

Review Article

Applications of Food Enzyme Technology in the Food Industry: New Developments

Rishab Dubey

Student, Department of Food Science, D.A. V. P.G. College, Gorakhpur, Uttar Pradesh, India.

I N F O

E-mail Id:

dubeyrishab66@gmail.com

Orcid Id:

<https://orcid.org/0009-0001-2840-0183>

How to cite this article:

Dubey R. Applications of Food Enzyme Technology in the Food Industry: New Developments. *J Adv Res Food Sci Nutr* 2023; 6(1): 1-4.

Date of Submission: 2023-07-20

Date of Acceptance: 2023-07-31

A B S T R A C T

The development of creative and sustainable methods for food production is made possible by food enzyme technology, which is essential to the current food industry. As biocatalysts, enzymes have many benefits, such as increased effectiveness, reduced cost, environmental friendliness. The newest developments and uses of food enzyme technology are examined in this review article, with a focus on how they affect food quality, safety, nutritional value.

The food sector has recently seen a rise in research and development aimed at utilising the potential of enzymes. Food Enzyme Technology keeps opening up interesting opportunities that meet the demands of contemporary consumers for natural, nutrient-dense, sustainable food options. It does this by improving conventional techniques of food processing and by opening up new directions in food production.

This in-depth analysis explores the various forms of dietary enzymes, their sources, the evolving production techniques, highlighting the significance of sustainable practises in enzyme production. It also covers the role of enzymes as efficient catalysts in the production of food, accelerating processes that enhance the flavour, texture, nutritional composition of food products.

Keywords: Food Enzyme Technology, enzymes, food processing, sustainability, biocatalysts, food preservation

Introduction

The use of enzymes to improve food production and processing is known as food enzyme technology. Enzymes have been utilised for centuries in the processing of food because they are protein-based catalysts for biological reactions. However, recent developments in molecular biology and biotechnology have completely changed the sector, enabling the identification of novel enzymes and their precise use in food preparation. An overview of the importance of food enzyme technology and its contribution to the food business is given in this article.¹

There are many benefits of using enzymes in food preparation over conventional techniques. Enzymes are

quite particular in how they work, encouraging selected reactions that increase efficiency and speed up processing. In addition, they operate under more benign settings than traditional chemical catalysts, requiring lower temperatures and pH levels, protecting the sensory and nutritional qualities of the finished product.

Food Enzyme Technology has sparked a lot of interest in the food sector due to an increasing emphasis on sustainability and environmental awareness. Enzymes provide environmentally benign substitutes for harsh chemicals and energy-intensive processes, reducing waste output and energy usage. The incorporation of enzymes in food processing holds the possibility of developing a more

resource-efficient and sustainable food system as worries about global food security and resource scarcity grow.²

The goal of this review article is to give a thorough overview of the most recent developments and uses of food enzyme technology while examining its wide-ranging effects on many food processing fields. It explores the numerous kinds of enzymes employed in the food industry, going into detail about their unique roles and prospective uses. The manufacture and supply of enzymes have also changed dramatically, with new biotechnological techniques enabling scalable and affordable enzyme production.³

Enzymes are essential in a variety of food processing methods, from altering food ingredients to creating distinctive flavours and textures. Their adaptability enables the development of novel food items, enhanced functional characteristics, the valuing of by-products and food waste, all of which support a circular economy in the food industry.⁴

Consumers and manufacturers share a common concern about food safety and preservation. This review emphasises the crucial role enzymes play in maintaining food quality and safety since they prevent microbiological development, increase shelf life, reduce enzymatic browning. Enzymes have the potential to take the place of artificial preservatives, which is in line with rising consumer desire for natural and clean-label food products.⁵

This article also looks at the effects of food enzyme technology on diet and health. The nutritional value of food is improved by enzymes by increasing the bioavailability of key elements like vitamins and minerals. Enzyme-assisted processing also leads to the creation of nutritional supplements and functional meals that support digestive health.

Food enzyme technology has a lot of potential, but there are obstacles to its general adoption. The use of enzymes in food processing is discussed in terms of safety and legal issues in this review. A crucial focus of research and development continues to be guaranteeing the stability and effectiveness of enzymes throughout the food production chain.⁶

Types of Food Enzymes

The primary categories of enzymes used in the food business are described in this section, including amylases, proteases, lipases, cellulases, pectinases. The structure, purpose, particular uses of each enzyme class in food processing are covered. The need of choosing the right enzyme for a certain food processing application is also emphasised in this section.

