

EvaPig®

Edition 2020

www.evapig.com



Reference manual

INRAE



ME EX NOOVISTA GO

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Disclaimer

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Credits and acknowledgments

EvaPig® has been created, designed, and developed by Jean Noblet (INRAE; retired), Alain Valancogne (INRAE), Gilles Tran (AFZ) and METEX NØØVISTAGO.



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The chemical data for EvaPig® 2020 were provided by AFZ, the editor of the INRAE-CIRAD-AFZ Tables (www.feedtables.com, created in 2017). As in the previous version, the nutritional values were obtained using expertise from INRAE and equations derived from *in vivo* measurements published in the scientific literature. The data for amino acid digestibility were derived from: AFZ, Ajinomoto Eurolysine, Aventis Animal Nutrition, INRA, ITCF, 2000. *AmiPig. Standardised Ileal Digestibility of amino acids in feedstuffs for pigs*, AFZ, Paris.

In addition to INRAE and METEX NØØVISTAGO (formerly Ajinomoto Animal Nutrition), the following organisations have supported the French Feed Database of the AFZ since 1989: Arvalis Institut du Végétal, CCPA, Cargill, CIRAD, Cooperl, Désialis, IFIP-Institut du Porc, MG2MIX, MixScience, Techna, Terres Univia, USICA, and Wisium. We thank in advance the people who will help to make EvaPig® better and more useful, notably by providing us with nutritional values for new ingredients, or more accurate and up to date information. If your organisation is willing to share such data, please send inquiries and suggestions through www.evapig.com.

Welcome to EvaPig®

Introduction

EvaPig® is a calculator of energy, amino acid and phosphorus values of ingredients and diets for growing and adult pigs. EvaPig® Edition 2020 includes a database of chemical composition and nutritive values for more than **250 reference ingredients**. The composition data are derived from the **INRAE-CIRAD-AFZ Tables of chemical composition and nutritive values** (available on the website Feedtables.com, AFZ, 2017-2021) while the nutritional data were obtained using expertise from INRAE and equations derived from *in vivo* measurements published in the scientific literature. This new edition of EvaPig® includes twice more ingredients than the first edition, released in 2008, as well as new information such as electrolyte balance values of ingredients and diets.

Users can create their own ingredients, either by copying and modifying the reference ingredients, or by creating new ingredients using only chemical composition data. EvaPig® uses equations and coefficients that calculate the nutritive values of the new ingredients.

EvaPig® can create and compare diets created from the reference or user-defined ingredients. It calculates the chemical and nutritional values of the diet by using those of the diet ingredients, with possible corrections for the physical form of the diet and phytase supplementation. EvaPig® can calculate the energy values of a diet from its chemical composition only. EvaPig® also provides graphical representations that allow to visualize and compare diet composition and energy values.

Figure 1. EvaPig® main menu



Why using EvaPig®?

Pig production faces numerous challenges.

Feeding accounts for more than half of the cost of pig production and heavily impacts upon the technical and economic results of the pig unit. As feed prices change very quickly, optimising diet composition becomes important. Because energy is the main component of the feed cost, it is highly beneficial to use an energy system that matches animal requirements as closely as possible to minimise the feed cost.

Likewise, the utilization of amino acid and phosphorus values close to animal requirements results in a more efficient use of these nutrients by the animals, lower feed costs and less excretion of nitrogen and phosphorus into the environment.

Another challenge to pig feeding is the large number of available ingredients. Reference documents like the INRAE-CIRAD-AFZ Tables provide values for the most common ingredients. However, the values are given for representative ingredients: the nutritional value of actual ingredients may differ significantly due to variation in chemical composition. Tables often include “correction” equations but using them to predict complex nutritional values is not straightforward. For new ingredients that have recently appeared on the feed market, tables offer little or no way to calculate their nutritional values.

Finally, animals, husbandry conditions and production targets are variable with subsequent variable nutritional requirements and quantities of feed.

EvaPig® provides several answers to these challenges.

- It offers net energy values, ileal standardised amino acid digestibilities and phosphorus digestibilities for ingredients and diets. These are currently the most advanced nutritional systems for pigs. Nutritional values based on former concepts (digestible energy, digestible protein, total amino acids, etc.) are also available.
- It makes it easy to calculate these values as accurately as possible. The energy values for a new ingredient can be derived from the reference ingredient that is biologically and/or botanically closest to it, using ingredient-specific equations that consider the differences in composition between the reference ingredient and the new one. For ingredients that do not have a reference available, EvaPig® calculates nutritive values using the chemical values provided by the user and generic equations.
- EvaPig® calculates energy values for two stages of pig production: the growing pig and the adult pig.

Data sources

The data used in EvaPig® were obtained from two sources:

- The reference values for chemical composition are derived from the INRAE-CIRAD AFZ Tables published on the [FeedTables.com](https://www.feedtables.com) website since 2017. These tables are based on the data collected by the French Feed Database of the AFZ since 1989. This database, that includes several hundreds of thousands of samples with chemical and nutritional values, was used to establish a new and longer list of reference ingredients, their updated and representative chemical compositions.
- The nutritional values for energy, protein, amino acids, and phosphorus, were obtained using expertise from INRAE and equations derived from *in vivo* measurements published in the scientific literature.

The values included in EvaPig® may be slightly different from the INRAE-CIRAD-AFZ data as the latter tables are updated on a regular basis. A few additional reference ingredients measured at INRAE for their nutritional values have also been included.

Because pig production is constantly evolving, EvaPig® will be regularly updated to reflect these changes, using newly available *in vivo* data about ingredients, either from the published literature or sent by the researchers themselves. If you are willing to help in the development of EvaPig® and its reference database, particularly by sharing such data, please contact us through the website www.evapig.com.

Nutritional concepts

Energy

Energy systems

The energy value of a feed (ingredient or diet) can be expressed as digestible energy (DE), metabolizable energy (ME) and net energy (NE) (Noblet et al., 2006; Noblet and van Milgen, 2013). Research has shown that net energy is the best estimator of the true energy value of ingredients and complete feeds (Noblet et al., 2003; 2006) as DE and ME underestimate the energy value of feeds rich in fat and starch and overestimate that of feeds rich in protein and fibre. The NE system is also better for predicting animal performance and carcass quality, particularly when pigs are fed low-protein or high-fat diets. For that reason, using net energy for ingredients and for feed formulation is highly recommended.

EvaPig® also provides DE, ME values and NE values. These values were derived from literature data and calculated as follows:

- Estimation of gross energy
- Estimation of energy digestibility (Ed) and calculation of DE
- Estimation of energy losses from methane and urine and calculation of ME (assuming that nitrogen excretion in urine represents 50% of digestible nitrogen)
- Calculation of NE, using equations

As research from INRAE showed that live weight and feeding level influence the digestibility of energy and nutrients, separate values are given for the growing pig (from weaning up to 150 kg) and the adult pig (boar, gestating sow and lactating sow).

Finally, the contributions of the ingredients are considered to be additive when included in a complete diet, assuming that vitamins and minerals supplements have a zero-energy value.

Energy bonus

The energy values provided in the table refer to mashed ingredients. However, technological processes such as intensive grinding, pelleting and extrusion, or the addition of substances such as enzymes, are known to increase energy digestibility. The increase depends on the ingredient and on the nature of the process. It is mostly noticeable in the growing pig and is supposed to be less important in the adult pig. EvaPig® makes it possible to take into account the effect of technology by applying an “energy bonus” that can add up to 5% to the energy values. This bonus can also be used when the energy value of the reference ingredient seems underestimated. Likewise, a negative value can be used when the reference data seems overestimated. This correction is applied to the DE value and consequently modifies the ME and NE values, both for the growing and the adult pig.

Similarly, it is possible to use an “energy bonus” for diets (positive bonus only) that have undergone a technological process. For instance, pelleting increases digestibility by 1 to 3 points for diets based on wheat, maize or soybean meal. In EvaPig®, it is possible to add a different bonus to growing and adult pigs, as the effect of technology is supposed to be smaller or insignificant in the latter case. Note that one should not use at the same time an energy bonus for a diet and individual energy bonuses for its constitutive ingredients. Also, the energy values for ingredients such as rapeseeds or linseeds are already provided for processed materials since the raw, unprocessed ingredients (and particularly their lipid fraction) have a low digestibility: for those ingredients, adding a bonus to the reference data is not required.

Protein

Protein value can be assessed through the digestibility of the protein itself or, more accurately, through the digestibility of its individual amino acids. There are several methods to determine these digestibility values: they can be measured at faecal or ileum level, and they can be corrected (standardised, real) or not (apparent) for the different types of endogenous losses.

Ileal standardised digestibility of amino acids

EvaPig® provides values of ileal standardised digestibility of amino acids. This system is currently the most elaborate for protein value, with data being available for all common ingredients. The digestible amino acid value is corrected (or standardised) for basal endogenous losses of amino acids unrelated to the feed protein and supposed to be proportional to the dry matter intake (Noblet et al., 2002; Stein et al., 2007). The majority of the standardised ileal amino acid digestibility coefficients for ingredients provided with EvaPig® originate from a series of *in vivo* experiments carried out in France by INRAE, Adisseo, Arvalis (with METEX NØØVISTAGO) in the years 1980-2000. These data were collected and processed into table values, first published as the AmiPig CD-Rom (AFZ and al., 2000), and later in the INRA-AFZ tables (Sauvant et al., 2002; 2004).

The ileal standardised digestibilities of amino acids provided for the reference ingredients in EvaPig® are theoretically independent from the amount of feed protein. The standardised digestible amino acids of diets ingredients are assumed to be additive. Unlike energy digestibility, ileal digestibilities of amino acids are supposed to be identical for all stages of pig production and there is insufficient literature data to take into account the effects of technological processes.

For ingredients without known ileal digestibilities of amino acids, missing values have been replaced by average digestibility coefficients obtained by INRAE on a large number of diets.

The ideal protein is defined as one that provides the exact balance of amino acids needed for optimum performance. To make the best use of this concept, EvaPig® also expresses digestible amino acids as a percentage of digestible lysine (Dourmad et al., 2008; van Milgen et al., 2008). The amino acid balance being a good indicator of the equilibrium between amino acid intake and

requirements, digestible amino acid content in diets is also expressed relatively to the content in digestible lysine.

Faecal protein digestibility

EvaPig® provides and calculates the faecal digestibility of nitrogen for ingredients and diets. Though of little interest for assessing the protein value, it is useful for estimating the breakdown of nitrogen output between faecal and urinary pathways.

Phosphorus

EvaPig® contains reference data for total and digestible phosphorus content, mostly derived from the INRAE-CIRAD-AFZ Tables.

When EvaPig® calculates the digestible apparent phosphorus content of a diet, it takes into account the effect of endogenous phytase (if still active in a mash form, for instance) and added (exogenous) phytase. The effects of added and endogenous phytase are additive. Endogenous phytase is used in the calculations when the diet includes ingredients with notable phytase activity, such as rye, wheat and their by-products, and when the diet does not undergo a technological process such as pelleting.

The effect of phytase on the release of phytic phosphorus is supposed to be curvilinear, with a marginal effect that decreases when the amount of exogenous phytase increases (Jondreville and Dourmad, 2005). The biological activity of the added phytase, calculated as the amount of digestible P released per 500 IU of phytase, is required in the calculations. Typical phytase activity ranges from 0.5 to 0.9 g per 500 IU of phytase.

Calculations for new ingredients and diets

Note: the equations and coefficients used in EvaPig® are provided in full detail on the website www.evapig.com.

EvaPig® uses equations to calculate the nutritional values of new ingredients and diets. These equations were obtained through INRAE experiments or derived from literature data.

The main benefit of using equations is that the predicted values are more precise than fixed values. However, this precision depends on many factors, not all of which are known, and users should always exercise caution when using predicted values.

