Fermentation products

The main fermentation products include organic acids, ethyl alcohol and CO_2. Commercially the most important are lactic acid and ethanolic fermentations.

Lactic acid fermentation is used in fermentation of milk, vegetables (cucumber, cabbage, cassava), cereals (wheat, maize), meat and fish.

- The end products of fermentation are alcohol, CO_2 and lactic acid. The ~~products~~ process is essential in the production of beer, fermented milk and bread. To arrive at these end products, sugars are broken down in a process called glycolysis.

- Fermentation bacteria are anaerobic, but use organic molecules as their final electron acceptor to produce fermentation endproducts. Streptococcus, Lactobacillus, and Bacillus, ~~for~~ produce Lactic acid, while Escherichia and Salmonella produce ethanol, lactic acid, succinic acid, acetic acid, Co_2 and H_2.

- The science of fermentation is known as Zymology.

- In microorganisms, fermentation is the primary means of producing ATP by the degradation of organic nutrients anaerobically. Humans used fermentation to produce foodstuffs and beverages since the Neolithic age. For example, fermentation is used for preservation in a process that produces lactic acid found in such sour foods as pickled cucumber, kimchi, and yogurt as well as for producing alcoholic beverages such as wine and beer.

- Fermentation occurs within the gastrointestinal tracts of all animals, including humans.

Lactic acid - In industry, lactic acid fermentation is performed by lactic acid bacteria (Lactobacillus, Lactococcus, and Streptococcus.

- LA is an organic acid, soluble in water. Solubility is so high in water ie. 1 part of lactic acid can dissolve 12 parts of water

- LA bacteria, which convert simple carbohydrates such as glucose, sucrose, or galactose to lactic acid.

- These bacteria can also grow in the mouth; the acid they produce is responsible for the tooth decay known as Caries.

In medicine, lactate is one of the main components of lactated Ringer's solution and Hartmann's solution.

(1)
(2) Ringer's lactate solution

- (1) + (2) - intravenous fluids consist of sodium and potassium cations along with lactate and chloride anions in solution with distilled water, generally in cons. isotonic with human blood. It is most important for fluid resuscitation after blood loss due to trauma, surgery, or burns.

- Ethanol

also called alcohol, ethyl alcohol and grain alcohol, is a clear, colourless liquid and the principle ingredient in alcoholic beverages like beer, wine or brandy.

Ethanol is a natural by product of plant fermentation and also can be produced through the hydration of ethylene.

Uses

- is a common ingredient in many cosmetics and beauty products - hair spray, lotion
- Solvent - paints, varnish, house hold cleaning products.
- Food additive - food coloring, as well as flavor. eg. Vanilla extract is made by curing and processing Vanilla beans in a solution of ethanol and water
- Fuel - more than 94% of U.S gasoline contains ethanol
- highly inflammable.

Co_2

Co_2 is a colorless gas with a density about 60% higher than that of dry air
- a Carbon atom double bonded two oxygen atoms. - Sources include natural volcanoes, hot springs and geysers,
- also found in ground water, rivers, lakes ice caps sea water

Food poisoning

Food poisoning - 2 types

① Food intoxication → bacterial exotoxin
② Food infections

↓

Five types

① Botulism
② Staphylococcal food poisoning
③ Infantile gastroenteritis
④ Travellers diarrhoea
⑤ Mycotoxicosis

① **Botulism** - is a neuroparalytic disease.
- Bacterium Clostridium botulinum
  ↓
  present in improperly canned preserved food
- lives in anaerobic condition
- does not grow in fresh food.
- Food easily conta by spores of C.b.
- C.b - release exotoxin
  ↓
  called Botulinum.
- toxin - is a protein - destroyed by heat (70°C)
- main sources of Botulism: canned meat, fish & other protein foods.

②

- The food → swallowed → absorbed into blood stream.
↓
nerve endings in the muscles
↓
prevents acetylcholine produced in the nerve ending
↓
impulse is not conducted from nerve to muscles
so muscles no cannot contract. They are paralysed.

- Signs of paralysis
① Para of eye lid (muscles)
- symptoms appear in a few hours of eating the food.
② next paralysis affects the muscles of speech & pharyngeal muscles.
when swallowing becomes difficult
③ Finally the respiratory muscles stop their activity (vital) forms of suffocation occurs & death may result within a day

- The symptoms of Botulism occur within 24 hrs. from the time of consumption of contaminated food

- neuroparalytic diseases symptoms
- double vision
- dilated pupils
- paralysis of eye muscles.
- Difficulty in speaking & swallowing.

prevention

1. avoid - canned & preserved food.
2. - heated before eating
   - heating destroys botulism.
3. well cooked.

