content of feed in g/kg DM or % in DM.

Ash
Ash (inorganic matter) content of feed in g/kg DM or % in DM.

Cost $/t DM
The cost of the feed expressed in $/t dry matter.

Cost $/t fed
The cost of the feed expressed in $/t as fed.

Losses
The proportion of dry matter lost from a feed after purchase. This in effect increases the cost of feed actually consumed by the animal.

Source
A place for the user to record the source of information for a feed.

Comment
A place for the recording of any other useful information for a feed. Click on the magnifying glass to the left of the comment box to open a larger editing window for more detailed comments.
8. PREFERENCES

Access to the Preferences window is via the Preferences option in the File menu of the main Rumen8 window. The settings you can adjust in Rumen8 are divided into General, Advanced and Recommended levels tabs.

GENERAL PREFERENCES

Figure 8.1. The General Preferences tab.

- **Milk yield units**: Milk yield can be entered and reported in litres or kilograms.
- **Milk component units**: The fat, protein and lactose percentage of milk can be entered and reported in mass/volume (i.e. per litre) or mass/mass (i.e. per kg) units (mm% or mv%).
Feed concentration units
The units for concentration in feeds used by Rumen8 can be set to g/kg or percentage.

Feed proportion units
The units for parameters such as aN, bN or cN can entered and displayed as a proportion (0 to 1) or a percentage.

Fat to protein ratio
The ratio of fat and protein displayed on the Animal tab can be shown as Fat: Protein or Protein: Fat.

Tool tips detail
This allows you to set the level of information provided by the tool tips. Standard displays a one-line explanation and Extended provides more detailed explanations with diagrams.

Dry matter intake estimate
The animal’s feed intake potential can be estimated using the ‘Standard’ or ‘NDF as a percentage of live weight’ methods and is selected on the Animal tab. For each method parameters can be modified to adjust the estimate.

Animals are divided into 4 classes, lactating cows, dry cows, transition/close-up cows (dry cows in the last 4 weeks before calving) and heifers.

If an animal has the standard DMI method selected lactating cows will have their maximum intake calculated using the NRC (2001) intake equation, heifers use the AFRC (1993) intake equation and dry and transition/close-up cows use fixed DM intake amounts specified by the user.

If the NDF DMI method is selected for a cow, for each of the cow classes above, a predicted NDF intake amount as a percentage of liveweight can be specified by the user.

Currency – System
Check to use the currency symbol set in Windows on your computer.
Uncheck to manually set the currency symbol from the drop-down list.
Choose ‘Custom’ at the end of the drop-down list to enter you own currency symbol.

Currency – Do not display cents
When checked all prices and costs will not show cents.

Currency – Divisor
For currencies with very large values select a divisor from the drop-down list. For example, if the currency divisor is set to 1000 all feed costs and milk prices should be entered into Rumen8 already divided by 1000. For example, 100,000 Rp/t would be entered as 100 Rp. The currency divisor will be displayed on
reports if it is greater than 1 and a flag appears on the main Rumen8 window below the tabbed section.

**Show the Diet tab**
The Diet tab can be turned off by un-ticking this box. Useful if you only use the Diet detail tab.

**Show the Split Herd tab**
The Split Herd tab can be turned off by un-ticking this box. Useful if you never use split calving herds.

**Load warning for milk price change**
When checked a warning will be given if a file is opened with a different milk price to the current. See below for more details.

**Load warning for intake estimate change**
When checked a warning will be given if a file is opened with a different intake estimation method to the current. See below for more details.

**Change the Rumen8 home directory after restart**
If you want to change where Rumen8 stores its files (usually `\Documents\Rumen8`) then clicking the ‘Change home’ button will cause Rumen8 to ask you where to place the Rumen8 directory next time it is started. If this is a new directory the default feed library and Preferences files will be copied across. If you wish to retain your existing library files you should copy them into the new location using Windows Explorer.

**Restore all the Preferences to their default setting**
This will set all the preference settings back to their default values.

**Optimiser disabled/enabled**
The Optimiser tab will be available in the main window if this box is selected. This also makes available the Optimiser Preferences below it. See the Optimiser section of this document for more information on using the Optimiser as it requires Microsoft Excel and the Solver add-in along with careful setup. It will not work if you just enable it here!

**The Optimiser parameters**

**Excel visible during optimisation**
Tick this to see Excel load and optimise the diet. Usually left un-ticked.

**Excel saves diet after optimisation**
Tick this to make Excel save the Optimiser spreadsheet after optimising the diet. This is useful for debugging and is usually left un-ticked.

**Milk price changes result in a warning**
Rumen8 stores the current milk price in the save file (.rm8) when the diet is saved. When the Rumen8 file is opened Rumen8 checks to see if the milk price has changed and if so, warns the user.
Rumen8 then looks for the saved milk price in three locations and if it finds it offers the user the option to switch to the previous milk price. In order of priority the 3 locations are:

1. In the previous location (set number and price number).
2. In the previous milk price set at a new price number.
3. The current milk price set.

If the previous milk price cannot be found in any of these locations the user is warned the milk price has changed but not offered the option to change it.

Checking for milk price changes when opening a Rumen save file can be disabled in the General Preferences.

**Dry Matter Intake Estimate Changes Result in a Warning**

The method and parameters to estimate the animal’s dry matter intake are saved with the current diet in the save file (.rm8) and if they have changed when the file is reopened the user will be warned and given the option to revert to the value when the diet was saved.

For example, a lactating cow has the DMI estimation method set to NDF on the Animal tab and in Preferences this is 1.2% of liveweight. A diet is created, saved and the user moves on to other scenarios, during which the lactating cow value for NDF is changed to 1.3% of liveweight in Preferences after talking to a colleague. A few months later when opening the save file it reloads the cow parameters, setting DMI method to NDF, and then prompts the user that the Preferences value for lactating cows NDF intake has changed from 1.2% when saved to the current 1.3% of liveweight. The user can ignore this and continue with the 1.3% value or choose to set it back to 1.2%. **If the Preferences are set back to 1.2% this will apply to all lactating cows with DMI set to NDF method.**

Whether Rumen8 warns the user about changes to DMI parameters in the Preferences can be turned off in the General Preferences.
ADVANCED PREFERENCES

The advanced section of the Preferences contains those settings that are unlikely to need adjustment and may have a significant impact on the cow nutrition model if they are changed. Please change them only in consultation with a highly experienced and qualified nutritionist. Or better, contact us to discuss the impact of the changes you are wanting to make.

Figure 8.2. The Advanced Preferences tab.