New ingredients derived from reference ingredients

When calculating the energy value or amino acid and phosphorus digestibility of an ingredient that derived from a reference ingredient, EvaPig® uses for the new ingredient a combination of generic equations and specific equations. For instance, gross energy is predicted using a generic equation requiring protein, fat and ash with coefficients that are identical for all ingredients; on the other

hand, energy digestibility is predicted from fibre content with coefficients specific to the ingredient (botanical species, type of process...).

The calculations consist in combining the nutritional value of the reference ingredient and coefficients that are applied to the differences in chemical composition between the new ingredient and the reference ingredient. The formula takes the following general form:

$$Y_{\text{New}} = Y_{\text{Reference}} + a \times (X_{\text{New}} - X_{\text{Reference}}) + b \times (Z_{\text{New}} - Z_{\text{Reference}}) + \dots$$

where Y is the predicted value and X, Z etc. are the predictors. "New" refers to the new ingredient and "Reference" refers to the reference ingredient.

For instance, the calculations of energy values involve the following steps:

1. $GE = f(\text{chemical composition})$
2. $Ed = f(\text{fibre})$
3. $DE = GE \times Ed$
4. $ME/DE = f(\text{protein, DE})$
5. $ME = DE \times ME/DE$
6. $NE/ME = f(\text{protein, fat, starch, ME})$
7. $NE = ME \times NE/ME$

New ingredients and diets known from their chemical composition only

EvaPig® can calculate nutritional values of new ingredients and diets from their chemical composition only. For energy values, the calculation process predicts gross energy, energy digestibility, ME and NE using generic equations based on chemical composition (and on *in vitro* organic matter digestibility, in the case of diets).

Ingredients and diets should be created using chemical composition only when no other option is available, but users should be aware that the generic equations used in the calculations are less precise and fail to take into account ingredient-specific effects such as anti-nutritional factors or the structure of cell walls.

Diets created from a list of ingredients

For diets created from a list of ingredients, the chemical and nutritional values are calculated as the weighed contributions of the ingredients, taking into account their incorporation rates and dry matter values.

When a nutrient is missing from an ingredient, it will not be part of the diet calculations: for instance, if an ingredient does not have a net energy value attached, net energy will not be calculated for any diet including this ingredient.

The calculations are more complex for phosphorus digestibility:

- When no phytase is added, the calculation consists of a summation of the contributions of each ingredient, taking into account the incorporation rate and whether or not the diet is processed: for an unprocessed diet, the values will be those of the mash ingredient while for a processed diet, the values will be those of the pelleted diet.
- When phytase is added and the diet is in mash form (i.e. unprocessed), some ingredients contribute to phosphorus release according to their endogenous phytase. Because the effect of phytase on phosphorus release is not linear, the total effect of phytase (endogenous and exogenous) needs to be estimated first, and several calculation steps are necessary to estimate the amount of the released phosphorus due to exogenous phytase, which is then added to the digestible phosphorus of the diet.
- When phytase is added and the diet is in pellet form (i.e. processed), only exogenous phytase contributes to phosphorus release. The released phosphorus is estimated and added to the digestible phosphorus of the diet.

EvaPig® and nutritional requirements

To efficiently use the nutritional values proposed by EvaPig®, adaptations of both diet characteristics and animal requirements may be necessary. EvaPig® provides specific diet criteria to help users to meet those requirements.

- For people who use DE or ME values and want to implement the NE system of EvaPig®, NE requirements can be estimated as $0.71 \times \text{DE}$ or $0.75 \times \text{ME}$.
- The ideal protein provides the exact balance of amino acids needed for optimum performance. To help users to formulate feeds based on the ideal protein, EvaPig® calculates the amino acid profile of diets as digestible amino acids expressed as % of digestible lysine.
- The protein:energy ratio is highly variable between pigs according to physiological stage, body weight, etc. EvaPig® provides the ratio between digestible lysine and NE, which is the best indicator of the protein:energy ratio of the diet.
- It is important to get an optimal ratio between Ca and digestible phosphorus (Pd). EvaPig® calculates the Ca:Pd ratio of the diet.

Using EvaPig®

Installing and updating EvaPig®

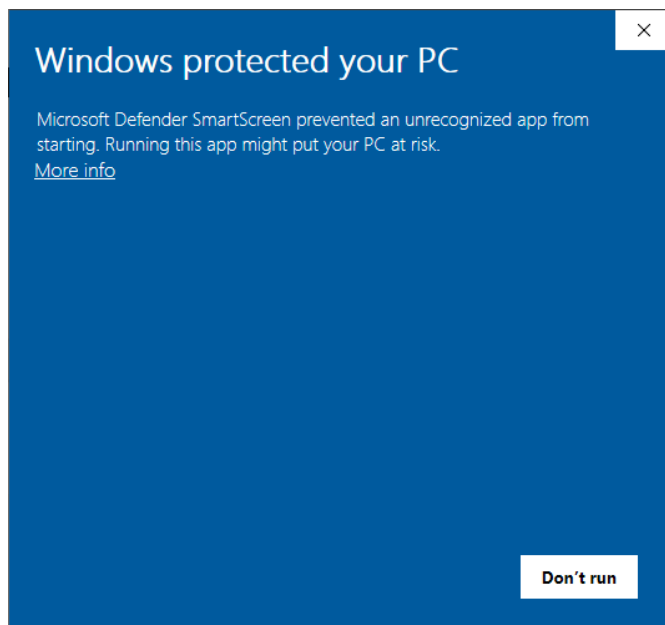
EvaPig® requires Microsoft Windows.

The tutorial requires Microsoft Powerpoint or the free Powerpoint viewer, which is available here www.microsoft.com/en-us/p/pptx-viewer/9np64t90941b.

To install EvaPig®:

- Download the `EvaPigSetup.zip` file from www.evapig.com
- Double-click on the file to uncompress its content
- Double-click on the resulting `EvaPig2020Setup.exe` file
- The following message may appear due to security measures introduced in Windows 10:

Figure 2. Windows protection message



If this message appears, click on “More info”, and then on “Run anyway”.

- Choose the installation language and follow the instructions.
- You can choose to launch the tutorial right after the installation. It will help you to use EvaPig® later on.

To update EvaPig®, just download and install the new version (without uninstalling the previous one). Your diets and ingredients will be kept.

You can check for updates by clicking on the Updates button in the main menu.

The EvaPig® files are installed in two locations on your computer. Depending on your version of Windows, the program itself and the tutorial are in:

- Windows 64 bits: C:\Program Files (x86)\EvaPig2020
- Windows 32 bits: C:\Program files\Evapig2020

If you want to save or transfer your diets and ingredients, the data files are in the directory

C:\Documents and Settings\YourName\EvaPig2020

Main menu

The screenshot below presents the main menu of EvaPig®.

Figure 3. Main menu



The main menu gives access to the major features of EvaPig®.

The following buttons are available.

- **Ingredients:** opens the list of ingredients for browsing and creating ingredients

- **Diets:** opens the list of diets for browsing and creating diets
- **Language:** pick your language in the drop-down list
- **Units:** opens a form where you can choose your preferred units
- **Tutorial:** opens a tutorial (Powerpoint presentation)
- **Help:** opens this Help text. The **F1 key** also opens a contextual help text wherever it is called in EvaPig®.
- **Disclaimer:** opens the disclaimer text
- **Credits:** opens the credits text
- **Website:** starts your default browser and opens the www.evapig.com homepage.
- **Updates:** checks that you have the latest version by comparing your version number to the version available at www.evapig.com
- **Quit:** quits EvaPig®

Language preferences

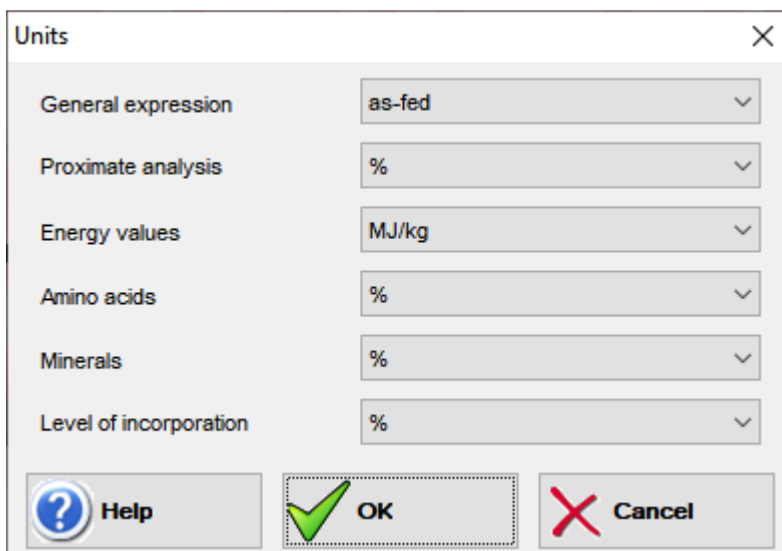
You can choose the language of your choice in the corresponding drop-down list in the main menu. It is unnecessary to restart EvaPig®.

The language choices change the texts in the interface and the names of the reference ingredients. Note that the diets and ingredients you have created yourself will keep the names you gave them originally.

Unit preferences

The unit preferences form is called by the **Units** button in the main menu.

Figure 4. Unit preferences



Setting	Value
General expression	as-fed
Proximate analysis	%
Energy values	MJ/kg
Amino acids	%
Minerals	%
Level of incorporation	%

You can change the units for the following elements:

- **General expression:** the values of ingredients and diets can be expressed either on a “as fed” (or “fresh”) basis or on a “dry matter” basis. It only affects the value for which this makes sense, typically nutrient content defined per unit of total or dry weight (like protein) rather than per unit of another nutrient (like digestibility).
- **Proximate analysis, amino acids, minerals, and level of incorporation:** such values can be expressed either as % or as g/kg.
- **Energy values:** such values can be expressed either as kcal/kg or MJ/kg.

The unit choices affect the way data are seen when displayed, printed, and exported.

The units chosen are the default units when a new ingredient or diet is created. However, it is possible to override them temporarily to facilitate data input.

It is unnecessary to restart EvaPig® after having changed the unit preferences.

Tutorial

Click on the Tutorial button to start the Powerpoint tutorial (EvaPigTutorial.ppsx) bundled with EvaPig®.

You can also download this tutorial from www.evapig.com.

Help

You can get contextual help anywhere in EvaPig® either by clicking on the **Help** button or by pressing the **F1** key.

If you have questions about using EvaPig® or about the underlying nutritional concept, go to www.evapig.com and use the Frequently Asked Questions page or the contact page.

Website and updates

Go to www.evapig.com for the latest news about EvaPig®, including:

- Software and database updates. You can check the availability of updates by clicking on the Updates button in the main menu
- Tutorials
- Lists of references
- Documents about nutritional concepts
- Ask questions about EvaPig®
- Propose new data for the reference tables

Ingredients

The **list of ingredients** is called by the **Ingredients** button in the main menu.