Treatment

with polyvalent botulinum antitoxin
- adult
  infant

HBAT (20ml) - intravenous injection
↓
diluted 0.9 % NaCl 1:10.

Botulism Antitoxin Heptavalent

HBAT

2. Staphylococcal food poisoning:
- one of the most common types of food poisoning.
- caused by bacteri Staphylococcus aureus
- is a gram-positive coccus arranged in clusters.
- produce - enterotoxin
- S. aureus resides in nose, & sometimes in hands. when the hands are contaminated with nasal secretions.

- Consumption of Contaminated raw or Cooked food & serving of not properly refrigerated food may lead to the devel of food poisoning
- Foods - involved in this type of food poisoning are milk products, Custards, Processed meat, Cream puff, Sandwich, poultry stuffing & potato Sala.
- The symptom occur within 1-6 hours after comsn of food.
- The symptoms - nausea, vomitting & moderate diarrhoea
  - no fever
  - The disease usually lasts for less than 12 hrs and never fatal.

preventing method.

- to use Sanitary (hygienic) precautions when preparing all perishable foods (storage) in refrigerator
- and refrigerate the food at temperature below 4 - 7°C
- Food should not allowed for several hours at room temperature before serving.

Microbiology (III Monday)

(1). General - classification of microorganisms.
① Based on plants and animals.
② " " cells (Arumuga)
③ " " nuclearity

(2). General structure of bacteria, fungi & Virus.

① Bacteria
- microscopic, unicellular, prokaryotic organisms.
- The study of bacteria called bacteriology.

Features
- present in everywhere, air, soil, water int out of body
Eg. E.Coli, Lactobacillus, streptococcus etc
Size - 0.5 micron - 3 micron
shape - rods, spheres, spirals or filaments
- cell is enclosed cell envelope (made of capsule, a cell and a PM)
- nuclear material is represented by a nucleoid without NM.
- extra chromosomal DNA called plasmid is present in cytopla.
- all organelles - 4o ribo & meronome present. others absent.
- appendages like flagella, pilli present
- absorptive - mode of nutrition.
- They multiply by binary fission
- Some produce endospores.

Singular – coccus
plural – cocci

Structure of bacteria

- Size range from 0.5 μm to 600 μm.
- are either spherical or rod or spiral or curved

① spherical – bacterium is called Coccus
– The

② Micrococcus – single spherical bacter is called monococcus)

Diplococci – Some spherical bacteria are arranged in pairs & they are called diplococci.

tetracocci – Cocci are arranged in fours they are called tetracocci.

streptococci – the cocci are arranged in chains,

staphylococci: – when cocci are arranged in clusters like a bunch of grapes, they are called staphylococci.

Rod

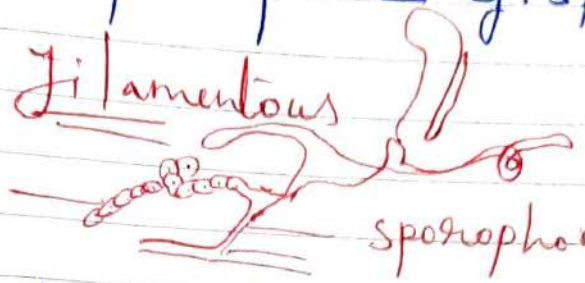
- Rod shaped bacteria called bacilli (sl. bacillus)
- They also found may be

① Bacilli – single rod like bacteria
② Diplobacilli – Bacilli arranged in pairs
③ Streptobacilli – a chain of bacilli; – streptobacilli
④ Staphylobacilli – a bunch of bacilli is

Spiral.

Spiral bacteria are spirally curved. They may be slightly coiled curved like a comma, eg vibrio or spirally coiled eg. spirillum.

Filamentous



Fungus like bacteria

Filamentous & fungus like bacteria are multicellular.

Types.

- 2 types of bacteria
  1. gram positive — violet colour
  2. gram negative — red colour at the time of gram staining

The bact are motile or non-motile
They may or may not contain flagella.