**Current preferences library file**

Create a new Preferences.db3 library file by clicking on the ‘New’ button. An existing preferences library file can be opened with the ‘Open’ button. The path of the current preferences file is displayed below. If it is too long to see all of it hover the mouse over the text and the full path will be shown in the tool tip.

**5% energy and protein safety margin**

Turn this on to add a 5% safety margin to the cow’s energy and protein requirement. Turning this on is recommended by the feeding standard.
Excess protein removal cost

The range of values for the cost of removing excess protein by the cow. A range is provided as there are differing values quoted in the literature, which vary depending on the degree of N recycling via saliva.

Net energy for live weight change

The net energy liberated by live weight loss or required for live weight gain.

Gross energy in 1 kg of dry matter

Enter the gross energy contained in 1 kilogram of dry matter in mega joules. Used as part of the cow energy requirement calculation. Set by default to 18.8 for a diet containing significant quantities of silages. May be set to 18.5 for diets not containing silages.

Fasting metabolism correction factor

Rumen8 will increase the fasting metabolism energy requirement by multiplying it by this value.

Fixed addition to ME requirement

Rumen8 will add this value to the cow’s energy requirement.

Cow time standing

Leave at 14 hours unless you have access to a better estimate.

Cow position changes

The number of times a cow gets up or down during the day. Leave at 10 unless you have access to a better estimate.

Milk true protein content

The percentage of crude protein in milk that is true protein.

Milk lactose

The lactose content (%) of the milk for your cows.

MP requirement correction

The cow’s total protein requirement will be multiplied by this value. For more information see below.

Protein demand model

The feeding standard used to calculate metabolisable protein demand can be set to AFRC (1993) or Feed into Milk (2004). It is recommended you use the later Feed into Milk standard as it better estimates the animal demand. A MP requirement correction is not required when the model is set to FiM. For more information see below.

Weight of a litre of milk

The weight of one litre of milk in kilograms.

DCAD target levels

The DCAD targets for early dry cows (dry off to entering the transition/close-up herd), ‘transition/close-up cows’ (the transition/close-up period is last 4 weeks before calving) and lactating cows.

Traffic light and progress bar accuracy

These parameters set the sensitivity of the ‘traffic lights’ for the cow’s energy, protein, intake and minerals on the Diet detail tab and the progress bars.
in the Diet tab. The lights will show green if the diet provides an amount of energy, protein, dry matter intake or mineral that is within this percentage of the cow demand. The exception is the DMI acceptable range, which is asymmetric, with the ‘green’ values below the maximum intake x10 the value entered. For the default 2% this gives a ‘green’ range of 80-102%.

**MP requirement correction**

Rumen8 originally used the AFRC (1993) feeding standard for calculating metabolisable protein (MP) demand. Within years after publication, it became clear that AFRC (1993) significantly underestimated the requirement for MP in dairy cows. This underestimation has since been corrected in the successor to AFRC (1993), known as Feed into Milk (Thomas, 2004).

In order to overcome this deficiency of the AFRC (1993) standard, Rumen8 applied a so-called "MP demand correction factor" as a pragmatic approach to bring AFRC predictions of MP requirements in line with Feed into Milk (2004). This was achieved by using a correction factor of 1.25. With the introduction in Rumen8 version 3.3.0.0., we now use Feed into Milk (2004) as the default model to estimate MP requirements which means there is no need to us the correction factor. For those users who wish to stick to the old AFRC model (not recommended) a value of 1.25 for the "MP correction factor" still applies.

The Feed into Milk (2004) feeding standard results in significantly higher requirements for MP than predicted by the AminoCow model but significantly lower than predicted by the CPM-Dairy model. The Feed into Milk (2004) standard therefore results in a ‘middle of the road' estimate of MP requirements for dairy cows.

Should experienced users of Rumen8 wish to increase MP requirements further to be in line with MP predictions made by CPM-Dairy, the "MP requirement correction" may be increased to a value of 1.1-1.15. However, we caution that this will lead to a significant increase in cost of the diet and risks a high rate of nitrogen loss in urine and manure, thus increasing potential loss of nitrogen into the wider environment.

For growing young stock an MP correction factor will still be required to account for higher relative MP demand in young growing heifers. Based on 2015 review by Tedeschi et. al., Rumen8 uses a polynomial function to calculate a correction factor based on the heifers liveweight. Examples are shown in the table below.

*Table 4. Correction factors used to determine heifer metabolisable protein demand.*

<table>
<thead>
<tr>
<th>Liveweight (kg)</th>
<th>FiM Correction factor</th>
<th>AFRC correction factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>200</td>
<td>1.18</td>
<td>1.36</td>
</tr>
<tr>
<td>300</td>
<td>1.30</td>
<td>1.55</td>
</tr>
<tr>
<td>400</td>
<td>1.30</td>
<td>1.62</td>
</tr>
<tr>
<td>500</td>
<td>1.30</td>
<td>1.62</td>
</tr>
</tbody>
</table>
References


RECOMMENDED LEVELS

Rumen8 allows the user to set a recommended level range for several important diet parameters. These provide quick feedback on the suitability of the current level of a diet measure on the Diet and Diet detail tabs with a traffic light. Five sets of Recommended Levels can be defined and quickly switched between on the Diet detail tab. These could be used for early, mid, late lactation, dry and transition/close-up cow diets for example.

*Figure 8.3. The Recommended levels tab in Preferences showing example ranges for early lactation cows.*

Select the current Recommended Levels set by clicking on one of the buttons across the top of the tab. Describe the use of the set with a short description below.

For each of the 14 diet measures you can set an acceptable range by moving the minimum and maximum sliders left or right. The actual values are displayed to the left of the slider. So, if you wish to target NDF levels of 28-30% in early lactation activate the NDF recommended level by clicking on the check-box to the left and then move the sliders until that range is displayed. Now a traffic light will appear on the Diet and Diet detail tabs that will show you if the diet NDF level is below (red), within (green) or above (yellow) your recommended NDF level. Repeat this process for each of the diet measures for you wish to display a Recommended Level traffic light.
Linking Recommended Levels sets to Cow Day of Lactation or Days Pregnant

Each recommended level set has an additional two auto parameters called ‘Day of lactation’ and ‘Days pregnant’. These can be set to a range of days and turned on or off. For example, the early lactation set might have the day of lactation parameter set to days 1 to 60 as shown in Figure 8.3 above.

If the ‘Day of lactation’ parameter is checked and ‘Recommended Levels set switching’ is set to automatic, when the current cow is between 1 to 60 days in milk, the first set of Recommended Levels will be activated. When the cow is outside the range 1 to 60 days the Recommended Levels will be turned off.

Figure 8.4. The Diet Detail tab with the Recommended Levels selection control highlighted in blue.

