Indices of food sanitary quality and sanitizers

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INTRODUCTION

Food quality and safety are important consumer requirements.

Indicator organisms can be employed to reflect the microbiological quality of foods relative to product shelf life or their safety from foodborne pathogens.

In general, indicators are most often used to assess food sanitation.

Three groups of microorganisms are commonly tested for and used as ***indicators*** of overall food quality and the hygienic conditions present during food processing, and, to a lesser extent, as a marker or ***index*** of the potential presence of pathogens (i.e. food safety): coliforms, *Escherichia coli* (*E. coli;* also a coliform) and *Enterobacteriaceae.*

Microbiological indicator organisms can be used to monitor hygienic conditions in food production. The presence of specific bacteria, yeasts or molds is an indicator of poor hygiene and a potential microbiological contamination.

Index Microorganisms

- Microbiological criteria for food safety which defines an appropriately selected microorganism as an index microorganisms suggest the possibility of a microbial hazard without actually testing for specific pathogens.
- Index organisms signal the increased likelihood of a pathogen originating from the same source as the index organism and thus serve a predictive function.
- Higher levels of index organisms may (in certain circumstances), correlate with a greater probability of an enteric pathogen(s) being present.
- The absence of the index organism does not always mean that the food is free from enteric pathogens.

Indicator Microorganisms

The presence of indicator microorganisms in foods can be used to:

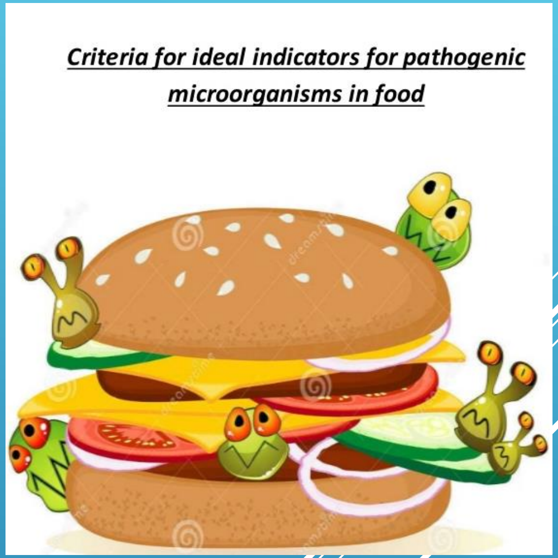
- assess the adequacy of a heating process designed to inactivate vegetative bacteria, therefore indicating process failure or success;
- assess the hygienic status of the production environment and processing conditions;
- assess the risk of post-processing contamination; assess the overall quality of the food product.

A number of factors must be considered before testing for a particular indicator organism or group of organisms:

