FALCON ACADEMEY

LESSON NOTE FOR GRADE TEN

2014E.C

UNIT ONE BIOTECHNOLOGY

What is biotechnology?

- Is the process in which people use MOS to make things that people need by solving the practical problems in different areas
  - ✓ Food industries
  - ✓ Health
  - ✓ Agriculture
  - ✓ Environment
- It is based on microbiology
- It is primarily involves in ways of making & preserving food

The Application of biotechnology

1. Traditional Application

- In this application bacteria and yeast are used
- Some of the traditional application of biotechnology are
  - ✓ Production of alcoholic drinks
  - ✓ Food production using bacteria

A. PRODUCTION OF ALCHOLIC DRINKS

- Requires a principal species of yeast known as saccharomycete.
- Yeast respires aerobically and they facilitate the baking of bread and injera.
- When they respire anaerobically in the absence of oxygen they facilitate the production of alcohol

(ethanol) from sugar (glucose). This process is called fermentation.
$C_6H_{12}O_6 \text{----------} 2C_2H_5OH + 2CO_2 + \text{energy (2ATP)}$

- Alcoholic products(drinks) in Ethiopia
  - Tej
  - Tella
  - Areke(katikala)
  - Borde
- Tej ingredients
  - Honey: consists of sugar of sugar fermented by yeast.
  - Water: to dissolve fermented sugar (honey)
  - Gesho (rhamus)sticks: gives tej a bitter taste
- Tella ingredients
  - Cereals: maize, sorghum, barely(sources of sugar)
  - Bikil:germinated seeds of cereals
  - Gesho:to give tella a bitter taste
  - Water: needed to dissolve the substance added
- Areke (katikala)
  - It uses the same as tella.
  - It is prepared by a process of distillation.

Other alcoholic substances that are produced traditionally

- Wine
  It is prepared from natural sugar that is found in fruits of grapes.

STEPS OF WINE PRODUCTION

1. Press the fruit and mix the juice with yeast and water
2. Let the yeast respire anaerobically until most of the sugar has been used up.
3. Filter the wine to remove yeast and put it in the bottles, where matures
   - As the alcoholic content of the yeast gets higher, it kills the yeast and stops fermentation.

B. PRODUCTION OF FOOD USING BACTERIA

➢ MAKING YOGHURT(irgo)

- Yoghurt and cheese are the diary products produced from milk by the action of the bacterial species known as:
  - ❖ Lactobacillus bulgaricus
  - ❖ Streptococcus thermophiluss
- The milk consists of a sugar called lactose.
- As the bacteria break down the lactose in the milk, they produce lactic acid, which gives the yoghurt its sharp, tangy taste; this is known as lactic fermentation. The lactic acid produced by the bacteria causes the milk to clot and solidify into yoghurt. The action of the bacteria also gives the yogurt a smooth, thick texture.

CHEESE MAKING

- Just as in yoghurt making, a starter culture of bacteria is added to warm milk. The bacteria in cheese making also convert lactose to lactic acid, but they make much more lactic acid. As a result, the solid part (curds) is much more solid than in yoghurt. Enzymes are also added to increase the separation of the milk when it has completely curdled, you can the separate the curds from the liquid whey (aguat) then you can use the curds for cheese making.

NEW APPLICATION OF BIOTECHNOLOGY

The new (modern) application involves:

- ➢ Large scale industrial production
- ➢ Use of modern technologies

- ❖ Genetic engineering: is a technique of changing, altering organism's characteristics (genotypes) by inserting another organism's gene into its DNA.
- ❖ It helps to give an organism to have desired characteristics, this helps to increase productivity in areas such as agriculture and medicine.
- ❖ It requires a little space and time

APPLICATIONS OF BIOTECHNOLOGY IN AGRICULTURE

- It is widely used in:
  - ✓ Genetic engineering
  - ✓ Tissue culture
  - ✓ Development of microbial insecticides

Genetic engineering in agriculture used in

- ➢ Gives desired characteristics
- ➢ Takes short period of time
- ➢ Requires a few space
- ➢ Improvements on growth of plants and animals
- ➢ Improvements on the food value of crops
- ➢ Development of plants that is resistant to drought, disease and pollutants as well as salt tolerant.
- ➢ To produces plants that makes their own pesticide chemicals.

Draw backs of genetic engineering in agriculture

- ▪ Pesticide resistant insect may appear as they eat pesticide forming plants.
- ▪ Plants and animals may spread to other forms of wildlife
- ▪ Modified plant (crops) may not be fertile which makes farmers to by seeds each year.

MICROBIAL INSECTSIDES IN AGRICULTURE

Are produced from microorganisms (bacteria) that can produce toxics to control insects that destroy crops.

Example: bacterium (bacillus) has been used to produce protein toxin against insects such as flies and mosquitoes.

APPLICATION OF BIOTECHNOLOGY IN FOOD

- Production of enzymes from genetically engineered bacteria which is used in:
  - ✓ Production of processed foods and drinks
  - ✓ To clarify beer
  - ✓ To convert starch into glucose
  - ✓ To breakdown food used in production commercial baby food.
- Production of fungal protein called Mycoprotein. These protein can be incorporated as food: advantages of using fungal protein as food :
  - ✓ They have low fat content
  - ✓ They are preferred by vegetarians and people who want to reduce the fat in their diet.

APPLICATION OF BIOTECHNOLOGY IN MEDICINE

- Used in production of vaccine and antibiotics
- Penicillin produced from a fungal species called penicillin notatum used to treat bacterial infection.
- Drugs and hormones that used as medicine can be produced from genetically engineered bacteria.
- Insulin produced by pancreas used to regulate the blood sugar level.