In Figure 8.4 the Active recommended level is set to set one and Rumen8 will switch between sets automatically as the button in the bottom right corner is displaying an ‘A’ for automatic. The mode can be toggled between automatic and manual by clicking on the button. It will display a ‘M’ when in manual mode. The user can also switch to manual mode by simply selecting one of the Recommended Levels sets directly by clicking on its round button.

If no ‘Recommended Levels sets’ in the Preferences have the day of lactation or days pregnant parameter turned on (checked) then the button will not appear in the active Recommended Levels section of the Animal tab as automatic mode is not available.

An example of automatic switching between Recommended Levels sets:

1. Define recommended sets for early, mid and late lactation cows as well as dry and transition/close-up cows in Preferences.
2. Set the day of lactation range when each of the sets should be active and ensure each is turned on. You might choose early 1-60, mid 61-150, late 151-500 and 0 days of lactation for dry and transition/close-up cows.
3. Set the days pregnant range off for sets one to three (early, mid and late lactation) and on for dry and transition/close-up sets. You might choose days 222- 256 for the dry cows and transition cows 257-285 days.

4. Close the Preferences are return to the Diet Detail tab. Click on the button in the bottom right of the Active Recommended Levels section until it shows (A)utomatic mode.

5. Now as the Animal day of lactation and days pregnant parameters are changed the relevant recommended levels will automatically become active through the cows lactation and dry period. Note, if none of the sets cover a particular day of lactation then the Recommended Levels set will be turned off.

Recommended level sets can have overlapping day of lactation ranges. In this instance Rumen8 switches to the set with the lowest number. For example, if set 2 is day of lactation 80 - 120 and set 3 is days 100 – 180, for an animal that is at day 110 of lactation set 2 will be selected.

If both day or lactation and days pregnant ranges are active for a set, the current animal must match both to automatically switch the set.
**STANDARD COWS**

Rumen8 allows the user to quickly change the current cow from the Animal menu. From here you can select a cow based on lactation yield (2000 – 10000 litres or kilograms) and stage of lactation (early, mid or late). The provided cow definitions are a guide and they can be modified to better suit the animal sizes and performance in your region.

*Figure 8.5. The standard cow editor in the preferences.*

<table>
<thead>
<tr>
<th></th>
<th>Early</th>
<th>Mid</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactation yield (l)</td>
<td>6000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live weight (kg)</td>
<td>600</td>
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To adjust a standard cow definition, select the lactation yield at the top of the window and then each of the seven parameters for each stage of lactation can be edited. Lactation totals and averages are shown in the rightmost column and kilograms of fat + protein and energy corrected milk is shown below.
9. KEEPING RUMEN8 UPDATED

Rumen8 can check for updates if your computer is connected to the Internet. Select ‘Check for updates’ under the Help menu and if an update is available a small blue information icon will appear above the Margin section of the main window.

Figure 9.1. The information icon that means an update is available highlighted with a blue arrow.

Clicking on the blue information icon will roll out a menu telling you the update will be installed the next time Rumen8 starts. If you click on this text a drop-down menu gives you the choice to install the update now or view the changes in the new version.
When Rumen8 is restarted, it will download the files required, update your installation of Rumen8 and then start the new version. The blue information icon will be replaced by a green tick which when clicked will confirm you have updated to the latest version.

If you check for updates and there is not one available a green tick will appear above the Margin section of the main window and if you click on it, it will confirm you already have the latest version of Rumen8.
Rumen8 will check for updates once a day automatically if your computer has a connection to the Internet. The update system has been optimised for slow connections so it only downloads the file changes that are necessary, not the entire Rumen8 installation each time.

If your computer is offline, you can download the latest version of Rumen8 from the website and then install the new version manually. Your library and diet files will not be changed when you do this.
10. UNINSTALLING RUMEN8

Completely removing Rumen8 from your computer will take three steps.

1. Remove your registration information from the computer.
   Go to the Registration option under the Help menu and click the ‘Deregister’ button. Your details will be removed from the computer and Rumen8 will revert to trial mode.

   Figure 10.1. Removing the registration information from Rumen8.

2. Uninstall the Rumen8 software.
   Go to the Windows Control Panel and in the ‘Programs’ section click on ‘Uninstall a program’ in Category view, or ‘Programs and features’ in icon view. Select Rumen8 from the list and click the ‘Uninstall’ button at the top of the list. Follow the prompts and Rumen8 will be removed from your computer.
3. Delete the Rumen8 folder from your Documents folder. If you do this you will lose your feed library, Preferences and any saved diet files.

4. (Optional) Delete the ‘Rumen8_Nutrition_Pty_Ltd’ folder containing the settings files from the AppData\Local folder from within your user folder. This folder is normally hidden so this step is for advanced users only. These files only take up a tiny amount of disk space so this isn’t important.
11. OPTIMISER INSTALLATION (ADVANCED)

The Optimiser function in Rumen8 requires using advanced non-standard features of Microsoft Excel. Specifically, the Optimiser requires communication with specific versions of Microsoft Excel and configuration is cumbersome. However, if you have a good knowledge of Microsoft Excel and Windows and would like to try, the steps for Excel 2016 are listed below. The process is very similar for Excel 2010 and 2013.

Rumen8 only supports Microsoft Excel 2010, (version 14), 2013 (version 15) and 2016/2019 (version 16) and it needs the free and included Solver add-in to be installed. At the time of writing this guide, Excel version 16 was part of the Office365 subscription from Microsoft. The animal model used by Rumen8 requires non-linear optimisation to estimate the lowest cost diet from the chosen ingredients and Solver provides this for no additional cost if you already own Microsoft Excel.

Rumen8 copies the current diet into the Optimiser3.xlsm spreadsheet, configures Solver with the required constraints, runs it and then copies the results back into Rumen8. To allow this you must make three setting changes in Excel and one in the Optimiser3.xlsm spreadsheet located in the Rumen8 libraries folder. The steps below show you how to do each of these.

1. Change the Excel security settings allowing Rumen8 to run the macros in the spreadsheet.
2. Install the Solver add-in in Excel. This is the optimiser used by Rumen8 and it is run by the macro in the Optimiser3.xlsm spreadsheet.
3. In the Visual Basic for Applications (VBA) editor allow the macro access to the Solver add-in.

INSTALLATION INSTRUCTIONS FOR EXCEL 2016

1. Open the Optimise3.xlsm spreadsheet in the ~\Documents\Rumen8\libraries folder in Excel. If you have installed Rumen8 to the default location the Rumen8 folder will be in your Windows Documents folder and the complete path for the spreadsheet will be C:\Users\<logon name>\Documents\Rumen8\Libraries\Optimise3.xlsm

Figure 11.1. Open the Optimise.xlsm spreadsheet.

