



Preservation by natural antimicrobial compounds



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Advantages of Natural Food Preservatives

**Do not alter color of food
and gives required flavour**

**No main health concern
associated with use of
natural food preservatives**

**These compounds
naturally do process of
osmosis and completely
safe for consumption**



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Activated lactoferrin (ALF, Activin)

- Antimicrobial protein present as normal component of fresh milk.
- Antibacterial, antifungal and antiviral activity.
- Activin is activated lactoferrin and is more potent antimicrobial than plain lactoferrin.
- Accorded GRAS status by USFDA.
- Antimicrobial activity due to its capacity to chelate Fe^{2+} along with HCO_3^- .
- Binds to cell surfaces and has high affinity for outer membrane proteins (OMP) of Gram negative bacteria.
- Also inhibits growth and neutralizes endotoxins.
- Approved at level of 65.2 ppm for beef carcasses, and may be applied either as mist or by spraying.



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Ozone

- ☐ Gaseous compound possesses antimicrobial activity.
- ☐ 1.5 times more potent than chlorine.
- ☐ Effective in solution and in its gaseous form is unstable.
- ☐ Because it is more effective in killing *Cryptosporidium parvum*, its use in water treatment systems is increasing.
- ☐ Cell target for O₃ is membrane where it disrupts permeability functions.
- ☐ Ozone is GRAS for bottled water use, and used on variety of fresh foods, but its strong oxidizing power is not recommended for red meats.
- ☐ Typical conc. used is 0.1-0.5 ppm, which is effective against Gram-positive and Gram-negative bacteria as well as viruses and protozoa.
- ☐ Used in vegetables, fruits, beef etc. to destroy pathogens like *E. coli* O157:H7, *S. typhimurium* etc.



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Hydrogen Peroxide

- Strong oxidizing agent and degraded by catalase.
- Used as sterilant for food-contact surfaces of olefin polymers and polyethylene in aseptic packaging systems.
- Hydrogen peroxide vapors have microbiocidal properties.
- Antimicrobial effect of hydrogen peroxide attributes to strong oxidizing effect on bacterial cells and destruction of basic molecular structure of cellular proteins.
- H_2O_2 also prevent spores of *Bacillus cereus* from swelling properly during germination process.
- Treatment of vegetables, fruits and fruit juice in form of vapors.