- ❖ Hybridoma antibodies that are produced outside the body in the hybrid cell culture.
- ❖ Interferon is proteins that make the body less suspected to be attacked by viruses.

APPLICATIONS OF BIOTECHNOLOGY IN ENERGY PRODUCTION

- ➢ Energy that are produced by using biotechnology are important in:
  - ✓ Using most renewable forms of energy sources
  - ✓ Productions of environment friendly form of energy, these sources of energy are biogas and biofuel.

What is biogas?

- ➢ Is a flammable mixture of gases, formed when bacteria breakdown plant material, waste products of animals in anaerobic conditions
- ➢ It is mainly methane

Components of biogas

Component	Percentage in the mixture by volume
Methane	50-80
Carbon dioxide	15-45
Water	5
Hydrogen sulfide	0-3
Other gases including hydrogen	0-1

- ➢ To produce biogas, you collect dung or plant material which contains a high level of carbohydrate, faces and urine produced by animals, cow, pig, sheep and chicken and put into a biogas generator or digester. You can add the mixed population of bacteria to digest the carbohydrate. The

bacteria you use are similar to those in the stomachs of ruminants(cow or sheep)

- Some of the bacteria breakdown the cellulose in plan cell walls, other break down the sugars formed to produce methane and other gases. The biogas produced is passed along a pipe into your home, where you burn it to produce heat, light or refrigeration.
- The bacteria involved in biogas production work best at a temperature of around 30C.

MORE BIOFUELS (ETHANOL)

- Sugarcane is a starting material for ethanol production.

Steps in ethanol production:

1. Sugarcane is crushed by rollers after harvested to extract juice.
2. Sucrose is extracted from the juice, but leaves a waste called molasses which contains glucose and fructose.
3. Molasses fermented anaerobically by yeast (saccharomyces cerevisiae) to produce ethanol.
4. Ethanol is separated from other fermented products by the process of distillation.

C6H12O6----------2C5H5OH+2CO2

SUGARCANE---------- fermentation ---------- ETHANOL

Maize ----------enzyme carbohydrate breaks down starch into glucose----------fermentation ----------ethanol

- Ethanol (biofuel) can be used in a mixture with petroleum and used to the engines of vehicles including car. The mixture of ethanol and petroleum is called gasohol.

Advantages of using ethanol as a fuel

- It do not produce toxic gases when it burns
- It can be mixed with petrol and used for car engines which are reducing economic wastage and pollution levels.
- Carbon neutral activity

Disadvantages of using ethanol as a biofuel

- It takes a lot of plant material
- It requires large space and suitable climate to grow the plants

UNIT TWO

HEREDITY

INTRODUCTION

Offspringare similar to their parents in some ways and also different from their parents in other ways. Why? Is it by coincidence or due to the inheritance of hereditary characteristics? Heredity is defined as the transmission of hereditary characteristics from parents to offspring and from generation to generation. It is the science of genetics which

concerned with why offspring resemble and differ from their parents. It also investigates how the inherited information is expressed in the developing organism. Parents pass hereditary characteristics to their offspring during sexual reproduction through their sex cells or gametes. Therefore, gametes are the bridge that connects parent and their offspring.

2.1 MITOSIS AND MEIOSIS

Cell division

In any cell division an examination of a nucleus under a light microscope reveals the presence of a number of fine threads like structure, the CHROMOSOME this is where the genetic information passed on from parent to offspring is stored.

Why cells divide?

- ✓ Single celled organism divide to reproduce
- ✓ In multicellular organisms it enables the organism to grow larger while the cells remain small.
  Generally, cell division
  - ➢ Enables multi cellular organisms to grow
  - ➢ To replace any damaged cells
  - ➢ To replace worn out cells
  - ➢ Basis of reproduction
- A chromosome is the structure in the nucleus of a cell consisting of genes. It is made up of genetic material DNA in a DNA PROTIEN COMPLEX.

- Different type of organism has a different number of chromosomes in the cells.
    - Chromosomes come in pairs known as **homologous** pairs.

The photographs of chromosomes in human cells when they are dividing and arrange them in pairs to make special pictures known as **karyotype.**

- **Human** karyotypes show 23 pairs of chromosomes. In 22 of these pairs, both chromosomes are the same size and shape, regardless of whether you are a boy or a girl. These 22 pairs of chromosome are known as the **autosomes.**They control almost everything the way you look and way your body works. The remaining pair of chromosome is known as sex chromosome.
    - ✓ **X chromosome carry information about**
- **Being female**
- **The way our blood clots**
- **The formation of your teeth**
- **Body hair and sweat glands**

Y chromosomes mainly carry information about maleness.

CHROMOSOME GENES AND DNA

Chromosome carries all information and kept in the form of genes which have a small section of DNA.

- A gene is a unit of hereditary material located on the chromosome.

- DNA is a long molecule, made up of two strands twisted together to make spiral known as a double helix(pair of parallel helices intertwined about a common axis)
- The big DNA molecule is actually made up of lots of smaller molecules (nucleotides) joined together. A nucleotide consists of a phosphate group, a sugar and a base. The bases link the two strands of the DNA molecule together.

MITOSIS

Body cells also known as somatic cells divide to make new cells. The cell division that takes places in the normal body cells and produces identical cells is known as mitosis. It is the division of the somatic cells to make identical daughter cells.

Before a cell divides, it produces new copies of the homologous pairs of chromosomes in the nucleus. Each chromosome forms two identical chromatids (the two strands of a chromosome that separate during mitosis).