2. If Excel’s security level is still set to the default you will be prompted under the ribbon menu with a Security warning that macros have been disabled. Click on 'Enable content' in the message that
appears. If Excel’s security level is set too high, it will automatically and silently disable macros which will prevent Rumen8 from optimising diets.

Figure 11.2. Enable macros in the Optimiser spread sheet.
**Set Excel security levels**

3. To ensure the macros security settings are correct we must go into the File menu. It is the left most menu on the ribbon.

*Figure 11.3. Click on the File ribbon menu to access Excel options.*

4. Click on the ‘Options’ button at the bottom of the menu.

*Figure 11.4. Accessing Excel Options from the bottom of the menu.*
5. On the left side of the window click on the ‘Trust Centre’ and then the ‘Trust Center Settings’ button to enter the Trust center.

*Figure 11.5. Enter the Trust Centre in Excel.*

6. Select ‘Macro Settings’ on the left side of the window and then check that Macro Settings are set to ‘Disable all macros with notification’. If the macro security level is set higher than this Rumen8 will not be able to run the Optimiser.
   Also ensure there is a tick in the box alongside the setting ‘Trust access to the VBA project model’.
   Click on ‘Okay’ to exit the Trust Centre once you have finished.

*Figure 11.6. Set the Macro Security settings in Excel.*
If the previous setting was ‘Disable all macros without notification’, changing it will result in Excel prompting you when it opens any spreadsheet containing macros instead of simply blocking them silently in the background. Macros can be used to load malware under some circumstances so only allow spreadsheets access to them when you are sure they are from a reputable source.

In this case, the Rumen8 application copies the cow and diet information into the Optimiser spreadsheet and then uses a macro to run Solver to calculate the lowest cost diet. If access to macros is blocked the optimiser function of Rumen8 cannot be used.
**Install the Solver Add-In**

7. While remaining in the Trust Centre, click on the ‘Add-Ins’ option on the left of the window and then set the Manage drop-down list at the bottom of the window to ‘Excel Add-Ins’ and click the ‘Go’ button.

*Figure 11.7. Enter the Add-ins manager.*

8. A list of possible Add-Ins appears in the new window. Click on the checkbox alongside ‘Solver Add-In’ to install it if it is not already selected. Click ‘Okay’ to install Solver and exit Options back to the spreadsheet.

   If it is not available or doesn’t install correctly you may need to uninstall and re-install your copy of Excel or Office to remedy this.

*Figure 11.8. Install the Solver Add-In.*
9. Confirm Solver is correctly installed by checking ‘Solver’ is visible at the end of the ‘Data’ ribbon after exiting Excel options.

Figure 11.9. Solver is visible at the end of the Data menu in the Ribbon.
ADD THE REFERENCE TO SOLVER IN THE VISUAL BASIC FOR APPLICATIONS EDITOR

The macros included in the Optimiser spreadsheet also must also be able to access the Solver add-in. To enable this you must go into the macro editor and then tell it where the solver file is located.

10. Click on the ‘View’ menu of the ribbon. The last option is called ‘Macro’, click on the drop-down menu and select ‘View macros’ from it.

Figure 11.10. The Macro menu in the View ribbon.

11. In the Macro window that opens select the macro ‘Sheet1.Solve’ and then click the ‘Edit’ button.

Figure 11.11. Start the Visual Basic for Applications editor.
A new window will open. This is the Visual Basic for Applications editor which lets you create macros that can be executed as part of a spreadsheet. Rumen8 calls the Solve macro to optimise the diet previously copied into the spreadsheet.

12. In the Visual Basic Editor select ‘References’ from the ‘Tools’ menu.

*Figure 11.12. Open the Visual Basic for Applications References editor.*

13. Visual Basic for Applications needs to know where to find the Solver add-in. You may need to search down the list to find the Solver entry. When you first open the editor, it may be listed as missing. *Even if it does not say MISSING continue with the steps below.*
14. Click on the ‘MISSING: SOLVER.XLAM’ line and then the Browse button. At the bottom of the dialog box change the “Files of type” drop-down to show all files. Now navigate to the directory in which Microsoft Office has installed the solver files.

For Office 365 Excel 2016 this is usually the folder “C:\Program Files\Microsoft Office\Root\Office 16\Library\SOLVER\”. If you are using an earlier version of Office the number 16 in the path will be lower, 15 for Office 2013 for example. Standalone installations may not include the ‘Root’ folder part of the path. It is important to find the SOLVER.XLAM file used by the default version of Excel on your computer.
If you cannot find the SOLVER.XLAM file manually an alternative is searching for it using the Windows File Explorer.
Go back to the Windows Desktop and open the File Explorer and select ‘Local Disk (C:)’ in the folder view on the left (1). In the search box in the top right type in ‘solver.xlam’ and hit the Enter key (2). The search may take some time but it will list all files on your C drive called Solver.xlam. When the search has finished the entry you are looking for has ‘Type: Microsoft Excel Application’ alongside it. Note down the full location (path) of the file and then return to the VBA References file browser and go to that location.

Figure 11.14. Using the Windows File Explorer to find the Solver.xlam file.

Figure 11.15. The SOLVER folder for Office 365 Excel 2016.

15. With ‘All Files’ selected SOLVER.XLAM should now be visible. Select it and click on “Open”.
16. The Solver reference should no longer be listed as missing. Ensure it has a tick against it and click the ‘Okay’ button to exit the window.

Figure 11.17. Solver is installed correctly for Visual Basic for Applications.
17. Save the Optimiser3.xlsx file by selecting ‘Save Optimiser3.xlsx’ from the File menu.

Figure 11.18. Save the Optimiser spreadsheet.

18. Exit back to the spreadsheet using the ‘File’ menu and the ‘Close and Return to Microsoft Excel’ option.

19. Excel setup for use with Rumen8 optimisation is now complete, so exit from Excel saving changes if you are prompted to do so.

20. Rumen8 defaults to not allow access to the Optimiser so the final step is to tell it you have configured Excel correctly. In the Rumen8 Preferences General tab enable the Optimiser tab by clicking on the down arrow to the left of ‘Optimiser disabled’ at the bottom of the window. The Optimiser settings box will open and the title will change to ‘Optimiser enabled’. Both settings in the box should be left off for normal use.
Figure 11.19. Setup the Rumen8 Preferences to use the Optimiser.

Now when you return to the main Rumen8 window a new tab called ‘Optimiser’ will be available.
**After an Optimiser Update**

Occasionally updates to Rumen8 require changes to the Optimiser3.xlsm spreadsheet in the `~\Documents\Libraries` folder. If this occurs and you have the Optimiser turned on in the Preferences, you will be warned when starting the new version of Rumen8 that the Optimiser has also been updated and you **may** need to repeat part of the Optimiser setup.

