# Demo Optimeal 3.0

## Creating a healthy and sustainable lunch

▸opti meal◂

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**Creating a healthy and sustainable lunch**

▸opti meal◂

# 1. Contents

# 1.  Introduction

This report will guide you through your first encounter with Optimeal®. It is a demo to help you to grasp the purpose and possibilities of Optimeal®.

## 1.2  Challenge: Sustainable and healthy nutrition

The world's food system faces a great balancing act. By 2050 it must feed around 10 billion people in a more sustainable way: without increasing the area of agricultural land, using fewer natural resources and emitting less greenhouse gases. In addition, diets should be healthier, meet human nutritional needs and reduce disease risks such as non-communicable diseases, like obesity and cardiovascular disease. The research area of sustainable nutrition attempts to provide answers on how to meet these challenges.

A main challenge for all food and beverage producing companies is to anticipate on these health and sustainability challenges. Making better food and beverage products means, amongst others, creating a better balance between the nutritional value and environmental impact.

## 1.3  Why Optimeal?

Optimeal® is developed to help companies to create insight in their product's position regarding the balance between nutritional and sustainability aspects. It supports identifying the possibilities to improve the performance of products to make them future proof.

Optimeal came about from the fact that food and beverage items all have their specific nutritional contribution and cannot be simply compared to each other. For instance, milk and soy drink are marketed as alternatives but are not comparable from a nutritional viewpoint. These differences need to be considered when replacement is studied.

Optimeal analyses the impact of shifts between products in a diet or changes of a product's consumption by evaluating the effect on the complete diet and how the diet should optimally be adapted to these changes. The starting point can be an average diet based on national food consumption surveys or any other realistic and relevant diet for a target group. When changes in a reference diet are studied, for instance by changing from milk to soy drink, Optimeal will find the optimal adjustment to the new diet so it meets all the nutritional (and environmental) boundaries that have been set. During an optimization, product consumption is in or decreased to make this happen, compensating for the nutritional changes in this replacement of milk by soy drink.

## 1.4  How does Optimeal® work

Using optimization to gain insight into sustainable nutrition requires a lot of data. Optimeal comes with a default dataset for the EU. This dataset consists of:

1. Reference diet
2. Nutritional constraints
3. Nutritional properties for the products in the reference diet
4. Environmental properties for the products in the reference diet

### Demo: Healthy & sustainable lunch

In this demo a simple **lunch** is taken as a reference diet. The composition and constraints for the lunch are hypothetical to help you understand how Optimeal® works and how it can benefit your organization. Nutritional constraints for a healthy lunch have been set, as well as nutritional and environmental properties for the ingredients of the lunch and possible alternative products to add to the lunch. The details of the lunch, constraints and product properties will be discussed in Chapter 2.

### 1.4.1 Reference diet

The reference diet is the **starting point** of the optimization. It can be based on Food Consumption Surveys and is in that case representative for an average diet for a certain target group in the region of focus. For the **EU average** the EFSA Comprehensive European Food Consumption Database has been used. It is a source of information on food consumption across the European Union. It contains detailed data for many EU countries.

Products can be added to the reference diet/ dataset as well.

### 1.4.2 Nutritional constraints

**Nutritional constraints** determine whether a diet is healthy. The nutritional constraints are upper and lower boundaries for all the nutritional properties. The optimal diet falls in between the upper and lower boundaries. Additional constraints can be set for other properties, like **environmental properties** or **price**.

The nutritional constraints are based on EFSA Dietary Reference Values (EFSA, 2017)(EFSA, 2006) and can be adapted if needed for your purpose. Also additional constraints can be set, for instance on environmental impact or price of the diet.

### 1.4.3 Properties (nutritional and environmental)

Various **properties** of the products are needed to be able to optimize a reference diet. A great number of **nutritional properties** (like kcal energy, mg vitamin C, gram dietary fibre and mg magnesium) as well as **environmental properties** (like impact on climate change and land use) are part of the default dataset. Properties can also be added to the default dataset, for instance on price.

Nutritional properties of all the products in the reference diet are based on EFSA Food Composition Data (EFSA, 2018b). Environmental properties of all the products in the reference diet are determined using Life Cycle Assessment (LCA).

### 1.4.4 Optimization

The **optimal diet** is a diet that complies to the constraints that have been set for nutrition and environment, and that is as similar as possible to the reference diet. Reasoning behind this is that people find changing their dietary habits quite difficult and adoption of dietary changes is likelier to happen when the suggested diet is not that different from the reference diet.