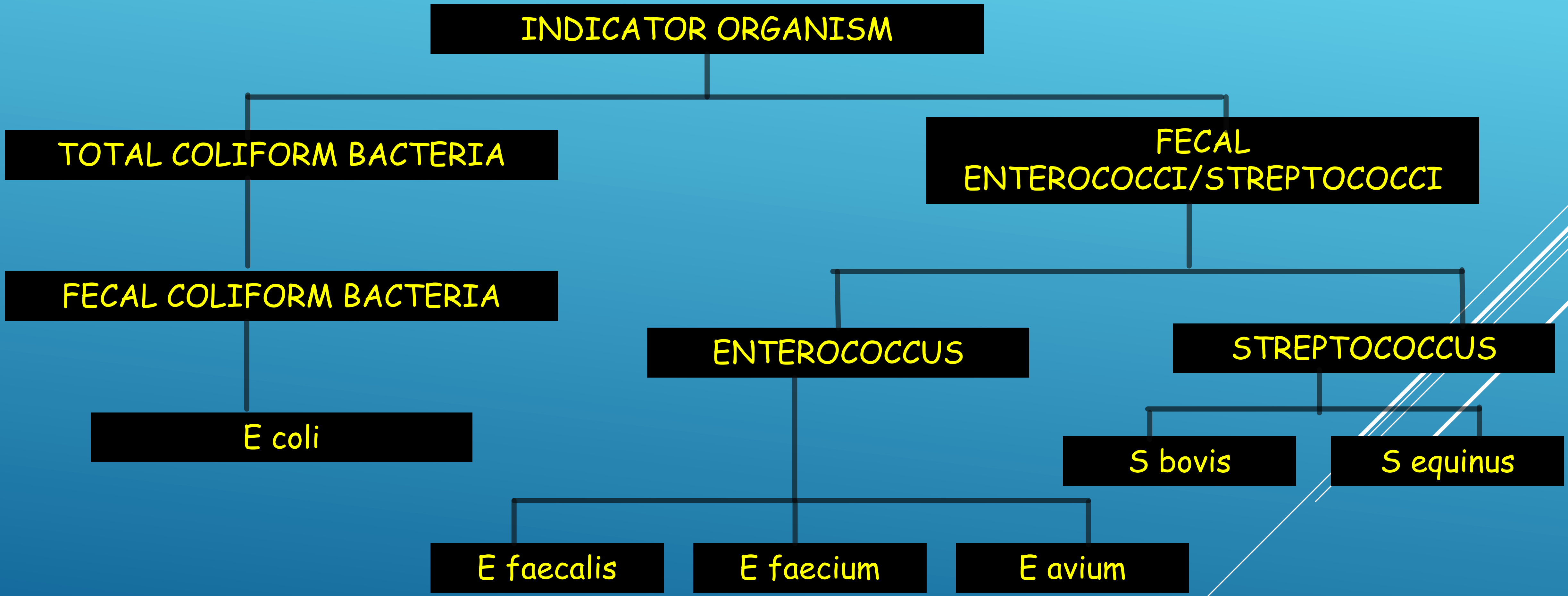
- the physio-chemical nature of the food; the native microflora of the food (fresh fruit and vegetables often carry high levels of *Enterobacteriaceae* and/or coliforms as part of their normal flora)
- the extent to which the food has been processed; the effect that processing would be expected to have on the indicator organism(s)
- the physiology of the indicator organism(s) chosen.

CRIETIA FOR IDEAL INDICATORS FOR PATHOGENIC MICROORGANISMS IN FOOD

- The indicator should preferably contain a single species or a few species with some common and identifiable biochemical characteristics.
- The indicator should be of enteric origin, that is, it should share the same habitat as the enteric pathogens.
- The indicator should be nonpathogenic so that its handling in the laboratory does not require safety precautions.
- The indicator should be present in the fecal matter in much higher numbers than the enteric pathogens so they can be easily detected.
- The indicator should be detected and identified within a short time.
- The indicator should have a growth and survival rate in a food as that of the enteric pathogen.
- The indicator should preferably be present when the pathogens are present in food; conversely, it should be absent when the enteric pathogens are absent. It is apparent that no single bacterial group or species will be able to meet all the criteria of an ideal indicator. Several bacterial groups or species satisfy many of these criteria.



POSSIBLE INDICATOR ORGANISMS



FECAL ENTEROCOCCI/STREPTOCOCCI

The fecal streptococci are a group of gram-positive Lancefield group D streptococci. The fecal streptococci belong to the genera *Enterococcus* and *Streptococcus*. The genus *Enterococcus* includes all streptococci that share certain biochemical properties and have a wide range of tolerance of adverse growth conditions.

They are differentiated from other streptococci by their ability to grow in 6.5% sodium chloride, pH 9.6, and 45°C and include *Ent. avium*, *Ent. faecium*, *Ent. durans*, *Ent. facculis*, and *Ent. gallinarium*.