Figure 5. List of ingredients

Name	Digestibility of amino acids (%)		Digestible amino acids (%)		Minerals (%)		Phosphorus digestibility (%)	
	Dry matter (%)		Proximate analysis (%)		Energy utilization (%)			
	Energy values (MJ/kg)		Total amino acids (%)		Total amino acids / crude protein (%)			
	GE	DE, growing pig	ME, growing pig	NE, growing pig	DE, adult pig	ME, adult pig	NE, adult pig	
Maize germ meal, oil 5-20%	20.33	14.44	13.64	9.63	15.18	14.16	10.09	
Maize germs, oil > 30%	27.51	18.11	17.68	15.56	19.00	18.42	15.92	
Maize germs, oil 14-30%	20.37	15.02	14.57	11.77	16.43	15.81	12.57	
Maize processing by-product, protein 8-18%, oil < 1%	16.17	10.83	10.37	7.59	12.57	11.88	8.61	
Maize processing by-product, protein 8-18%, oil 5-10%	17.33	12.86	12.41	9.56	14.23	13.59	10.36	
Maize starch	15.44	15.13	14.94	12.22	15.13	14.90	12.21	
Maize starch by-product	16.37	8.69	8.30	6.08	11.24	10.54	7.57	
Maize, extruded	16.06	14.25	13.91	11.21	14.77	14.35	11.47	
Maize, flaked	16.06	14.25	13.91	11.21	14.77	14.35	11.47	
Maize, high moisture	12.43	10.90	10.63	8.51	11.35	11.01	8.76	
Maize, local	15.88	13.88	13.54	10.83	14.46	14.04	11.16	
Mealworm larvae, dehydrated	26.27	21.53	20.29	15.12	21.53	20.20	15.12	
Meat and bone meal, fat < 7.5 %	15.31	11.62	10.43	6.59	11.62	10.41	6.50	
Meat and bone meal, fat > 7.5 %	16.65	11.38	10.33	7.04	11.38	10.31	6.93	
Methionine Hydroxy Analogue MHA, 80% efficiency	20.85	20.85	19.80	15.27	20.85	19.77	15.25	
Milk powder, skimmed	17.35	16.70	15.72	11.44	16.70	15.70	11.41	
Milk powder, whole	22.23	20.67	19.92	15.65	20.67	19.89	15.67	
Molasses, beet	11.66	9.91	9.63	6.62	10.20	9.90	6.81	
Molasses, sugarcane	10.77	9.16	8.98	6.26	9.44	9.23	6.48	
Monoammonium phosphate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NB: values in italics represent information which has been inherited from reference tables since it has not been filled in

Filters

- Class Disabled
- Database Disabled
- Name Disabled

Buttons: View, Create, Help, Close

The names of the ingredients are shown on the left panel while the corresponding values are grouped on the right panel under separate tabs.

List of ingredients

The list of ingredients contains the reference ingredients (on a pink background) and the user-defined ingredients (on a blue background). By default, the list is sorted by alphabetical order.

Navigation

- Click on an ingredient to select it.
- Use the vertical scroll bar and the navigation keys (Arrow up, Arrow down, Page up, Page down, Home and End) to browse through the list.
- Use the horizontal scroll bar to see an ingredient name in full if it is truncated.
- The following buttons are available:

- **View:** opens the **ingredient view** with all the nutrients for the selected ingredient.
- **Create:** opens the ingredient creation form. If the currently selected ingredient is a reference ingredient, it will be used by default to create a new ingredient.
- **Close:** closes the window. You can also use the Escape (Esc) key.
- If the list of ingredients has been sorted previously by a chemical or nutritional value, click on the list header to sort it alphabetically again.

Filtering

By default, EvaPig® shows the full list of ingredients, including those defined by the user. Because this list may be long, you can limit it to certain groups of ingredients by using the filter options at the bottom of the ingredients list.

There are 3 filter options: each option needs to be enabled first by clicking on the check box in front of it. It is possible to enable several filters at the same time.

- **Class:** choose the class of ingredients from the drop-down list
- **Database:** choose the reference database or the user database from the drop-down list
- **Name:** enter a string of characters that matches the ingredient name. The filter is case-insensitive: *Wheat* and *wheat* return the same wheat-based ingredients.

Data tabs

Each data tab shows a group of related nutrients. The units used are those chosen in the **Unit preferences** form.

The tabs are organised as follows:

- **Dry matter:** the dry matter value in this tab is always expressed on the as-fed basis.
- **Proximate analysis:** it contains the main chemical nutrients: dry matter, ash, protein, crude fat, crude fibre, the Van Soest fibre analysis (NDF, ADF, ADL), starch and sugars.
 - Protein, fibre, sugars, and starch values have been set to zero for those ingredients that do not contain these constituents.
 - Methods of analysis:
 - Dry matter: oven drying (or officially recommended methods for specific ingredients such as molasses or fat)
 - Ash: incineration
 - Crude fibre: Weende method
 - Protein: Kjeldhal or Dumas method
 - Fat: ether extract, obtained with or without HCl hydrolysis, depending on the official recommendations for specific ingredients.
 - Starch: polarimetry
 - Sugars: Luff-Schoorl method

- **Energy utilization:** ratios of energy values (including energy digestibility) for growing and adult pigs.
 - The letters *g* and *a* indicate (in DE_g for instance) that the value is for *growing* and *adult* pigs, respectively.
 - Ed is the digestibility of energy
 - DE, ME, and NE are the digestible energy, the metabolizable energy and the net energy contents, respectively.
- **Energy values** for growing (DE_g, ME_g, NE_g) and adult (DE_a, ME_a, NE_a) pigs.
- **Total amino acids** expressed as % or g/kg of ingredient weight
- **Total amino acids** expressed as percentage of the crude protein
- **Digestible amino acids:** ileal standardised digestible amino acids
- **Digestibility of amino acids:** ileal standardised digestibility of amino acids
- **Minerals:** total calcium (Ca), phosphorus (P), sodium (Na), potassium (K), and electrolyte balance (EB, mEq/kg) values
- **Digestibility of phosphorus:** digestibility of phosphorus for the mash and pellet form of the ingredient. In the reference table, the digestibility values of mash and pellet are different for soft wheat grain, the by-products of wheat milling and rye.

To use the tabs:

- Click on the tab to see the data for the current (selected) ingredient.
- Use the horizontal and vertical scroll bars when a tab contains many elements.
- Click on a nutrient header to sort the table by ascending order or the nutrient values.
- For user-defined ingredients copied from reference ingredients, the values in italics are those that were not modified by the user.

Ingredient view

The ingredient view is called up by selecting an ingredient in the list and either double-clicking on the selection or clicking on the **View** button.

The data are displayed using the default units.

The screenshot below presents the ingredient view for a reference ingredient, the Soybean meal 48.

Figure 6. View of a reference ingredient

Ingredient
✕

Name Soybean meal, oil < 5%, 48% protein + oil

Class Oil seed meals

Origin Reference tables (©EvaPig2020)

Dry matter (%) 87.99

Proximate analysis (%)	
Ash	6.23
Crude protein	46.25
Crude fat	1.55
Crude fibre	5.96
NDF	12.50
ADF	7.41
ADL	0.56
Starch	5.02
Sugars	8.08

Minerals (%)	
Calcium (Ca)	0.337
Phosphorus (P)	0.620
Sodium (Na)	0.014
Potassium (K)	2.091
Chlorine (Cl)	0.027
Electrolyte balance (mEq/kg)	534.5
Phosphorus digestibility (%)	
	Mash Pellet
Pd	48.0 32.0

Energy values (MJ/kg)			
	Growing pig	Adult pig	Ratio (%)
Gross energy (GE)	17.33	17.33	100.0
Digestible energy (DE)	14.73	15.66	106.3
Metabolisable energy (ME)	13.47	14.19	105.4
Net energy (NE)	8.28	8.87	107.1

Energy utilization (%)			
	Growing pig	Adult pig	Bonus
Ed (DE / GE)	85.0	90.4	0.0
ME / DE	91.4	90.6	
NE / ME	61.4	62.5	

Faecal nitrogen digestibility (%)		
	Growing pig	Adult pig
	86.7	89.6

Digestible lysine / NE (g/MJ)		
	Growing pig	Adult pig
	3.12	2.91

Comments

Amino acids (%)	Total	Digestible	Digestibility (%)
Lysine	2.88	2.58	89.8
Threonine	1.77	1.53	86.5
Methionine	0.66	0.60	91.5
Cysteine	0.73	0.63	86.3
Methionine + Cysteine	1.38	1.23	88.7
Tryptophan	0.64	0.57	89.1
Isoleucine	2.11	1.89	89.4
Valine	2.23	1.97	88.2
Leucine	3.53	3.15	89.3
Phenylalanine	2.34	2.11	90.5
Tyrosine	1.63	1.49	91.5
Phenylalanine + Tyrosine	3.96	3.60	90.9
Histidine	1.24	1.12	90.6
Arginine	3.38	3.18	94.0
Alanine	2.01	1.73	85.8
Aspartic acid	5.22	4.67	89.5
Glutamic acid	8.25	7.42	89.9
Glycine	1.94	1.64	84.4
Serine	2.17	1.93	89.1
Proline	2.30	2.06	89.7

Modify

Delete

Print

Excel

Help

Close

Figure 7. View of a user-defined ingredient

Ingredient X

Name **Comments**

Class

Origin

Dry matter (%)

Proximate analysis (%)		Minerals (%)	
Ash	<input type="text" value="1.16"/>	Calcium (Ca)	<input type="text" value="0.038"/>
Crude protein	<input type="text" value="7.80"/>	Phosphorus (P)	<input type="text" value="0.249"/>
Crude fat	<input type="text" value="3.40"/>	Sodium (Na)	<input type="text" value="0.003"/>
Crude fibre	<input type="text" value="2.30"/>	Potassium (K)	<input type="text" value="0.306"/>
NDF	<input type="text" value="10.61"/>	Chlorine (Cl)	<input type="text" value="0.049"/>
ADF	<input type="text" value="2.62"/>	Electrolyte balance (mEq/kg)	<input type="text" value="66.1"/>
ADL	<input type="text" value="0.53"/>	Phosphorus digestibility (%)	
Starch	<input type="text" value="63.09"/>	Mash	<input type="text" value="42.0"/>
Sugars	<input type="text" value="1.70"/>	Pellet	<input type="text" value="28.0"/>

Amino acids (%)	Total	Digestible	Digestibility (%)
Lysine	0.24	0.19	79.7
Threonine	0.29	0.24	82.7
Methionine	0.17	0.15	91.3
Cysteine	0.20	0.17	88.5
Methionine + Cysteine	0.36	0.32	89.8
Tryptophan	0.05	0.04	80.0
Isoleucine	0.29	0.25	88.0
Valine	0.39	0.34	87.2
Leucine	0.95	0.88	92.7
Phenylalanine	0.38	0.34	91.4
Tyrosine	0.33	0.30	90.4
Phenylalanine + Tyrosine	0.70	0.64	90.9
Histidine	0.23	0.20	88.6
Arginine	0.37	0.34	90.6
Alanine	0.58	0.51	89.1
Aspartic acid	0.51	0.44	87.3
Glutamic acid	1.44	1.33	92.6
Glycine	0.30	0.25	81.8
Serine	0.39	0.35	88.7
Proline	0.72	0.64	88.9

Energy values (MJ/kg)	Growing pig	Adult pig	Ratio (%)
Gross energy (GE)	<input type="text" value="15.88"/>	<input type="text" value="15.88"/>	<input type="text" value="100.0"/>
Digestible energy (DE)	<input type="text" value="13.88"/>	<input type="text" value="14.46"/>	<input type="text" value="104.2"/>
Metabolisable energy (ME)	<input type="text" value="13.54"/>	<input type="text" value="14.04"/>	<input type="text" value="103.7"/>
Net energy (NE)	<input type="text" value="10.83"/>	<input type="text" value="11.16"/>	<input type="text" value="103.0"/>

Energy utilization (%)	Growing pig	Adult pig	Bonus
Ed (DE / GE)	<input type="text" value="87.4"/>	<input type="text" value="91.1"/>	<input type="text" value="0.0"/>
ME / DE	<input type="text" value="97.6"/>	<input type="text" value="97.1"/>	
NE / ME	<input type="text" value="80.0"/>	<input type="text" value="79.5"/>	

	Growing pig	Adult pig
Faecal nitrogen digestibility (%)	<input type="text" value="80.6"/>	<input type="text" value="91.5"/>
Digestible lysine / NE (g/MJ)	<input type="text" value="0.18"/>	<input type="text" value="0.17"/>

Navigation

The following buttons are available:

- **Modify:** opens the ingredient modification screen (**only for user-defined ingredients**)
- **Delete:** deletes the current ingredient (**only for user-defined ingredients**).
- **Excel:** sends the current ingredient data to an Excel file
- **Print:** sends the current ingredient data to the printer or to a PDF file
- **Help:** opens the help file.
- **Close:** closes the window. You can also use the **Escape** (Esc) key.