Firstly, attempt to optimise a diet and if everything goes well you do not need to do anything. If you get an error message or Excel appears showing the VBA window similar to Figure 11.21 below you will need to tell Excel where the Solver.xlam file is again.

The first two sections of the optimiser setup in the previous section will not need to be repeated as they are specific to your installation of Excel and have not been changed. These are

- Set Excel security levels,
- Install the Solver add-in.

Unfortunately, the last part of the optimiser setup process where you add the reference to Solver in the Visual Basic for Applications editor may need to be repeated. This is because the new Optimiser3.xlsm spreadsheet provided in the update is set up for the most common Excel configuration, an Office365 subscription with the latest version of Excel. If the location of the Solver.xlam file is different on your computer due to being an earlier version of Excel or different installation process it will need to be located again.

If you are already in the Visual Basic for Applications Editor when the error occurred, you can start at step 12 of the Optimiser setup instructions.

If you got an error message in Rumen8 you will need to open the Optimise3.xlsm spreadsheet in the `~\Documents\Rumen8\libraries` folder in Excel. If you have installed Rumen8 to the default location the Rumen8 folder will be in your Windows Documents folder and the complete path for the spreadsheet will be `C:\Users\<logon name>\Documents\Rumen8\Libraries\Optimise3.xlsm`. This is the same as step 1 and 2 of the Optimiser setup instructions and is shown in Figure 11.1. Once there you can skip forward to step 10 to set the location of the Solver.xlam file.

Unfortunately, when setting up the Reference for the Solver.xlam file after an Optimiser update Excel may incorrectly think it knows where the add-in is located and even shows the correct path as shown in Figure 11.20 below.
Figure 11.20. The References window incorrectly shows the Solver is correctly setup after a Optimiser3.xlsm update (1). The path to the Solver.xlam file must still be selected again using the Browse button on the right of the window. The location shown at 2 will still be the location of the Solver.xlam file.

Ignore this and as for the initial setup of the Solver, use the Browse button to specify the location of the Solver.xlam file. It will probably be found at the location at the bottom of the References window - Figure 11.20 highlight 2.

Once the Reference has been updated you can click the ‘Okay’ button and then ‘Close and Return to Microsoft Excel’ via the File menu to get out of the VBA editor window. Then exit Excel saving the Optimiser3.xlsm spreadsheet as you go. The updated Optimiser spreadsheet should now make the Solver available to Rumen8 for optimising.
OPTIMISER TROUBLESHOOTING

If you have followed the setup instructions for the Optimiser and it fails when you try to optimise, the most likely problem is the VBA reference to the SOLVER.XLAM file. If this happens you will see the Visual Basic for Applications editor appear with an error message telling you it cannot compile because it cannot find a project or library (the SOLVER.XLAM file).

Figure 11.21. Trying to optimise causes the VBA editor to appear with a compile error message.

Close the error message by clicking on the ‘Okay’ button and then reset the macro by clicking on the Reset button in the toolbar. It is a square stop button in the style of VCR play, pause and stop buttons (see Figure 11.22).
Now you can update the reference to the SOLVER.XLAM file as you did in the third part of the Optimiser setup instructions starting with the References editor in the ‘Tools’ menu on page 125.
From this point follow the instructions as you did when you originally set up the Optimiser from step 12. The only difference is when you return to Rumen8 after saving your changes it will have an error message telling you it could not start the Solver. This is left over from the initial optimiser error that caused the problem. Just click ‘Okay’ and then try optimising again with the new Solver location you just entered.
12. REFERENCES


However, it is now well recognised that maintenance requirements for metabolisable protein (MP-m) were underestimated in AFRC 1993 so we have adopted the revised approach for MP-m published in Thomas C. (2004) Feed into milk: a new applied feeding system for dairy cows. Nottingham University Press, UK.

The DCAD and minerals demand information is from Transition Cow Management. Lean I., and DeGaris P. (2010) Transition Cow Management. A review for nutritional professionals, veterinarians and farm advisors. Dairy Australia

Addition information for the tool tips:


Rumen8 version 1 was independently evaluated by the Dairy Australia Grains2Milk project and the report can be downloaded from the Rumen8 and Dairy Australia websites. Note, Rumen8 was owned by the Department of Agriculture and Food, Western Australia when this review was conducted. The nutrition model in Rumen8 version 3 is unchanged from version 1.