Of the genus *Streptococcus*, only *S. bovis* and *S. equinus* are considered to be true fecal streptococci. These two species of *Streptococcus* are predominately found in animals; *Ent. faecalis* and *Ent. faecium* are more specific to the human gut. Fecal streptococci are considered to have certain advantages over the coliform and fecal coliform bacteria as indicators.

- They rarely multiply in water.
- They are more resistant to environmental stress and chlorination than coliforms.
- They generally persist longer in the environment

Coliform

- The coliform group is defined on the basis of biochemical reactions, not genetic relationships, and thus the term "coliform" has no taxonomic validity. Coliforms are aerobic and facultatively anaerobic, gram negative, non-sporeforming rods that ferment lactose, forming acid and gas within 48 hours at 35C.

- In the case of refrigerated ready-to-eat products, coliforms are recommended as indicators of process integrity with regard to reintroduction of pathogens from environmental sources and maintenance of adequate refrigeration. The source of coliforms in these types of products after thermal processing is usually the processing environment, resulting from inadequate sanitation procedures and/or temperature control.

- Coliforms are ubiquitous in nature, therefore a number of factors should be considered when testing for a particular indicator organism such as the native microflora of the food, the extent to which the food has been processed, and the effect that processing would be expected to have on the indicator organisms.

E. coli

- A gram negative rod-shaped bacterium that is commonly found in the lower intestine of warm-blooded organisms (endotherms). Most *E. coli* strains are harmless, but some, such as serotype O157:H7 can cause serious food poisoning in humans. The harmless strains are part of the normal flora of the gut, and can benefit their hosts by producing vitamin K, and by preventing the establishment of pathogenic bacteria within the intestine. *E. coli* are easily destroyed be heat, and cell numbers may decline during freezing and frozen storage of foods.

- *E. coli* is the only member of the coliform group that unquestionably is an inhabitant of the intestinal tract and it has become the definitive organism for the demonstration of fecal pollution of water and food not undergoing any processing which would kill the organism.

- In cases where it is desirable to determine whether fecal contamination may have occurred, at present, *E. coli* is the most widely used indicator of such, the presence of which implies a risk that other enteric pathogens may be present in the food. In many raw foods of animal origin, small number of *E. coli* can be expected because of the close association of these foods with the animal environment and the likelihood of contamination of carcasses from fecal material, hides, or feathers during slaughter-dressing procedures

- Dairy microbiologists use *E .coli* as a true indicator organism to assess post-pasteurization contamination in milk. The presence of *E. coli* in pasteurized milk may indicate inadequate pasteurization, poor hygienic conditions in the processing plant, and/or post-processing contamination because proper pasteurization inactivates levels of *E. coli* anticipated in raw milk.

Enterobacteriaceae: The taxonomically defined family, *Enterobacteriaceae*, includes those facultatively anaerobic gram-negative straight bacilli which ferment glucose to acid, are oxidase-negative, usually catalase-positive, usually nitrate-reducing, and motile by peritrichous flagella or nonmotile.

The *Enterobacteriaceae* group does include many coliforms, with the addition of other microorganisms which ferment glucose instead of lactose (i.e. *Salmonella*). Common foodborne genera of the Family *Enterobacteriaceae* include *Citrobacter*, *Enterobacter*, *Erwinia*, *Escherichia*, *Hafnia*, *Klebsiella*, *Proteus*, *Providencia*, *Salmonella*, *Serratia*, *Shigella*, and *Yersinia*.

Psychrotrophic strains of *Enterobacter*, *Hafnia*, and *Serratia* may grow at temperatures as low as 0C.

If the meat ecosystem favors their growth, genera in the family *Enterobacteriaceae* may be important in muscle food spoilage. Conditions allowing growth of *Enterobacteriaceae* include limited oxygen and low temperature. Members of this family produce ammonia and volatile sulfides, including hydrogen sulfide and malodorous amines, from amino acid metabolism.

The *Enterobacteriaceae* have been used for years in Europe as indicators of food quality and indices of food safety.