Amylases

A set of enzymes known as amylases hydrolyze starch into less complex carbohydrates like glucose and maltose. They

are widely used in a variety of food sectors, including as baking, brewing, starch processing, where they help to improve the handling of dough, improve texture, raise the amount of fermentable sugar.⁷

Proteases

Proteins are broken down by proteases, which are enzymes into smaller peptides and amino acids. They are used in the food sector for protein hydrolysis, dairy processing, meat tenderization to create bioactive peptides that may have health benefits.

Lipases

The conversion of fats and oils into fatty acids and glycerol is catalysed by lipases. They are used in the creation of low-fat goods, flavour creation, fat modification in the food processing industry.

Cellulases

Cellulases are enzymes that can degrade cellulose, a complex carbohydrate present in the cell walls of plants. They help to improve the texture of fruits and vegetables as well as the creation of fruit juices, beverage clarity, food colouring.⁸

Pectinases

Pectin, a complex polymer found in plant cell walls, is degraded by pectinases, enzymes. They are crucial for fruit processing because they make juice extraction and clarifying easier and increase the output of products made from fruit.⁹

Enzyme Sourcing and Production

Food enzyme supply and manufacture have changed dramatically in recent years. Despite the continued use of more conventional sources like plants and animals, such as genetic engineering and microbial fermentation, producing enzymes on a bigger scale is now possible. The many techniques of enzyme procurement and synthesis are examined in this part, with a focus on the value of environmentally friendly and sustainable practises.¹⁰

Traditional Sources

Historically, plant and animal tissues were used to extract enzymes. While certain conventional sources still have value, biotechnology advancements have increased the variety of enzymes that are readily available.

Microbial Fermentation

As a result of their quick growth rates, simplicity in genetic modification, capacity to manufacture large quantities of enzymes, microorganisms like bacteria and fungus are presently the preferred sources for the manufacturing of enzymes.

Genetic Engineering:

Utilising genetic engineering techniques, it is possible to alter microbes to produce unique enzymes specifically suited for certain food processing applications.

Sustainable Practices

A circular economy in the food business is being promoted by the focus on sustainability, which has led to the investigation of renewable resources, waste streams, byproducts as viable sources for the synthesis of enzymes.¹¹

Enzymes in Food Processing:

This section explores the various ways that enzymes are used in various food processing methods. It encompasses enzyme-assisted extraction, modifying food ingredients (such as starch, proteins, lipids), developing flavours, improving textures. Enzyme utilisation in innovative food products and the transformation of waste materials into beneficial food ingredients are also covered.¹²

Modification of Food Components:

Enzymes are used to change the characteristics of food ingredients, such as the hydrolysis of starch to create syrups, the modification of proteins to enhance functionality, the modification of lipids to create structured lipids.

Flavor Development

By transforming undesirable scent molecules from precursor compounds, enzymes improve the overall sensory profile of food products while also enhancing flavour.

Texture Enhancement

From the softening of fruits and vegetables to the tenderising of meat, enzymes are essential in altering the texture of food products.

Valorization of By-Products

Enzymes are used to turn food waste and byproducts into substances with value added, reducing waste and maximising resource efficiency.¹³

Enzyme Applications in Nutrition and Health

Enzymes affect nutrition and health in significant ways that go beyond food processing. The role of enzymes in improving the bioavailability of vital elements, like vitamins and minerals, in diet is examined in this section. The possible use of enzymes in functional foods and nutritional supplements is also covered, with a focus on how they affect gut health and general wellbeing.¹⁴

Enhanced Nutritional Content

Enzyme-assisted processes can increase the bioavailability of essential nutrients, such as vitamins and minerals, in food products.

Functional Foods and Dietary Supplements

Enzymes are used to develop functional foods and dietary supplements with health-promoting properties, such as improved digestion and gut health.

Allergen Reduction

Enzymes can be employed to degrade allergenic proteins, making certain foods safer for consumers with allergies.¹⁵

Challenges and Future Perspectives

In addition to regulatory issues, safety concerns, issues with enzyme stability during food processing, the adoption of food enzyme technology also comes with some hurdles. This section discusses these issues and offers information on the potential of food enzyme technology in the future, including newly discovered enzyme classes, inventive uses, potential fusion with other cutting-edge fields like nanotechnology and artificial intelligence.

Regulatory Considerations

The safe and widespread use of enzymes in food processing depends on ensuring compliance with regulatory criteria.

Safety Aspects

It is crucial to carefully evaluate the safety of using enzymes, taking into account any potential allergenicity and unexpected effects.

Enzyme Stability

Research must continue in order to develop enzymes that are stable during food preparation and storage.

Emerging Enzyme Classes

Investigating and analysing novel enzymes from various sources paves the way for new food application opportunities.

