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ALTERNATIVE PROTEIN SOURCES

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Yeast is a highly promising solution to address the escalating global demand for proteins, to mitigate the environmental impact of animal protein production and to reduce Europe's heavy dependence on imported problematic plant protein for animal feed (e.g. soya).

ROLE OF YEAST

As a direct natural protein source

Proteins are composed of amino acids, there are 20 types of them, 9 of which are essential and must come from our diet. Animal proteins (meat, eggs, dairy) provide these essential amino acids, unlike most plant proteins. This is why vegans often need dietary supplements. However, yeast is an exceptional source of all essential amino acids:

- Protein Content: Yeast is 45% protein by dry weight, and 50% of these are essential amino acids.
- Digestibility: Comparable to egg proteins, yeast proteins are highly digestible.
- Nutritional Value: In addition to its protein content, yeast is rich in fibre, vitamins, and minerals.

Yeast can be consumed as a powder, condiment, or food industry ingredient, rounding off the taste of soups, sauces, stock cubes, snacks, and ready meals.

PROCESS:
Yeast extract and yeast-based ingredients process

As a fermenting agent

Reducing animal proteins in favour of plant-based proteins is key for sustainability and a healthy diet, yet taste and food habits hinder consumer acceptance. Yeast-based fermentation can optimise nutritional and sensory qualities of plant-based foods:

- Flavour Improvement: Certain yeast strains eliminate unwanted tastes (e.g., hexanal's herbaceous flavour) and improve texture.
- Microbial Synergy: Yeast can ferment protein-rich plants (e.g., legumes) in combination with bacteria, improving taste and digestibility.
- Innovative Products: Fermented plant-based products, such as dairy-free cheese substitutes from almond, walnut, pea, and soy purées, present vast innovation opportunities.

PROCESS:
Living yeast production technology

KEY DATA

A high Protein Content: Yeast benefits from a high protein content, ranging from 45-65% on a dry weight basis vs. 8-14% for plant sources like grains. Yeast protein is highly digestible with a Protein Digestibility Corrected Amino Acid Score (PDCAAS) of 1, the highest possible score indicating an excellent absorption by the human body.

SPECIES OF YEAST USED

Saccharomyces cerevisiae: The most widely used for its high protein content and ease of cultivation.
Applications: dietary supplements, meat substitutes (e.g. veggie burgers and sausages).

Saccharomyces boulardii: Used for its probiotic properties.
Applications: probiotic supplements for gut health, fortified foods for improved digestion.

Cyberlindnera jadinii: Valued for its high protein content and ability to grow on various substrates.
Applications: meat substitutes, flavouring purposes for soups, sauces.

Kluyveromyces lactis: Commonly used in dairy-related fermentation processes, this yeast is also investigated for its protein production capabilities and nutritional profile.
Applications: lactase enzyme supplements for lactose-intolerant people, fermented dairy products (e.g. cheese and yoghurt substitutes).

Pichia pastoris: Known for its high protein expression and ability to perform post-translational modifications, making it suitable for producing complex proteins.
Applications: recombinant proteins for pharmaceuticals (e.g. insulin), bioengineered food ingredients (e.g. baking and brewing enzymes).

Yarrowia lipolytica: Utilized for its high lipid content and potential for producing single-cell proteins, making it a candidate for both protein and oil production.
Applications: single-cell protein products (animal feeds), omega-3 fatty acid supplements.

A SHORT HISTORY

1950s-1960s: Early research highlighted yeast's rapid growth and high protein content.
In 1963, FAO/WHO compiled data on its amino-acid content and the biological value of its proteins.

1970s-1980s: Industrial-scale production based on optimized strains and improvements in process efficiency characteristics. Regulatory bodies like the FDA (1977) and the European Union approved specific yeast strains *(Saccharomyces cerevisiae)* for use as a protein supplement in food.

1990s-2000s: Genetic engineering enhanced yeast strains for higher yield and better nutrition, broadening its benefits beyond protein content.

2010s-Present: Focus on sustainable methods and integration of yeast-based proteins into mainstream foods to address food security and environmental issues.

PROSPECTS AND INNOVATIONS

Yeast proteins offer exciting prospects in the alternative protein market:

Precision Fermentation: It goes further than traditional fermentation and involves the production of very specific ingredients through the intervention of carefully selected and enhanced micro-organisms, such as yeast. Enzymes, flavors, proteins, vitamins, natural pigments and much more can now be produced this way, with a high level of purity. At the end of the fermentation process, these molecules are separated from the yeast that produced them. This process which has been used for years to produce medicines such as insulin, can now be used to produce key food products such as dairy proteins using less water, land and energy.

Hybrid Foods: Development of yeast-based protein blends with plant or animal proteins to improve the texture, flavour, and nutritional profiles of meat alternatives.

Metabolic Engineering: Optimisation of yeast metabolic pathways for higher protein yield from non-traditional, sustainable feedstocks like agricultural waste.

Functional Foods: Incorporation of yeast proteins into fortified foods with added vitamins, minerals, or probiotics for improved well-being.

Sustainable Production Systems: Implementation of closed-loop, zero-waste systems to minimize environmental impact and promote circular economy principles in yeast protein production.

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