Sanitation in Food Processing

- Sanitation is an applied science that incorporates the principles of design, development, implementation, maintenance, restoration, and/or improvement of hygienic practices and conditions.

- Sanitation maintains or restores a state of cleanliness and promotes hygiene for prevention of foodborne illness.

- Foodborne illness can be controlled when sanitation is properly implemented in all food operations.

- Inspection is becoming more stringent because inspectors are using the Hazard Analysis Critical Control Point (HACCP) concept to establish compliance.

A sanitary processing environment is essential to food safety, and ensuring a sanitary plant means implementing cleaning standards as well as sanitation standards.

> "Cleaning and sanitation are different because the cleaning steps address physical soils that are loose or adhering to a surface. Sanitation is directly related to microorganisms,"
>
> Alan Parker, managing director of Parker Associates consulting organization.

Sanitation controls. Sanitation controls include procedures, practices and processes to ensure that the facility is maintained in a sanitary condition adequate to significantly minimize or prevent hazards such as environmental pathogens, biological hazards due to employee handling, and food allergen hazards. Sanitation controls must include, as appropriate to the facility and the food, procedures, practices and processes for the:

(i) Cleanliness of food-contact surfaces, including food-contact surfaces of utensils and equipment;

(ii) Prevention of allergen cross-contact and cross-contamination from insanitary objects and from personnel to food, food packaging material, and other food-contact surfaces and from raw product to processed product.

Attaining a sanitary environment involves seven essential steps:

1. Inspection, Identification, Equipment Breakdown
2. Sweeping and Flushing
3. Washing
4. Rinsing
5. Sanitizing
6. Rinse/Air Dry
7. Validation

1. Inspection, Identification, and Equipment Breakdown

Prior to beginning the cleaning program, equipment should be broken down, and an inspection conducted to identify any areas needing particular attention and select the application methods and chemicals to be used. While a plant will generally have standards for selection, it is also important to determine if any extenuating conditions exist that may require extra cleaning or sanitation, different detergent or sanitizer, or other variation.

2. Sweeping, Scraping, and Flushing

The first step in the cleaning and sanitation is, then, the physical removal of gross solids and large particles. This could include the use of brooms and scrapers or simply physical lifting and disposing of items. The more food residues removed ahead of time, the cleaner the wash water will stay. This is often followed by flushing or rinsing of the surfaces to remove as much of the solids and particles prior to cleaning as possible. Warm water, of 105° to 115°F is recommended to be used for rinsing. "If the water is too hot, it can cause the soils to become more adherent,".

3. Washing

The second step of cleaning is the application of a detergent. This may be applied manually, but a mechanical foamer is generally preferred, Manufacturer directions for dilution rates and contact time should be used, then physical cleaning conducted to scrub the surfaces.

If operating in a dry facility, equipment and components may instead be cleaned with alcohol or other solvents that evaporate over time.

4. Rinsing

Following washing, a potable-water rinse is conducted to ensure that all the detergent is removed. The rinse step is critical because detergent residues will neutralize many sanitizers.

5. Sanitizing

Once the surfaces are verified as "clean," the sanitizing steps are begun. A variety of applications are used for sanitizing processing environments, from heat to chemical disinfectants. "In the food and beverage industry, there are probably four or five general categories of hard-surface sanitation that are used," Parker said. The most common of these are chlorine-based, sodium hypochloride, commonly known as bleach.

6. Rinsing/Air Dry

Sanitizers come in two forms: leave on and rinse off. According to Food Industry Quality Control Systems by Mark Clute, QA Manager of Turtle Mountain, most food processors currently use leave-on sanitizers due to the "glove-like protection" they provide. These, he said, can be left on the surfaces for several hours and still maintain their effectiveness.

As with detergents, rinse-off sanitizers should be completely rinsed from surfaces prior to operational start-up, and label directions should be followed for dry time for leave-on sanitizers.