- when the flagellum is absent, the bacterium is called atrichous.
- only one flagellum — monotrichous
  at the end
- when the flage present at both ends that bacterium called amphitrichous

04 February Thursday

Viruses

- are defined as sub-microscopic, self reproducing particles capable of being introduced into living cells and reproducing inside such cells only.
- cellular m.gs, but posses some properties of cells.
- To live inside the cells - where active, feed, respire, reproduce, grow & move
- outside the cells inactive - not "
- very small size.

Discovery - was disco by Ivanowski in 1899

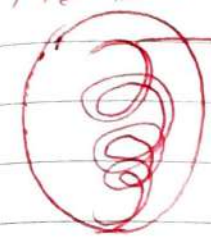
Size
- Small size.
- Smaller than bacteria
- but slightly larger than a large protein and a NA
- size range from 100 A° - 2500 A°

DNA or RNA - single NA either DNA or RNA (except RNA - PNA, Viruses)
- not contain cellular structures PM, GA, Mc etc.
- Crystallised.
- They are intracellular parasites They live inside the cells of plants, animals and bacteria.

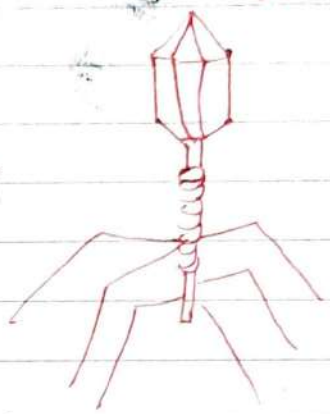
Structure of viruses.

- Viruses living on animals are called animal viruses.
- plant viruses
- viruses that live on bacteria are called bacterial viruses or bacteriophage.

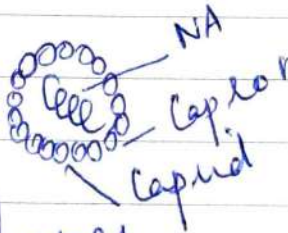
Animal virus



plant virus



- ultramicroscopic.
- They can be seen only by an electron microscope.
- Viruses smaller than bacteria.
- The smallest

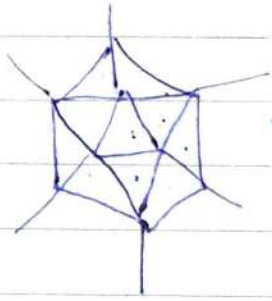


Capsid 2 shapes.

12 corners

← ① icosahedral (cubical)

② helical



helical

NA + Capsid - nucleocapsid

Icosahedral

eg: polio virus
Adenovirus

08 Saturday

- Porcine Circovirus (PCV) is the smallest virus (with only 17 nm in diameter).
- biggest virus — Pandoravirus (1500 nm in length and 0.5 μm (500 nm) in diameter)
Pithovirus *

SsDNA Eg. Coliphage
DsDNA . Vaccinia
SsRNA . ~~SsRNA~~ TMV
DsRNA Reo..

* NA - Capsid — Capsomeres — polypeptide chain

Capsid Junction

shape to virus
protection
attachment to host cell

Capsid shapes

unday

- spherical virus — adenovirus
Rod — TMV
Tad pole — T4 Ba. ph.

11-02-2016 042 324 07

11 2016 February Thursday

Food Microbiology

The study of M.orgs associated with food, food spoilage, food poisoning and their role in the welfare of human beings both in harmful and useful ways forms food microbiology

- Foods Contamination - preparation, harvest, transport + storage - Cooking - eating etc.
- Microorganisms are
  1. food spoilage organisms
  2. pathogenic forms causing diseases and food poisoning by their toxic Secretions.
  3. useful microbes - needed for preparation of different types of food and beverages
  4. Mgs. themselves form food, eg. Single cell proteins & Mushrooms.

edible & unicellular protein.

Food spoilage (FS)

- FS refers to the process, when the food is made unfit for eating
- It alters physical properties, appearance, colour, taste, flavour, odour of the food. The altered food is called spoiled food.

less palatable & toxic.

Causes of Food spoilage.

Food is spoiled by many factors.

They are

(a). Mgs (b). Insects (c). Rough handling
(d). Transport (e). enzyme activity

Biochemical changes of food spoilage:

are
1. putrefaction
2. Fermentation
3. Rancidity
4. Autolysis

1. Putrefaction (ಕೊಳೆತು)

is the enzymatic decomposition of the proteins present in the food with the production of foul smelling compounds such as hydrogen sulphide, ammonia etc. It is caused by pseudomonas, proteus etc.

