ROLE OF MICROORGANISMS IN FOODS

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Microorganisms in foods

- Pathogenic microorganisms
  - cause infections or intoxications
- Saprophytic microorganisms
  - Important role in biodegradation
  - Cause food spoilage
- Cultured microorganisms are used in food processing
  - Among them: Probiotic bacteria

PATHOGENIC MICROORGANISMS

Pathogenic microorganisms

- Cause food-borne infections or intoxications
  - Bacteria
  - Viruses
  - Parasites

  Described in epidemiology
  - Moulds producing toxins

Moulds

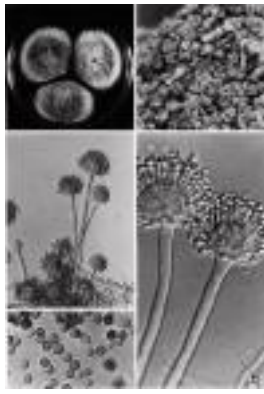
- Some strains produce under certain conditions mycotoxines:
  - Aspergillus – aflatoxin, ochratoxin, citrinin, patulin
  - Fusarium
  - Cladosporium
  - Alternaria

Mycotoxins – acute toxicity

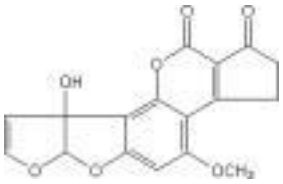
- Hepatotoxins: aflatoxins, sporidesmins, luteoskyrin, sterigmastocytin ..
- Nefrotoxins: ochratoxins, citrinin …
- Alimentary tract toxins: trichocetens
- Neuro- & myotoxins: tremorgens, citreoviridin …
- Dermatotoxins: verukarins, psoralen, sporidesmins, trichocetens
- Respiratory tract toxins: patulin

Mycotoxins

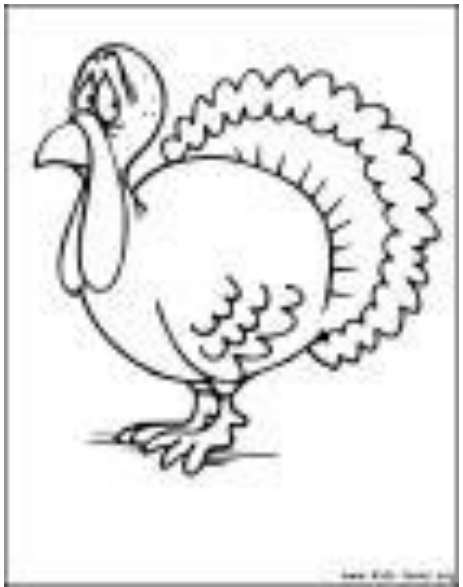
- Penetrate to parts of food that are not visibly mouldy
  - If there is mould on a part of a food – throw it all out
- Most chemically & physically (heat) very stable
  - Destroying difficult (chemical) & usually spoils the food … not done
- If contaminated fodder fed to animals - metabolised – toxic derivatives in milk, meat