### 1.4.5 Optimization example

The figure below shows how a 'starting' diet is optimized to a 'low carbon diet' that still meets all nutritional constraints, for instance for a recommended caloric input and vitamin, folate and iron sufficiency.
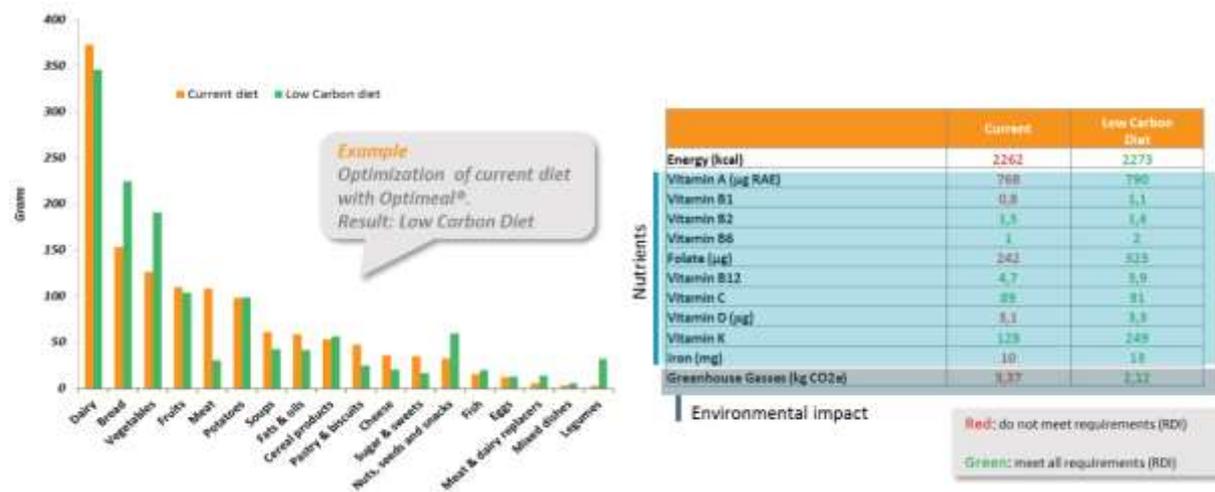
# 2 Getting started

## 2.1 Creating a new project

Start by creating a **new project** (red button). Select the 'demo dataset' from the drop-down list. Then select choose a gender (male or female) and push the red button to create your project.



You've now created your project and it will appear in the list of projects when you start using Optimeal the next time. You can choose to work on projects you have already worked on by clicking 'edit'.
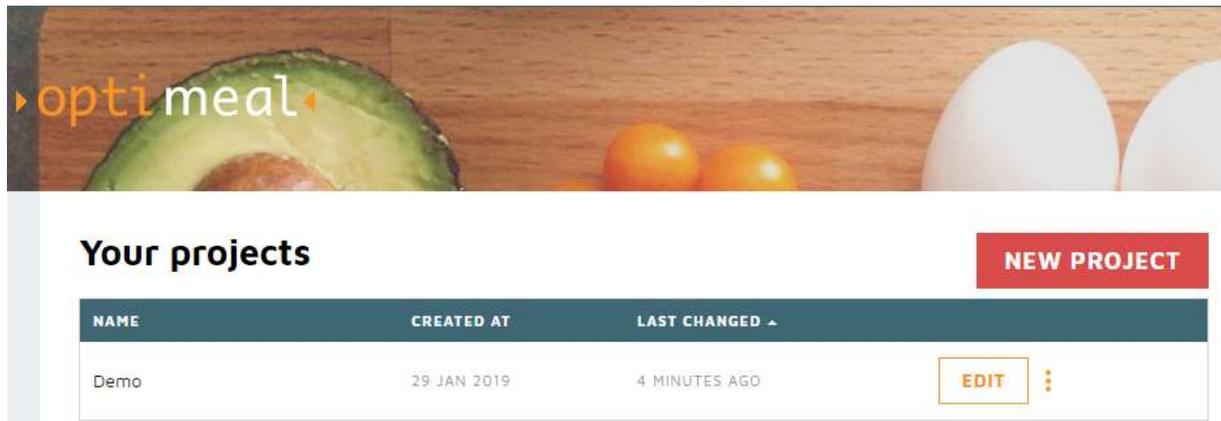


The project you are working on is shown in the right top corner of the screen. It is possible to create a new version of this project. This will be explained in chapter 5.1.

## 2.2 Getting to know the dataset

Start by exploring the 'food products' tab. On this screen you can view and edit all the food products that make up the diet (or in this case lunch) you will optimize. There are toggles to select which columns are visible:

- **Product constraints** – the minimum and maximum amount of a product you want to allow in the optimised diet.
- **Product properties** – amounts of nutrients and environmental impact per 100 grams of food product.
- **Reference diet** – the default diet which is used as a starting point.
- **Optimized diet** – the diet created by optimization. This toggle is only available when you've performed an optimization.



*Example:* *This lunch contains 100 grams of banana, 45 grams of beef (smoke-dried), 140 grams of bread (wholemeal average), 150 grams of orange juice (freshly squeezed) and 30 grams of sandwich chicken meat. You can check which food products contribute to the intake of a specific property by selecting the property of interest (e.g. carbohydrates) in the drop-down and clicking the title bar. This will change the order of the food products from the most contributing to intake of carbohydrate to the least contributing food product.*

When you're done exploring the 'food products' tab you can go to the **'properties'** tab. Properties are the characteristics that must be defined for every product. There are three types of properties:

- **Nutritional** – like protein, vitamin B12 and zinc. (amount)
- **Environmental** – like carbon footprint and land use. (amount)
- **A category** – which can be used to group products together – like fruits, meat products or dairy. (category)

This tab also contains toggles to select which columns are visible:

