Discover Engevita®

HIPRO BEYOND

Engevita® HiPRO Beyond is a very mildly flavored yeast protein containing all essential and branched chain amino acids.

MINIMUM 80% PROTEIN
FROM BAKER'S YEAST
(SACCHAROMYCES CEREVISIAE)

CLEAN FLAVOR AND SMELL
SUITABLE FOR SWEET AND SAVORY APPLICATIONS

SEAMLESS INTEGRATION IN FOOD
IT DOESN'T ALTER THE NATURAL CHARACTERISTICS OF THE FOOD MATRICES.

COMPLETE AND SAFE PROTEIN
INCLUDING BRANCHED CHAIN AMINO ACIDS

SUSTAINABLE PROTEIN
A GLOBAL NEED

NON-ANIMAL SOURCE
SUITABLE FOR VEGETARIAN AND VEGAN APPLICATIONS

REGULATORY STATUS
CONTACT US FOR DETAILS

Harnessing the goodness of
yeast protein in food applications

Lallemand Savory Ingredients

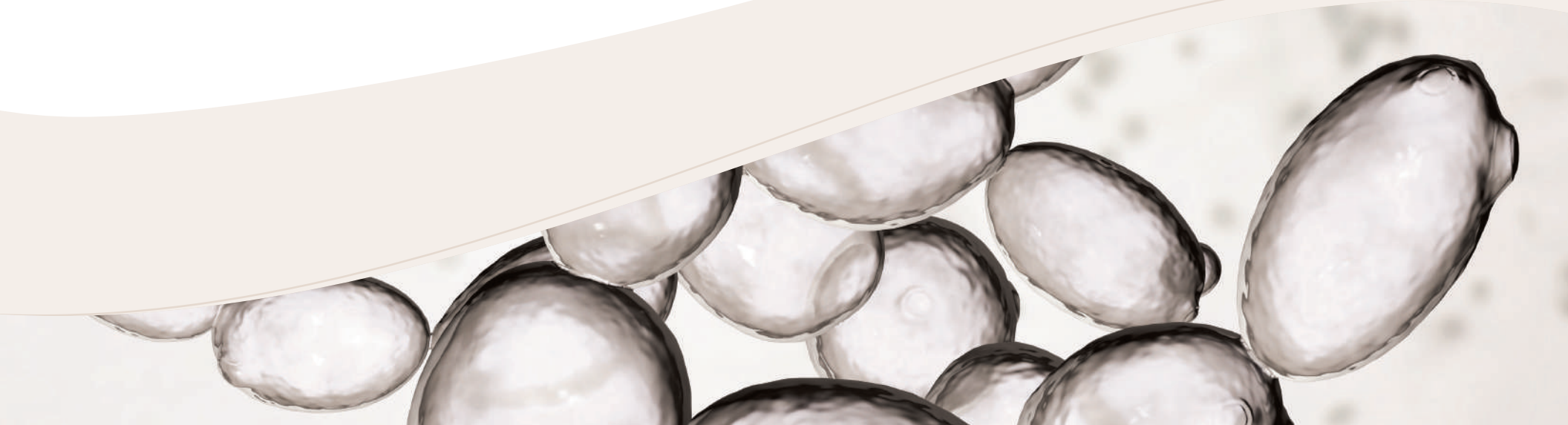
LALLEMAND

LALLEMAND BIO-INGREDIENTS

Minimum
80% Protein

Engevita® HiPRO Beyond is a very mildly flavored yeast protein from *Saccharomyces cerevisiae*, also known as baker's yeast. **Engevita® HiPRO** Beyond is a complete protein containing all essential and branched chain amino acids. It is a source of high quality, gluten free, vegan protein. It is allergen-free and non-GMO.

Engevita® HiPRO Beyond is suitable for a wide range of foods, where a dependable and sustainable source of protein is desired to enrich or complete the nutritional profile.



Seamless integration in food

Enhancing Food Quality without compromising taste, texture, or appearance.

