

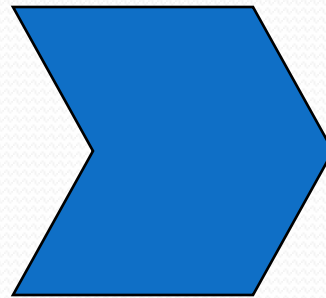
MIKROBIOLOGI MAKANAN

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Pendahuluan



Makanan



- kebutuhan nutrisi
- pertumbuhan mikroba
- transmisi penyakit

Fermentasi

{ pengawetan makanan
pembusukan makanan

Mikroorganisme Yang Tumbuh Pada Makanan

- Faktor intrinsik
- Faktor ekstrinsik

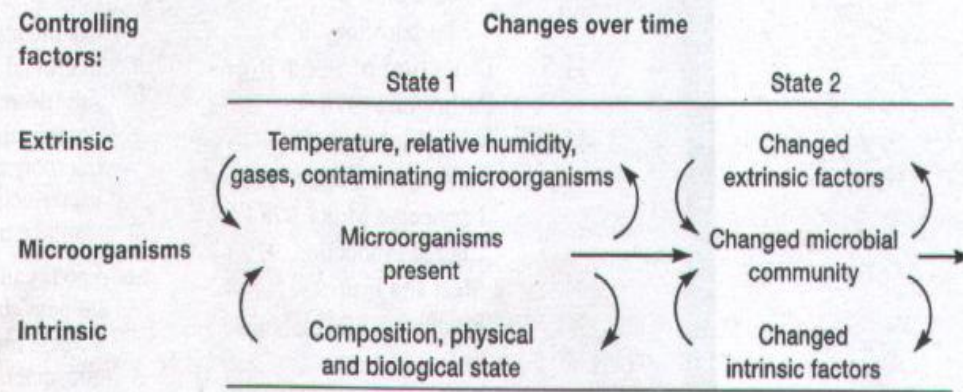


Figure 41.1 Intrinsic and Extrinsic Factors. A variety of intrinsic and extrinsic factors can influence microbial growth in foods. Time-related successional changes occur in the microbial community and the food.

Faktor Intrinsik

- Komposisi makanan
- pH
- Kandungan air
- Potensial oksidasi-reduksi
- Struktur fisik
- Zat antimikroba alami



Faktor Ekstrinsik

- Temperatur
- Kelembaban
- Komposisi udara

$\text{CO}_2 \uparrow \rightarrow \text{pH} \downarrow \rightarrow$ pertumbuhan mikroba terhambat

Pencegahan Pembusukan Makanan

Table 41.4 Basic Approaches to Food Preservation

Approach	Examples of Process
Removal of microorganisms	Avoidance of microbial contamination; physical filtration, centrifugation
Low temperature	Refrigeration, freezing
High temperature	Partial or complete heat inactivation of microorganisms (pasteurization and canning)
Reduced water availability	Water removal, as with lyophilization or freeze drying; use of spray dryers or heating drums; decreasing water availability by addition of solutes such as salt or sugar
Chemical-based preservation	Addition of specific inhibitory compounds (e.g., organic acids, nitrates, sulfur dioxide)
Radiation	Use of ionizing (gamma rays) and nonionizing (UV) radiation
Microbial product-based inhibition	The addition of substances such as bacteriocins to foods to control food-borne pathogens

Pencegahan Pembusukan Makanan

- Pengawetan kimia

Table 41.5 Major Groups of Chemicals Used in Food Preservation

Preservatives	Approximate Maximum Use Range	Organisms Affected	Foods
Propionic acid/propionates	0.32%	Molds	Bread, cakes, some cheeses, inhibitor of ropy bread dough
Sorbic acid/sorbates	0.2%	Molds	Hard cheeses, figs, syrups, salad dressings, jellies, cakes
Benzoic acid/benzoates	0.1%	Yeasts and molds	Margarine, pickle relishes, apple cider, soft drinks, tomato ketchup, salad dressings
Parabens ^a	0.1%	Yeasts and molds	Bakery products, soft drinks, pickles, salad dressings
SO ₂ /sulfites	200–300 ppm	Insects and microorganisms	Molasses, dried fruits, wine, lemon juice (not to be used in meats or other foods recognized as sources of thiamine)
Ethylene/propylene oxides	700 ppm	Yeasts, molds, vermin	Fumigant for spices, nuts
Sodium diacetate	0.32%	Molds	Bread
Dehydroacetic acid	65 ppm	Insects	Pesticide on strawberries, squash
Sodium nitrite	120 ppm	Clostridia	Meat-curing preparations
Caprylic acid	—	Molds	Cheese wraps
Ethyl formate	15–200 ppm	Yeasts and molds	Dried fruits, nuts

From James M. Jay. 2000. *Modern Food Microbiology*, 6th edition. Reprinted by permission of Aspen Publishing, Frederick, Md.