1. **Type** – the type of property and the unit in which it is expressed.
2. **Property constraints** – the lower (minimum) and upper (maximum) boundary which define what a healthy diet looks like.
3. **Reference diet** – the 'score' of the reference diet compared to the property constraints.
4. **Optimized diet** – the 'score' of the optimized diet compared to the property constraints.

| Enabled | Name | Type | | | Property constraints | | Reference diet | |
|---|---|---|---|---|---|---|---|---|
| | | Property type | Unit | | Minimum per day | Maximum per day | | Reference diet per day |
| ☑ | Carbohydrates total | Amount | kg | ⌄ | 0.04 kg | 0.1 kg | | 0.0921 kg |
| ☑ | Carbon footprint | Amount | kg CO₂eq | ⌄ | 0 | 7 kg CO₂eq | | 1.07 kg CO₂eq |
| ☑ | Energy | Amount | kcal | ⌄ | 201 kcal | 502 kcal | ± | 578 kcal |
| ☑ | Fat total | Amount | g | ⌄ | 8 g | 18 g | ⊤ | 5.86 g |
| | Fruits | Category | | | | | | |
| ☑ | Grams | Amount | g | ⌄ | 0 | 1000000 g | | 465 g |
| ☑ | Protein total | Amount | g | ⌄ | 10 g | 25 g | ± | 32.5 g |

_Example:_ _This lunch contains 578 kcal, which is too high, compared to the property constraints for energy (201-502 kcal). This is indicated by the yellow colour of the cell and the icon with the arrow pointing upward in the left of the cell, to indicate the upper constraint is exceeded._

# 3 Optimizing

The reference lunch does not comply to the property constraints which define a healthy and sustainable lunch in terms of energy (kcal), fat total (g) and protein total (g). This is corrected by using optimization, which will correct all the properties of the reference lunch by shifting amounts of ingredients.



Push the red button in the top right of the screen to select the conditions for the optimization.
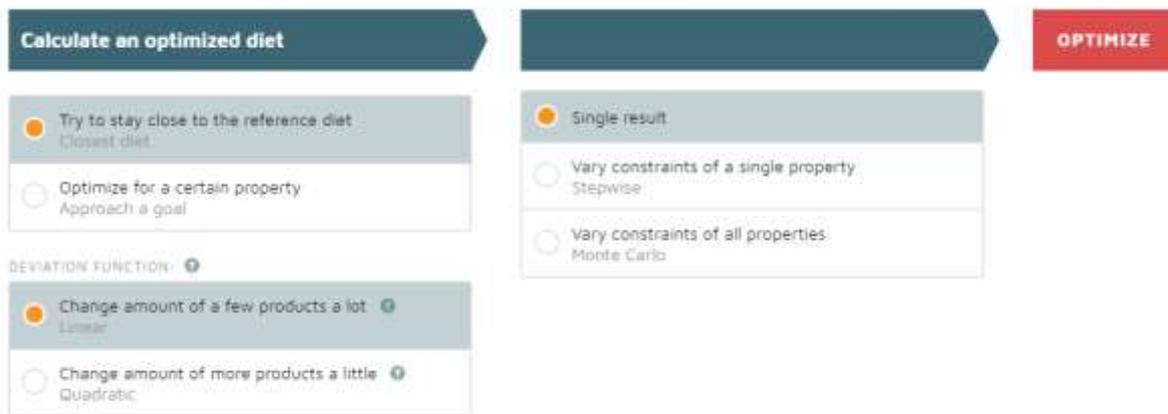


Select '**Try to stay close to the reference diet**' and '**change amount of a few products a lot**' and '**single result**'. These options, as well as the other options will be briefly explained later. Then, push the red button to optimize and when the optimization is done 'view optimized diet'.



| Enabled | Name | Property type | Unit | Minimum per day | Maximum per day | | Optimised diet 1 per day | | Change from reference diet |
|---|---|---|---|---|---|---|---|---|---|
| ✓ | Carbohydrates total | Amount | kg | 0.04 kg | 0.1 kg | | 0.0771 kg | | -16% |
| ✓ | Carbon footprint | Amount | kg CO₂eq | 0 | 7 kg CO₂eq | | 0.509 kg CO₂eq | | -53% |
| ✓ | Energy | Amount | kcal | 201 kcal | 502 kcal | ▼ | 502 kcal | | -13% |
| ✓ | Fat total | Amount | g | 6 g | 16 g | ▲ | 8 g | | 37% |
| | Fruits | Category | | | | | 0 g | | |
| ✓ | Grams | Amount | g | 0 | 1000000 g | | 409 g | | -12% |
| ✓ | Protein total | Amount | g | 10 g | 25 g | ▼ | 25 g | | -23% |

*Example: The property constraints have been corrected and fall either within or on a lower or an upper boundary. The optimized lunch contains 502 kcal, 8 gram of fat and 25 grams of protein. Also, these changes have decreased the carbon footprint of the lunch by 53%.*

Now go to the '**food products'** tab to view the optimized lunch.



