The Neotia University

Plant Physiology Lab Manual Course No: 2021

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Contents

Practical 1: Demonstration of inhibition: Demonstration the process of inhibition of using raisins

Objective: Demonstration the process of inhibition of using raisins

Principle: It is the phenomena wherein water adsorption takes place by substances without solution formation. Example: When seeds are immersed in water, they swell due to imbibition. This swelling up causes a temporary increase in the volume of the cell and does not require energy as materials are transported passively. Raisins increase in size due to imbibition of water. The quantity of water imbibed can be obtained by considering the difference in the mass between the dry raisins and the swollen raisins. It is transported through imbibition, diffusion, and osmosis. It primarily occurs due to the presence of lyophilic and hydrophilic colloids. Through the sub-microscopic capillaries that are located on the body's surface water is imbibed. The imbibition of water continues until a dynamic equilibrium is established which causes an increase in the imbibant's volume resulting in imbibitional pressure which is of enormous magnitude.

Materials Required:

- 25-30 raisins with their stalks intact
- Blotting paper
- Petri dish
- Electronic balance
- Spatula
- Beaker
- Distilled water

Procedure:

- Weigh around 20 raisins that are dry and with intact stalks on an electronic balance
- Make note of the weight
- Into the small beaker, add some distilled water
- Shift the weighed raisins to the beaker
- Leave the raisins soaking in water for around 2 to 3 hours
- Once soaked, shift the raisins from the beaker to a petri dish placed with a blotting paper with the help of a spatula
- Gently pat dry the raisins
- Make note of the weight of the dry raisins using the electronic balance

Observation:

Result:

Discussion: Based on the result obtained

Safety precautions: Students should maintain the hygiene during experiment.

Practical 2: Study of osmosis in plant: Demonstration osmosis in living plant cell by potato asmoscope

Objective: To study by demonstrating the osmosis process by potato osmometer

Principle: Osmosis is the phenomena in which solvent molecules pass through a semi-permeable membrane from an area of higher concentration to an area of lower concentration. The process continues until the quantity of fluid is balanced or equalized in both regions, the region of higher concentration and the region of lower concentration of the semipermeable membrane. In other words, osmosis is the diffusion or movement of water from a region of higher water potential to a region of lower water potential.

In osmosis, what are solvent and solute?

The fluid that permeates through the semipermeable membrane is called the solvent whereas the solute is the dissolved particles in the fluid.

What is the solution?

The mixture of solute and solvent form the solution.

List the different types of solutions.

The following are the types of solutions:

- **Hypertonic solution** – It is a solution with a high solute level. If living cells are placed in a hypertonic solution, because of lower concentration water moves out of the cell causing it to shrink and becomes plasmolyzed.
- **Hypotonic solution** – It is a solution with low concentration levels of solute. If living cells are placed in this solution, water passes into the cells because of higher water concentration in comparison to the cell causing the cells to swell and turn turgid.

- **Isotonic solution** – A solution is said to be isotonic if both solutions have an equal concentration of solute. If living cells are placed in an isotonic solution, no change is shown as there is equal concentration on both the regions hence the cell retains its original shape.

Materials Required:

- A fresh large sized potato tuber
- 20% sucrose solution
- Beaker
- Water
- Scalpel/blade
- Petri dish
- Bell pin needle that is labelled with a waterproof ink

Procedure:

- Slice the potato tuber into two equal halves with the help of a scalpel or a blade. The outer skin is to be peeled off. Since the tuber shape is irregular, slice the halves into squares
- From the mid-region of the tuber, scoop from the soft parenchyma so as to form a tiny cavity of a square or a circular shape. At the base, the cavity prepared should have a minimum thickness.
- Fill up half the cavity with the freshly prepared 20% sugar solution. Into the cavity, fix a pin in a way that the mark is in the same line with the layer of the sucrose solution.

- Set up the osmometer in a Petri dish/beaker that is filled with water in a way such that 75% of the potato osmometer is immersed in water
- The set up should remain uninterrupted for close to 1 hour.
- Notice the sugar solution in the osmometer towards the end of the experiment
- Carry out the experiment with the help of water in the cavity and the sucrose solution in the petri dish/beaker.