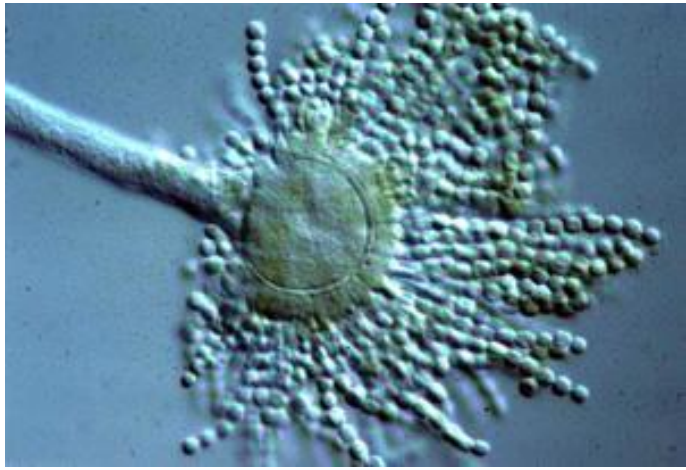
Aflatoxins



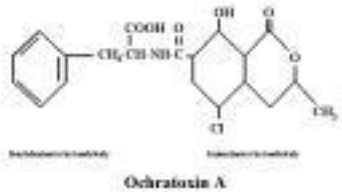
- 1960 England
  - Thousands of turkeys fed by mouldy peanuts died before X-mas
  - Discovery of aflatoxins produced by Aspergillus flavus
- Acute toxicity: hepatotoxic
- Chronic toxicity:
  - carcinogenic (hepatoma),
  - terato & genotoxic



Ochratoxins



- Aspergillus
- A,B,C derivatives of isocoumarine
- Chemically & physically VERY stable
- Occur most frequently in grains
- Toxicity: hepato & nephrotoxic
- Ochratoxicosis: balkan nephropathy



Ochratoxin A

Patulin

- Producers: Aspergillus, Penicillium
- Not very heat stable
- Occurs in: fruits & fruit products, grains
- Toxicity: confirmed in animals
- Chronic intake: considered carcinogenic

Moulds: Foods most at risk

- Grains & grain products (many mycotoxin types)
- Peanuts, nuts, pulses (aflatoxin)
- Fruits, vegetables: raw & preserved (patulin)
- Milk, milk products (aflatoxin)

SAPROPHYTIC MICROORGANISMS

Food spoilage

- Caused by:
  - Bacteria
  - Moulds
  - Yeasts
- Change of look, consistency, flavour, odour

Action of bacteria involved in food spoilage

Action	Example species of:
Acetic acid formation	Acetobacter
Butyric acid formation	Clostridium
Gas formation	Leuconostoc, Lactobacillus, Proteus
Lactic acid formation	Lactobacillus, Leuconostoc,
Lipolysis	Pseudomonas, Serratia, Micrococcus
Pectolysis	Erwinia, Bacillus, Clostridium
Pigment formation	Flavobacterium, Serratia, Micrococcus
Proteolysis	Bacillus, Pseudomonas, Clostridium,
Saccharolysis	Bacillus, Clostridium etc.
Slime formation	Enterobacter, Streptococcus

Source: http://www.microbiologyprocedure.com/food-microbiology/importance-of-microbes-in-foods.htm

PROBIOTICS

Probiotics

- "Probiotic" antonym to "antibiotic"
- WHO/FAO definition 2001: "Live micro-organisms which, when administered in adequate amounts, confer a health benefit on the host.
- In yoghurt and other fermented milk products:
  - *Lactobacillus acidophillus, Bifidobacterium bifidum, breve, or longum* etc.

Criteria

- Must have undergone controlled evaluation to document health benefits in the target host
- Have to be alive when administered
- Taxonomically defined microbe or combination of microbes (genus, species, strain).
  - Most effects of probiotic are strain-specific and cannot be extended to other probiotics of the same genus or species.
- Must be safe for their intended use
- Must be supplied in adequate numbers, which may be defined as the number able to trigger the targeted effect on the host: min. 10^8 bacteria/1 ml

Probiotics: Effects – relates to specified strains – not all probiotics

- Reduce the duration of diarrhoea (Cochrane review)
- Antibiotic-associated diarrhoea: protect
- May help lactose-intolerant individuals tolerate more lactose
- Preliminary studies: may reduce serum cholesterol levels
  - break down bile in the gut, thus inhibit its reabsorption - enters the blood as cholesterol
- May affect pathogens (competitive inhibition)
- Some evidence suggests: may improve immune function
  - by increasing the number of IgA-producing plasma cells and increasing or improving phagocytosis + proportion of T lymphocytes + natural killer cells.
- May affect Helicobacter pylori infections

Probiotics - EFSA Panel concludes that :

