**SPOILAGE OF SUGAR AND SUGAR PRODUCTS AND THEIR PRESERVATIONS**

- Sugar is the widely used sugar in the food industry as a food product as well as a food preservative.
- Sucrose is the widely used sugar and is easily available in nature however, dextrose, lactose, and fructose are also used in the food industry.
- Recently, polyols such as sorbitol, mannitol, xylitol, and maltitol have been used as replacements for sugar in sugar-free products.
- Some of the sugar products widely used in the food industry are refined sugars, sugar syrups, maple syrup, and honey

# Sucrose

- Sugar (sucrose) is derived from two main sources, sugar cane (*Saccharum officinarum*) and sugar beet (*Beta vulgaris*).
- Sucrose is also produced from sugar palms (1%), sweet sorghum (0.05%), and maple trees (0.01%) but in a small amount.
- The sugarcane and sugar beet go through various processes to form 99.9 % pure sucrose.
- Such process includes crushing and extraction, clarification, evaporation/crystallization, centrifuge, filtration.

### Contamination source of sucrose

- Soil
- Raw materials (Sugarcane, sugar beet)
- Handlers
- Equipment and machine used
- poor hygienic handling,
- inappropriate cleaning of the sugar cane press knives, interaction surfaces,
- airborne contamination

### Spoilage of sucrose

- The microorganism population changes during the processing of sugarcane and sugar beet to sucrose.
- The spoilage-causing microorganism which contaminated raw juice depends upon the microorganisms during the processing of sugarcane and sugar beets.
- Microorganisms species found in sugarcane include *Pseudomonas, Bacillus, Enterobacteriaceae, Lactobacillus, Erwinia, Leuconostoc, Flavobacterium, Xanthomonas, Corynebacterium,* yeasts, and molds.
- Microorganisms species found in sugar beets include *Pseudomonas, Arthrobacter, Erwinia, Streptomyces, Bacillus, Clostridium, Flavobacterium*, and yeasts.
- The yeasts associated with raw juice spoilage are *Saccharomyces, Candida,* and *Pichia.*

Microorganisms associated with raw sugar and refined sugar and the defects caused by it are:

| Product | Microorganisms | Defects |
|---|---|---|
| Raw sugar | *Z.rouxii* | Sugar loss |
| | Xerophilic molds | Invert sugars are produced, Acid production, increase in water activity |
| Refined sugars | Surviving thermophilic spores | Introduction of spores into final products |

# Honey

- Honey is the natural sweet substance produced by honey bees which also is defined as the nectar and saccharine exudation of plants, gathered, modified, and stored as honey in the honeycomb by honeybees, *Apis melifera*.
- Honey is widely used in the food industry in products such as condiments, salad dressings, barbecue sauce, peanut butter, dairy products, meats, beverages, snacks, bread, cereal products, and candy.
- It generally contains 15 –21% water, 30 –35% glucose, 35 –45% fructose, 1 – 3% sucrose, 10 –12% maltose, organic acids, minerals, proteins, amino acids, and enzymes.
- The water activity of honey ranges between 0.54 and 0.75 with an acidic pH range of between 3.2 and 4.5

### Contamination source of honey

- Flowers, pollen,
- the digestive tracts of honeybees,
- dirt, dust, and air
- food handlers
- equipment used

### Spoilage of honey

- Microorganisms that survive in honey are those that withstand the concentrated sugar, acidity, and other antimicrobial characters of honey.
- A wide range of bacteria, yeasts, and molds are found contaminating the honey.
- Most bacteria and other microbes cannot grow or reproduce in honey i.e. they are dormant and this is due to the antibacterial activity of honey.
- Yeasts and molds can survive in honey. Some vegetative and spore-forming bacteria can survive in honey.
- The microorganisms found in honey are osmophilic yeasts, which can grow and cause spoilage as compared to bacteria and mold.
- Bacteria species found in honey are *Bacteridium, Bacterium, Bacillus (B. cereus* and *B. pumilus), Brevibacterium, Enterobacter, Flavobacterium, Micrococcus, Neisseria, Pseudomonas*, and *Xanthomonas*.

- The yeast species found in honey are *Rhodotorula, Debaryomyces, Hansenula, Lipomyces, Oosporidium, Pichia, Torulopsis, Trichospora, Nematospora, Schizosaccharomyces, Schwanniomyces, Torula*, and *Zygosaccharomyces*.
- The mold species found in honey are *Ascosphaera, Aspergillus, Cephalosporium*, and *Penicillium*.
- The microorganisms cause foul flavors due to the production of alcohol, $CO_2$, lactic acid, and other organic acids.

**Preservation of honey**

- Honey itself is a preservative agent. Its high antimicrobial activity is a result of an osmotic effect, acidity, hydrogen peroxide, and phytochemical factors.
- Honey shows a bactericidal to many pathogenic microorganisms such as *Salmonella* spp, *Shigella* spp, *Escherichia coli*, *Vibrio cholerae,* and other Gram-negative and Gram-positive organisms.
- Honey is pasteurized at 71°C for 5 minutes and cool promptly to 38°C.
- Further, the pasteurized honey can be stored at refrigerated temperature or canned to prolong its shelf-life and to avoid microbial contamination.