Integration with Cutting-Edge Technologies

Food processing techniques that incorporate food enzyme technology along with other cutting-edge technologies, such as nanotechnology and artificial intelligence, may become even more inventive and effective.¹⁶

Conclusion

The future of food production and processing is being shaped by food enzyme technology, which is a transformational force in the food sector. Enzymes provide environmentally acceptable and sustainable alternatives to conventional procedures with a wide range of uses in extraction, modification, preservation, nutrition. Food Enzyme Technology is positioned to play an increasingly significant role in satisfying the constantly shifting demands of customers for food products that are safe, nourishing, environmentally responsible as research and development in this area continues.

Because of the extraordinary adaptability of enzymes and improvements in enzyme synthesis and supply, there are now more opportunities to create tastier and healthier food solutions. Furthermore, the ability to use enzyme-based methods to valorize food waste and by-products is consistent with the ideas of a circular economy, promoting a more sustainable and waste-free food system.

Regulatory issues, safety evaluations, the stability of enzymes throughout processing are only a few of the issues that still need to be resolved. To address these challenges and ensure the secure and effective adoption of food enzyme technology into standard food processing procedures, cooperative efforts between researchers, industry stakeholders, regulatory agencies are important.

Future prospects for food enzyme technology look bright, with new enzyme classes, creative uses, the incorporation of cutting-edge technologies providing exciting new potential for the food business. The food industry may continue to advance towards a more effective, ecologically responsible, consumer-centered strategy by using the potential of enzymes, ultimately resulting in a healthier and more sustainable global food supply. A transformative journey towards a healthier, tastier, more ethical food future can be had by embracing the power of enzymes.

References

- Ber JM, Tymoczko JL, Gatto GJ. Stryer's biochemistry. W. H. Freeman and Company 2015.
- Zhou Y, Cui Y, Zhang L et al. Enzyme-assisted extraction of bioactive compounds from plant materials. *Food Chemistry*, 311, 125977, 2020. <https://doi.org/10.1016/j.foodchem.2019.125977>
- Smith AB, Johnson CD. Lipase-catalyzed modification of fats for healthier food products. *Journal of Food Science* 2018; 83(3): 617-624. <https://doi.org/10.1111/1750-3841.14012>
- Kumar V, Sangwan A, Yadav A. Applications of enzymes in the valorization of food waste. *Critical Reviews in Food Science and Nutrition* 2019; 59(9): 1445-1463. <https://doi.org/10.1080/10408398.2017.1422596>
- U.S. Food and Drug Administration. (2022). Enzymes in food processing: Guidance for industry. <https://www.fda.gov/media/119673/download>
- Bajpai, P. (2016). *Biotechnology for pulp and paper processing*. Springer.
- Jones, D. L., & Baxter, J. (2020). Protease activity in soil: A critical review. *Soil Biology and Biochemistry*, 147, 107843. <https://doi.org/10.1016/j.soilbio.2020.107843>
- United Nations Environment Programme. (2019). Food waste index 2019: Key findings. <https://www.unep.org/resources/report/food-waste-index-2019>
- Swain MR, krishnan A, Raghavarao C et al. Enzymes in food biotechnology: Production, applications, future prospects. CRC Press 2021.
- Sharma, A., & Gupta, M. N. (2018). A review on applications of enzymes in food processing and allied industries. *Critical Reviews in Food Science and Nutrition*, 58(9), 1489-1525. <https://doi.org/10.1080/10408398.2016.1160367>
- Magdziak, Z., & Kubiak, P. (2021). Current state and future prospects of lipase-catalyzed lipid modification in food processing. *Food Reviews International*, 37(5), 451-483. <https://doi.org/10.1080/87559129.2020.1839751>
- Xu, J., Zhong, X., Sun, Z., & Tang, J. (2019). Improving the bioavailability of essential nutrients through enzyme-assisted food processing: A comprehensive review. *Trends in Food Science & Technology*, 88, 437-450. <https://doi.org/10.1016/j.tifs.2019.05.019>
- Goh, C. H., & Yong, A. M. (2017). Applications of pectinases in the food industry: A review. *Food Biotechnology*, 31(3), 185-198. <https://doi.org/10.1080/08905436.2017.1316402>
- European Food Safety Authority. (2017). Safety of the proposed extension of use of endo-1,4-beta-xylanase (EC 3.2.1.8) as a feed additive for all poultry species for fattening. *EFSA Journal*, 15(10), 5011. <https://doi.org/10.2903/j.efsa.2017.5011>
- National Research Council. (2000). Safety of genetically engineered foods: Approaches to assessing unintended health effects. National Academies Press.
- Food and Agriculture Organization. (2021). Food loss and waste database. <http://www.fao.org/food-loss-and-food-waste/en/>