- The evidence provided is insufficient to establish a cause and effect relationship between the consumption of Actimel® and a reduction of the risk of *C. difficile* diarrhoea by reducing the presence of *C. difficile* toxins. EFSA Journal 2010;8(12):1903
- A cause and effect relationship has not been established between the consumption of
  - *B. bifidum* CNCM I-3426 and defence against pathogens in the upper respiratory tract. EFSA Journal 2015;13(5):4094
  - SYNBIO® and maintenance of normal defecation. SYNBIO®, a combination of *Lactobacillus rhamnosus* IMC 501® and *Lactobacillus paracasei* IMC 502®, EFSA Journal 2015;13(5):4095

MICROORGANISMS IN FOOD PRODUCTION

Microorganisms in food production

- Bacteria,
- Yeast,
- Moulds, or
- a combination of these organisms

- Fermentation of food results in the production of organic acids, alcohols, esters etc.
  - helps to preserve the food
  - generates distinctive new food products

Yeasts in food production

- Leavened bread & bakery products
  - *Saccharomyces cerevisiae* - ferment the sugars to produce CO_2 (gas - porous structure) and contributes to the flavour – formation of alcohols acids, aldehydes, esters etc.

Yeasts in food production

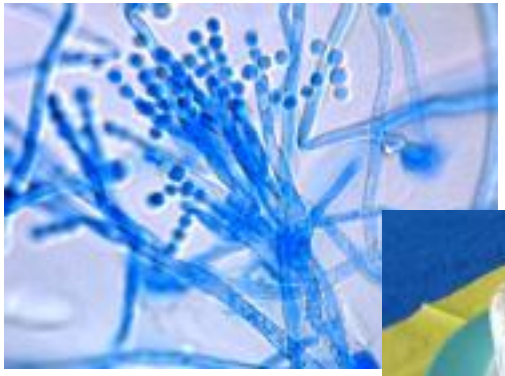
- Beer
- Wine
- Vinegar
- Sauerkraut
- Pickles

Fermenting bacteria in food production

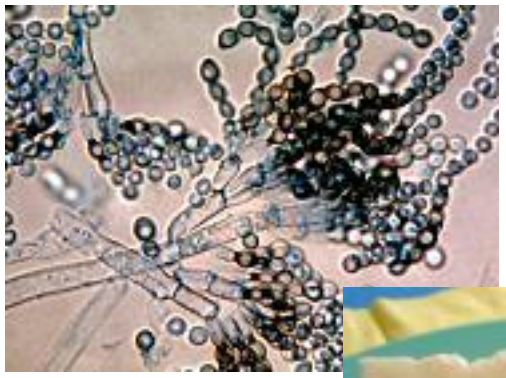
- Fermented milk products
  - *Lactobacillus, Lactococcus, Bifidobacterium, Streptococcus* strains
- A variety of foods e.g. Indian dosa, rabri
  - Fermentation with *Leuconostoc mesenteroides, S. faecalis* and *Pediococcus cerevisiae*.

Moulds in food production: cheese

- Penicillium camemberti
  - Produces mycotoxin at 25 °C
  - Cheese production at 15 °C – no mycotoxin



- Penicillium roqueforti



Moulds in food production: Dry Salami

- Some ripen under *Penicillium, Scopulariopis* moulds
  - Toxin producing variants may occur …..
  - It has not happened in practice ….

Moulds in food production

– Soy sauce
  - *Aspergillus sp.* especially *A. oryzae.* In the subsequent lactic fermentation, lactic bacteria produce lactic acid.
– Sake (14-17 % of alcohol)
  - Produced using a combination of a mould *Aspergillus oryzae* and yeast.

Moulds in food production

- Tempeh (Indonesian food)
  - Prepared from soybean inoculated with spores of *Rhizopus sp*.
- A variety of Japanese and Chinese foods e.g. miso, soybean cheese

Coffee & cocoa

- **Coffee** fermentation
  - Pectinolytic bacteria degrade the pectin
  - Lactic fermentation
- **Cocoa** fermentation
  - Yeasts & lactic bacteria

- ***Tea*** *fermented (black), unfermented (green) or semi fermented.*
  - *Auto-fermentation - no microorganisms*

Thanks