| Enabled | Name | Reference diet | | | | Optimized diet | | |
| | | Reference diet gram per day | | Carbohydrates total | | | Optimised diet 1 gram per day | | Change from reference diet |
|---|---|---|---|---|---|---|---|---|
| ✓ | Bread wholemeal average | 140 | | 0.0546 kg | | | 104 | -26% |
| ✓ | Banana | 100 | | 0.0206 kg | | | 100 | |
| ✓ | Juice orange freshly sque... | 150 | | 0.0156 kg | | | 150 | |
| ✓ | Sandwich meat chicken | 30 | | 0.00111 kg | | | 12.8 | -57% |
| ✓ | Beef smoke-dried | 45 | | 0.000225 kg | | | | -100% |
| ✓ | Strawberries | 0 | | | | | | |
| ✓ | Salmon smoked | 0 | | | | | 42.7 | |
| ✓ | Milk semi-skimmed | 0 | | | | | | |

*Example: Changes have been made to 4 ingredients of the lunch. The optimized lunch contains 26% less wholemeal bread, 57% less chicken sandwich meat, and no smoke-dried beef. These changes have been compensated by 42.7 grams of smoked salmon.*

These changes are visualised in charts and graphs. Go to the charts and graphs by pushing the button in the top right of the screen.

## Charts and graphs
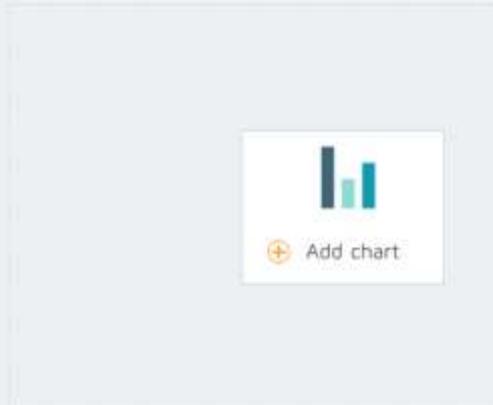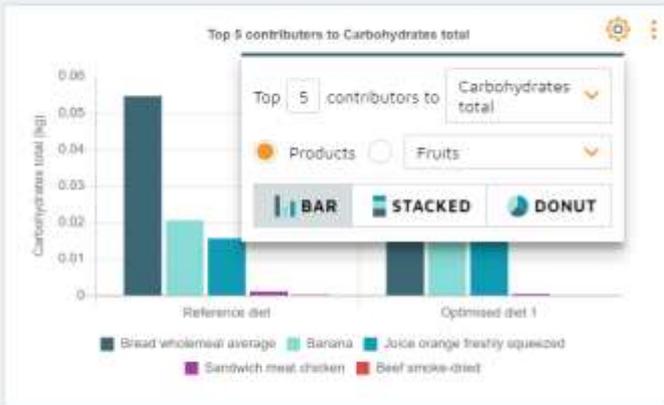


## Category table



| Name | Reference diet Per day | Optimized diet Per day | Change % |
|---|---|---|---|
| Banana | 100 | 100 | |
| Not fruit | 365 | 309 | -15% |
| Strawberry | | | |

A chart and table will be shown. The table contains the amount per food category (e.g. fruits) of the reference lunch and the optimized lunch, as well as the % of change. For this demo three categories have been identified: banana, not fruit and strawberry.

Add a chart and choose your preferred options:

- Bar, stacked or donut
- Top .. contributors to …. (property)



Charts can also be displayed per product category. Check the fruits instead of the products to display the contributors to (e.g.) carbon footprint in a donut chart.

# 4 Making changes

Changes can be made to fit the optimized diet to your wishes. You can make changes to amounts of product constraints or to property constraints. These changes will aid shaping the optimized diet to the goals you want to achieve.

Make changes in the product constraints in the 'food products' tab.



*Example: Let's say you do not want meat in your lunch. Change the maximum amount of chicken sandwich meat and the maximum of smoke-dried beef from 1000 to 0.00001 grams per day[1]. You can double click these cells to change its contents. Rerun the optimisation by pushing the circled arrows on the right side of the red optimization button. Check out the optimized lunch in the 'food products' tab, 'properties' tab and the 'charts and graphs'. These changes have also decreased the carbon footprint of the lunch, which is now 0.483 kg CO$_2$eq/day. You might want to decrease the carbon footprint even further.*

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[1] The upper and lower boundary cannot be exactly the same.

Show:  Type  Property constraints ✓  Reference diet  Optimized diet ✓

| Enabled ❓ | Name | Property constraints | | Optimized diet | |
|---|---|---|---|---|---|
| | | Minimum per day | Maximum per day | Optimised diet 1 per day | Change from reference diet |
| ✓ | Carbohydrates total | 0.04 kg | 0.1 kg | 0.0779 kg | -15% |
| ✓ | Carbon footprint | 0 | 7 kg CO₂eq | 0.483 kg CO₂eq | -55% |
| ✓ | Energy | 201 kcal | 502 kcal | 502 kcal | -13% |
| ✓ | Fat total | 8 g | 18 g | 8 g | 37% |
| | Fruits | | | 0 g | |
| ✓ | Grams | 0 | 1000000 g | 404 g | -13% |
| ✓ | Protein total | 10 g | 25 g | 24.1 g | -26% |

*Example: Change the upper boundary of the property constraints for carbon footprint from 7 to 0.4 kg CO2eq. Rerun the optimization. Check out the optimized lunch in the 'food products' tab, 'properties' tab and the 'charts and graphs'.*

These are the basics of Optimeal 3.0. There are more features to help you to optimize future products and diets in terms of sustainability and health. These features are explained in the next chapter.