^aMethyl-, propyl-, and heptyl-esters of *p*-hydroxybenzoic acid.

Penyakit Yang Diakibatkan Oleh Makanan

- Penelitian terakhir, tersering :
 - *Norwalk Like Viruses*
 - *Campilobacter jejuni*
 - *Salmonella*
 - *E. coli*
 - *Listeria*

Penyakit Yang Diakibatkan Oleh Makanan

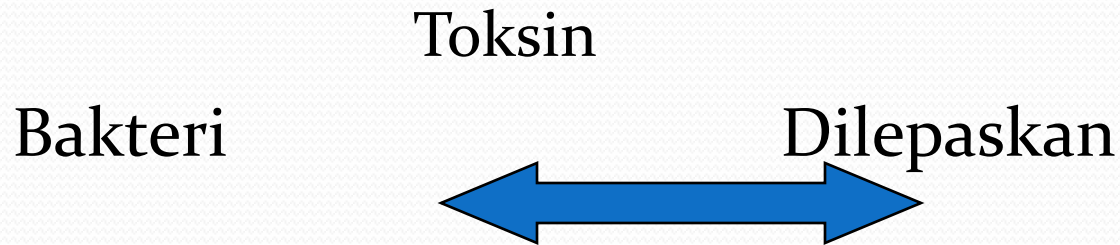
- Food-Borne Infection

Table 41.6 Major Food-Borne Infectious Diseases

Disease	Organism	Incubation Period and Characteristics	Major Foods Involved
Salmonellosis	<i>S. typhimurium</i> , <i>S. enteritidis</i>	8–48 hr Enterotoxin and cytotoxins	Meats, poultry, fish, eggs, dairy products
<i>Arcobacter</i> diarrhea	<i>Arcobacter butzleri</i>	Severe diarrhea, recurrent cramps	Meat products, especially poultry
Campylobacteriosis	<i>Campylobacter jejuni</i>	Usually 2–10 days Most toxins are heat-labile	Milk, pork, poultry products, water
Listeriosis	<i>L. monocytogenes</i>	Varying periods Related to meningitis and abortion; newborns and the elderly especially susceptible	Meat products, especially pork and milk
<i>Escherichia coli</i> diarrhea and colitis	<i>E. coli</i> , including serotype O157:H7	24–72 hr Enterotoxigenic positive and negative strains; hemorrhagic colitis	Undercooked ground beef, raw milk
Shigellosis	<i>Shigella sonnei</i> , <i>S. flexneri</i>	24–72 hr	Egg products, puddings
Yersiniosis	<i>Yersinia enterocolitica</i>	16–48 hr Some heat-stable toxins	Milk, meat products, tofu
<i>Plesiomonas</i> diarrhea	<i>Plesiomonas shigelloides</i>	1–2 hr	Uncooked mollusks and foreign travel
<i>Vibrio parahaemolyticus</i> gastroenteritis	<i>V. parahaemolyticus</i>	16–48 hr	Seafood, shellfish

Penyakit Yang Diakibatkan Oleh Makanan

- Food-Borne Intoxication



- Bakteri :
- *Clostridium botulinum*
 - *Clostridium perfringens*
 - *Bacillus cereus*

Mikrobiologi Makanan Fermentasi

➤ Cara tersering dalam pengawetan makanan

- Susu fermentasi

Table 41.7 Major Categories and Examples of Fermented Milk Products

Category	Typical Examples
I. Lactic fermentations	
Mesophilic	Buttermilk Cultured buttermilk Långofil Tötmjolk Ymer
Thermophilic	Yogurt, laban, zabadi, labneh, skyr Bulgarian buttermilk
Therapeutic	Biogarde [®] , Bifihurt [®] Acidophilus milk, yakult Cultura-AB [®]
II. Yeast-lactic fermentations	Kefir, koumiss, acidophilus-yeast milk
III. Mold-lactic fermentations	Viili

Source: Table 3.1, p. 58. In B. A. Law, editor. 1997. *Microbiology and Biochemistry of cheese and fermented milk*, 2nd ed. New York: Chapman and Hall.