7. Validation and Verification

Validation should be conducted through both visual inspection and protein swabs. Verification criteria should include that no visible residue be present and micro counts be within acceptable limits.

The USDA's HACCP regulation puts sanitation—cleaning and sanitizing—in its proper perspective:

The regulation establishes the following preventive controls:

- Process
- Allergen
- Sanitation
- Supply Chain
- Recall
- Other

DEFINITIONS

CLEANING: The removal of soil particles from surfaces by mechanical, manual or chemical methods.

SANITIZING: Treatment of a cleaned surface with a chemical or physical agent to destroy disease/spoilage causing organisms. Reduces total vegetative cell population to a safe level.

DISINFECTING: Destruction of all vegetative state organisms.

STERILIZING: The complete destruction of all organisms, including spores.

DIRTY: A surface that is not clean.

Elements of cleaning and sanitizing

There are many different ways to clean and sanitize equipment. These include the use of clean-in-place (CIP) systems, foaming, clean-out-of-place (COP), spraying, high pressure and manual systems. Manual is the old-fashioned route that usually involved scrubbing of some sort.

THE BASIC ISSUES THAT MUST BE CONSIDERED HERE ARE **"TACT WINS"**

T – Time

A – Action

C – Concentration

T – Temperature

W – Water

I – Individual

N – Nature

S – Surface

Cleaning is a necessary first step because one cannot sanitize a dirty surface.

Time

Time depends on many factors like method of cleaning, soil and type of equipment.
Neither too little nor too much time should be used for cleaning.
For example if foaming is used for cleaning a surface, it should be rinse within a set period of time otherwise foam and soil will redeposited on surface.
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Action

This is the energy required to properly clean a surface. Action brings the cleaning compounds into contact with the soil and enhances their removal. Examples of action would be the activity of a foam cleaner, the flow through pipes in a CIP system, the moving water in a COP tank, or the use of brushes or white pads when doing manual cleaning.

Concentration

To properly clean surfaces, the processor must use the correct cleaning compound at the proper concentration. There are a wide range of cleaning compounds available to the industry. What is needed depends upon factors such as the nature of the soil, water hardness and the surface being cleaned. Cleaning compounds have many functions, including saponification, wetting (surfactancy), emulsification, water softening, foaming or lack thereof, and rinsability.

Temperature

The temperature at which cleaners are used affects their efficacy. The rule of thumb is that cleaning efficacy doubles (up to a point) for every 10°C increase in temperature. Each cleaner has an optimum temperature range at which it should be used.

Individual

Who will do the cleaning? Each person assigned to cleanup must be properly educated on each and every cleaning procedure that he or she will be conducting.

Surface

What is the equipment that is being cleaned made of? The most common material is stainless steel, but one sees plastics in various shapes and forms, rubber, and other metals. All metals will corrode, some more quickly than others. Stainless steel is favored because it has high resistance, whereas aluminum corrodes easily.

Water

Water is the universal solvent. The first step in cleaning is a rinse with water to remove gross soil from the surface and away from the equipment. Water is also used to convey the detergents to the surface and to carry away the soil. The use of surfactants in cleaners enhances the ability of water to react with the soils.

Nature

What products are being manufactured in each plant will determine the kind of soil that must be removed. There are five basic kinds of soils the food industry must deal with: fats/grease, proteins, minerals, sugars and complex carbohydrates.

As with other areas of food safety, sanitation and food hygiene should be proactive. End-product testing is important, but a positive result in the end-product doesn't tell you where the contamination originated. The overall food hygiene system, when applied at each point in the supply chain, is about managing risks before they result in a case of food contamination. Using common sense and **food science** based approaches, a well-designed food hygiene program can provide for proactive responses and risk-mitigation from farm to fork.

For more detail study go through the book
Principles of Food Sanitation
Fifth Edition
Norman G. Marriott, PhD
Robert B. Gravani