Reference ingredients

When the ingredient is a reference ingredient, the **Origin** field contains "Reference tables" and the **Comments** field contains the name of the original reference. **Note that reference ingredients cannot be modified or removed from EvaPig®.** However, you can create a copy of a reference ingredient and change its values: click on the **Create** button, use the reference ingredient as a basis for the new ingredient and then modify the copy.

User-defined ingredients

User-defined ingredients can be modified (**Modify** button) and deleted (**Delete** button).

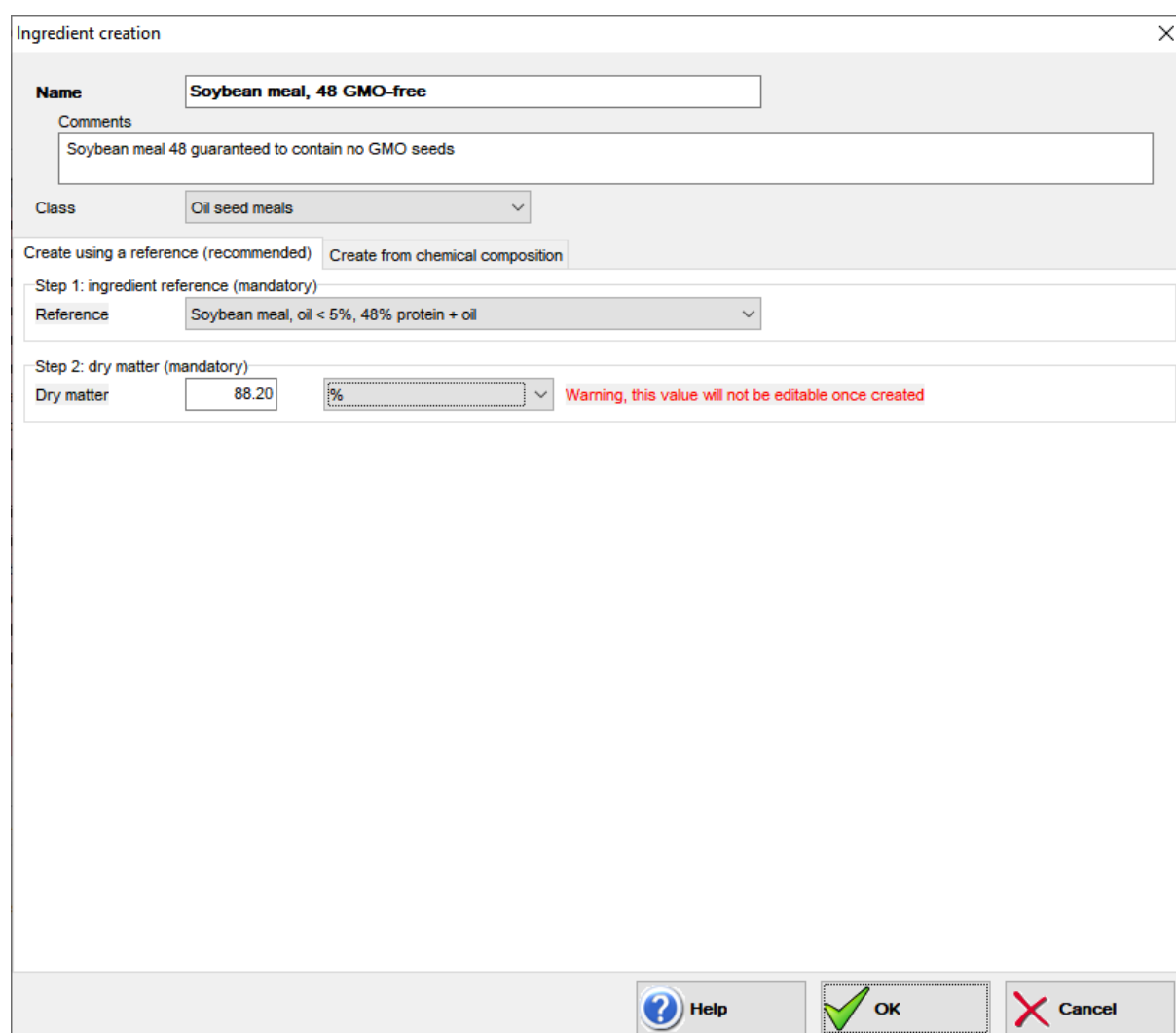
- If the ingredient was created using only original chemical values, the **Origin** field contains the text “Original item”.
- If the ingredient was created by copying a reference ingredient, the **Origin** field contains the text “Copy of X” where X is the reference ingredient.

User-defined ingredients cannot be used as a basis for creating new ingredients.

Ingredient creation

The ingredient creation form is called up by the **Create** button in the list of ingredients.

Figure 8. Ingredient creation: first step



The screenshot shows a dialog box titled "Ingredient creation" with a close button (X) in the top right corner. The form is divided into several sections:

- Name:** A text input field containing "Soybean meal, 48 GMO-free".
- Comments:** A text area containing "Soybean meal 48 guaranteed to contain no GMO seeds".
- Class:** A dropdown menu set to "Oil seed meals".
- Creation Method:** Two tabs are visible: "Create using a reference (recommended)" (selected) and "Create from chemical composition".
- Step 1: ingredient reference (mandatory):** A dropdown menu set to "Soybean meal, oil < 5%, 48% protein + oil".
- Step 2: dry matter (mandatory):** A text input field for "Dry matter" containing "88.20", followed by a dropdown menu set to "%". A red warning message "Warning, this value will not be editable once created" is displayed to the right.

At the bottom of the dialog box, there are three buttons: "Help" (with a question mark icon), "OK" (with a green checkmark icon), and "Cancel" (with a red X icon).

Name the ingredient

The following fields have to be filled first:

- **Name:** name the new ingredient.
- **Comments:** short comment about the new ingredient (not mandatory)
- **Class:** pick a class in the drop-down list. If the form was called when a reference ingredient was selected, the class of this ingredient is proposed by default. Otherwise, the field is left blank and you have to fill it yourself.

Ingredients are created either by copying a reference ingredient and then modifying its data, or by using only chemical values.

Choose one of the following tabs to start the creation process:

- Create using a reference
- Create from chemical composition

Ingredient creation using a reference ingredient

Whenever possible, a new ingredient should be derived from the closest reference ingredient from a biological (and botanical when applicable) point of view. The main reason is that the calculations will use equations specific to that ingredient rather than generic ones, resulting in more precise values than the ones calculated using chemical composition only.

- **Ingredient reference:** choose an ingredient reference from the drop-down list.
 - Note that if the form was called up when a reference ingredient is selected, the class of this ingredient is proposed by default. If the selected ingredient was user-defined, no default ingredient is proposed.
 - This list only contains reference ingredients: user-defined ingredients cannot be used to create new ingredients.
- **Dry matter:** enter a value for the dry matter.
 - The default value is always set to 0 and must be changed. This is by design.
 - You can choose a unit different from the default unit in the drop-down list next to the dry matter field.
 - The choice of a dry matter value is mandatory as this value cannot be changed later. Choose wisely: if you type the wrong value you will have to go through the whole process again. However, the dry matter can be changed when the ingredient is used in a diet.
- Click on the **OK** button to continue. This validates the choice of the dry matter and opens the **ingredient modification** form below.

Figure 9. Ingredient creation from a reference ingredient: modifying the reference data

Ingredient modification

Name Soybean meal, 48 GMO-free

Class Oil seed meals

Reference Soybean meal, oil < 5%, 48% protein + oil

Dry matter (%) 88.20

Proximate analysis %

Ash	5.51	<input checked="" type="checkbox"/>
Crude protein	45.42	<input checked="" type="checkbox"/>
Crude fat	1.91	<input checked="" type="checkbox"/>
Crude fibre	6.02	<input checked="" type="checkbox"/>
NDF	12.20	<input checked="" type="checkbox"/>
ADF	7.43	<input type="checkbox"/>
ADL	0.56	<input type="checkbox"/>
Starch	5.03	<input type="checkbox"/>
Sugars	8.10	<input type="checkbox"/>

Minerals %

Calcium	0.34	<input type="checkbox"/>
Phosphorus	0.62	<input type="checkbox"/>
Sodium	0.01	<input type="checkbox"/>
Potassium	2.10	<input type="checkbox"/>
Chlorine	0.03	<input type="checkbox"/>
Phosphorus digestibility (%)		
Mash	48.0	<input type="checkbox"/>
Pellet	32.0	<input type="checkbox"/>

Amino acids Total %

Lysine	2.83	<input type="checkbox"/>
Threonine	1.74	<input type="checkbox"/>
Methionine	0.65	<input type="checkbox"/>
Cysteine	0.71	<input type="checkbox"/>
Methionine + Cysteine	1.36	<input type="checkbox"/>
Tryptophan	0.63	<input type="checkbox"/>
Isoleucine	2.07	<input type="checkbox"/>
Valine	2.19	<input type="checkbox"/>
Leucine	3.47	<input type="checkbox"/>
Phenylalanine	2.30	<input type="checkbox"/>
Tyrosine	1.60	<input type="checkbox"/>
Phenylalanine + Tyrosine	3.89	<input type="checkbox"/>
Histidine	1.22	<input type="checkbox"/>
Arginine	3.32	<input type="checkbox"/>
Alanine	1.98	<input type="checkbox"/>
Aspartic acid	5.12	<input type="checkbox"/>
Glutamic acid	8.11	<input type="checkbox"/>
Glycine	1.91	<input type="checkbox"/>
Serine	2.13	<input type="checkbox"/>
Proline	2.26	<input type="checkbox"/>

Energy

Energy bonus (%) 0.0

Rename Comment Help OK Cancel

The proposed chemical values are copied from the reference ingredient.

- To change a value in the ingredient modification form, first click on the checkbox next to the value you want to change and then type the value itself.
- You can temporarily override the default units and expression by choosing a unit/expression pair in one of the drop-down lists.
- The **Energy bonus** field lets you add or subtract up to 5% to the calculated digestible energy. Use the little arrows next to the field to increase or decrease the bonus.
- You can change the total amino acid values but not the amino acid digestibilities, which are derived from the reference ingredient and considered as fixed.

In the example above, the ash, crude protein and lysine value were changed from the original reference ingredient.

- **Rename:** renames the ingredient.
- **Comment:** adds a comment to the ingredient
- **Help:** opens the help file.
- **OK:** validates the changes. During the creation, the **OK** button terminates the process
- **Cancel:** cancels the edition of the values. It does not delete the ingredient itself. To do so, go back to the list of ingredients, select the ingredient, double-click to see its values and click on the **Delete** button.

Ingredient creation using chemical composition

First, click on the tab **Create from chemical composition** in the ingredient creation form. The headers show the chosen ingredient name and class and the form looks like the screenshot below.

Figure 10. Ingredient creation from chemical composition: choosing the dry matter

Ingredient creation

Name

Comments

Class

Create using a reference (recommended) Create from chemical composition

Step 1: dry matter (mandatory)

Dry matter Warning, this value will not be editable after this step

Step 2: ash (mandatory)

Ash

Step 3: crude protein (mandatory)

Crude protein

Step 4: fibre (at least one criteria mandatory)

Crude fibre

NDF

ADF

Step 5: crude fat (needed to calculate gross, metabolisable and net energy) and/or gross energy

Crude fat If you do not have this information, you must provide the gross energy value

Gross energy If you are not sure of this, leave it blank and it will be calculated

Step 6: starch (needed to calculate metabolisable and net energy)

Starch

Step 7: sugars (improve the precision of the calculation)

Sugars

Remark: without crude fat and starch, only the digestibility values will be calculated

Creating an ingredient using chemical composition requires that the user provides several values.