In the realm of food formulation, maintaining the integrity and sensory appeal of complex food matrices is crucial. Introducing ingredients that seamlessly integrate without altering the natural characteristics of the food can significantly enhance product quality. This is where the concept of "inert" ingredients becomes invaluable.

Engevita® HiPRO Beyond harmoniously blends into complex food matrices without causing unwanted changes. It acts as a supportive element, enhancing nutritional content without compromising taste, texture, or appearance.

✓ **Preserves Taste and Texture:**

Unlike other alternative protein sources, that may alter flavor profiles or textures, **Engevita® HiPro Beyond** maintains the authentic taste and texture of the food it enriches with its nutritional profile. This ensures a consistent and enjoyable eating experience for consumers.

✓ **Supports Nutritional Goals:**

Engevita® HiPRO Beyond provides high-quality protein that complements diverse dietary needs.

✓ **Versatility in Applications:**

Due to its nature, **Engevita® HiPRO Beyond** can be seamlessly incorporated into various food applications - from meat alternatives to dairy analogs, enhancing their nutritional content without compromising production processes.

✓ **Processability:**

Choosing our protein means selecting a product that not only excels in stability under extreme heat treatments like UHT but also avoids the negative impacts of Maillard reactions. This combination of features ensures that your food and beverage products will deliver superior quality, consistent taste, and excellent nutritional value, even after rigorous processing.

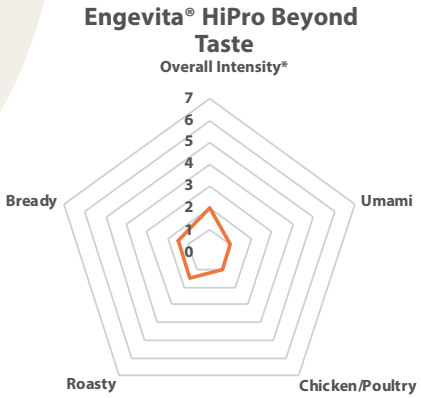
Clean Flavor and smell

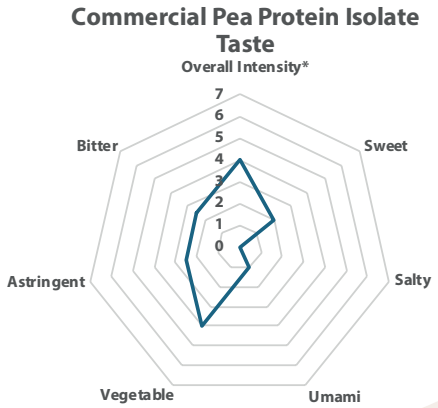
Suitable for Sweet and Savory applications

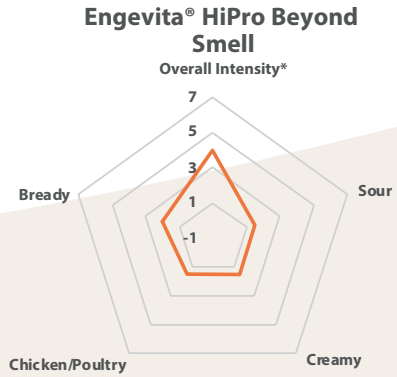
Alternative proteins, including plant-based options, often come with distinct taste profiles that can sometimes include off-tastes. These off-tastes are typically characterized by bitterness, astringency, and sometimes earthy or beany flavors.

- **Bitterness** is a common attribute in many plant proteins and can be attributed to the presence of certain compounds such as saponins and phenolics.
- **Astringency**, which creates a dry, puckering sensation in the mouth, is another frequent characteristic and is often linked to tannins and certain proteins.
- **Earthy or beany flavors** are particularly noticeable in legume-based proteins, reflecting the natural taste of the source ingredient.

Engevita® HiPRO Beyond stands out for its significantly milder and more neutral profile, making it an excellent choice for enhancing nutritional content without compromising the taste of your food products.







