Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 03, Issue: 05 (SEP-OCT, 2023)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Biotechnology Entrage in Food Sector

(*Seerat Gupta, Neeraj Gupta, Daman Preet Kour and Shivani Verma)
Division of Post Harvest Management, Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha, Jammu-180009, J&K, India
*Corresponding Author's email: seeratgupta03@gmail.com

Biotechnology is the study of approaches for utilizing living things or their enzymes for the production of goods and procedures that are beneficial to society. Food biotechnology is described as a broad range of procedures that use living things like plants, animals, bacteria or any of their portions to create novel or enhanced food items. Food biotechnology, offers a quicker and more accurate way to create food items. The implementation of modern technologies to develop or alter organisms with desirable characteristics for food manufacturing, marketing or nutrition is generally referred as food biotechnology.

Principles of Biotechnology

Two main approaches that have assisted modern biotechnology progress include:

1. **Genetic engineering**: The chemistry of genetic material (DNA and RNA) is altered via this technology with the intent to transfer it into host organisms and subsequently affect the host organism's phenotypical characters (Ulucay *et al*., 2022).
2. **Bioprocess engineering**: Retention of sterile (microbial contamination-free) environment throughout chemical engineering processes thus allowing large-scale development of only the appropriate microbe/eukaryotic cell for the production of biotechnological items like antibiotics, vaccines, enzymes etc.

Importance in Food Sector (Rehana, 2020)

- Being a technological application, biotechnology develops or modifies goods for particular uses.
- When biotechnology is implemented in food processing, it makes use of various breeding techniques and inoculants of microbes for improving food qualities like flavour, aroma, shelf life, texture and nutritional content.
- Food processing method transforms unappealing and quickly perishable raw materials into appetizing and drinkable food and beverages which possess a better shelf life.
- Advances in microbial genetics, pathogen identification and mycotoxin detection are all made possible by biotechnology in the food processing sector. Food fermentation, food additives and processing aids are also significantly impacted.

Application in Food Sector

Biotechnology has been used for thousands of years to produce fermented foods by genetically modifying the bacteria, yeasts and moulds that are utilized in food fermentation. On March 1, 1990, the British Ministry of Agriculture, Fisheries and Food authorized the use of the first genetically modified food-grade microbe. With the use of genetic engineering, single, well-defined feature can be precisely, controllably as well as predictably selected and

transferred from almost any living organism. It has a favourable effect on the manufacturing, nutritional value, microbiological safety and shelf life of fermented foods.

Cheese	Bacteriophage resistance	Eliminate economic losses due to destruction of culture by viruses
Yogurt	Accelerated ripening, increase the levels of beta-galactosidase	Decreased storage costs, more digestible product for lactose-intolerant individuals
Sausage	Bacteriocin generation	Inhibition of bacteria and organisms that cause spoiling
Beer	Alpha-amylase production	Used for production of "lite" or low calorie beer
Bread	Maltase and maltose permease concentrations are higher	Better and more reliable leavening

Maltose permease and maltase, two enzymes involved in the utilization of starch, were increased in the strain's production through genetic engineering (Donev, 2001). Dough with significantly varying sugar contents are produced through consistent fermentations, guaranteeing the quality of the final product.

Healthy microbes- Due to a steady decline of lactase (an enzyme found in the brush border of the gut that dissolves lactose into glucose and galactose) enzyme, more than 70% of the world's population loses their capacity to digest lactose. *Streptococcus thermophilus* and *Lactobacillus bulgaricus* (Nagaoka, 2019), the two microorganisms used to make yogurt, generate microbial betagalactosidase at high levels, which might be increased through genetic engineering and make digestion of yoghurt easier for those with lactose intolerance.

Probiotics- Probiotics, also known as good bacteria, are responsible for keeping the body in a healthy state of equilibrium. It maintains the homeostasis of the body. Numerous uses in food and agriculture may arise from the development of strains that can restrict potentially dangerous intestinal microbes through competitive tactics (Faujdar *et al*., 2016). For instance, the food-grade bacteria *Lactobacillus acidophilus*, which has been utilized for developing acidophilus milk, might endure transit through the stomach and, under certain conditions, are capable of colonizing the GI tract. Engineered bacteriocin-producing strains with improved colonization potential may be employed to control the ecology of the gut.

Microbially derived ingredients- Numerous metabolites generated from microorganisms are being harnessed as components in processed food products. These include flavours (diacetyl, pyrazines, lactones, esters), sweeteners (aspartame), pigments (monascin, astazanthan), enzymes (proteases, lipases, cellulases, pectinases), acidulants (acetic, lactic, benzoic, propionic), nutritive additives (vitamins, amino acids), flavour enhancers (MSG), preservatives (nisin), stabilisers and thickeners (xanthan gum, dextrans). These components boost functioning, elevate nutritional value, prolong shelf life, increase convenience and guarantee safety. Most of the aforementioned substances are synthesized by microorganisms that have a long history of being used in foods without inciting harm. Plenty of microbes in our environment additionally manufacture intriguing compounds that could be utilized in processed foods. Extracellular biopolymers, for instance, could be used as flavour encapsulating agents, viscosifiers, stabilising agents, noncaloric gelling agents, surfactants and even as a source of soluble fibre in the diet (Revuelta *et al*., 2016).

