MICROBIOLOGY OF FRUITS AND VEGETABLES

NORLIA MAHROR

26/11/2020

NEW ASSESSMENT (100% COURSEWORK)

Coursework Assessment (100%)

Note: The final examination has been replaced with coursework assessment only

	Jenis	Kod	%
(i)	Test	13	10 + 10 + 20
(ii)	Presentation	53	10
(iii)	Practical test	26	10

	Jenis	Kod	%
(iv)	Lab report	11	10 + 10
(v)	Assignment	03	10 + 10

** The 40% final examination component has been converted to assignment as highlighted above (20% test, 10% lab report, and 10% assignment).

The non-highlighted component is the existing 60% coursework assessment.

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IMPORTANT DATES!!

- 07/01/2021 TEST 2 (NM) -10%
- 14/01/2020 ASSIGNMENT SUBMISSION (10%)
- 19/01/2021 PRACTICAL TEST
- 24/01/2020 SUBMISSION OF LAB REPORT 1
- 02/02/2021 TEST 3 (20%) –NEW
- 07/02/2020 – SUBMISSION OF LAB REPORT 2

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INDIVIDUAL ASSIGNMENT (10%)

Choose **one food** from the list below:

- **Leafy vegetables**
- **Raw meat**
- **Oyster**

Infographic + Essay

Prepare an **infographic and essay** related to pathogenic bacteria that might contaminate the food. You need to identify the **source of contamination**, **symptoms of the foodborne illness**, and the **prevention methods** pertaining to the pathogenic bacteria. You can also add other information that you think is necessary to be included in the infographics (e.g. statistic of outbreak, ingredients, intrinsic/extrinsic factor, etc.)

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CONTENT

- Spoilage of fruits and vegetables
- Mechanism of microbial spoilage
- Source of contamination
- Control of spoilage
- Preservation of fruits and vegetables

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VEGETABLES

- **Edible component** of plant: leaves, stalks, roots, tubers, bulbs, flowers, fruiting bodies (mushroom)
- Principle component: **water**, fiber, **starch,** vitamins, minerals
- pH range 5-7
- Subjected to spoilage when the cell integrity is lost due to wilting, aging & injury
- Spoilage by bacteria, yeast & molds

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FRUITS

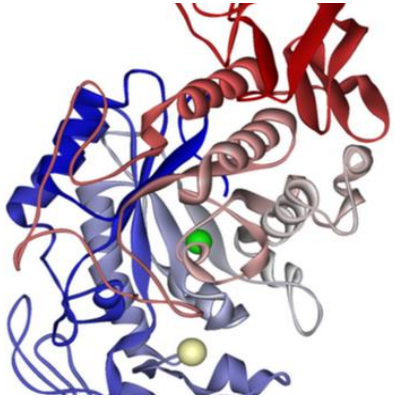
- Fruits are defined as "**the portion of plants which bear seeds**"
- Composition: 85% water, 13% carbohydrate, 0.9% proteins, 0.3% fats, 0.5% ash
- High in organic acid (**pH < 4.5**)
- Spoilage by yeast, mold, LAB
- Some fruits may be chilled or frozen

SPOILAGE OF FRUITS AND VEGETABLES

PHYSICAL FACTORS

Insects / bird damage

Mishandling during pre- and postharvest



ENZYMES ACTIVITY

Pectinase, phenolase, peroxidase and polyphenol oxidase (PPO)

Promotes the softening and browning of fruits

MICROBIAL CONTAMINATION

Contamination at the stage of pre-and postharvest, processing, storage, & contact between spoiled & nonspoiled product

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ABOUT 20% OF VEGETABLES & FRUITS IN THE WORLD IS LOST DUE TO MICROBIAL SPOILAGE!!

- Mainly by bacteria, yeast and molds
- Can be spoiled during harvesting, processing, transport and storage
- Damage crops enable microbes to enter the tissues and cause spoilage

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SOURCE OF CONTAMINATION DURING PRE-HARVEST

- Fecal contamination from manure fertilizer (must be properly composted to eliminate pathogenic bacteria)
- Untreated sewage can contaminate water source for irrigation
- Soils – *Bacillus cereus, Listeria monocytogenes, and Clostridium botulinum* occur naturally in soil

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RISK PATHOGENIC BACTERIA ???