During putre protein is converted into a.as, amines, ammonia and H_2S.

protein $\xrightarrow{\text{Microbes}}$ A.a + NH_3 + H_2S.

2. Fermentation : (ಹುದುಗು) (ಹುಳಿ)

is the anaerobic enzymatic conversion of fermenting ethyl Carbohydrates $\xrightarrow{\text{Microbes}}$ alcohol + gases by streptococcus, Micrococcus etc

3. Rancidity : ಜಿಡ್ಡು ಬಿಡುವುದು (ಘಾಟು ವಾಸನೆ ಬರುವುದು)

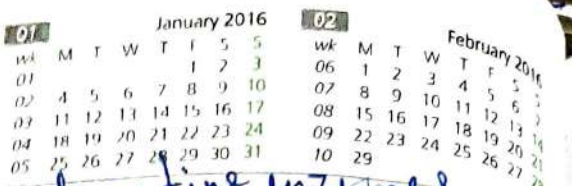
is the decaying of fat.

Fat ⟶ Fatty acids + glycerol

lipases – bacteria or moulds

13-02-2016 | 044-322 | 07

13 | 2016 February Saturday



④. Autolysis: - lysosomes → digestive enzymes

is the spontaneous disintegration of cells or tissues by enzymes.

① clostridium perfingen - meat & poultry

Bacillus cereus - milk & cream

Spoilage of Meat

② Meat is the animal flesh used as human food.

↓ sheep, goats, cattle, pig and chicken.

↓ Meat contains 75% H_2O
19% protein
2.5% lipid &
1.2% carbohydrate.

- Spoilage of meat is due to chemical and biological process.

↓ putrefaction
fermentation
rancidity & autolysis

- Microbes enter
↓ external sources
↓ cutting, microbes of gut contents & the skin of the animal may infect the meat
↓ also micro entrodue during handling, processing, packaging & storage.

Sunday

09.00
10.00
11.00
12.00
01.00
02.00
03.00
04.00
05.00
06.00
07.00

- Meat undergo deep spoilage near the bone called bone taint caused by clostridium & enterococcus
- The fungi, Mucor & Rhizopus caused (the long white growth) whiskers on meat
- Cladosporium (fungus) causes black spot
- Cheysosporium produces white spot
- The common bacterium spoiling meat is Pseudomonas.

spoilage of fish

- Fish is a perishable food. It is a non-acid food because the pH is above 4.5
- Fish contains proteins, carbo, lipids.
- It is spoiled by mechanical, chemical and biological process
- The chemical processes of spoilage include putrefaction, fermentation, rancidity & autolysis
- The biological processes of spoilage due to bacteria
- The common bacteria are pseudomonas, flavobacterias, Bacillus, Micrococcus.

Spoilage of Milk

- Raw milk becomes ropy. (ಹಾಲು ಹಾಳಾಗುವುದು)
- Ropiness is caused by bacterium Alcaligenes Viscolactis.
- it is due to the synthesis of viscous poly-saccharide in the milk.
- Curdling is a spoilage of milk
  ↓ lactose of milk is fermented into lactic acid.
  ↓ caused by streptococcus lactis, Lactobacilli. etc.
- Rapid fermentation of milk by stormy fermentation
  ↓ by Clostridium
- The milk becomes rancid when the milk lipids undergo lipolysis (Rancidity) by pseudomonas & achromobacter.

Spoilage of Egg

Freshly laid eggs are sterile. Soon after laying, mgs enter the eggs and spoil them. (Decaying)

Caused by
Green rot is caused by Pseudomonas fluorescens
Colourless rot — pseudomonas.
Black rot — proteus

Spoilage of Bread

- The bacterial spoilage of bread is called ropiness. Ropey bread is caused by B. Subtilis.
- Bacillus gives the bread a soft and cheesy texture with long stringly threads.

Moldy Bread is caused by Rhizopus
Red Bread " " by Neurospora.

Spoilage of Canned Food

- Food preserved in cans is called Canned food.
- Normally Canned food remains fresh as it is preserved under sterile conditions.
- Spoilage of Canned food is caused by 3 factors

① . chemical changes ② . The spores or microbes surviving during process
③ . Microbes entering through leakage of cans

Canned-food spoilage is of the following types:

① . putrefaction
② . Flat sour spoilage.
③ . Swelled can spoilage.
④ . Sulfide spoilage
⑤ . spoilage by thermophilic microbes.
⑥ . spoilage by mesophilic microbes. "

① . putrefaction.
- Produce putrid odour
- " gas.
- hence the can bulges at the ends and bursts
- caused by the bacterium, Clostridium sporogenes

② . Flat Sour spoilage.
in the spoilage, gas is not produced, so can does not swell. Can flat - only see the can after opening - Caused by B. Coagulans.
- It causes Souring & abnormal odour
- cloudy liquid like substances is formed in the food.