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Sodium chloride and sugars

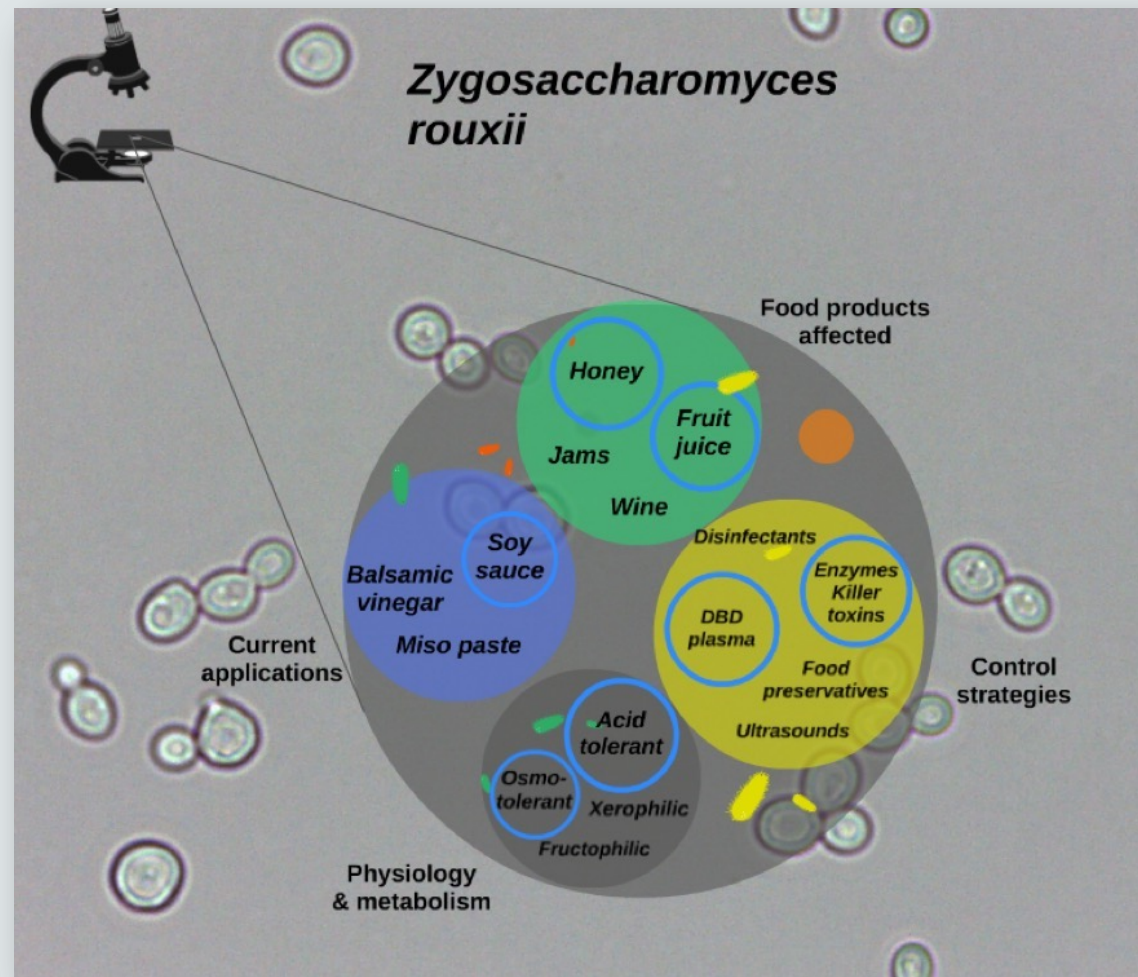
- Salt exerts drying effect on both food and microorganisms.
- Salt in water at conc. of 0.85–0.90% produces an isotonic condition for non-marine microorganisms.
- Because amounts of NaCl and water are equal on both sides of cell membrane, water moves across cell membranes equally in both directions.
- When microbial cells are suspended in high salt conc. (5% saline solution), conc. of water is greater inside cells than outside.
- In diffusion, water moves from area of high conc. to area of low conc. (plasmolysis).
- Both microbial cells and meat undergo plasmolysis (shrinkage), resulting in drying of meat, as well as inhibition or death of microbial cells.
- Higher the concentration, greater are drying effects.
- Fish and meats are effectively preserved by salting.



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- Sugars such as sucrose, exert their preserving effect.
- Common uses as preserving agents are in making of fruit preserves, candies, jams, jellies, fruit juices, condensed milk etc.
- Some yeasts and molds can grow in presence of as much as 60% sucrose.
- Some osmophilic yeasts (*Zygosaccharomyces rouxii*) can grow in presence of extremely high concentrations of sugars.





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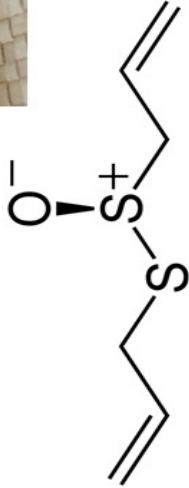
Flavoring agents

- ❖ Flavor compounds have more antifungal activity than antibacterial.
- ❖ Non-lactic, Gram-positive bacteria are most sensitive and LAB are rather resistant.
- ❖ Diacetyl is produced by *Lactobacillus*, *Leuconostoc*, more effective against Gram-negative bacteria and fungi.
- ❖ Diacetyl reacts with arginine binding proteins of Gram negative bacteria.
- ❖ Menthol, imparting peppermint like aroma inhibits *S. aureus* at 32 ppm, and *E. coli* and *C. albicans* at 500 ppm.
- ❖ Vanillin and ethyl vanillin are inhibitory to fungi at levels <1,000 ppm.





Allicin



Spices and essential oils

- Essential oils, such as eugenol and Allicin.
- Cinnamon and clove oils are also highly effective against *Aspergillus parasiticus* aflatoxin production.
- Basil has high activity against *B. cereus*, *Enterobacter aerogenes*, *E. coli*, and *Salmonella*.
- Lemon balm and sage EOs have adequate activity against *L. monocytogenes* and *S. aureus*.
- Oregano and thyme EOs had high activity against enterobacteria.
- Minimum inhibitory concentration of oregano and thyme at a range of 190 ppm and 440 ppm, respectively for *E. cloacae* and for lactic acid bacteria.

