GREEN TECHNOLOGY

FOOD & AGRICULTURAL PRODUCTS BIO'CONSERVATION

Bio-conservation aims to extend the shelf life of food products without the addition of chemical additives. It includes the use of natural preservatives and microorganisms and their products to preserve food. Bio-conservation is gaining more attention with increasing demand and preference of consumers for products that are "generally recognized as safe" (GRAS).

LACTIC ACID BACTERIA (LAB)

Main by-products of LAB used in food preservation

- **CO_2** — Creates an anaerobic environment unfavorable for aerobic microorganisms
- **Organic Acids** — Reduce the activity of enzymes and damaging proteins and DNA
- **Diacetyl** — Antibacterial for pathogenic bacteria such as Listeria, Salmonella, E. coli and others.
- **Hydrogen Peroxide** — Attacks bacteria through protein oxidization and increasing membrane permeability

Bacteriocins

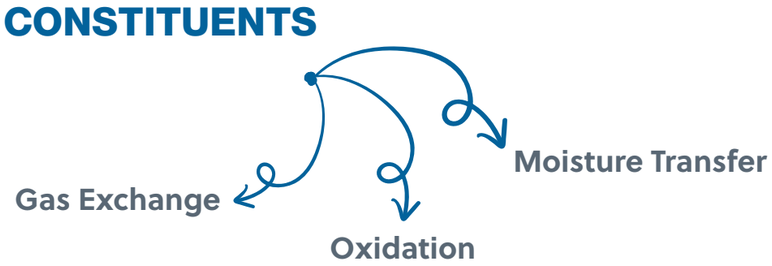
They are bacterial peptides that have anti-microbial activity against other bacterial strains that are close relative strains to bacteriocin producers.

The two mostly used Bacteriocins are Nisin and Pediocin

EDIBLE COATINGS

An eco-friendly coating technique that relies on using natural and biodegradable products to extend the shelf-life of food products by controlling

CONSTITUENTS



Polysaccharide & Protein based coatings

- Commonly used to coat fruits and vegetables.
- Good gas barrier.
- Poor moisture barrier.

Lipid-based coatings

- Based on waxes, oils, or resins
- Poor gas barrier.
- Good moisture barrier

Composite coatings

- Combine properties of polysaccharides, proteins and lipids coatings
- Good moisture, gas, and mechanical properties

APPLICATIONS

The type and method of application depends on the product itself, the characteristics of its surface and the main purpose of the coating

Dipping **Brushing** **Spraying** **Panning**

Examples of main Bio Preservatives

ANTIFUNGAL COMPOUNDS

Natamycin

- Has an antifungal activity produced by bacteria
- Increase the membrane permeability of fungi when added to foods and beverages
- Inactive against bacteria and viruses

NISIN

- The mostly used bacteriocin in food industry.
- The only bacteriocin that is commercially available in its purest form.
- Approved by FDA.
- Nontoxic, heat stable and does not alter food flavors.
- Available in liquid and powder form.
- The applications of nisin in bio-conservation include liquid egg, pasteurized milks, aged and processed cheeses and canned vegetables and soups.

BACTERIOPHAGES

Viruses that multiply in bacteria and are usually harmless to humans, animals, and plants

Listex

- FDA approved
- Used to treat live animals prior to slaughter to reduce the occurrence of E. coli and Salmonella in ready-to-eat meat

ANTIMICROBIALS FROM PLANTS

Oregano · Thyme · Cinnamon · Cloves · Jasmine

Grape Seed

- Include phenolic compounds
- Have inhibitory activity against bacteria

Green Tea

- Rich source of polyphenol antioxidants
- Antimicrobial against foodborne pathogens
- Used in food packag-es to extend the self-life of products

Essential Oils

- Prevent oxidization of fat
- Antimicrobial against foodborne pathogens
- Concentration of 0.05–0.1% is effective
- Plants with oils of proven antimicrobial activity include:
- Used in active food packaging as well

ANTIMICROBIALS FROM ANIMAL SOURCES

Lysozyme

- A natural enzyme found in egg white and milk
- Effective against gram positive bacterias

Chitosan

- A biopolymer naturally present in exoskeletons of crustaceans and arthropods
- Has antibacterial activity & acts against a wide range of fungi and yeasts.
- Chitosan-based packaging films are used in fruit, fruit juices, eggs, dairy, cereal, meat products and seafood products

Advantages	Points to Consider
Act against a wide spectrum of food spoilage and pathogenic bacteria, yeasts and molds	Applications of the phages & phages derived lytic proteins are used in the following applications: Phage Therapy; Veterinary Medicine; Control of Plant Diseases; Food Safety; Wastewater Treatment
Ecologically benign, help reduce food loss & consequently economic losses & negative environ-mental impacts	LAB bacteriocin can inhibit the activity of other beneficial cultures in food product
Fewer chemical preservatives are added & less intense heat treatments are used on food products to extend their shelf-life	New emerging technology that might not have enough supporting research
Bacteriophage have the advantages of being specific, safe, effective against multi-drug resistant bacteria, and being easily manipulated genetically	Bioconservatives should be generally recognized as safe and don't produce toxic or harmful substance or interfere with physical characteristics of food
LAB bacteriocins are generally recognized as safe substances (GRAS), non-toxic and easily inactivated by digestive enzymes, pH and heat-tolerant	

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