# 5 Other features

## 5.1 Versions

Sometimes it can be handy to create a parallel project. For instance, if you are considering adding a supplement to a food product and are contemplating between two food products. You would be able to change the settings of these two food products in a new version of your project, leaving your original project as it is. Using versions also allows you to compare results to one another. This will aid the decision making.



*Example: Create a new version by clicking 'versions' (1) in the top right of the screen and then push the red button (2) to create a new version. Tick the tick-box (3) to show the differences between the two versions of the projects.*

Now you can alter settings in the dataset which are of interest to you. When you alter a cell the colour of the cell changes and you can enter a comment to help you remember why you changed the contents of the cell. You can always return to the original value by clicking the circled arrow (see next page).

| Enabled? | Name | Minimum gram per day | Maximum gram per day | Carbohydrates total kg in 100g product | Carbon footprint kg CO₂eq in 100g product |
|---|---|---|---|---|---|
| ✓ | Banana | 0 | 1000 | 0.0206 kg | 0.0979 kg CO₂eq |
| ✓ | Beef smoke-dried | 0 | 0.000001 | 0.0005 kg | 1.42 kg CO₂eq |
| ✓ | Bread wholemeal average | 0 | 1000 | 0.039 kg | 0.0896 kg CO₂eq |
| ✓ | Juice orange freshly sque... | 0 | 1000 | 0.0104 kg | 0.0717 kg CO₂eq |
| ✓ | Milk semi-skimmed | 0 | 1000 | 0.0046 kg | 0.118 kg CO₂eq |
| ✓ | Salmon smoked | 0 | 1000 | 0 kg | 0.385 kg CO₂eq |
| ✓ | Sandwich meat chicken | 0 | 0.000001 | 0.0037 kg | 0.2 kg CO₂eq |
| ✓ | Strawberries | 0 | 1000 | 0.0051 | |

+ ADD ROW

✎ PRODUCT CREATOR ❓

"DEMO" VALUE
0.355766 ⊗

COMMENT
more efficient chicken meat production

## 5.2 Linear and quadratic programming

Optimeal® uses either Linear (LP) or Quadratic programming (QP). Every deviation from the reference diet comes with a penalty. The optimization strives to achieve the least amount of penalties. The reasoning behind this principle is that a diet that is close to the reference diet is more achievable, as consumers tend not to want to make large changes to their diet.

Using LP the penalties are attributed in a linear way, which means that every change comes with the same amount of penalty. With QP the amount of penalty per amount of change increases in a quadratic way. Using LP a few products are changed a lot, while with QP more products are changed a little.
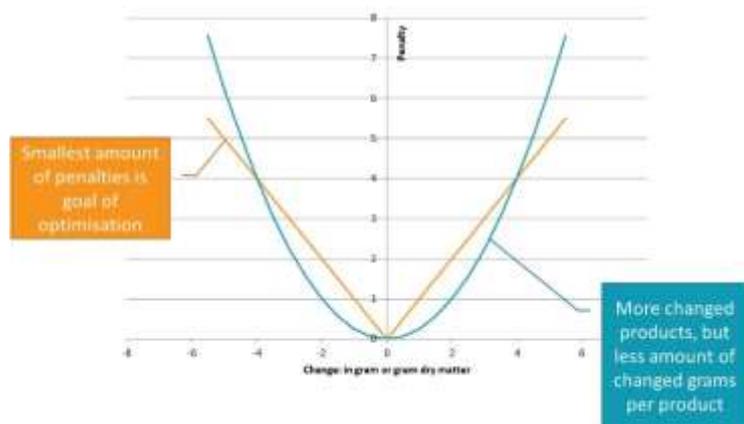
The result of QP can be more realistic when investigating future diets. LP can be a good fit when investigating possible directions for change on the level of food categories.

Smallest amount of penalties is goal of optimisation

More changed products, but less amount of changed grams per product

The effect with the demo dataset is minor because it contains a relatively small amount of products.

## 5.3 Approach a goal

Approach a goal allows you to achieve a minimum or maximum of a specific property. This feature is handy for instance to investigate what the minimum carbon footprint of the diet would be, while maintaining all the property and product constraints. This means the target is achieved while still complying to the definitions of a healthy diet.

*Example: In the optimization setting, select 'Optimize for a certain property' and select to optimize for the property 'carbon footprint'. Tick to minimize the amount of carbon footprint and push the red button to optimize. The minimum carbon footprint of the lunch with these ingredients, that complies to all the property constraints that have been set, is 0.293 kg CO₂eq per day.*

## 5.4 Stepwise optimization

With stepwise optimization you can do multiple optimizations in one go. Stepwise optimization is useful when you want to investigate the role of a specific food product or food category in a healthy and sustainable diet. It is possible to grasp the effect on environmental indicators with varying amounts of product in a diet.