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14. ABBREVIATIONS

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<thead>
<tr>
<th>Abbreviation</th>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>MJ/d</td>
<td>activity allowance</td>
</tr>
<tr>
<td>Abs</td>
<td></td>
<td>Absorption</td>
</tr>
<tr>
<td>ADIN</td>
<td>g/kg DM</td>
<td>acid detergent insoluble nitrogen</td>
</tr>
<tr>
<td>aN</td>
<td>g/kg DM</td>
<td>proportion of water soluble N in the total N of the feed</td>
</tr>
<tr>
<td>Ash</td>
<td>g/kg DM</td>
<td>ash content of feed (after heating to 600°C for 10 hours)</td>
</tr>
<tr>
<td>Balance (MJ)</td>
<td>MJ</td>
<td>the difference between metabolisable energy requirements and supply</td>
</tr>
<tr>
<td>BCS</td>
<td></td>
<td>Body condition score.</td>
</tr>
<tr>
<td>bN</td>
<td></td>
<td>proportion of degradable N, other than water soluble N, in the feed</td>
</tr>
<tr>
<td>Ca</td>
<td></td>
<td>Calcium</td>
</tr>
<tr>
<td>Calcium</td>
<td>g/kg or g/kg DM</td>
<td>concentration of calcium in the diet</td>
</tr>
<tr>
<td>CI</td>
<td>MJ/d</td>
<td>plane of nutrition correction factor in calculating ME requirements</td>
</tr>
<tr>
<td>cN</td>
<td></td>
<td>fractional rumen degradation rate per hour of the b fraction of the feed N</td>
</tr>
<tr>
<td>Comp. 1</td>
<td>kg</td>
<td>the amount of component 1 must fall within specified minimum and maximum values</td>
</tr>
<tr>
<td>Comp. 2</td>
<td>kg</td>
<td>the amount of component 2 must fall within specified minimum and maximum values</td>
</tr>
<tr>
<td>Comp. 3</td>
<td>kg</td>
<td>the amount of component 3 must fall within specified minimum and maximum values</td>
</tr>
<tr>
<td>Con+By (kg)</td>
<td>kg</td>
<td>amount of concentrate and byproduct in the diet</td>
</tr>
<tr>
<td>Conc. + ByPr.</td>
<td>g</td>
<td>the total amount of concentrate + byproduct in the diet</td>
</tr>
<tr>
<td>Conc. + ByPr.</td>
<td>g/kg</td>
<td>the concentration of concentrate + byproduct in the diet</td>
</tr>
<tr>
<td>Cost</td>
<td>$/cow and c/MJ</td>
<td>diet cost ($/cow and c/MJ) and margin ($/cow)</td>
</tr>
<tr>
<td>Cost</td>
<td>$/tonne</td>
<td>cost to produce or buy 1 tonne of feed (nominate if wet or dry)</td>
</tr>
<tr>
<td>Cost ($/t)</td>
<td>$/tonne</td>
<td>diet cost per tonne</td>
</tr>
<tr>
<td>Cost (c/MJ)</td>
<td>c/MJ</td>
<td>diet cost on a metabolisable energy basis</td>
</tr>
<tr>
<td>Cost A.L. DM</td>
<td>$/tonne DM</td>
<td>cost after losses on a dry matter basis</td>
</tr>
<tr>
<td>Cost A.L. wet</td>
<td>$/tonne wet</td>
<td>cost after losses on a wet or fresh basis</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Units</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CP</td>
<td>g/kg</td>
<td>the concentration of CP in the diet must fall within specified minimum and maximum values</td>
</tr>
<tr>
<td>CP</td>
<td>g/kg DM</td>
<td>crude protein (N * 6.25)</td>
</tr>
<tr>
<td>Days in milk</td>
<td>d</td>
<td>number of days the cow has been lactating</td>
</tr>
<tr>
<td>Days pregnant</td>
<td>d</td>
<td>number of days the cow has been pregnant</td>
</tr>
<tr>
<td>DCAD</td>
<td></td>
<td>Dairy cation anion exchange</td>
</tr>
<tr>
<td>DIM</td>
<td></td>
<td>Days in milk</td>
</tr>
<tr>
<td>Distance walked</td>
<td>m/d</td>
<td>distance walked each day by the cow</td>
</tr>
<tr>
<td>DM</td>
<td>g/kg</td>
<td>dry matter</td>
</tr>
<tr>
<td>DMI</td>
<td>kg and %</td>
<td>dry matter intake (kg) and % of maximum intake (NDF/NRC methods)</td>
</tr>
<tr>
<td>DMTP</td>
<td>g</td>
<td>digestible microbial true protein</td>
</tr>
<tr>
<td>DUP</td>
<td>g</td>
<td>digestible undegraded protein</td>
</tr>
<tr>
<td>Ec</td>
<td>MJ/d</td>
<td>net energy retained in concept (foetus and placenta etc.)</td>
</tr>
<tr>
<td>El</td>
<td>MJ/d</td>
<td>net energy secreted as milk</td>
</tr>
<tr>
<td>Em</td>
<td>MJ/d</td>
<td>net energy for maintenance</td>
</tr>
<tr>
<td>eNDF</td>
<td>g/kg or %</td>
<td>the proportion of NDF that is deemed ‘effective’ i.e. that leads to rumination.</td>
</tr>
<tr>
<td>ERDP</td>
<td>g</td>
<td>effective rumen degradable dietary protein</td>
</tr>
<tr>
<td>ERDP CP</td>
<td>%</td>
<td>percentage of the CP that is effective rumen degradable dietary protein</td>
</tr>
<tr>
<td>Excess MP</td>
<td>g</td>
<td>MP in excess of requirements which will take ME to remove from the body</td>
</tr>
<tr>
<td>Excess MP cost</td>
<td>$??</td>
<td>the metabolic cost to remove excess metabolisable protein expressed as forgone weight change or milk production</td>
</tr>
<tr>
<td>F</td>
<td>MJ/d</td>
<td>fasting metabolism</td>
</tr>
<tr>
<td>fat</td>
<td>g/kg</td>
<td>the concentration of fat in the diet must fall within specified minimum and maximum values</td>
</tr>
<tr>
<td>Fat</td>
<td>g/kg DM</td>
<td>Fat</td>
</tr>
<tr>
<td>Feed ($/cow)</td>
<td>$/cow/day</td>
<td>feed cost</td>
</tr>
<tr>
<td>FME</td>
<td>MJ</td>
<td>fermentable ME of the diet</td>
</tr>
<tr>
<td>Height walked</td>
<td>m/d</td>
<td>height change during walk each day</td>
</tr>
<tr>
<td>Intake (kg)</td>
<td>kg</td>
<td>the maximum DMI cannot exceed 100% as determined by live weight, milk yield and week of lactation</td>
</tr>
</tbody>
</table>

In the context of milk production, some key indicators include:
- **Feeding Efficiency**: The amount of feed required to produce a unit of milk.
- **Milk Production**: The amount of milk produced by the cow over a specific period.
- **Milk Quality**: The composition of milk, including fat, protein, and other components.
- **Efficiency of Utilization**: The efficiency with which the cow converts feed into milk production.