Taste and Smell comparison

Engevita® HiPRO Beyond and a commercial pea protein isolate.

Methodology

- The samples were suspended in hot water to reach a 2% w/w suspension. The 2% w/w suspensions (40 mL) were served hot in a glass container to each assessor for organoleptic analysis (N = 2, n = 2).
- Two main organoleptic modalities were investigated, i.e., smell and taste.
- The participants select relevant terms from a given list and rate their intensity using a numerical scale of 1 to 9 where 1 refers to "very low"; 5 to "moderate" and 9 to "very strong".

The product comparison conducted at an external, renowned lab reveals that commercial pea protein isolate is characterized by strong vegetable notes, including distinct pea odor and taste, as well as noticeable bitterness and astringency.

In contrast, **Engevita® HiPRO Beyond** exhibits the lowest average scores in these sensory attributes. Importantly, none of the samples, including **Engevita® HiPRO Beyond**, exhibited any cheesy odor, fermented taste, off-odor, or off-taste, ensuring a pleasant and consistent sensory experience.

Cheese and cheese analogues

VEGAN PARMESAN CHEESE - GLUTEN-FREE

LALLEMAND'S CHOICE

A plant-based cheese which features some of the traits of traditional cheese, such as a rich mouthfeel and umami. A savory flavor obtained with no fermentation process or aging.

Savor-Lyfe® CA gives cheesy flavor and **Engevita® HiPRO Beyond** increases protein concentration: (Control 0.004, Enhanced 6.9%)

INGREDIENTS	QUANTITY	
	Control % by weight	Enhanced % by weight
Water	45.57	41.92
Coconut oil (refined)	27.17	25.00
Potato starch	26.09	24.00
Engevita® HiPRO Beyond	**-**	**8.00**
High-Lyfe® 605 A	**0.65**	**0.60**
Savor-Lyfe® CA	**0.43**	**0.40**
Curcuma extract	0.09	0.08
TOTAL	100.00	100.00

DIRECTIONS

1- Combine all ingredients into a Thermomix mixer.
2- Pre-mix in Thermomix for 2 minutes, Thermomix Speed 3.
3- Steam for 45 minutes.
4- Transfer to molds. Allow to set at 4°C.
5- Recommended resting time to cube, slice or shred, Day 3-5.

THIS APPLICATION IS:

GLUTEN FREE VEGAN

Complete and safe protein

A complete protein, by definition, contains all the essential amino acids (EAA), including branched chain amino acids (BCAA). Complete proteins are usually from animal-based sources of nutrition, and soy as a plant-based source. Some EEA may be found in plant-based proteins, however, these are usually incomplete proteins. **Engevita® HiPRO Beyond** is a non-animal source complete protein, containing all EAA and BCAA.

Essential amino acids (EAA): These are amino acids that humans and other vertebrates cannot synthesize from metabolic intermediates and therefore they must be supplied by the diet. Those include histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.

Branched chain amino acids (BCAA): BCAA are essential amino acids and are synthesized in bacteria, plants, and fungi, but not in animals. The group includes isoleucine, leucine, and valine.

BCAA, and specifically leucine, are important for protein synthesis and muscle building, as they contribute to anabolism.