The balance between nutrition and the sustainability impact (e.g. environmental impact) is the key for determining whether a product is future proof. This is called the **sustainability nutrition balance** (SNB). A product that provides nutrients which improve the quality of the current diet with a low sustainability impact will have a better SNB-score than a product that contains nutrients that we tend to consume in excess (like salt or saturated fat) and/ or with a high sustainability impact. Optimeal can assist in understanding the SNB-score, and aid in product development for improvement of the SNB-score.

## Calculate an optimized diet

- ● Try to stay close to the reference diet
  Closest diet
- ○ Optimize for a certain property
  Approach a goal

DEVIATION FUNCTION ●

- ○ Change amount of a few products a lot ●
  Linear
- ● Change amount of more products a little ●
  Quadratic

- ○ Single result
- ● Vary constraints of a single property
  Stepwise
- ○ Vary constraints of all properties
  Monte Carlo

VARY CONSTRAINTS OF

Milk semi-skimmed

CONSTRAINT STEPS

Start at: 0 gram per day

End at: 300 gram per day

Number of steps: 7

THESE STEPS WILL BE TAKEN:

| STEP | MILK SEMI-SKIMMED CONSTRAINT |
|------|------------------------------|
| 1 | 0 gram per day |
| 2 | 50 gram per day |
| — | |
| 6 | 250 gram per day |
| 7 | 300 gram per day |

*Example: Let's investigate whether semi-skimmed milk has a positive role in a future healthy and sustainable lunch. Go to the optimization settings. Select 'Try to stay close to the reference diet' and 'change amount of more products a little' and 'vary constraints of a single property'. We are going to vary the constraints of semi-skimmed milk, between 0 and 300 gram per day in 7 steps. Then press the red button to optimize.*



*The relative results of all the steps are displayed to the right of the screen. The carbon footprint of the lunch increases with increasing amount of semi-skimmed milk, while the other properties stay almost the same. The results of step 1 (of 7 in this case) are displayed as the optimized results.*

### 5.4.1 SNB-score

The SNB-score can be calculated from the charts and graphs. The SNB score is the direction coefficient of the line as displayed below. The lower the SNB score the more future proof the product is. You can use this principle to improve your products. For instance, for semi-skimmed milk it would be possible to investigate if the SNB-score would decrease when you would add vitamin D as a supplement. When the SNB-score is negative (below 0) it means that the environmental impact of the diet can decrease when more of the product is consumed.
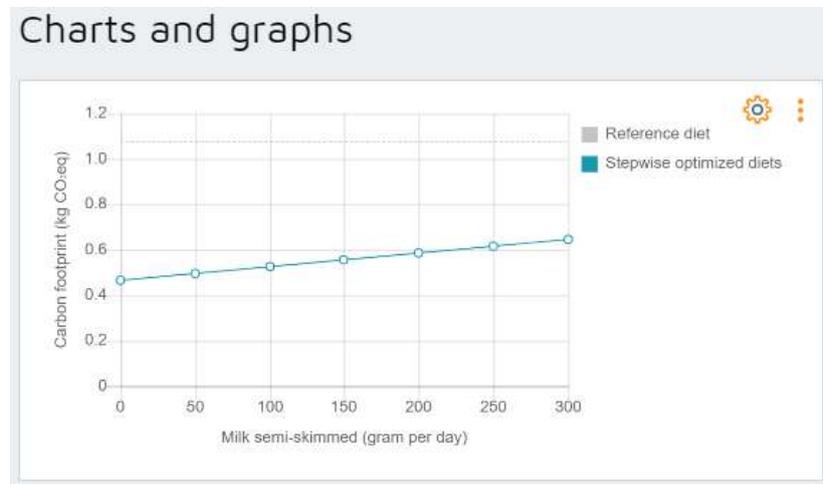


## 5.5 Monte Carlo analysis

The product properties are not set in stone and can vary for all kinds of reasons. The optimized result is one out of many possible solutions. Monte Carlo analysis is incorporated in Optimeal® 3.0 to be able to understand the extent to which the optimized result is certain.

The variability of the property products is approximated using a normal distribution and a standard deviation. The standard deviation is equal between properties and products. In a future update we hope to differentiate the standard deviation between properties which are quite certain versus properties that come with a larger uncertainty.



You can use this uncertainty analysis via the optimization settings, by ticking the box for 'vary constraints of all properties'. You can pick a number of iterations to include for the Monte Carlo analysis.

| Enabled | Name | Monte Carlo result gram per day | Change from reference diet | Monte Carlo boxplot |
|---|---|---|---|---|
| ✓ | Banana | 85.3 | -15% | |
| ✓ | Beef smoke-dried | | -100% | |
| ✓ | Bread wholemeal average | 115 | -18% | |
| ✓ | Juice orange freshly sque... | 143 | -5% | |
| ✓ | Milk semi-skimmed | 2.71 | | |
| ✓ | Salmon smoked | 45.5 | | |
| ✓ | Sandwich meat chicken | | -100% | |
| ✓ | Strawberries | | | |

*Example: In the Monte Carlo boxplot it is visualised where 95% of the solutions are, and where the minimum and the maximum lie. The relative distribution is represented for the food products, which ensures that the boxplots can be compared between one another to understand relative uncertainty. For the food properties it is the actual distribution which is shown, as the properties cannot be compared to one another.*

## 5.6 Adding products and properties

You might want to add products to the dataset to be able to introduce your product into the reference or optimized diet. You might also want to add properties to be able to integrate your companies KPIs into the dataset and investigate the performance.