Phosphates

- These salts are commonly added to certain processed meats to increase their water holding capacity.
- Contribute to flavor and antioxidative activity.
- Food-grade phosphates range from one phosphate (trisodium phosphate) to at least 13 (sodium polyphosphate).
- Possess antibotulinal activity, especially when combined with nitrites.
- Combination of 140 ppm NaNO_2 , 0.26% potassium sorbate, and 0.14% sodium acid pyrophosphate (SAPP) delay *C. botulinum* neurotoxin production .



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Acetic and lactic acids

- Present in fermented pickles, sauerkraut, and fermented milks due to their production within food by lactic acid bacteria.
- These acids possess antimicrobial effect which is due to both depression of pH below growth range and specific toxicity by undissociated acid molecules.
- Lactic acid functions as a permeabilizer of outer membrane of Gram-negative bacteria and thus possibly acts as a potentiator of other antimicrobials.
- Organic acids are employed to wash and sanitize animal carcasses after slaughter to reduce carriage of pathogens and increase product shelf life.

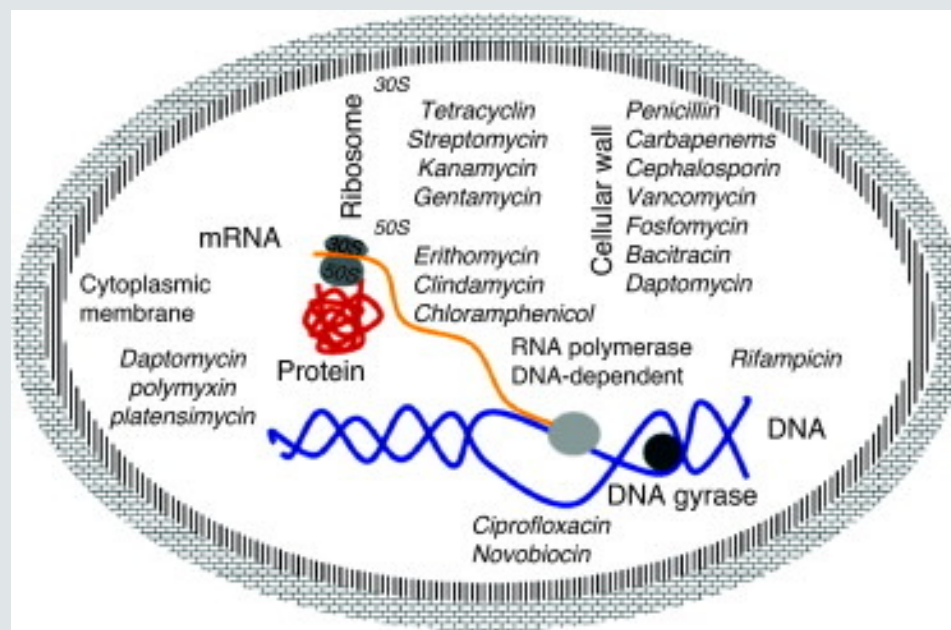


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Antibiotics

- Secondary metabolites produced by microorganisms that inhibit/kill wide spectrum of other microorganisms.
- Produced by mold, *Streptomyces*, *Penicillium* and a few by *Bacillus*.
- Chlorotetracycline and oxytetracycline at 7ppm conc. has been applied to poultry and natamycin used as food fungistat.
- Tetracycline permitted for fresh and other see foods.
- Antibiotics may be applied as a dip or an ice.





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Antimicrobial peptides

- First isolated from natural sources in 1950s when nisin was isolated from LAB for potential application as food preservative.
- Isolated from plants, insects, amphibians, crustaceans, and marine organisms.
- A solution to problem of antibiotic resistance because, unlike traditional antimicrobial agents, specific molecular sites are not targeted, and their characteristic rapid destruction of membranes does not allow sufficient time for even fast-growing bacteria to mutate.
- Lactoferrin bovine and activated lactoferrin (ALF), an iron binding glycoprotein in milk, has antimicrobial activity against Gram-positive and negative bacteria, fungi, and parasites.
- Lactoferrin approved for their application in preservation of beef in USA.



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- Biopreservation is use of natural or controlled microbiota or antimicrobials as a way of preserving food and extending it's shelf life.
- LAB have antagonistic properties which make them useful as biopreservatives.
- When LABs compete for nutrients, their metabolites such as lactic and acetic acid, hydrogen peroxide, and peptide bacteriocin.
- Some LABs produce antimicrobial nisin which is a effective preservative.
- Using them in combination with other preservative techniques can effectively control spoilage bacteria, pathogens, and resistant Gram-negative bacteria.