			(% of raw material)									
			Protein content	Histidine	Isoleucine	Leucine	Lysine	Cyr +Met (SAA)	Phe + Tyr (AAA)	Threonine	Valine	ΣEAA (%)
		FAO reference pattern (%)		1.9	2.8	6.6	5.8	2.5	6.3	4.8	3.5	
	Animals*	*Human muscle*	84	2.8	3.4	6.3	6.6	1.7	5.8	2.9	4.3	33.8
	Animals*	Milk	78	1.9	2.9	7.0	5.9	2.3	7.3	3.5	3.6	34.4
	Animals*	Egg	51	0.9	1.6	3.6	2.7	1.8	4.1	2.0	2.0	18.7
	Yeast	**Engevita® HiPRO Beyond**	81	2.2	4.6	7.1	7.5	2.2	7.8	4.2	5.3	41.0
Commercial plant-based protein isolates*	Cereales	Wheat	81	1.4	2.0	5.0	1.1	1.4	4.9	1.8	2.3	24.0
Commercial plant-based protein isolates*	Cereales	Corn	65	1.1	1.7	8.8	1.0	1.4	6.1	1.8	2.1	24.1
Commercial plant-based protein isolates*	Cereales	Brown rice	79	1.5	2.0	5.8	1.9	2.6	7.2	2.3	2.8	26.1
Commercial plant-based protein isolates*	Pulses	Soybean	80	1.5	1.9	5.0	3.4	0.5	5.4	2.3	2.2	22.2
Commercial plant-based protein isolates*	Pulses	Pea	80	1.6	2.3	5.7	4.7	0.5	6.3	2.5	2.7	26.3
Commercial plant-based protein isolates*	Tubers	Potato	80	1.4	3.1	6.7	4.8	1.6	8.0	4.1	3.7	33.4

Engevita® HiPRO Beyond EEA content is superior FAO reference pattern for Essential Amino Acids.

Gorissen et al (2018). Protein content and amino acid composition of commercially available plant-based protein isolates. Amino acids, 50, 1685-1695

Non-animal source

Suitable for vegetarian and vegan applications

Proteins comprise an important macronutrient in the diet, providing nitrogen and amino acids, which play a role in the synthesis of muscles, hormones, enzymes and other important structural or functional elements of the body. Protein-rich animal-derived foods, including meat, dairy and egg products are the source of most protein to many populations.

Risk related to high animal protein diets.

High consumption of protein-rich animal derived products (e.g. beef, pork, lamb) has a detrimental impact on both health and the environment. In addition, the increasing demand of protein, globally, has made eating meat an unsustainable practice.

Transitioning to a more sustainable diet is a way to reduce the environmental footprint while also delivering health benefits to the consumer.

Typical amino acid (AA)composition of Engevita® HiPRO Beyond.

Total AA (g/100g)	
Histidine	2.3
Serine	4.4
Arginine	4.7
Glycine	4.0
Aspartate + Aparagine	10.8
Glutamate + Glutamine	10.9
Threonine	4.5
Alanine	5.4
Proline	3.3
Cysteine	0.6
Lysine	8.1
Tyrosine	3.8
Methionine	1.7
Valine	5.7
Isoleucine	4.9
Leucine	7.6
Phenylalanine	4.4
Tryptophan	1.2
Amino Acid Score	**1.16**
In Vitro Protein Digestibility	**90.5**
In Vitro PDCAAS	**1.05 ≈ 1.0**

	Vegan	Protein quality (complete protein)	Allergen-free	Sustainable	Mild Flavor	Digestibility
Engevita® HiPRO Beyond	●	●●	●	●●	●●	●●
Whey		●●			●●	●●
Soy	●	●		●		●
Pea	●	●		●		●
Pumpkin seed	●	●	●	●	●	●

Yeast protein and other alternative protein concentrates were studied, along with a whey protein concentrate as reference, to determine their protein composition, digestibility and quality.[6]

The results revealed that yeast protein concentrate has a high IVDIAAS*, comparable to whey protein and higher than corn, pea and potato protein.[6*]

*The FAO recommends the digestible indispensable amino acid score (DIAAS) as the measure for protein quality, for which the true ileal digestibility needs to be assessed in humans or pigs. However, due to high costs and ethical concerns, the FAO strongly encourages validated in vitro methods, which complement the in vivo experiments.[7]

Alternative Proteins – Antinutritional Factors

Several alternative protein sources can contain antinutritional factors, which can affect their nutritional quality and digestibility. Naturally occurring antinutritional factors (ANFs) such as cyanogenic glycosides, lectins, saponins, tannins, phytic acid, trypsin inhibitors, alpha-galactosides, and oxalates are found in plant materials. ANFs are known to have some adverse effects on human health. Common health concerns associated with ANFs include vomiting, bloating, and reduced bioavailability of minerals and proteins.