It is possible to add new food products in the 'food products' tab by clicking '+ add row'. It is also possible to add new properties in the 'properties' tab by clicking '+ add amount property'.

## 5.7 Product Creator

The product creator will give insight into the nutritional and environmental profile of your new product. You can alter ingredient combinations to identify the optimal composition for the intended market. When you are satisfied with the product composition, you can introduce the new product into a diet for a thorough analysis of how it can make the best contribution to a balanced diet.
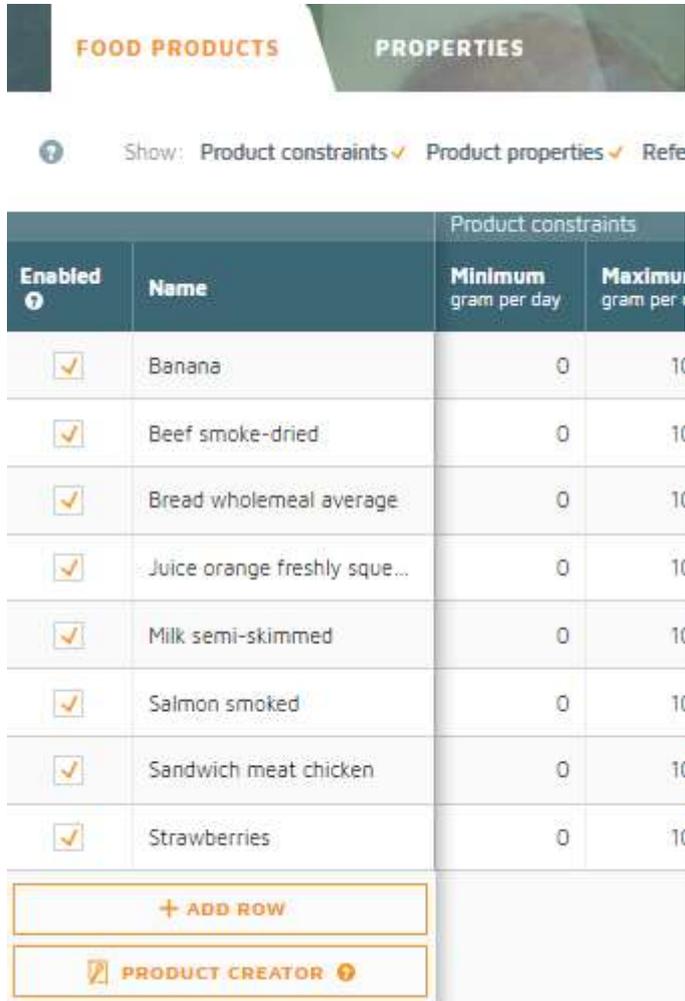
**FOOD PRODUCTS**   **PROPERTIES**

Show: Product constraints ✓  Product properties ✓  Refe

| Enabled ❓ | Name | Product constraints | |
|---|---|---|---|
| | | Minimum gram per day | Maximum gram per |
| ✓ | Banana | 0 | 10 |
| ✓ | Beef smoke-dried | 0 | 10 |
| ✓ | Bread wholemeal average | 0 | 10 |
| ✓ | Juice orange freshly sque… | 0 | 10 |
| ✓ | Milk semi-skimmed | 0 | 10 |
| ✓ | Salmon smoked | 0 | 10 |
| ✓ | Sandwich meat chicken | 0 | 10 |
| ✓ | Strawberries | 0 | 10 |

+ ADD ROW

▣ PRODUCT CREATOR ❓

| Ingredient name | Ingredient amount gram in 100g product | Carbohydrates total g per 100g ingredient | Carbon footprint kg CO₂eq per 100g ingredient | Energy kcal per 100g ingre |
|---|---|---|---|---|
| flour | 15 | 60 | 0.04 | |
| water | 45 | 0 | 0.005 | |
| tomato paste | 20 | 20 | 0.12 | |
| cheese | 10 | 5 | 1 | |
| salt | 2 | 0 | 0.005 | |
| olive oil | 8 | 0 | 0.8 | |

Product creator ❓ — Product name: Pizza margherita — Amount in reference diet (g): 25

+ ADD INGREDIENT

| Total property amount: % of reference diet: | **13.5 g** 0% | **0.196 kg CO₂eq** 4% | **0 kcal** 0% |
|---|---|---|---|

*Example: Press the 'product creator' in the bottom left of the screen and enter the name of your product. We've chosen a pizza. Define the amount of this product in the reference diet. Add ingredients and the amount of each ingredient per 100 gram of product. You'll also need to enter all the properties per 100 gram of ingredient to be able to take all nutritional properties into consideration for the optimization. You can use the % of the reference diet to alter the amounts of the ingredients to the type of product you want to develop for your target group. This pizza margherita contains 13.5 gram carbohydrates per 100 gram of product. When you are satisfied with your product you can push the red button to the top right of the product creator: 'update product'. This will insert your product into the reference diet, which allows for optimisation in the context of the diet.*

Products from the product creator can be disabled to skip them from the optimization, but they cannot be deleted from the dataset.

