Indicator Organisms

Use of indicator organisms

- Testing foods
  - Primarily microbiological analysis
- Determination of the microbiological quality of a food product
  - Shelf life
  - Food safety
  - Compliance with criteria

Indicators of quality

- Microorganisms and/or their metabolic products
- Their presence at certain levels may be used to assess existing quality or predict shelf life
Must meet the following criteria:

- Should be present and detectable in the food where quality is being assessed
- Growth and numbers should correlate negatively with product quality
- Easily detected and enumerated
- Clearly distinguishable from other organisms
- Enumerable within a short period of time
- Their growth should not be inhibited by other background microflora

Organisms related to quality of specific foods

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetobacter spp.</td>
<td>Fresh cider</td>
</tr>
<tr>
<td>Brevibacter spp.</td>
<td>Bread dough</td>
</tr>
<tr>
<td>Brevibacter spp.</td>
<td>Canned fruits</td>
</tr>
<tr>
<td>Comamonas spp.</td>
<td>Hard cheeses</td>
</tr>
<tr>
<td>Flavobacterium spp.</td>
<td>Canned vegetables</td>
</tr>
<tr>
<td>Lactic acid bacteria</td>
<td>Beers, wines</td>
</tr>
<tr>
<td>Lactobacillus lactis</td>
<td>Raw milk (refrigerated)</td>
</tr>
<tr>
<td>Leuconostoc mesenteroides</td>
<td>Sugar (during refining)</td>
</tr>
<tr>
<td>Pectinatus eversiphilus</td>
<td>Beers</td>
</tr>
<tr>
<td>&quot;Pseudomonas putrefaciens&quot;</td>
<td>Butter</td>
</tr>
<tr>
<td>Yeasts</td>
<td>Fruit juice concentrates</td>
</tr>
<tr>
<td>Zymosacharomyces bailii</td>
<td>Mayonnaise, salad dressing</td>
</tr>
</tbody>
</table>

Jay, 1998

Metabolites related to product quality

<table>
<thead>
<tr>
<th>Metabolites</th>
<th>Applicable Food Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadaverine and putrescine</td>
<td>Vacuum-packaged beef</td>
</tr>
<tr>
<td>Diacetyl</td>
<td>Frozen juice concentrate</td>
</tr>
<tr>
<td>Ethanol</td>
<td>Apple juice, fishery products</td>
</tr>
<tr>
<td>Histamine</td>
<td>Canned tuna</td>
</tr>
<tr>
<td>Lactic acid</td>
<td>Canned vegetables</td>
</tr>
<tr>
<td>Trimethylamine (TMA)</td>
<td>Fish</td>
</tr>
<tr>
<td>Total volatile bases (TVB), total volatile nitrogen (TVN)</td>
<td>Seafoods</td>
</tr>
<tr>
<td>Volatile fatty acids</td>
<td>Butter, cream</td>
</tr>
</tbody>
</table>

Jay, 1998
Total bacterial counts
- Generally not reliable as indicators of product stability
- Useful to determine general microbiological quality

Food safety indicators
- Sometimes called “index” instead of “indicators”
  - Some authors propose that the term “indicator” should be applied to organisms used for assessing food quality and “index” to those used to assess food safety

Characteristics of the ideal food safety indicator
1. Readily and easily detectable
2. Easily distinguishable from other members of the food flora
3. Has a history of association with the pathogen whose presence is indicated
4. Always present when the pathogen of concern is present
5. Its levels in the food have a good correlation with the levels of the pathogen of concern
Characteristics of the ideal food safety indicator (cont.)

6. Has the same growth requirements and growth rates as those of the pathogen
7. Has a die-off rate that at least parallels that of the pathogen
   - Ideally persists slightly longer than the pathogen
8. Is absent from foods that are free of the pathogen
   - Except perhaps at minimum levels

Indicators most commonly used

- ACP (aerobic plate count)
- Coliforms
- Fecal coliforms
- Enterobacteriaceae
- Escherichia coli

Commonly accepted indicators

- APC (aerobic plate count)
  - The greater the contamination, the greater the food safety risk?
Commonly accepted indicators

• **Coliforms**
  – Gram-negative, oxidase negative, non-sporeforming rods capable of producing gas from lactose when incubated at 35°C for 24-48 h
  – Not all of them are of fecal origin
  – Do not survive pasteurization
    • Use in the dairy industry
    • Do not measure effectiveness of pasteurization
    • However their presence in large numbers would likely be related to non-pasteurized milk
  – Used to indicate adherence to GMP in processed foods
    • Cooked
    • Pasteurized

• **Fecal coliforms**
  – Different from total coliforms in their ability to produce gas from lactose at 44.5°C
  – Somewhat specific of fecal matter
    • Can multiply in the environment
  – Accuracy as fecal indicators is questionable
    • May originate from poorly sanitized surfaces

• **Enterobacteriaceae**
  – Broader group (glucose fermentative)
  – Same limitations as the coliform group
    • No fecal origin
  – Same applications and significance in foods as coliforms
Commonly accepted indicators

- *Escherichia coli*
  - Close association with feces
  - Their presence in foods is indicative of fecal contamination
  - Therefore of the potential presence of a pathogen