FACTORS AFFECTING MICROBIAL GROWTH IN FRUITS AND VEGETABLES

EXTRINSIC FACTORS

Presence of air, high humidity, high temperature during storage increase the risk of microbial growth and spoilage

INTRINSIC FACTORS

High a_w fresh fruits and vegetables support microbial growth (bacteria, yeast & molds)

pH of vegetables (5-7) is favourable to bacterial , yeast & molds growth

Fruits (< 4.5) – yeast & molds

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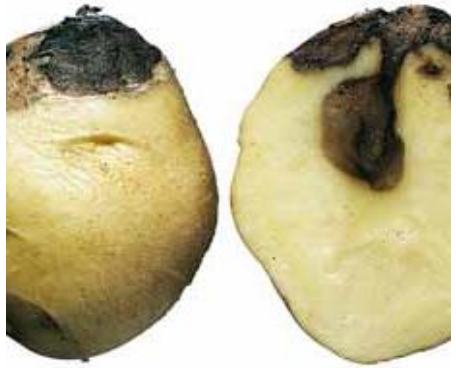
Product	Microorganisms responsible	Type of spoilage
Apples, pears	*Cryptosporiopsis malicorticis*	Lenticel rot
Bananas	*Ceratocystis paradoxa*, *Fusarium roseum*, *C. musae*, *Verticillium theobromae*	Crown rot, bitter rot
Cabbage	*Botrytis*,	Green rot
	Xanthomonas compestris	Black rot
Citrus fruit	*Alternaria*, *Penicillium digitatum*	Green rot
	G. candidum	Sour rot
Grapes	*Botrytis cinerea*	Green mold rot
Green beans	*Rhizopus*	Soft rot
Lettuce, spinach	*Bremia*, *Phytophthora*	Rot
	Pseudomonas marginalis	Slime
Onions	*Aspergillus niger*	Black rot
	Penicillium spp.	Blue rot
Peaches, cherries	*C. herbarum*	Rot
Pears	*Erwinia*	*Erwinia* rot
Potatoes	*Erwinia carotovora*	Black rot
	Corynebacterium sepedonicum, *Streptomyces scabies*	Vascular ring and discoloration
Tomatoes	*G. candidum*	Green rot
	Corynebacterium michiganense	Bacterial spot
	Xanthomonas vesicatoria	Bacterial spot
	P. syringae	Bacterial speck
	Pseudomonas tomato	Soft rot
Various vegetables	*Bacillus*, *Clostridium*, *Erwinia*, *Pseudomonas marginali*	Bacterial soft rot

MICROBIAL SPOILAGE OF FRUITS AND VEGETABLES DURING HARVESTING & STORAGE

BACTERIAL SOFT ROT



BLACKLEG

GRAY MOLD

RHIZOPUS ROT

SOUR ROT

ANTHRACNOSE

BLACK ROT

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SPOILAGE DURING THE PROCESSING OF FRESH PRODUCE

- Processing of fresh produce
  - ➢Washing & rinsing
  - ➢Cutting, slicing, chopping,
  - ➢Mixing

- Source of microbial contamination during processing
  - ➢Poorly sanitized equipment
  - ➢Contaminated wash water / ice
  - ➢Unhygienic food handler
  - ➢Improper storage
  - ➢Fluid flow from fruits & vegetable tissue can serve as substrate for microbial growth
  - ➢Pest / insect in the processing plant

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MECHANISM OF MICROBIAL SPOILAGE

1. Microbes need to overcome the protective barrier (skin or peel)
   - Epidermal layer consist of cellulose and pectin
   - Damaged epidermal layer facilitate microbial invasion
     - ➢ Insect infestation, physical damage by processing equipment / mishandling
     - ➢ Dehydration of vegetables result in cell separation

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MECHANISM OF MICROBIAL SPOILAGE

2. Microbe penetrate the external barrier and invade the internal tissue
   - Utilize fermentable carbohydrate & produce metabolites (undesirable changes in colour, flavor, aroma, texture

