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Applied and Industrial Microbiology

Food Microbiology

I. The earliest methods of preserving foods were drying. the addition of salt or sugar, and fermentation.

Foods and Disease

2. Food safety is monitored by the FDA and USDA and also by use of the HACCP system.

Industrial Food Canning

3. Commercial sterilization of food is accomplished by steam under pressure in a retort.
4. Commercial sterilization heats canned foods to the minimum temperature necessary to destroy *Clostridium botulinum* endospores while minimizing alteration of the food.
5. The commercial sterilization process uses sufficient heat to reduce a population of C. *botulinum* by 12 logarithmic cycles (J 2D t reat - ment).
6. Endospores of thermophiles can survive commercial sterilization.
7. Canned foods stored above 45"C can be spoiled by thermophilic anaerobes.
8. Thermophilic anaerobic spoilage is sometimes accompanied by gas production; if no gas is formed, the spoilage is called flat sour spoilage.
9. Spoilage by mesophilic bacteria is usually from improper heating procedures or leakage.
10. Acidic foods can be preserved by heat of 100°C because microorganisms that survive are not capable of growth in a low pH.

II. Byssochlamys, Aspergillus, and *Bacillus coagulans* are acid-tolerant and heat -resistant microbes that can spoil acidic foods.

Aseptic Packaging

12. Presterilized materials are assembled into packages and aseptically filled with heat-sterilized liquid foods.

Radiation and Industrial Food Preservation

13. Gamma and X-ray radiation can be used to sterilize food, kill insects and parasitic worms, and prevent the sprouting of fruits and vegetables.

High-Pressure Food Preservation

14. Pressurized water is used to kill bacteria in fruit and meat.

The Role of Microorganisms in Food Production

Cheese

15. The milk protein casein curdles because of the action by lactic acid bacteria or the enzyme rennin.

16. Cheese is the curd separated from the liquid portion of milk, called whey.
17. Hard cheeses are produced by lactic acid bacteria growing in the interior of the curd.
18. The growth of microbes in cheese is called repening.
19. Semisoft cheeses are ripened by bacteria growing on the surface; soft cheeses are ripened by *Penicillium* growing on the surface.

Other Dairy Products

20. Old-fashioned buttermilk was produced by lactic acid bacteria growing during the butter-making process.
21. Commercial buttermilk is made by letting lactic acid bacteria grow in skim milk for 12 hours.
22. Sour cream, yogurt, kefir, and kumiss are produced by lactobacilli, streptococci, or yeasts growing in low-fat milk.

Nondairy Fermentations

23. Sugars in bread dough are fermented by yeast to ethanol and CO_2; the CO_2 causes the bread to rise.
24. Sauerkraut, pickles, olives, soy sauce, and even cocoa and coffee, are products of microbial fermentations.

Alcoholic Beverages and Vinegar

25. Carbohydrates obtained from grains, potatoes, or molasses are

fermented by yeasts to produce ethanol in the production of beer, ale, sake, and distilled spirits.

26. The sugars in fruits such as grapes are fermented by yeasts to produce wines.
27. In winemaking, lactic acid bacteria convert malic acid into lactic acid in malolactic fermentation.

28. Acetobacter and *Gluconobacter* oxidize ethanol in wine to acetic acid (vinegar).

Industrial Microbiology

I. Microorganisms produce alcohols and aceto ne that are used in industrial processes.
2. Industrial microbiology has been revolutionized by the ability of genetically modified cells to make many new products.
3. Biotechnology is a way of making commercial products by using living organisms.

Fermentation Technology

4. The growth of cells on a large scale is called industrial fermentation.
5. Industrial fermentation is carried on in bioreactors, which control aeration, pH, and temperature.
6. Primary metabolites such as ethanol are formed as the cells grow (during the trophophase).
7. Secondary metabolites such as penicillin are produced during the stationary phase (idiophase).
8. Mutant strains that produce a desired product can be selected.

Immobilized Enzymes and Microorganisms

9. Enzymes or whole cells can be bound to solid spheres or fibers . When substrate passes over the surface, enzymatic reactions change the substrate to the desired product.

10. They are used to make paper, textiles, and leather and are environmentally safe.

Industrial Products

11. Most amino acids used in foods and medicine are produced by bacteria.
12. Microbial production of amino acids can be used to produce I.-isomers; chemical production results in both D- and L-isomers.

13. Lysine and glutamic acid are produced by *Corynebacterium* glu*tamicum.*
14. Citric acid, used in foods, is produced by *Aspergillus niger.*
15. Enzymes used in manufacturing foods, medicines, and other goods are produced by microbes.
16. Some vitamins used as food supplements arc made by microorganisms .
17. Vaccines, antibiotics, and steroids are products of microbial growth.

18. The metabolic activities of *Thiobacillus ferrooxidans* can be used to recover uranium and copper ores.
19. Yeasts are grown for wine- and bread making; other microbes *(Rhizobium, Bradyrhizobium,* and *Bacillus thuringiensis)* are grown for agricultural use.

Alternative Energy Sources Using Microorganisms

20. Organic waste, called biomass, can be converted by microorganisms into the alternative fuel methane, a process called bioconversion

21. Fuels produced by microbial fermentation are methane, ethanol, and hydrogen.

Biofuels

22. Biofuels include alcohols and hydrogen (from microbial fermentation) and oils (from algae).

Industrial Microbiology and the Future

23. Recombinant DNA technology will continue to enhance the ability of industrial microbiology to produce medicines and other useful products.

References':1- Microbiology an introduction TWELFTH EDITION. Gerard. Tortora.2016.

2- Microbiology an introduction TENTH EDITION. Gerard. Tortora.2010.