These elements are critical for optimizing dairy production and ensuring sustainable practices in the agricultural sector.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake (max. NDF)</td>
<td>g</td>
<td>the maximum DMI cannot exceed 100% as determined by NDF intake and live weight</td>
</tr>
<tr>
<td>Kc</td>
<td></td>
<td>efficiency of utilisation of ME for growth of the concepta</td>
</tr>
<tr>
<td>Kg</td>
<td></td>
<td>efficiency of utilisation of ME for weight change when lactating</td>
</tr>
<tr>
<td>Kl</td>
<td></td>
<td>efficiency of utilisation of ME for lactation</td>
</tr>
<tr>
<td>Km</td>
<td></td>
<td>efficiency of utilisation of ME for maintenance</td>
</tr>
<tr>
<td>Kt</td>
<td></td>
<td>efficiency of utilisation of mobilised tissue for lactation</td>
</tr>
<tr>
<td>L</td>
<td>MJ/d</td>
<td>level of feeding as a multiple of MJ of ME for maintenance</td>
</tr>
<tr>
<td>Limited by</td>
<td></td>
<td>factor limiting MP supply</td>
</tr>
<tr>
<td>Live weight</td>
<td>kg</td>
<td>the cow’s live weight</td>
</tr>
<tr>
<td>Live weight change</td>
<td>kg/d</td>
<td>cow’s daily live weight change</td>
</tr>
<tr>
<td>Losses</td>
<td>%</td>
<td>dry matter loss from feed after costing</td>
</tr>
<tr>
<td>Magnesium</td>
<td>g/kg or g/kg DM</td>
<td>concentration of magnesium in the diet</td>
</tr>
<tr>
<td>Mg</td>
<td></td>
<td>Magnesium</td>
</tr>
<tr>
<td>Margin ($/cow)</td>
<td>$/cow/day</td>
<td>margin (milk income - feed costs)</td>
</tr>
<tr>
<td>Max DM Intake %</td>
<td>%</td>
<td>percentage of predicted maximum intake currently provided by the diet based on live weight, milk yield and stage of lactation</td>
</tr>
<tr>
<td>Max MP cost</td>
<td>MJ</td>
<td>Maximum ME cost to remove excess MP</td>
</tr>
<tr>
<td>Max NDF DMI %</td>
<td>%</td>
<td>percentage of predicted maximum intake currently provided by the diet based on NDF intake and live weight</td>
</tr>
<tr>
<td>Mc</td>
<td>MJ/d</td>
<td>ME requirement for growth of concepta</td>
</tr>
<tr>
<td>MCP</td>
<td>G</td>
<td>microbial crude protein</td>
</tr>
<tr>
<td>ME</td>
<td>MJ</td>
<td>metabolisable energy supplied and required</td>
</tr>
<tr>
<td>ME requirement</td>
<td>MJ/kd DM</td>
<td>metabolisable energy</td>
</tr>
<tr>
<td>ME requirement</td>
<td>MJ</td>
<td>the diet must provide the ME required for maintenance and production</td>
</tr>
<tr>
<td>M₈</td>
<td>MJ/d</td>
<td>ME requirement for live weight change when lactating</td>
</tr>
<tr>
<td>Milk ($/cow)</td>
<td>$/cow/day</td>
<td>milk income</td>
</tr>
<tr>
<td>Milk fat</td>
<td>% m/v</td>
<td>percentage of milk that is fat</td>
</tr>
<tr>
<td>Milk lactose</td>
<td>% m/v</td>
<td>percentage of milk that is lactose</td>
</tr>
<tr>
<td>Milk protein</td>
<td>% m/v</td>
<td>percentage of milk that is true protein</td>
</tr>
<tr>
<td>Milk yield</td>
<td>L</td>
<td>daily milk production</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Units</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Min MP cost</td>
<td>MJ</td>
<td>Minimum ME cost to remove excess MP</td>
</tr>
<tr>
<td>MI</td>
<td>MJ/d</td>
<td>ME requirement for milk production</td>
</tr>
<tr>
<td>Mm</td>
<td>MJ/d</td>
<td>ME requirement for maintenance</td>
</tr>
<tr>
<td>Mmp</td>
<td>MJ/d</td>
<td>ME requirement for maintenance and production</td>
</tr>
<tr>
<td>MP</td>
<td>g</td>
<td>metabolisable protein</td>
</tr>
<tr>
<td>MP balance</td>
<td>g</td>
<td>metabolisable protein balance</td>
</tr>
<tr>
<td>MP min. requirement</td>
<td>g</td>
<td>the diet must provide an MP supply at least that required for maintenance and production</td>
</tr>
<tr>
<td>MP required</td>
<td>g</td>
<td>the amount of metabolisable protein required for the production level</td>
</tr>
<tr>
<td>MPb</td>
<td>g/d</td>
<td>basal endogenous nitrogen requirement</td>
</tr>
<tr>
<td>MPc</td>
<td>g/d</td>
<td>MP requirement for the growth of the concepta</td>
</tr>
<tr>
<td>MPd</td>
<td>g/d</td>
<td>dermal loss as scurf and hair</td>
</tr>
<tr>
<td>MPg</td>
<td>g/d</td>
<td>MP requirement for live weight gain when lactating</td>
</tr>
<tr>
<td>MPI</td>
<td>g/d</td>
<td>MP requirement for milk production</td>
</tr>
<tr>
<td>MPm</td>
<td>g/d</td>
<td>MP requirement for maintenance</td>
</tr>
<tr>
<td>MPmp</td>
<td>g/d</td>
<td>MP requirement for maintenance and production</td>
</tr>
<tr>
<td>MTP</td>
<td>g</td>
<td>microbial true protein</td>
</tr>
<tr>
<td>NDF</td>
<td>g/kg</td>
<td>the concentration of NDF in the diet must fall within specified minimum and maximum values</td>
</tr>
<tr>
<td>NDF (%)</td>
<td>%DMI</td>
<td>neutral detergent fibre in the diet</td>
</tr>
<tr>
<td>NDF (kg)</td>
<td>kg</td>
<td>total NDF in the diet</td>
</tr>
<tr>
<td>NDF forage</td>
<td>g/kg</td>
<td>the concentration of NDF from forage in the diet must fall within specified minimum and maximum values</td>
</tr>
<tr>
<td>NDF forage (%)</td>
<td>%DMI</td>
<td>NDF in the diet supplied from forages</td>
</tr>
<tr>
<td>NFC (%)</td>
<td>%DMI</td>
<td>non fibrous carbohydrate in the diet</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>g/kg or g/kg DM</td>
<td>concentration of phosphorus in the diet</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>Phosphorus</td>
</tr>
<tr>
<td>Position changes</td>
<td>no./d</td>
<td>number of body position changes per day (lying down / standing up)</td>
</tr>
<tr>
<td>Protein</td>
<td>g and %</td>
<td>metabolisable protein supplied and required and crude protein %</td>
</tr>
<tr>
<td>QDP</td>
<td>g</td>
<td>quickly degradable protein</td>
</tr>
<tr>
<td>Qm</td>
<td></td>
<td>metabolisability of GE at maintenance</td>
</tr>
<tr>
<td>r(fraction/hr)</td>
<td></td>
<td>rumen digesta fractional outflow rate per hour</td>
</tr>
<tr>
<td>RDP</td>
<td>g</td>
<td>rumen degradable protein</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Units</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td>Required (MJ)</td>
<td>MJ</td>
<td>metabolisable energy supply required from the diet for specified production</td>
</tr>
<tr>
<td>SDP</td>
<td>g</td>
<td>slowly degradable protein</td>
</tr>
<tr>
<td>Source</td>
<td>source of information</td>
<td>FIM (feed information manual) / TFD (top fodder data) / VMF (Vasse Milk Farmlets) / MvHS (M Staines data) / Protein Plus project etc.</td>
</tr>
<tr>
<td>starch</td>
<td>g/kg or g/kg DM</td>
<td>the concentration of starch in the diet must fall within specified minimum and maximum values</td>
</tr>
<tr>
<td>Starch (%)</td>
<td>%DMI</td>
<td>starch in the diet</td>
</tr>
<tr>
<td>sugar</td>
<td>g/kg or g/kg DM</td>
<td>the concentration of sugar in the diet must fall within specified minimum and maximum values</td>
</tr>
<tr>
<td>Sugar (%)</td>
<td>%DMI</td>
<td>sugar in the diet</td>
</tr>
<tr>
<td>Time standing</td>
<td>hr/d</td>
<td>time cow spends standing each day</td>
</tr>
<tr>
<td>Total (kg)</td>
<td>kg</td>
<td>total dry matter in the diet</td>
</tr>
<tr>
<td>Total (MJ)</td>
<td>MJ</td>
<td>total metabolisable energy supplied from the diet</td>
</tr>
<tr>
<td>Total MP (g)</td>
<td>g</td>
<td>total metabolisable protein in the diet</td>
</tr>
<tr>
<td>Type</td>
<td>name</td>
<td>other forage / grass silage / other silage / distillery product / other non-forage</td>
</tr>
<tr>
<td>UDP</td>
<td>g</td>
<td>undegradable dietary protein</td>
</tr>
<tr>
<td>y</td>
<td>g</td>
<td>potential microbial protein yield in the rumen from FME</td>
</tr>
</tbody>
</table>
15. **FEED IMPORT FORMAT**