3. Release microbial enzyme responsible for the degradation of plant tissue
   - Pectinase – depolymerization of pectin chain (softening)
   - Cellulase – degrade cellulose to glucose (softening)
   - Protease, phosphatase, dehydrogenase

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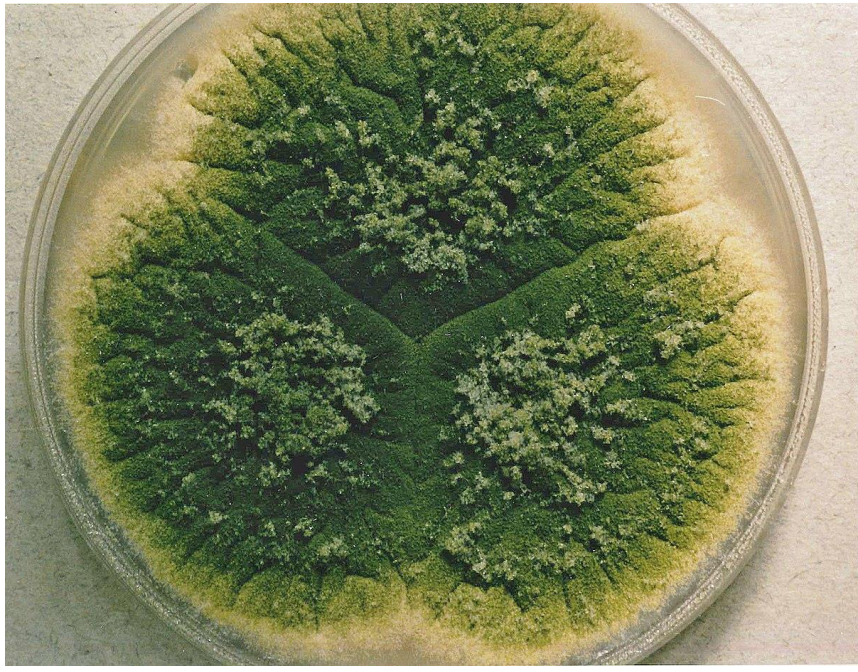
TYPES OF SPOILAGE IN FRUITS

- Low pH in fruits only allow the growth of acidophile (LAB, *Acetobacter, Gluconobacter*)
- Spoilage mainly occur during ripening (pH increase, skin layer soften, soluble carbohydrate build up, defence barrier weaken)
- Bacterial spoilage
  - Souring in fruits – lactic acid bacteria
  - Soft rot - *Erwinia carotovara*
- Fungal spoilage
  - Yeast spoilage - *Saccharomyces, Candida*
  - Blue rot– *Penicillium italicum, P. expansum, P. verrucosum* (Berries, grapes, lemon, apples)
  - Green rot - *P. digitatum*
  - Black rot – *Alternaria alternata*
  - Antrachnose – *Colletotrichum*
  - Gray rot – *Botrytis cinerea* (berries, grapes, apples)

TYPES OF SPOILAGE IN FRUITS

- Pathogens is rare except for certain cases which has been reported:
  - *L. monocytogenes* in melon
  - *E. Coli* O157:H7 in fruit cut
  - *Salmonella* in apple

- Mycotoxin
  - Patulin – *Penicillium expansum*
  - Ochratoxin A – *Aspergillus carbonarius*
  - Aflatoxin – *Aspergillus flavus*



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PRESERVATION OF FRUITS AND FRUITS PRODUCT

- Removal of microorganisms (washing, trimming)
- Use of heat (the more acidic the fruit, the less heat required)
- Use of low temperature
  - Chilling
  - Freezing
- Drying
- Use of preservatives