Enzyme engineering- Most enzymes work best at particular physiological temperature and pH (Gupta *et al*., 2023) that are not the conditions present during food processing procedures, which usually entail high temperature and low pH. In order to enhance the functionality of

enzymes in food systems, genetic engineering techniques have (Ranjha *et al.*, 2022) been utilized to selectively modify the primary amino acid sequence of enzymes.

Enzymes	Application	Useful Improvement
Alpha-amylase	Starch liquefaction	Acid-tolerant and thermostable
Amyloglucosidase	High fructose corn syrup production	Immobilized with higher productivity
Esterases Lipases Proteases	Flavor development	Improved substrate specificity
Glucose isomerase	High fructose corn syrup production	Increased thermostability
Limoninase	Debittering of fruit juices	More complete limonin degradation
Protease	Beer chill proofing	Improved substrate specificity
Pullulanase	High fructose corn syrup production	Increased thermostability

Food output has surged and food quality and safety have improved because to the use of biotechnology in food processing. Scientists have improved crops' tolerance to diseases and harsh conditions through the application of food biotechnology, enabling them to be cultivated on often unsuitable and unproductive area. Transgenic plants that are resistant to pathogens, insects and herbicides have enhanced the production and reduced the production cost of several agricultural crops (Deckers *et al.*, 2020). With the creation of various enzymes and manufacturing techniques that keep dairy and meat products fresh and toxic-free, biotechnology also aids in enhancing the manufacture of these products. "FLAVR SAVR TOMATO" is a tomato that has been genetically altered to have less polygalactouranase, an enzyme that breaks down the pectin in the cell walls, and hence have a longer shelf life. With the exception of several vitamins, such as A and E, rice is nutrient-rich. Golden rice is a modified variety of rice that is high in vitamins. Most of the world's population eats "GOLDEN RICE" as a primary food.

Conclusion

The broad field of biotechnology could be summed up succinctly as the creation of technology that resides on biology. It is obvious that the idea of biotechnology can grow to encompass a large range of application sectors and as a result, future breakthroughs in biotechnology are expected to be similarly vast in scope across numerous application fields. Food and nutrition security may benefit from the use of biotechnology. Better feed and fuel for a rising world are made possible by biotechnology, which has a significant impact on agriculture. In this regard, microorganisms have long been used biologically to create a variety of products with added value.

References

1. Deckers, M., Deforce, D., Fraiture, M.A. and Roosens, N.H.C. (2020). Genetically modified micro-organisms for industrial food enzyme production: An overview. *Foods*, **9**(3): 326.
2. Donev, T. (2001). Methods for conservation of industrial microorganisms. Sofia: National Bank for industrial microorganisms and cell cultures.

3. Faujdar, S.S., Mehrishi, P., Bishnoi, S. and Sharma, A. (2016). Role of probiotics in human health and disease: an update. *International Journal of Current Microbiology and Applied Sciences*, **5**(3): 328-344.
4. Gupta, S., Gupta, N., Kour, D.P. and Choudhary, A. (2023). Enzymes in the food sector: current applications. *AgriaCos e-Newsletter*, **4**(10): 69-72.
5. Nagaoka S. (2019). Yogurt production. *Methods in Molecular Biology* (Clifton, N.J.), **1887**: 45-54.
6. Ranjha, M.M.A.N., Shafique, B., Khalid, W., Nadeem, H.R., Mueen-ud-Din, G. and Khalid, M.Z. (2022). Applications of biotechnology in food and agriculture: a mini-review. *Proceedings of the National Academy of Sciences, India, Section B: Biological Sciences*, **92**(1): 11-15.
7. Rehana. (2020). A research on importance of biotechnology and its important applications in different fields likes agriculture, food, industrial areas and medicines. *Middle East Journal of Applied Science & Technology*, **3**(2): 83-95.
8. Revuelta, J.L., Buey, R.M., Ledesma-Amaro, R. and Vandamme, E.J. (2016). Microbial biotechnology for the synthesis of (pro) vitamins, biopigments and antioxidants: challenges and opportunities. *Microbial Biotechnology*, **9**(5): 564-7.
9. Ulucay, O., Gormez, A. and Ozic, C. (2022). For biotechnological applications: Purification and characterization of recombinant and nanoconjugated xylanase enzyme from thermophilic Bacillus subtilis. *Biocatalysis and Agricultural Biotechnology*, **44**: 102478.