Feeds can be imported from a text file of comma separated values (csv). These can be exported from a Microsoft Excel spreadsheet, so it is straightforward to change the order and format of feed data from a laboratory analysis. The first line can be a comment as it will be ignored. The data lines must have 42 values separated by commas and contain a single feed definition. Text fields do not require quotes and cannot contain a comma. The value order is shown in Table 5.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Units</th>
<th>Type</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed name</td>
<td>Text</td>
<td></td>
<td>Must be unique across existing feed and mix names</td>
</tr>
<tr>
<td>Category</td>
<td>Integer</td>
<td></td>
<td>0=not used, 1=grazed pasture, 2=grazed forage, 3=conserved as hay, 4=conserved as silage, 5=concentrate/grain, 6=byproduct, 7=minerals</td>
</tr>
<tr>
<td>Protein type</td>
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<td></td>
<td>0=other forage, 1=grass silage, 2=other silage, 3=distillery byproduct, 4=other non-forage</td>
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<tr>
<td>Forage or concentrate</td>
<td>Integer</td>
<td></td>
<td>0=forage, 1=concentrate</td>
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<tr>
<td>Cost</td>
<td>Dollars</td>
<td>Decimal</td>
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</tr>
<tr>
<td>Cost DM or as fed</td>
<td>Integer</td>
<td>Decimal</td>
<td>0=cost entered on DM basis, 1=cost entered on as fed basis</td>
</tr>
<tr>
<td>Max feeding rate</td>
<td>g/kg</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Wet density</td>
<td>kg/tonne</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Losses</td>
<td>%</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Dry matter</td>
<td>g/kg</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Metabolisable energy</td>
<td>MJ/kg</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Crude protein</td>
<td>g/kg</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Neutral detergent fibre</td>
<td>g/kg</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Effective neutral detergent fibre</td>
<td>g/kg of NDF</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Starch</td>
<td>g/kg</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Sugar</td>
<td>g/kg</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Fat</td>
<td>g/kg</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Ash</td>
<td>g/kg</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>aN</td>
<td>Decimal</td>
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<td></td>
</tr>
<tr>
<td>bN</td>
<td>Decimal</td>
<td>0.00 to 1.00</td>
<td></td>
</tr>
<tr>
<td>Component</td>
<td>Unit</td>
<td>Type</td>
<td>Description</td>
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<td>------</td>
<td>-------</td>
<td>-------------</td>
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<tr>
<td>cN</td>
<td>g/kg</td>
<td>Decimal</td>
<td>0.00 to 1.00</td>
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<tr>
<td>ADIN</td>
<td>g/kg</td>
<td>Decimal</td>
<td>Not used so can be left empty</td>
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<tr>
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<td>Decimal</td>
<td>Not used so can be left empty</td>
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<td>Threonine</td>
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<td>Decimal</td>
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<td>g/kg</td>
<td>Decimal</td>
<td>Not used so can be left empty</td>
</tr>
<tr>
<td>Histidine</td>
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<td>Not used so can be left empty</td>
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<tr>
<td>Calcium</td>
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</tr>
<tr>
<td>Calcium absorption</td>
<td>g/kg</td>
<td>Decimal</td>
<td>0.0 to 1.0</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>g/kg</td>
<td>Decimal</td>
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<tr>
<td>Phosphorus absorption</td>
<td>g/kg</td>
<td>Decimal</td>
<td>0.0 to 1.0</td>
</tr>
<tr>
<td>Magnesium</td>
<td>g/kg</td>
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<td></td>
</tr>
<tr>
<td>Magnesium absorption</td>
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<td>Decimal</td>
<td>0.0 to 1.0</td>
</tr>
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<td>Sodium</td>
<td>g/kg</td>
<td>Decimal</td>
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</tr>
<tr>
<td>Potassium</td>
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<td></td>
</tr>
<tr>
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<td>Decimal</td>
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<tr>
<td>Sulphur</td>
<td>g/kg</td>
<td>Decimal</td>
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<tr>
<td>DCAD calculated</td>
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<td>Source</td>
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<td>Text</td>
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<tr>
<td>Comment</td>
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<td>Text</td>
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<tr>
<td>Selected</td>
<td></td>
<td>Integer</td>
<td>0=not visible in ingredient lists, 1=visible in ingredient lists</td>
</tr>
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</table>

**FILE EXAMPLE**

```plaintext
#Name, Category, Type, ForageConcentrate, Cost, CostWet, MaxFeedingRate, WetDensity, Losses, DM, ME, CP, NDF, eNDF, Starch, Sugar, Fat, Ash, aN, bN, cN, ADIN, LYS, THR, MET, CYS, HIS, Calcium, CalciumAbsorption, Phosphorus, PhosphorusAbsorption, Magnesium, MagnesiumAbsorption, Sodium, Potassium, Chloride, Sulphur, DCAD, DCADCalculated, Source, Comment, Visible

Barley, Grain,5,4,1,185,0,500,100,2,911,12.5,110,166,77,567,35,28,29,0.24,0.71,0.35,0.4,4.02,3.64,1.8,2.28,2.46,1,0.3,4,0.4,2,0.5,0.5,1.5,2.5,3.5,100,0,Prot+ FIM,,1

Barley Hay - DemoDairy,5,0,0,150,1,500,200,12,850,9.5,90,600,550,80,150,16,82,0.22,0.6,0.08,1.2,5.5,5.22,1.52,1.13,2.12,3,0.3,2,0.4,2,0.5,0.5,1.5,2.5,3.5,100,0,FIM VMF,,1
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