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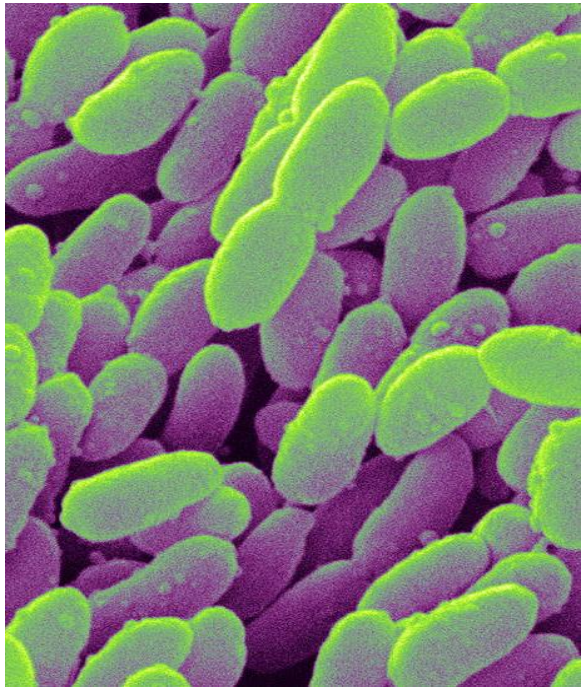
TYPES OF SPOILAGE IN VEGETABLES

- Bacterial spoilage
  - Soft rot - *Erwinia carotovara* (potato, cassava, carrot, tomato, onion, cabbage)
  - Blackleg - *Erwinia carotovara*
- Fungal spoilage
  - Gray mold – *Botrytis cinerea* (Asparagus, onions, tomatoes, carrot)
  - Black rot – *Aspergillus niger* and *Alternaria*
  - Rhizopus rot – *Rhizopus stolonifera* (berries)
  - Sour rot – *Geotrichum candidum* (Asparagus, onions, tomatoes, cabbage)
  - Anthracnose – *Colletotricum coccodes*
- Pathogens
  - Spore forming bacteria – *Bacillus cereus, Clostridium botulinum* (can grow in canned vegetables and MAP packaged product)



PRESERVATION OF VEGETABLES

- Washing with water containing chlorine and fungicide
- Use of heat (Canning, blanching)
- Use of low temperature (Chilling, Freezing)
- Use of preservatives
- Vacum packaging
- Modified atmosphere packaging
- Drying

CONTROL OF FRUITS & VEGETABLE SPOILAGE

- Follow Good Agricultural Practice (GAP) in every step of production from planting until harvest
- Follow Good Manufacturing Practice (GMP) at postharvest level
- Use non-contaminated water for irrigation
- Proper treatment if manure fertilizer
- Remove infected plants immediately
- Remove plant residues after harvest
- Use fungicide
- Good sanitation – equipments, transport vehicle, packing materials, warehouse

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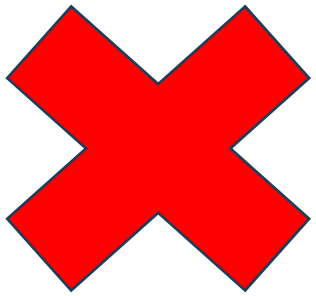
Careful handling of fresh produce

Personal hygiene



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Packaging can regulate the amount of oxygen and water to control microbial growth refrigeration

Contoso

Proper transportation and storage condition

Control of humidity – condensation will encourage bacterial growth but too dry will lead to wilting

Cucumber Salmonella Outbreak 2015: Deadly Food Poisoning Cases In 35 States Spread To Maryland Amid Recalls

A deadly outbreak of salmonella has been linked to cucumbers imported from Mexico. Four people have died, and 732 have been sickened by the bacteria, which is linked to cucumbers imported from Mexico. .**Salmonella Poona**

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Melon listeria kills three in Australia

3 March 2018 Share

WHO says Australia exported listeria-tainted melons to nine countries

Reuters Staff

3 MIN READ

GENEVA (Reuters) - Melons contaminated with deadly listeriosis bacteria were exported to at least nine countries from Australia, where an outbreak has killed seven people and caused one miscarriage, the World Health Organization said on Monday.

The rockmelons, or cantaloupes, were sent to Hong Kong, Japan, Kuwait, Malaysia, Oman, Qatar, Singapore, the United Arab Emirates and Bahrain, and may also have gone to the Seychelles, a WHO statement said.

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IMG 222 Microbiology of fruits and vegetables

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THANK YOU!