For example, legumes (e.g., soy, pea, lentil, chickpea) contain antinutritional factors such as lectins, saponins, tannins, phytic acid, trypsin inhibitors, and oligosaccharides. These compounds can interfere with protein digestion and mineral absorption and may cause gastrointestinal discomfort.

Saccharomyces cerevisiae, commonly known as baker's yeast, does not inherently contain antinutritional factors. In fact, it is often used in fermentation processes to reduce antinutritional factors in plant ingredients.

- **Engevita® HiPRO Beyond** offers advantages in this regard, as it does not contain any antinutritional factors.

Microbial Safety Considerations in Protein Production

Yeast cells are cultivated in aseptic fermenters, ensuring a controlled environment free from contaminants. In contrast, plant raw materials and seeds are grown in soil, where they may encounter various telluric microorganisms, including resilient structures known as spores. Microbial spores are designed for survival under adverse conditions and typically require thermal or pressure-assisted thermal processing for effective inactivation.

Studies have shown that moist heat treatments, such as exposure to very high temperatures (e.g., 89°C for 2 hours), can denature proteins in spores of bacteria like *B. subtilis, B. cereus, B. megaterium*, and *Clostridium perfringens*.

Microbial spores, which are prevalent in the soil of agricultural crops, form the basis of microbiological hazards in plant-based products. Crops like soy, pulses, wheat, or potatoes are exposed to a variety of microorganisms during cultivation, including those from soil, water, and air. If these microorganisms contaminate the crop, they can potentially affect the quality and safety of proteins isolated from it. The extent and type of contamination vary significantly based on product type, processing methods, and seasonal conditions.

- **Engevita® HiPRO Beyond** offers microbiological safety advantages compared to other alternative proteins derived from agricultural sources.

Protein Content Accuracy

In protein concentrates or isolates, the protein content is typically estimated by multiplying the nitrogen content by a nitrogen-to-protein conversion factor of 6.25 (N% * 6.25).

The nitrogen content and conversion factor (K) of a specific foodstuff can be calculated based on knowledge of the amino acid composition or sequence of all the constituent proteins in the source. This calculation is illustrated in the table below:

Table : Conversion factors from AA analysis (Mariotti et al., 2008)

Animal Sources			
Milk	5.85		
Casein	6.15	6.15	
Chesse	5.85		
Beef	5.57	5.38	
Chicken	5.53		
Fish	5.72	5.43	5.59
Whole egg	5.61	5.74	5.74

Plant sources			
Barley	5.50	5.40	
Triticale	5.36	5.62	
Oats	5.36	5.32	
Rye	5.33	5.35	
Millet	5.30	5.63	
Wheat (whole)	5.66	5.33	5.49
Wheat flour	5.43	5.59	5.53
Wheat germ	4.99		

Plant sources				
Wheat bran	5.20	4.71		
Buckwheat	5.24			
Rice	5.37	5.47	5.65	
Corn	5.61	5.59	5.65	
Soybean or Soybean flour	5.64	5.52	5.44	
Pea	5.24	5.40	5.44	5.40
Lupine	5.47	5.40		
Dry bean	5.28			

It appears that the conversion factor of 6.25, used to estimate protein content by multiplying nitrogen content, is typically accurate for dairy proteins. However, for plant proteins, including pulses, more specific conversion factors ranging from 4.99 to 5.62 are often more appropriate based on their amino acid profiles. For **Engevita® HiPro Beyond**, the conversion ratio has been calculated at 6.24, tailored to the amino acid profile of the yeast protein isolate.

- The indicated protein content for **Engevita® HiPro Beyond** is accurate when calculated using N% * 6.25. Conversely, in the case of pulse protein isolates, the protein content is often overestimated by approximately 15% when using the standard.