Mikrobiologi Makanan Fermentasi

- Produksi Keju

Klasifikasi keju berdasarkan teksturnya:

- *soft cheeses* (cottage, cream, brie)
- *semisoft cheeses* (Muenster, limburg, blue)
- *hard cheeses* (cheddar, colby, swiss)
- *very hard cheeses* (permesan)

Mikroorganisme tambahan →

Penicillium roqueferti, *P.camemberti*.

Mikrobiologi Makanan Fermentasi

- Daging dan Ikan

- Produk : sosis

→ Mikroorganisme : *Pediococcus cerevisisae*
Lactobacillus plantarum

- Produk : ikan

→ Mikroorganisme : *Lactobacillus spp.*
Aspergillus glaucus (tuna)

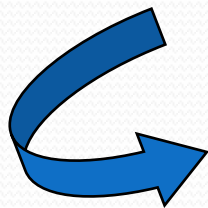
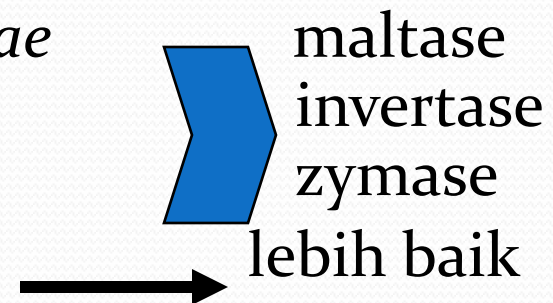
Mikrobiologi Makanan Fermentasi

- Produksi minuman beralkohol
 → tumbuhan karbohidrat tinggi
 - *Beers* dan *ales*
 - Bahan : biji-bijian cereal (gandum dan beras)
 - Difermentasikan dengan ragi bawah, *Saccharomices carlbergensis*

Mikrobiologi Makanan Fermentasi

- Produksi roti
 - Makanan telah lama dikenal
 - Ragi : *Saccharomices cereisiae*

- Mikroorganisme kompleks



Saccharomyces exiguus
Lactobacillus sp.

Mikrobiologi Makanan Fermentasi

- Makanan lain yang difermentasikan

Table 41.9 Fermented Foods Produced from Fruits, Vegetables, Beans, and Related Substrates

Foods	Raw Ingredients	Fermenting Microorganisms	Area
Coffee	Coffee beans	<i>Erwinia dissolvens</i> , <i>Saccharomyces</i> spp.	Brazil, Congo, Hawaii, India
Gari	Cassava	<i>Corynebacterium manihot</i> , <i>Geotrichum</i> spp.	West Africa
Kenkey	Corn	<i>Aspergillus</i> spp., <i>Penicillium</i> spp., Lactobacilli, yeasts	Ghana, Nigeria
Kimchi	Cabbage and other vegetables	Lactic acid bacteria	Korea
Miso	Soybeans	<i>Aspergillus oryzae</i> , <i>Zygosaccharomyces rouxii</i>	Japan
Ogi	Corn	<i>Lactobacillus plantarum</i> , <i>Lactococcus lactis</i> , <i>Zygosaccharomyces rouxii</i>	Nigeria
Olives	Green olives	<i>Leuconostoc mesenteroides</i> , <i>Lactobacillus plantarum</i>	Worldwide
Ontjom	Peanut presscake	<i>Neurospora sitophila</i>	Indonesia
Peujeum	Cassava	Molds	Indonesia
Pickles	Cucumbers	<i>Pediococcus cerevisiae</i> , <i>L. plantarum</i>	Worldwide
Poi	Taro roots	Lactic acid bacteria	Hawaii
Sauerkraut	Cabbage	<i>L. mesenteroides</i> , <i>L. plantarum</i>	Worldwide
Soy sauce	Soybeans	<i>Aspergillus oryzae</i> or <i>A. soyae</i> , <i>Z. rouxii</i> , <i>Lactobacillus delbrueckii</i>	Japan
Sufu	Soybeans	<i>Mucor</i> spp.	China
Tao-si	Soybeans	<i>A. oryzae</i>	Philippines
Tempeh	Soybeans	<i>Rhizopus oligosporus</i> , <i>R. oryzae</i>	Indonesia, New Guinea, Surinam

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Mikrobiologi Makanan Fermentasi

- Mikroorganismen sebagai makanan sehari-hari
 - Jamur : *Agaricus bisporus*
 - *Cyanobacterium spirulina*
 - *Lactobacillus* dan *Bifidobacterium*

TERIMA KASIH