- **Dry matter:** enter a value for the dry matter.
 - You can choose a unit different from the default unit in the drop-down list next the dry matter field.
 - The choice of a dry matter value is mandatory as this value cannot be changed later. Choose wisely: if you type the wrong value, you will have to go through the whole process again.
- Click on the **Next** button to continue. This will validate the choice of the dry matter and open the other chemical values for modification.

Figure 11. Ingredient creation from chemical composition: choosing the chemical composition and gross energy

Ingredient creation ✕

Name

Comments

Class

Create using a reference (recommended) Create from chemical composition

Step 1: dry matter (mandatory)

Dry matter % Warning, this value will not be editable after this step

Step 2: ash (mandatory)

Ash %

Step 3: crude protein (mandatory)

Crude protein %

Step 4: fibre (at least one criteria mandatory)

Crude fibre

NDF %

ADF

Step 5: crude fat (needed to calculate gross, metabolisable and net energy) and/or gross energy

Crude fat % If you do not have this information, you must provide the gross energy value

Gross energy MJ/kg If you are not sure of this, leave it blank and it will be calculated

Step 6: starch (needed to calculate metabolisable and net energy)

Starch %

Step 7: sugars (improve the precision of the calculation)

Sugars %

Remark: without crude fat and starch, only the digestibility values will be calculated

The requirements are stricter than for the creation from a reference ingredient, since EvaPig® has to know certain values:

- In order to calculate digestible energy values, the user must provide values for at least ash, protein, fibre and either a fat or a gross energy value.
- In order to calculate metabolizable and net energy values, the user must provide values for at least ash, protein, fibre, fat, and starch. The calculations will be more accurate if gross energy and sugars are provided.

The creation process requires the following values:

- **Ash:** mandatory
- **Protein:** mandatory
- **Fibre:** mandatory; it can be either crude fibre (Weende method), NDF or ADF.
- **Fat or gross energy:** either fat or gross energy is mandatory
 - If the fat content is unknown, you will have to provide a gross energy value. However, fat content is necessary to calculate metabolizable and net energy values: so, if you provide only the gross energy, EvaPig® will not be able to calculate ME and NE values, only DE.
 - If the gross energy is unknown, you will need to give a fat value that will be used to predict the gross energy. Because fat has a high energy content relative to other constituents, it is not possible to predict an accurate gross energy value without it.
- **Starch:** it is mandatory to calculate metabolizable and net energy values. Without it, EvaPig® will stop at the digestible energy.
- **Sugars:** not mandatory, but adds precision to the calculations
- Click on the **OK** button to continue. This validates the choice of the dry matter and opens the ingredient modification form.

The amino acid digestibilities proposed for an ingredient created using the chemical composition are default values. For this reason, it is possible to change them in the ingredient modification form (this is not possible for ingredients derived from reference ingredients).

Figure 12. Ingredient creation from chemical composition: choosing the mineral and amino acid values

Ingredient modification

Name: **Cassava pulp**

Class: Starch, roots and tubers

Dry matter (%): 89.01

Proximate analysis (%):

Ash	3.56
Crude protein	2.03
Crude fat	0.64
Crude fibre	15.44
NDF	
ADF	
ADL	<input type="checkbox"/>
Starch	47.53 <input checked="" type="checkbox"/>
Sugars	2.95 <input checked="" type="checkbox"/>

Minerals (%):

Calcium	0.58
Phosphorus	0.05
Sodium	0.01
Potassium	0.01
Chlorine	0.01
Phosphorus digestibility (%)	
Mash	20.0
Pellet	20.0

Amino acids:

Total	%	Digestibility (%)
Lysine	0.08 <input checked="" type="checkbox"/>	77.00 <input type="checkbox"/>
Threonine	0.06 <input checked="" type="checkbox"/>	76.00 <input type="checkbox"/>
Methionine	0.03 <input checked="" type="checkbox"/>	84.60 <input type="checkbox"/>
Cysteine	0.04 <input checked="" type="checkbox"/>	73.30 <input type="checkbox"/>
Methionine + Cysteine	0.07 <input checked="" type="checkbox"/>	78.80 <input type="checkbox"/>
Tryptophan	0.02 <input checked="" type="checkbox"/>	77.20 <input type="checkbox"/>
Isoleucine		80.70 <input type="checkbox"/>
Valine		77.70 <input type="checkbox"/>
Leucine		83.30 <input type="checkbox"/>
Phenylalanine		84.20 <input type="checkbox"/>
Tyrosine		85.50 <input type="checkbox"/>
Phenylalanine + Tyrosine		84.70 <input type="checkbox"/>
Histidine		84.10 <input type="checkbox"/>
Arginine		88.70 <input type="checkbox"/>
Alanine		77.30 <input type="checkbox"/>
Aspartic acid		79.10 <input type="checkbox"/>
Glutamic acid		86.10 <input type="checkbox"/>
Glycine		71.80 <input type="checkbox"/>
Serine		80.70 <input type="checkbox"/>
Proline		78.70 <input type="checkbox"/>

Energy (MJ/kg):

Gross energy	15.60
Energy bonus (%)	0.0

Missing chemical or nutritional values for an ingredient will not be calculated in diets that include this ingredient

Rename Comment Help OK Cancel

Ingredient modification

The ingredient modification form is called up by clicking on the **Modify** button in the Ingredient view. The button is only available for user-defined ingredients, as reference ingredients cannot be modified or deleted.

Figure 13. Ingredient modification form for an ingredient derived from a reference ingredient

Ingredient modification

Name Soybean meal, 48 GMO-free

Class Oil seed meals

Reference Soybean meal, oil < 5%, 48% protein + oil

Dry matter (%) 88.20

Proximate analysis %

Ash	5.51	<input checked="" type="checkbox"/>
Crude protein	45.42	<input checked="" type="checkbox"/>
Crude fat	1.91	<input checked="" type="checkbox"/>
Crude fibre	6.02	<input checked="" type="checkbox"/>
NDF	12.20	<input checked="" type="checkbox"/>
ADF	7.43	<input type="checkbox"/>
ADL	0.56	<input type="checkbox"/>
Starch	5.03	<input type="checkbox"/>
Sugars	8.10	<input type="checkbox"/>

Minerals %

Calcium	0.34	<input type="checkbox"/>
Phosphorus	0.62	<input type="checkbox"/>
Sodium	0.01	<input type="checkbox"/>
Potassium	2.10	<input type="checkbox"/>
Chlorine	0.03	<input type="checkbox"/>
Phosphorus digestibility (%)		
Mash	48.0	<input type="checkbox"/>
Pellet	32.0	<input type="checkbox"/>

Amino acids

Total	%	
Lysine	2.83	<input type="checkbox"/>
Threonine	1.74	<input type="checkbox"/>
Methionine	0.65	<input type="checkbox"/>
Cysteine	0.71	<input type="checkbox"/>
Methionine + Cysteine	1.36	<input type="checkbox"/>
Tryptophan	0.63	<input type="checkbox"/>
Isoleucine	2.07	<input type="checkbox"/>
Valine	2.19	<input type="checkbox"/>
Leucine	3.47	<input type="checkbox"/>
Phenylalanine	2.30	<input type="checkbox"/>
Tyrosine	1.60	<input type="checkbox"/>
Phenylalanine + Tyrosine	3.89	<input type="checkbox"/>
Histidine	1.22	<input type="checkbox"/>
Arginine	3.32	<input type="checkbox"/>
Alanine	1.98	<input type="checkbox"/>
Aspartic acid	5.12	<input type="checkbox"/>
Glutamic acid	8.11	<input type="checkbox"/>
Glycine	1.91	<input type="checkbox"/>
Serine	2.13	<input type="checkbox"/>
Proline	2.26	<input type="checkbox"/>

Energy

Energy bonus (%) 0.0

Rename Comment Help OK Cancel

The form displays the chemical composition and the other modifiable values.

- To change a value, first click on the checkbox next to the value you want to change and then type the value itself.
- You can temporarily override the default units and expression by choosing a unit/expression pair in one of the drop-down lists.
- The **Energy bonus** field lets you add or subtract up to 5% to the calculated digestible energy. Use the little arrows next to the field to increase or decrease the bonus.
- The ability to modify amino acid digestibilities depends on how the ingredient was created:

- For an ingredient created from a reference ingredient, the amino acid digestibilities cannot be changed and do not appear in the ingredient modification form.
- When the ingredient was created from its chemical composition only, you can provide your own amino acid digestibilities and they can be changed in the ingredient modification form.

The following buttons are available:

- **OK:** validates the changes
- **Rename:** renames the ingredient.
- **Comment:** adds a comment to the ingredient
- **Cancel:** cancels the current modifications.

Diets

EvaPig® creates diets using both the reference ingredients and the user-defined ingredients. The diets are stored in a database and can be compared graphically.

When the ingredients of a diet are unknown, it is possible to calculate the energy values of the diet using its chemical composition. However, diets created that way are not saved in the database.

List of diets

The **Diets** button in the main menu opens the **list of diets** below. This list is empty when you use EvaPig® for the first time: diets are created and maintained by the user.

The names of the diets are shown on the left panel while the corresponding values are grouped on the right panel under separate tabs.

Figure 14. List of diets

Name	Total amino acids (%)		Digestible amino acids (%)			Minerals (%)		Electrolyte balance (mEq/kg)	
	Dry matter (%)		Proximate analysis (%)			Energy utilization (%)		Energy values (MJ/kg)	
	Dry matter	Ash	Crude protein	Crude fat	Crude fibre	NDF	ADF	ADL	Starch
Diet 1	86.74	3.72	19.14	4.38	3.84	13.53	4.69	0.80	40.84
Diet 2	87.20	3.76	18.07	4.54	3.89	13.72	4.78	0.84	41.84
Diet 3	87.55	3.95	19.96	3.23	3.92	14.73	5.09	1.12	40.01

Navigation and sorting

- Use the vertical scroll bar and the navigation keys (Arrow up, Arrow down, Page up, Page down, Home and End) to browse through the list.
- Use the horizontal scroll bar to see a diet name in full if it is truncated.
- Click on, or scroll to, a diet to select it.

The following buttons are available:

- **View:** opens the full list of nutrients for the selected diet. Double-clicking on the selected diet achieves the same result
- **Create:** opens the diet creation form.
- **Graphs:** opens the diet comparison graphs.
- **Calculator:** opens the form for calculating diet energy values from chemical composition.
- **Close:** closes the window. You can also use the **Escape** (Esc) key

By default, the list is sorted by ascending date of creation (the oldest diets on top). Clicking on the header sorts the list by alphabetical order.

Data tabs

Each data tab shows a group of related nutrients. The units used are those chosen in the **Units preferences** screen.

- Click on the tab to see the data for the current (selected) diet.
- When a tab contains many elements, use the horizontal and vertical scroll bars.
- Click on a nutrient header to sort the table by ascending order or the nutrient values.