Nitrogen Content=Protein Content×K100\ text{Nitrogen Content} = \ frac{\text{Protein Content} \times K}{100}Nitrogen Content=100Protein Content×K

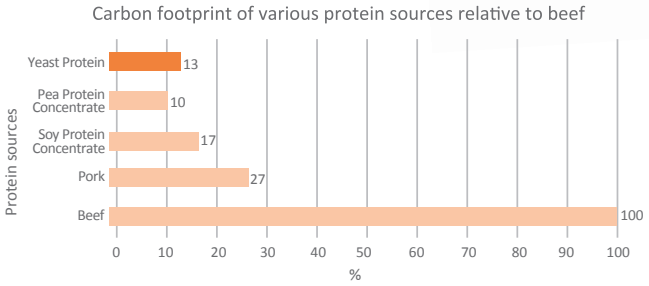
Where:

- **Nitrogen Content:** Percentage of nitrogen in the sample.
- **Protein Content:** Percentage of protein in the sample.
- **K:** Conversion factor specific to the source material.

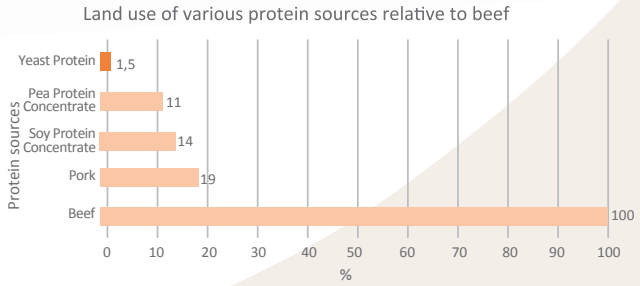
This method ensures accurate determination of protein content in various foodstuffs, leveraging detailed understanding of their protein composition.

Sustainable Protein

The carbon footprint and land use of protein yeast production.[1]



When comparing the relative carbon footprint, the value found for yeast protein (13) was much lower than beef (100) and pork (27) and comparable to soy protein concentrate (17) and pea protein concentrate (10).



In terms of relative land use yeast protein is extremely competitive (1.5) compared to beef (100), pork (19), soy protein concentrate (14) or pea protein concentrate (11).

Yeast is a microbe that serves as a valuable source of single cell protein (SCP), relying on fermentation technology.

From a food security perspective, yeast protein presents a compelling alternative as its production is independent of seasonal constraints and can be achieved relatively quickly. Fermentation can be likened to a new form of farming [2-3]. Yeast is recognized for its superior nutritional quality, making it a desirable source for SCP production[4]. The use of controlled systems called "bioreactors" for SCP production is gaining attention from both research and industry. Moreover, yeast protein requires minimal arable land and does not directly compete with crop-based food commodities. [5-6]

Yeast protein production is part of a circular economy where the substrate used in fermentation, such as molasses (a byproduct of the sugar industry derived from beetroots), is efficiently utilized. Vinasses, a byproduct of yeast production, can in turn be used as natural fertilizer for sugar beetroots and other crops [7-8].

Given the global population growth, yeast protein emerges as an attractive alternative to traditional protein sources like plants and meat. Yeast protein biomass also contains essential trace minerals and vitamins, including B-vitamins. Overall, nutritional yeast protein biomass represents a sustainable option for both human and animal nutrition, with a low environmental footprint.

Regulatory Status

Yeast protein, such as HiPRO Beyond, can be used to complement the nutritional profile of prepared meals and foods. Saccharomyces cerevisiae protein is not a novel food, rather, it is a traditional food ingredient that has been consumed in Europe for years through yeast present in foods. In the US, a GRAS (Generally Recognized as Safe) status is currently being established.

The information in this document has been carefully compiled to the best of our knowledge. Our products are sold with the understanding that prospective purchasers will conduct their own evaluation to determine the suitability of the products in their applications. Local food regulations should always be consulted with respect to specific applications and necessary declarations, as legislation may vary from country to country.

Please do not hesitate to contact our Regulatory office for support.

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LALLEMAND BIO-INGREDIENTS