③ . Smelled Can Spoilage:
due to accumulation of gas in the ca
the ends of the can bulge out
- Here hydrogen gas is produced.
↓
Caused by clostridium, yeasts & mold
- Depending of the pressure of the gas different stages of swells, - flipper, springer soft swell, hard swell etc.

Sulfide Spoilage:
- Caused by clostridium nigricans
↓
produces hydrogen sulfide
food blackened rotten egg odour

(5). Spoilage by thermophilic microbes:

↓

Bacteria survive alone at 45°C.

250
1150
250
70
30
1150

~~Red rot~~ — Serratia

Spoilage of Fruits & Vegetables.

↓ They are soft and bad smelling.

Grey mold rot is caused by the fungus Botrytis

soft rot is - Rhizopus,

The rot of potatoes is called black leg.

by

Erwinia sp.

spoilage of Bread

by Bacillus Subtilis.

Moldy Bread by Rhizopus.

Red Bread " Neurospora.

Friday 20

II PG Microbiology III unit

09.00 • Biochemistry of fermentation:

10.00 Fermentation reacts NADH with

11.00 an

12.00 Definition: Fermentation is a metabolic proce

01.00 that produces chemical changes in organic substrates thatough the action of

02.00 enzymes.

- In biochemistry, it is narrowly defined as the extraction of energy from

03.00 carbohydrates in the absence of oxygen.

04.00 - In the context of food production, it may more broadly refer to any

05.00 process in which the activity of microorganisms brings about a desirable change

06.00 to a foodstuff or beverage.

07.00 The Scenie of fermentation is known as Zymology.

In microorganisms, fer. is the primary means of producing ATP by the degradation of organic nutrien anaerobically.

Humans have used fermentation for production of foodstuffs and beverages.

For example, F is used for preservation in a process that produces lactic acid found in such sour foods as pickled cucumbers, kimchi and yogurt, as well as for producing alcoholic beverages such as beer and wine.

Fermentation occurs within the gastrointestinal tracts of all animals, including humans.

Biochemical Overview

Fermentation reacts NADH with an endogenous, organic electron acceptor. usually this is pyruvate formed from sugar through glycolysis.

28 Sunday

The reaction produces NAD^+ and an organic product, typical examples being ethanol, lactic acid, CO_2 and hydrogen gas (H_2). However, more exotic compounds can be produced by fermentation such as butyric acid and acetone.

For, products contain chemical energy (that are not fully oxidized),

but are considered waste products since they cannot be metabolised further without the use of oxygen.

Fermentation normally occurs in an anaerobic environment. In the presence of O_2, NADH, and pyruvate are used to generate ATP in respiration. This is called oxidative phosphorylation; and it generates more ATP than glycolysis. For this reason, fermentation is rarely utilized when oxygen is available.

However, even in the presence of abundant oxygen, some strains of yeast such as Saccharomyces cerevisiae prefer to aerobic respiration as long as there is an adequate supply of sugars.

Some fermentation processes involve obligate anaerobes, which cannot tolerate oxygen.

Although yeast carries out the fermentation in the production of ethanol in beers, wines and other alcoholic drinks, this is not only possible agent. Bacteria carry out the fermentation in the production of Xanthan gum.

↳ is a polysaccharide with many industrial uses, including as a common food additive

01 2016 March Tuesday

Products

Ethanol
Lactic acid
Hydrogen gas.

(1). Ethanol

In ethanol fermentation, one glucose mole is converted into 2 ethanol molecules and 2 CO_2 mole. It is used to make bread dough rise. The CO_2 forms bubbles, expanding the dough into a foam. The ethanol in the intoxicating agent in alcoholic beverages such as wine, beer and liquor.

Fermentation of feed stocks, including Sugarcane, Corn, and Sugar beets, produced ethanol that is added to gasoline, (or petrol)

In some species of fish, (gold fish and Carp), it provides energy when oxygen is scarce (along with lactic acid fermentation.

Fig