The tabs are organised as follows:

- **Dry matter:** the dry matter value here is always expressed on the as-fed basis.
- **Proximate analysis:** it contains the main chemical nutrients: dry matter, ash, protein, crude fat, crude fibre, the Van Soest fibre analysis (NDF, ADF, ADL), starch and sugars.
- **Energy utilization:** ratios of energy values (including energy digestibility) for growing and adult pigs.
 - The letters *g* and *a* indicate (in DE_g for instance) that the value is for *growing* and *adult* pigs respectively.
 - dE is the digestibility of energy
 - DE, ME and NE are respectively the digestible energy, the metabolizable energy and the net energy contents.
- **Energy values** for growing (DE_g, ME_g, NE_g) and adult (DE_a, ME_a, NE_a) pigs.
- **Total amino acids** expressed as % or g/kg of diet weight
- **Digestible amino acids:** ileal standardised digestible amino acids
- **Minerals:** total calcium, phosphorus, sodium, potassium, chlorine, and digestible phosphorus values
- **Electrolyte balance**

Diet view

The diet view is called up by selecting a diet in the **list of diets** and then by double-clicking on the selection or clicking on the **View** button.

Figure 15. Diet view

Diet X

Name **Comments**

Physical form

Dry matter (%)

Proximate analysis (%)

Ash	3.95
Crude protein	19.96
Crude fat	3.23
Crude fibre	3.92
NDF	14.73
ADF	5.09
ADL	1.12
Starch	40.01
Sugars	4.84

Minerals (%)

Calcium (Ca)	0.412
Phosphorus (P)	0.644
Sodium (Na)	0.008
Potassium (K)	0.914
Chlorine (Cl)	0.088
Electrolyte balance (mEq/kg)	213.3
Digestible P (dP)	0.340
Ca / dP	1.21

Amino acids (%)

	Total	Digestible	Profile (%)
Lysine	1.06	0.93	100
Threonine	0.70	0.59	63
Methionine	0.30	0.27	29
Cysteine	0.38	0.33	35
Methionine + Cysteine	0.67	0.59	63
Tryptophan	0.26	0.23	24
Isoleucine	0.82	0.72	78
Valine	0.93	0.80	85
Leucine	1.43	1.26	135
Phenylalanine	0.96	0.86	93
Tyrosine	0.66	0.59	63
Phenylalanine + Tyrosine	1.62	1.46	156
Histidine	0.51	0.45	49
Arginine	1.29	1.18	126
Alanine	0.82	0.68	72
Aspartic acid	1.75	1.53	164
Glutamic acid	4.29	3.95	422
Glycine	0.84	0.70	75
Serine	0.95	0.84	90
Proline	1.34	1.24	132

Energy values (MJ/kg)

	Growing pig	Adult pig	Ratio (%)
Gross energy (GE)	16.50	16.50	100.0
Digestible energy (DE)	13.82	14.32	103.6
Metabolisable energy (ME)	13.19	13.57	102.9
Net energy (NE)	9.70	9.99	103.0

Energy utilization (%)

	Growing pig	Adult pig
Bonus	0.0	0.0
Ed (DE / GE)	83.8	86.8
ME / DE	95.4	94.8
NE / ME	73.5	73.6

Faecal nitrogen digestibility (%)

	Growing pig	Adult pig
Faecal nitrogen digestibility (%)	83.8	87.3
Digestible lysine / NE (g/MJ)	0.96	0.93
Digestible phosphorus / NE (g/MJ)	0.35	0.34

The diet view shows the chemical and nutritional values of the selected diet, calculated from the values of its ingredients.

In addition to the values shown for the ingredients themselves, it also displays the following information:

- **Physical form** of the diet: pellet or mash
- **Macro minerals** with **electrolyte balance**
- **Calcium / digestible phosphorus** ratio
- **Digestible phosphorus / net energy** ratio
- **Adult / growing pig energy ratios** for DE, ME, and NE
- **Digestible lysine / net energy** ratio
- **Digestible amino acid profile** expressed relatively to the digestible lysine: digestible amino acid / digestible lysine ratio (x 100) for each amino acid (ideal protein concept)

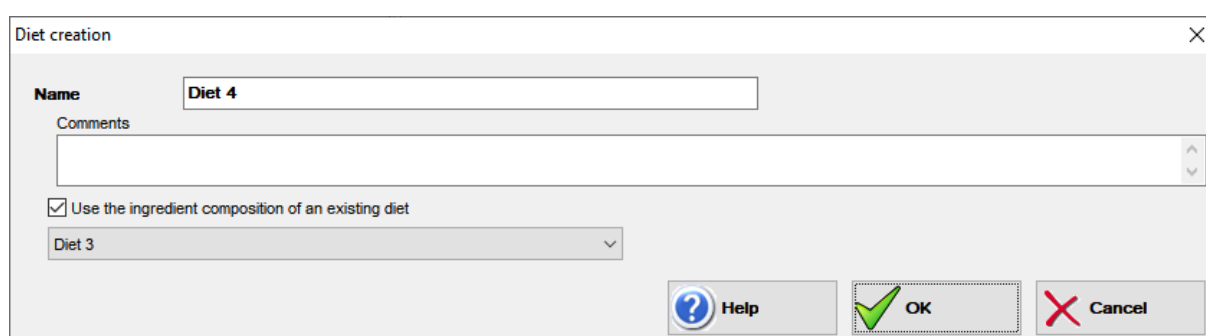
The following buttons are available:

- **Modify:** opens the diet modification form.
- **Delete:** deletes the current diet (after asking for confirmation from the user).
- **Graphs:** opens the diet graphs for the current diet.
- **Print:** sends the data to the printer or to a PDF file.
- **Excel:** exports the data to an Excel file.
- **Close:** closes the window. You can also use the **Escape** (Esc) key.

Diet creation

To create a new diet, click on the **Create** button in the **list of diets**. The following form appears:

Figure 16. Diet creation: choosing the name and the template



The screenshot shows a window titled "Diet creation" with a close button (X) in the top right corner. The form contains the following elements:

- Name:** A text input field containing "Diet 4".
- Comments:** A large text area for entering comments.
- Use the ingredient composition of an existing diet:** A checkbox that is checked.
- Existing diet selection:** A dropdown menu currently showing "Diet 3".
- Buttons:** Three buttons at the bottom: "Help" (with a question mark icon), "OK" (with a green checkmark icon), and "Cancel" (with a red X icon).

- Name the diet
- If you want to use the ingredient composition of an existing diet as a template, click on the corresponding checkbox and pick a diet in the drop-down list.
- Add a comment (optional)
- Click on the **OK** button to validate or click on **Cancel** to stop the creation.

Clicking on the **OK** button opens the **Diet modification** form.

Diet modification

The diet modification form is called up by clicking on the **OK** button in the **Diet creation** form or by clicking on the **Modify** button in the **Diet view**.

Figure 17. Diet creation and modification: choosing the ingredients and the incorporation rates

Diet modification

Name:

Physical form:

Ingredients Class:

Name	DM (%)	Level (%)
Linseed meal, oil > 5%		
Linseed, full fat		
Linseed, full fat, extruded		
Liquid potato feed		
L-Lysine HCL		
L-Threonine		
L-Tryptophan		
Lupin, blue		
Lupin, white		
Lupin, white, extruded		
L-Valine		
Magnesium phosphate		
Maize		
Maize bran		
Maize distillers grains with solubles, oil < 6 %, dried		
Maize distillers grains with solubles, oil > 6%, dried		
Maize feed flour		
Maize flour, crude fibre < 2%		
Maize germ meal, oil < 5%		

Name	DM (%)	Level (%)
Sunflower oil	99.26	1.500
Dicalcium phosphate anhydrous	96.97	1.000
Wheat middlings, starch 20-30%	88.03	12.000
Soybean meal, oil < 5%, 46% protein + oil	87.74	26.390
Maize, local	85.33	59.000
L-Lysine HCL	99.50	0.110

Phytase supplementation

Type of phytase	Concentration	Incorporation
<input type="checkbox"/>	<input type="text"/>	<input type="text"/>

Total: 100.000
Remainder: 0.000

Energy bonus (%)

Growing pig	Adult pig
<input type="text" value="0.0"/>	<input type="text" value="0.0"/>




Buttons: Rename, Comment, Help, OK, Cancel

Missing chemical or nutritional values for an ingredient will not be calculated in diets that include this ingredient





The purpose of this form is to create or modify a diet by adding and removing ingredients, and by setting their incorporation rates.

- The left panel shows the full list of ingredients.

The right panel shows the list of ingredients of the current diet. To add and remove ingredients from the diet, use the **horizontal blue arrows** as follows:

-  Adds the selected ingredient to the diet
-  Removes the selected ingredient from the diet
-  Replaces the selected ingredient from the diet by the selected ingredient from the full list

To change the order of the diet ingredients, use the **vertical blue arrows** and the sorting icons as follows:

-  Moves the selected ingredient one position up the list
-  Moves the selected ingredient one position down the list
-  Sorts the list by alphabetical order
-  Sorts the list by decreasing incorporation rate

After adding a new ingredient to the diet, you can:

- Change the **dry matter content** of the ingredient, replacing the original value by your own.
- Add the **incorporation rate** for the ingredient.
 - The sum of the incorporation rates for all the ingredients should be equal to 100%. The Total field shows the current total incorporation rate (including phytase)
 - The Remainder field shows the difference between 100% and the current sum of incorporation rates.
 - If the sum is different from 100%, a message will appear, but the diet will be created nonetheless.

The diet value can be modified by the following elements:

- **Physical form:** pick **Mash** (default) or **Pellet** in the drop-down list.
 - The diet value for phosphorus digestibility will be calculated from phosphorus digestibilities for mashed or pelleted ingredients, depending on the choice above.
 - Because the values for mashed ingredients are higher for certain ingredients due to the presence of active endogenous phytase (that is destroyed by pelleting), a mashed diet including one of these ingredients will have a higher content of digestible phosphorus than a pelleted diet.
- Phytase supplementation
 - Click on the checkbox to activate phytase supplementation
 - Choose a phytase type, defined as the phytase activity expressed in grams of digestible phosphorus released per 500 IU of phytase
 - Choose a concentration, expressed in IU per gram of phytase
 - Choose an incorporation rate, expressed in IU per kg of feed
 - EvaPig® will calculate the quantity of phytase in the diet expressed in % as the incorporation rate / concentration / 10

- **Energy bonus:** choose an energy bonus for the growing pig and for the adult pig

Once the changes are done, click on the **OK** button to validate, or on the **Cancel** button to cancel the modifications.

The following buttons are available:

- **Rename:** renames the current diet.
- **Comment:** lets you add a comment to the diet.
- **OK:** validates the changes and opens the **Diet view** form.
- **Cancel:** cancels the changes and goes back the **Diet view**.
 - When a diet is being created, using **Cancel** will only cancel the edition of the diet and will not cancel the diet itself. To delete a diet, go back to the diet view and click on the **Delete** button.

Diets comparison graphs

The diets comparison graphs are called by the **Graphs** button in the **list of diets**.

This form lets you compare up to 4 or 6 diets for the same nutrient.

