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इतिहास, संस्कृति, साहित्य एवं दर्शन की त्रैमासिक शोध पत्रिका

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प्रकाशक-श्रीमती पुष्पा शर्मा, 51/1509, वेद विहार, लोहाखान, अजमेर द्वारा मैसर्स सृजन संस्थान, अजमेर की ओर से प्रकाशित एवं मुद्रक-श्रीमती उषा गर्ग द्वारा मैसर्स आर्य प्रिन्टर्स, केसरगंज, अजमेर से मुद्रित।

Use of Enzymes in Food, Drink, and Industry

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1. Introduction

Enzymes are biological catalysts that accelerate chemical reactions in living organisms. In industry, enzymes are produced using microorganisms such as Bacillus, Aspergillus, and Saccharomyces species. Modern biotechnology allows scientists to modify enzymes so they become more stable, faster, and suitable for large-scale industrial operations. Industries prefer enzymes because

* They work under mild temperatures (30-50°C)
* They reduce the need for harsh chemicals
* They improve product quality naturally
* They are biodegradable, thus environmentally friendly

Thanks to these properties, enzyme have become essential in food processing, beverages, and heavy industries.

2. Enzymes in Food Industry

2.1 Dairy Industry-

Lactose. - Many people suffer from lactose intolerance. Lactase enzyme breaks lactose into glucose and galactose, making the milk sweeter and easier to digest.

Chymosin (Rennet) - Use genetically engineered microorganisms to produce chymosin, which is purer, cheaper, and more consistent than traditional animal rennet.

Lipases - Lipases help develop strong, aged cheese flavors by breaking down milk fats. They are used in Parmesan and Romano cheese production.

2.2 Baking Industry

Enzymes revolutionized baking:

Amylases - Break starch into sugars that yeast can ferment, resulting in fluffier bread. They also slow staling, keeping bread softer for longer.

Xylanases

Improve dough elasticity, leading to better loaf volume and better crumb structure.

Proteases - Reduce dough toughness, making handling easier and improving biscuit and cookie texture.

2.3 Meat & Fish Processing

Natural tenderizers such as papain (papaya), bromelain (pineapple), and ficin (fig) break muscle proteins, giving a soft and juicy texture.

Transglutaminase ("Meat Glue")

Used to bind meat pieces together, creating uniform shapes. It helpsindustries reduce wastage and produce value-added items like nuggets and sausages.

2.4 Fruit and Vegetable Processing Pectinases

These enzymes break down the pectin in fruit cell walls, helping industries extract more juice from fruits like apples, grapes, and berries.

Cellulases and Hemicellulases

Used in clarification-making juices transparent and more appealing to consumers.

3. Enzymes in Beverage Production

3.1 Brewing (Beer Production)

Enzymes optimize every stage of brewing:

(i) a-amylase & b-amylase: Convert starch into sugars

(ii) Glucanases: Reduce viscosity for easier filtration

(iii) Proteases: Prevent protein haze, improving shelf stability

These enzymes ensure consistent flavor and shorten brewing time.

3.2 Wine and Juice Industry

During winemaking, pectinases increase juice yield and help extract color from grape skins. Glycosidases improve aroma compounds, making the wine more fragrant and complex.

3.3 Soft Drinks

Invertase is used to convert sucrose into invert sugar, which dissolves quickly, blends well with flavors, and prevents crystallization in cold drinks.

4. Enzymes in Industrial Applications

4.1 Detergent Industry

Detergent enzymes changed laundry forever.

→

Types used:

Proteases: Remove protein-based stains (blood, sweat, food)

Lipases: Break down oily and greasy stains

Amylases: Remove starchy stains (rice, curry, chocolate)

Cellulases: Brighten color and remove fuzzy fibers from clothes

They allow washing at low temperatures → saves electricity.

4.2 Textile Industry

Bio-polishing - Cellulose's remove tiny fibers from cotton, giving fabric a smooth, glossy finish.

Bio-stoning. - Instead of real stones, cellulases create the "stonewashed" look in denim-saving water and reducing fabric damage.

Catalases - After bleaching, catalases remove excess hydrogen peroxide, reducing chemical pollution.

4.3 Paper & Pulp Industry

Xylanases reduce the need for chlorine in paper bleaching-making the process safer and eco-friendly. Laccases enhance fiber bonding, improving paper strength and reducing chemical consumption.

4.4 Biofuel Industry

Biofuel production depends heavily on enzymes:

Cellulases: Break cellulose into glucose

Hemicellulases: Break hemicellulose into pentose sugars

Amylases: Break starch into fermentable sugars

These sugars are fermented into ethanol-a renewable energy source.

4.5 Pharmaceutical Biotechnology

Enzymes like proteases and lipases are used to make medicines more active and stable.

DNA polymerases are vital for PCR tests, which are used in disease detection, forensics, and genetic research.

5. Technological Advancements

Immobilized enzymes: Enzymes attached to solid supports so they can be reused, reducing cost.

Genetically engineered enzymes: More stable at high temperatures and extreme pH.

Nano-enzymes (Artificial enzymes): New research area for high-

efficiency catalysis.

These advancements reduce production costs and expand enzyme applications.

6. Challenges

Enzymes are sensitive to pH changes.

High production cost for purified enzymes.

Storage stability issues

Possible allergenicity in food products (rare but noted).

Public concern about genetically modified enzyme sources.

7. Conclusion

Enzymes have become indispensable in food, drinks, and industrial operations. They increase efficiency, improve quality, reduce environmental impact, and enable sustainable manufacturing. With advancements in biotechnology, enzyme applications will expand even further in the next decade-especially in sustainable energy, eco-friendly manufacturing, and high-nutrient food production.

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