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AMFEP Information sheet

Contribution of enzymes to reduce emissions - Food applications

Enzymes are used in a variety of applications such as food & beverage, animal nutrition, detergents and/or textile production. They support and accelerate a number of bio-chemical reactions that drive environmental efficiency across many diverse EU sectors, in small to large companies.

The present document highlights the sustainability benefits of enzymes implementation when used in food and beverages applications.

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1 From technical roles to sustainability assets

Enzymes in food are used for a very diverse set of purposes, to help optimize production steps and yields and to help achieve intended traits for the food and beverage products. Enzymes are thus used to

- improve the quality of food
  - **Alpha amylase:** added to the dough to ensures a continuous supply of fermentable sugar for yeast growth and gas production. This, in turn, allows the yeast to have a more regulated fermentation leading to a homogenous proofing of the dough products.
  - **Glucose oxidase:** strengthens the gluten network in the dough through its interaction with glucose.
  - **Phospholipase:** strengthens the dough through interaction with phospholipids in the wheat flour.
  - **Xylanase:** strengthens the tolerance of the dough to mixing stress thanks to an enhanced gluten network, in bakery.
  - **Maltogenic amylase**: breaks down starch into dextrins and sugars and improves the freshness of bread.
- improve the tolerance to certain foods
  - **Lactase**: hydrolyses lactose and help produce lactose free milk for lactose-intolerant consumers.
  - **Protease**: decreases the allergenicity of protein-based ingredients for infant foods.
- reduce the use of other raw materials and reduces energy consumption
  - **Protease:** allows sparing energy and water usage in beer production
  - **Chymosin**: enhance the yield when producing cheese
  - **Pectinase**: enhance the yield in juice extraction processes
- help enhance the safety profile of food products

Enzymes are a special class of proteins produced either by fermentation of microorganisms or by extraction from animal or plant tissues. Enzymes are required by all living organisms, including humans, to conduct the physiological processes essential for growth and life. They act as catalysts that speed up the rate of specific chemical reactions.

All enzymes are readily biodegradable - only needed in very low concentrations in cleaning products to be effective. They generally exhibit no specific environmental toxicity Industrial enzymes have an excellent safety profile, with little ability to cause adverse responses in humans and in the environment and those risks are controlled. For detailed information about enzymes and their technical, food and animal feed uses, see here [About enzymes: definition, how they work and more - AMFEP]

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- **Asparaginase**: reduces acrylamide formation in cereal- and potato-based products cooked at high temperature

2 The assets of enzymes for sustainable food production

Enzymes can perform industrial processes with significantly less energy (allowing steps optimization or steps deletion), without the use of aggressive chemicals and with less waste, compared with traditional systems. Using enzymes consequently results in a more efficient use of natural resources and reduced energy consumption, either during the production stage when enzymes are added or indirectly in connected stages along the value chain. Some specific examples are listed hereafter.

2.1 Baking

Enzymes can be added during the baking process to maintain the freshness of breads and other baked products, by sustaining the softness and moistness of the crumb for longer, thereby reducing waste at the point of consumption and/or possibly substituting to conventional chemical stabilizers. Enzymes also make the dough more suited to aggressive high-speed lines and resistant to flour quality fluctuations.

The beneficial environmental impacts are:

- Reduced upstream emissions from cereal farming and grain/flour transportation
- Reduced waste at the point of consumption and in the supply chain
- More efficient bakery production process
- Sparing of chemicals

2.2 Cheese production

Enzyme are used in cheese production process to increase curd coagulation, enabling a higher output of cheese with the same quantity of milk as input. They are also used to reduce the ripening time and increase cheese shelf life.

The beneficial environmental impacts are:

- Reduced upstream emissions from a lower number of milk producing animals needed, enabling a reduction of associated GHG emissions (especially methane) and a lower pressure on land from the corresponding lower feed demand
- Reduced waste at the point of consumption

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- More efficient cheese production process

2.3 Wine and fruit juice

Enzymes are used in wine and juices production process to increase the yield of juice extraction, enabling a higher production of wine or juices with the same quantity of fruits input and reduced losses.

The beneficial environmental impacts are:

- Lower volume of grapes/fruits required to match the same consumption, enabling a reduction in associated GHG emissions at the primary production level

2.4 Brewing

Enzymes are used in bier manufacturing process to supplement (or substitute) enzymes occurring in malt towards increasing the release of fermentable sugars provided by the grains, increasing the filtration rate and optimizing the required stabilization time and temperature.

The beneficial environmental impacts are:

- Elimination of the GHG emissions associated to the steps than can be skipped (e.g. the malting step in some cases)
- Reduction of the GHG emissions thanks to yield improvement (e.g. filtration and stabilization)

2.5 Oils and fats

Enzymes can be deployed in the refining processes (e.g. degumming) of vegetable oils and fats as an alternative to chemical and/or physical processes.

The beneficial environmental impacts are:

- Elimination of the GHG emissions associated to the chemical processes substituted by enzymes
- Chemicals sparing

2.6 Lactose free milk and dairy alternatives

Enzymes can increase the efficiency of lactose free milk production and of oat milk production by reducing the hydrolysis time.

The beneficial environmental impacts is:

- Reduction of GHG emissions associated to the yield improvement

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3 Contribution to sustainability ambitions

3.1 Green Deal

Implementation of enzymes in food and beverage contribute to below Green Deal policies

- The reduction of carbon emissions from food production systems [Farm to Fork, Climate law]
- The minimization of food losses [Circularity Action plan]
- The reduction of use of chemicals of concern [Zero Pollution]

3.2 Sustainable development goals

Implementation of enzymes in food and beverage production supports

- SDG13 [Goal 13. **Take urgent action to combat climate change** and its impacts] because enzymes in food applications contribute to the reduction of the carbon footprint of food systems.
- SDG 12 [Goal 12. **Ensure sustainable consumption and production patterns**] because enzymes in food applications contribute to
  - an efficient use of natural resources [Target 12.2: By 2030, achieve the sustainable management and efficient use of natural resources], and
  - allow minimizing wastes in the food chain [Target 12.3: By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses] and
- SGD2 [Goal 2. End hunger, **achieve food security and improved nutrition and promote sustainable agriculture**] because enzymes in food applications contribute to spare agricultural goods and to efficiently produce food, minimizing losses [Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality]

4 Enzymes are essential sustainability enablers for the food industry

Enzymes are used for decades in the food industry. They became essential to nowadays users for the technical performance they deliver, sparing energy, raw materials and helping tailoring food and beverage up to customer needs.

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Enzymes can further reduce the environmental footprint of food and beverage products. Such improvement has to happen, be it from a regulation push or from a consumer pull, be it in Europe or in other part of the world.

5 Bibliography

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