Choose one of the following tabs to create a graph:

- Single graph
- Graphs comparison

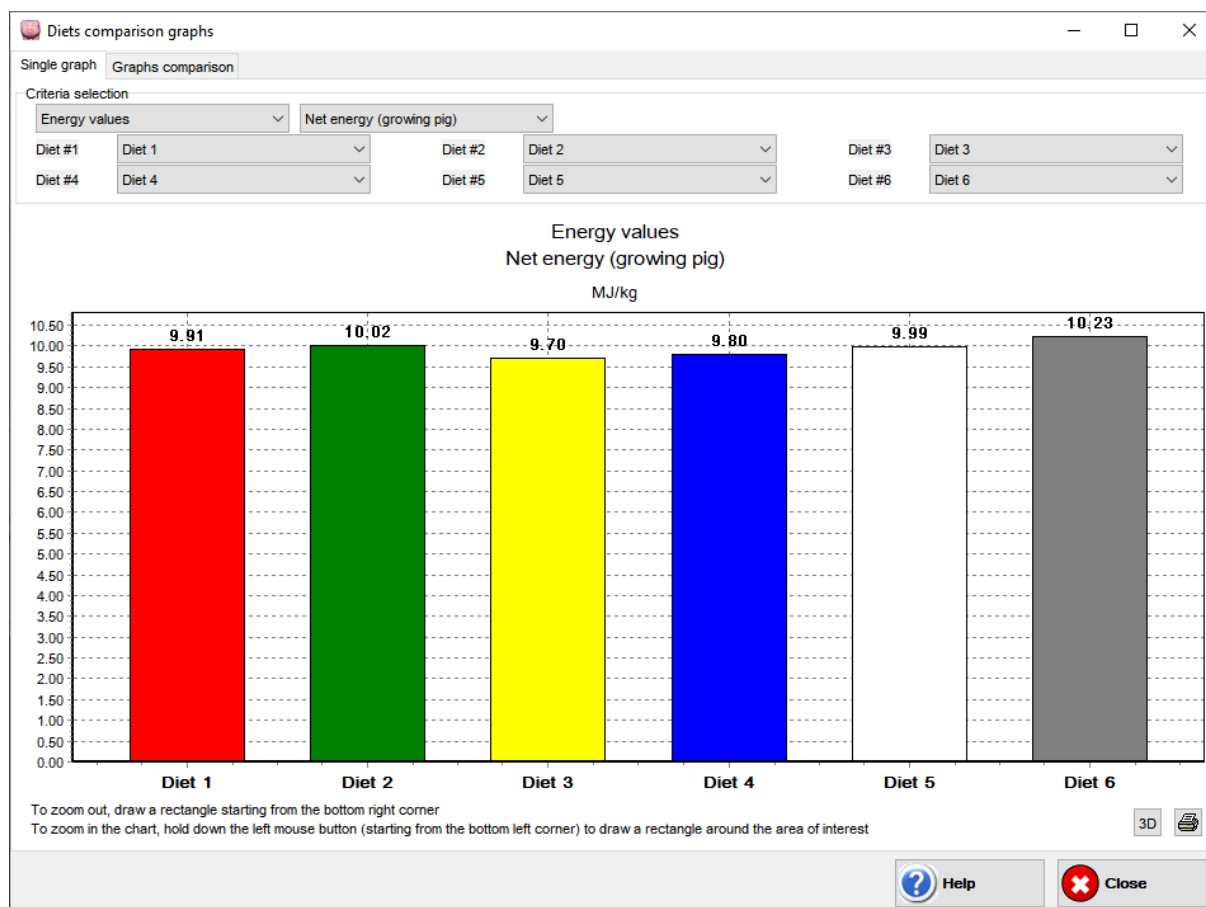
Single graph

The single graph displays on a bar chart the values of a single nutrient for 1 to 6 diets.

To create a single graph:

- Choose a group of criteria in the first drop-down list, then a nutrient from this group in the second drop-down list
- Choose the diets in the Diet #1-6 drop-down lists

Figure 18. Comparison of the net energy values of 6 diets



The following icons and buttons are available:



Gives the chart a 3D aspect



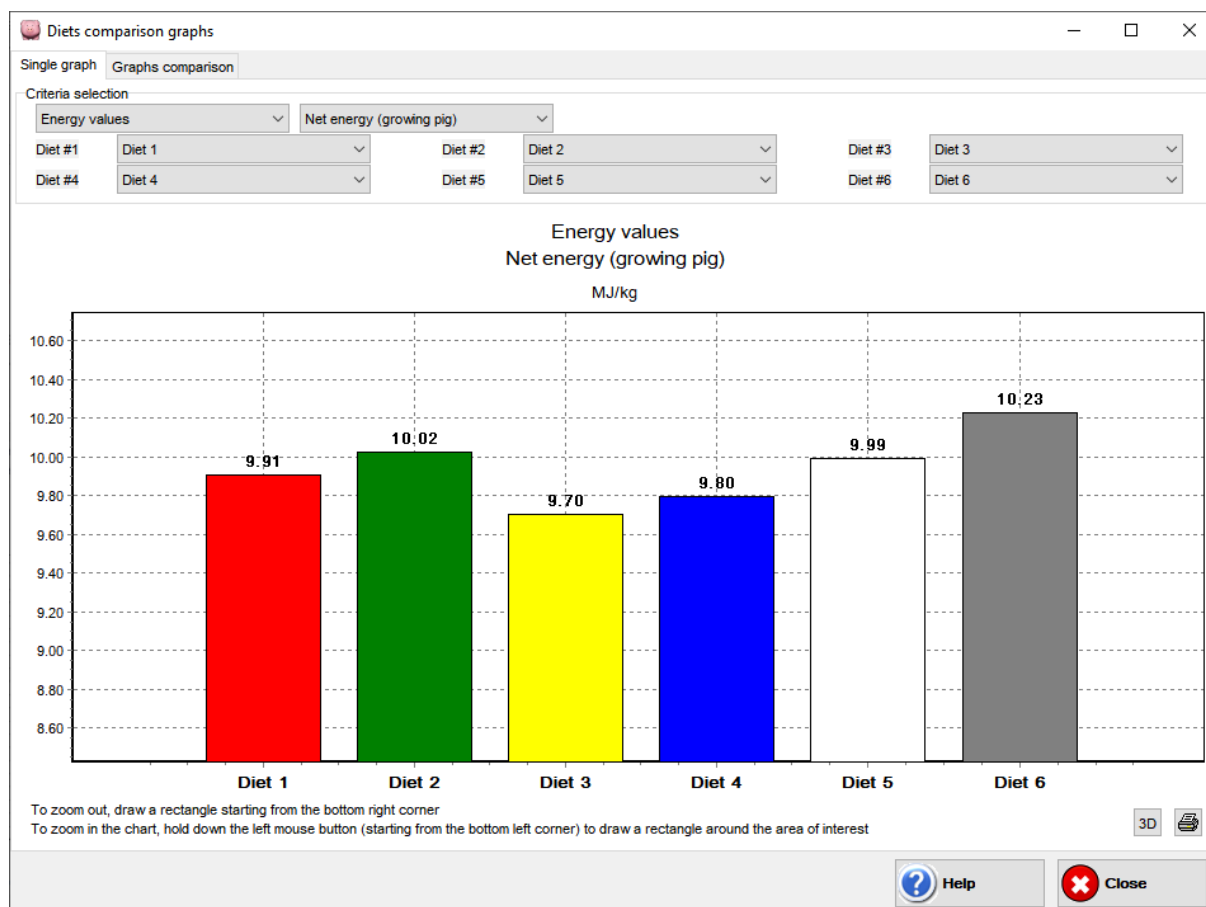
Sends the chart to the printer or to a PDF

Close

Closes the graphs comparison screen

Because the bar chart starts at 0 on the Y axis, the chart may not clearly show the differences between diets: to highlight those differences, you can zoom in the chart by holding down the left mouse button (starting from the bottom left corner) and then drawing a rectangle around the area of interest. To zoom out, draw a rectangle starting from the bottom right corner.

Figure 19. Comparison of the net energy values of 6 diets after zooming in



Graphs comparison

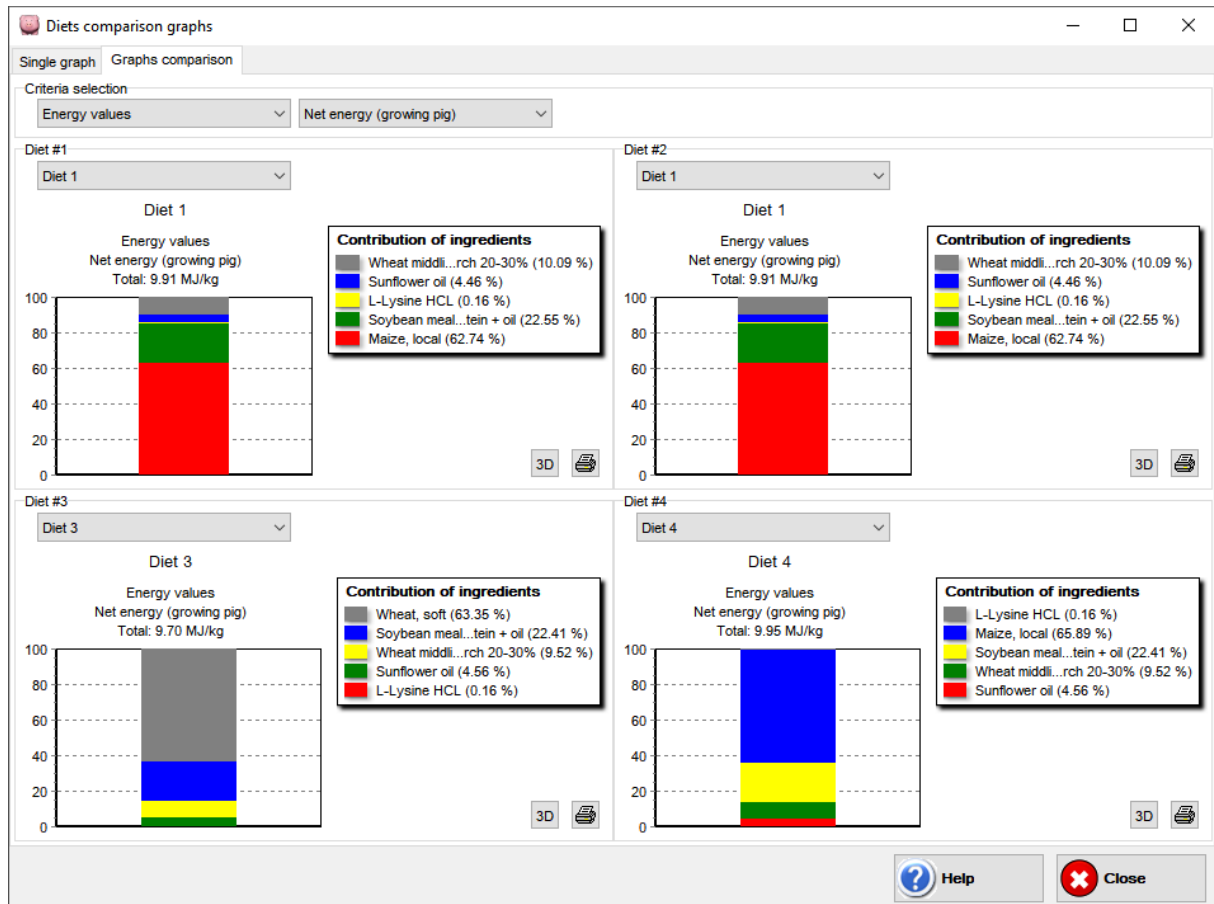
The graphs comparison screen displays as bar charts the contributions of ingredients to the same nutrient for up to 4 diets.

To create a graphs comparison:

- Choose a group of criteria in the first drop-down list, then a nutrient from this group in the second drop-down list
- Choose the diets in the Diet #1-4 drop-down lists

Note: when longer than 30 characters the names of the ingredients are shortened for legibility.

Figure 20. Contributions of ingredients to the net energy of 4 diets



Diet graphs

The diet graphs are called up by the **Graphs** button in the **Diet View**.

This form displays the contributions of the ingredients for a nutrient of the diet or let you compare the contributions of the ingredients for up to 4 nutrients.