## 5.8  Creating your own full dataset

You can use the features of Optimeal® 3.0 with your own dataset. It is possible to develop your own dataset using Excel and upload it into the tool.

This feature is however still under construction and will be added in a near future update.

# 6 Want to know more?

Thank you for your interest in Optimeal® 3.0. We hope you have been able to enjoy its features. If you have any questions, please do not hesitate to get in touch. We will be happy to assist!
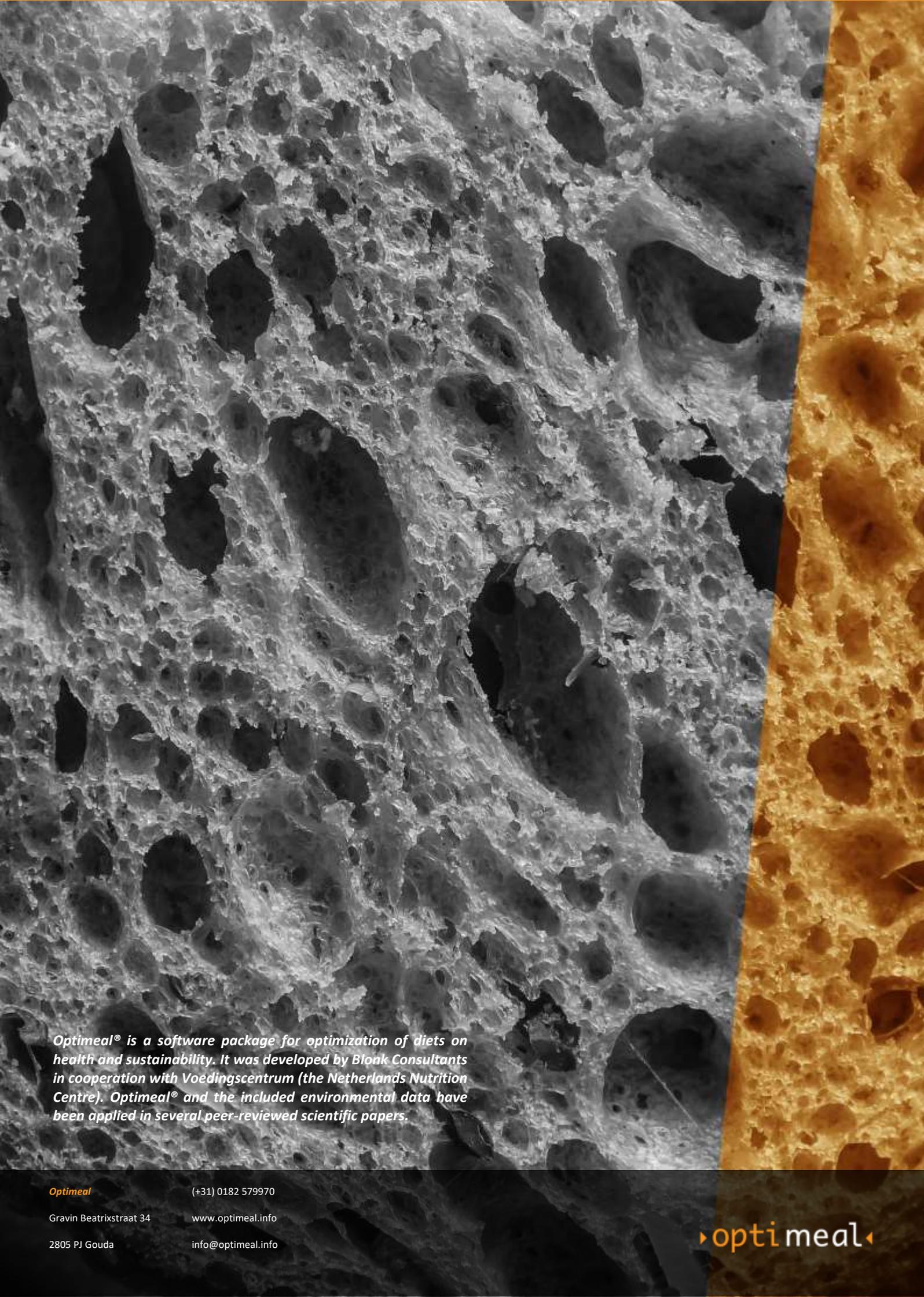
Do you see the possibilities of Optimeal® 3.0 for your organization? Get in touch for license possibilities.

Sincerely,

On behalf of The Optimeal Team,

Roline Broekema and Meike van de Wouw

info@optimeal.com

Optimeal® is a software package for optimization of diets on health and sustainability. It was developed by Blonk Consultants in cooperation with Voedingscentrum (the Netherlands Nutrition Centre). Optimeal® and the included environmental data have been applied in several peer-reviewed scientific papers.

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