Choose one of the following tabs to create a graph:

- Single graph
- Graphs comparison

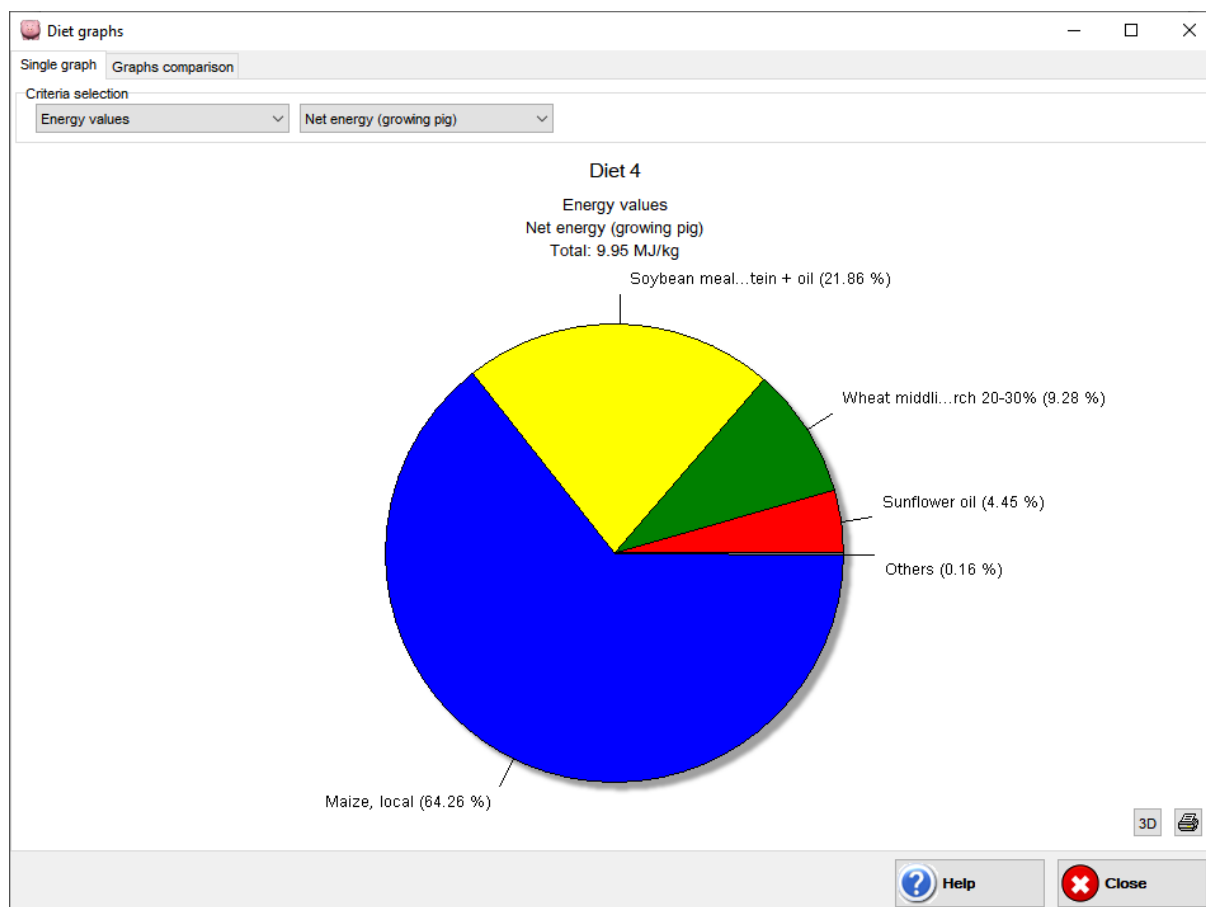
Single graph

The single graph displays on a pie chart the contributions of the ingredients for a single nutrient of the diet.

To create a single graph:

- Choose a group of criteria in the first drop-down list, then a nutrient from this group in the second drop-down list

Figure 21. Contributions of ingredients to the net energy of the diet



Graphs comparison

The graphs comparison screen displays as bar charts the contributions of ingredients for up to 4 nutrients.

To create a graphs comparison:

- For each Graph # 1-4, choose a group of criteria in the first drop-down list and then a nutrient from this group in the second drop-down list

Note: when longer than 30 characters the names of the ingredients are shortened for legibility.

Figure 22. Contributions of ingredients to the digestible amino acid content of the diet



Energy calculator

The composition of a diet is sometimes unknown. EvaPig® provides a calculator that makes it possible to calculate the energy value of a diet using only its chemical composition. **This calculator should not be used for predicting the energy value of ingredients.**

- Important: unlike diets created using ingredients, diets created from chemical composition **cannot** be saved in the database.

The Energy calculator is called up by the **Calculator** button in the **list of diets**.

Figure 23. Energy calculator: choosing the dry matter

The screenshot shows the 'Energy calculator' window with the following fields and options:

- Name:** New diet
- Step 1: dry matter (mandatory):** Dry matter: 87.72, unit: % (dropdown), Next button.
- Step 2: ash:** Ash: [input], unit: % (dropdown).
- Step 3: crude protein:** Crude protein: [input], unit: % (dropdown).
- Step 4: fibre and/or in vitro digestibility of organic matter:** Crude fibre: [input], NDF: [input], ADF: [input], Omdv (%): [input].
- Step 5: crude fat and/or gross energy:** Crude fat: [input], unit: % (dropdown); Gross energy: [input], unit: MJ/kg (dropdown).
- Step 6: starch:** Starch: [input], unit: % (dropdown).
- Step 7: sugars:** Sugars: [input], unit: % (dropdown).
- Energy bonus (%):** Growing pig: 0.0, Adult pig: 0.0.

Buttons at the bottom: View, Reset, Help, Close.

Creating a diet using chemical composition requires that the user provides a name for the diet and then several values.

- **Dry matter:** enter a value for the dry matter.
 - You can choose a unit different from the default unit in the drop-down list next to the dry matter field.
 - The choice of a dry matter value is mandatory as this value cannot be changed later.
- Click on the **Next** button to continue. This will validate the choice of the dry matter and will open the other chemical values for modification.

Figure 24. Energy calculator: choosing the chemical composition and gross energy

Name

Step 1: dry matter (mandatory)
Dry matter %

Step 2: ash
Ash %

Step 3: crude protein
Crude protein %

Step 4: fibre and/or in vitro digestibility of organic matter
Crude fibre
NDF %
ADF
OMdv (%)

Step 5: crude fat and/or gross energy
Crude fat %
Gross energy MJ/kg

Step 6: starch
Starch %

Step 7: sugars
Sugars %

Energy bonus (%)
Growing pig
Adult pig

EvaPig® has to know certain values to calculate the energy values:

- In order to calculate digestible energy values, the user must provide values for at least ash, protein, fibre and either a fat or a gross energy value.
- In order to calculate metabolizable and net energy values, the user must provide values for at least ash, protein, fibre, fat, and starch. The calculations will be made more accurate if gross energy and sugars are provided.

Step by step, the creation process requires the following values. Unlike ingredient creation, no value is mandatory. However, missing values can seriously limit the calculations and their accuracy.

- **Ash:** strongly recommended
- **Protein:** strongly recommended
- **Fibre** (crude fibre (Weende method), NDF, or ADF): strongly recommended.
- **OMDv** (in vitro organic matter digestibility): optional
- **Fat:** necessary to calculate metabolizable and net energy values.

- **Gross energy:** if you do not know the gross energy, you will need to give a fat value that will be used to predict the gross energy. Because fat has a high energy content relative to other constituents, it is not possible to predict an accurate gross energy value without it.
- **Starch:** mandatory to calculate metabolizable and net energy values. Without it, the calculation will stop at the digestible energy.
- **Sugars:** optional, but adds precision to the calculations
- Click on the **View** button to continue. This validates the previous choices and displays the calculated values.

Figure 25. Energy calculator: results

Energy calculator ✕

Name

Dry matter (%)

Proximate analysis (%)		Energy values (MJ/kg)			
Ash	<input type="text" value="6.87"/>	Growing pig	Adult pig	Ratio (%)	
Crude protein	<input type="text" value="19.84"/>	Gross energy (GE)	<input type="text" value="15.86"/>	<input type="text" value="15.86"/>	<input type="text" value="100.0"/>
Crude fat	<input type="text" value="3.09"/>	Digestible energy (DE)	<input type="text" value="12.81"/>	<input type="text" value="13.38"/>	<input type="text" value="104.4"/>
Crude fibre	<input type="text" value="3.96"/>	Metabolisable energy (ME)	<input type="text" value="12.19"/>	<input type="text" value="12.66"/>	<input type="text" value="103.8"/>
NDF	<input type="text" value="13.83"/>	Net energy (NE)	<input type="text" value="8.96"/>	<input type="text" value="9.36"/>	<input type="text" value="104.5"/>
ADF	<input type="text"/>	Energy utilization (%)			
Starch	<input type="text" value="37.11"/>	Growing pig	Adult pig		
Sugars	<input type="text" value="4.17"/>	Bonus	<input type="text" value="0.0"/>	<input type="text" value="0.0"/>	
dOMv	<input type="text"/>	Ed (DE / GE)	<input type="text" value="80.8"/>	<input type="text" value="84.4"/>	
Faecal nitrogen digestibility (%)		ME / DE	<input type="text" value="95.2"/>	<input type="text" value="94.6"/>	
Growing pig	Adult pig	NE / ME	<input type="text" value="73.5"/>	<input type="text" value="73.9"/>	
Nd	<input type="text" value="87.6"/>	<input type="text" value="91.9"/>			

Print
 Excel
 Help
 Close

The following buttons are available:

- **Print:** sends the current ingredient data to the printer or to a PDF file.
- **Excel:** exports the data to an Excel file.
- **Close:** closes the window and returns to the entry form of the calculator. You can also use the **Escape** (Esc) key.

List of publications

The full list of scientific publications can be downloaded from the website at en.evapig.com/publications-list. Links to corresponding on-line documents and libraries are also provided.

- AFZ, Ajinomoto Eurolysine, Aventis Animal Nutrition, INRA, ITCF, 2000. AmiPig. Standardised Ileal Digestibility of amino acids in feedstuffs for pigs, AFZ, Paris.
- AFZ, 2019. INRAE-CIRAD-AFZ Feed tables. www.feedtables.com
- Dourmad, J. Y., Étienne, M., Valancogne, A., Dubois, S., van Milgen, J. & Noblet, J. (2008). INRAPorc: a model and decision support tool for the nutrition of sows. *Animal Feed Science and Technology* 143, 372-386
- Jondreville, C. & Dourmad, J. Y. (2005). Le phosphore dans la nutrition des porcs. *INRA Productions Animales* 18, 182-192
- Noblet, J., Sève, B., & Jondreville, C. (2002). Valeurs nutritives pour les porcs. In: *Tables de composition et de valeur nutritive des matières premières destinées aux animaux d'élevage*, pp. 25-35 [D. Sauvant, J.-M. Perez, and G. Tran, editors]. Paris: INRA Edition
- Noblet, J., Bontems, V. & Tran, G. (2003). Estimation de la valeur énergétique des aliments pour le porc. *INRA Productions Animales* 16, 197-210
- Noblet, J. (2006). Recent advances in energy evaluation of feeds for pigs - 2005. In: *Recent Advances in Animal Nutrition*, pp. 1-26 [P. C. Garnsworthy and J. Wiseman, editors]. Nottingham: Nottingham University Press
- Noblet, J., van Milgen, J. (2013). Chapter 2: Energy and Energy Metabolism in Swine. In: *Sustainable Swine Nutrition*, pp. 23-57 [L.I. Chiba, editor]. Ames, Iowa: John Wiley & Sons
- Sauvant, D., Perez, J.-M., & Tran, G. (2004). Tables of composition and nutritional value of feed materials. Pigs, poultry, cattle, sheep, goats, rabbits, horses, fish. Paris: INRA Editions.
- Stein, H. H., Seve, B., Fuller, M. F., Moughan, P. J. & de Lange, C. F. M. (2007). Invited review: Amino acid bioavailability and digestibility in pig feed ingredients: Terminology and application. *Journal of Animal Science* 85, 172-180
- van Milgen, J., Valancogne, A., Dubois, S., Dourmad, J. Y., Sève, B. & Noblet, J. (2008). INRA Porc: A model and decision support tool for the nutrition of growing pigs. *Animal Feed Science and Technology* 143, 387-405