Observation:

Result:

Discussion: Based on the result obtained

Safty precaution: Students should maintain hygiene during the experiment

Practical 3: Study of osmosis in plant: Demonstration osmosis with varying solution concentration

Objective: Our objective is that to study osmosis with varying solution concentration

Principle: Osmosis is the process in which solvent molecules moves through a semi-permeable membrane from a region of higher concentration to a region of lower concentration until the amount of fluid is equalised on both sides of the semipermeable membrane. The fluid that passes through the semipermeable membrane is known as the solvent, while the dissolved substance in the fluid is known as the solute. The mixture of solvent and solute makes up a solution. Osmosis plays a critical role in plant and animal cells. It helps in the distribution of nutrients and in the release of waste products. The living cells of both plant and animals are surrounded by a semipermeable membrane known as the cell membrane. The membrane forms a selective barrier between the cell and its environment and does not allow toxic substances from the surroundings to enter into the cell. The selective permeability allows the cell to regulate the flow of necessary substances into and out of the cell. In plants osmosis is also responsible for absorbing water and minerals from the soil by using the semipermeable membrane of the root.

Materials Required Procedure:

Types of Solutions

Hypotonic Solution: These are solutions with low solute levels.

Hypertonic Solution: Solutions with high solute levels are known as hypertonic.

Isotonic Solution: If both solutions have the same amount of solute concentration they are then known as isotonic solution.

Occurence of Osmosis in Different Solution Types

Hypotonic Solution: If we place living cells in a hypotonic solution the water moves into the cell because of the higher concentration of water than in the cell. The cell then swells to become turgid.

Hypertonic Solution: If we place living cells in a hypertonic solution the water moves out of the cell because of the lower concentration of water than the cell. The cell then shrinks and becomes plamolyzed.

Isotonic Solution: If we place living cells in an isotonic solution, it won't show any change because of the equal concentration of water on either side. The cell remains as it is

Result:

Discussion: Based on the result obtained

Safety precaution: Students should maintain hygiene during experiment

Practical 4: Study of plasmolysis: Demonstration the process of plasmolysis in onion cells

Objective: Study of plasmolysis: Demonstration the process of plasmolysis in onion cells

Principle: Plasmolysis is the process during which cells lose water when placed in a hypertonic solution, a solution with greater concentration of solutes compared with the inside of a cell. During plasmolysis, the organelles inside of the cell shrink away from the cell wall, which results in severe water loss and leads to the collapse of the cell wall, which result in cell death. Osmosis is responsible for the occurrence of plasmolysis. There are three stages in plasmolysis. Based on certain criteria, plasmolysis can be classified into two different types:

- Concave plasmolysis – It is a reversible process.
- Convex plasmolysis- It is an irreversible process.

Materials Required:

- Glass slides
- Rhoeo leaf
- Coverslips
- Compound microscope
- Sodium chloride 5% solution
- Sodium chloride 0.1% solution
- Needle
- Forceps
- Droppers

Procedure:

- Place two glass slides on a table
- From the Petri dish, take a onion cell
- Make a fold on the leaf so as to tear it from the lower side of the onion cell
- Extract two small fragments of a fine and transparent layer with the help of forceps from the lower surface of the epidermis of the onion cell.
- Now set up the epidermal peels on each of the glass slides
- With the help of a dropper from the beaker, add some sodium chloride 0.1% solution
- Add 1-2 drops of the solution on one of the slides
- With the help of another dropper from the beaker, add some sodium chloride 5% solution
- Add 1-2 drops of the solution to another slide
- Set a coverslip on the peel of both sides with the help of a needle
- Observe each slide one by one under a compound microscope.

Result:

Discussion: Based on the result obtained

Safety precautions: Students should maintain hygiene.

Practical 5: Study of plasmolysis: Determine the toxicity of solutions using Rhediscolor leaves

Objective: Study of plasmolysis: Determine the toxicity of solutions using Rhediscolor leaves

Principle: Plasmolysis is the process during which cells lose water when placed in a hypertonic solution, a solution with greater concentration of solutes compared with the inside of a cell. During plasmolysis, the organelles inside of the cell shrink away from the cell wall, which results in severe water loss and leads to the collapse of the cell wall, which result in cell death. Osmosis is responsible for the occurrence of plasmolysis. There are three stages in plasmolysis. Based on certain criteria, plasmolysis can be classified into two different types:

- Concave plasmolysis – It is a reversible process.
- Convex plasmolysis- It is an irreversible process.

It is a process of contraction or shrinkage of the protoplasm of **a** plant cell due to loss of water from the cell. It takes place in extreme conditions and hence occurs rarely. Plasmolysis can be carried out in a laboratory by submerging a living cell in a concentrated sugar or salt solution for water loss from the cell. The cell membrane serves as a semipermeable membrane dividing the inner of all cells from that of its surroundings. This membrane permits movement of a few of the particles, water molecules, ions across the membrane while blocking others. There is continuous movement of water molecules in and out of the cell across the cell membrane, serves as an important attribute for enabling cells to absorb water.

Material Required:

- Glass slides
- Rhoeo leaf
- Coverslips
- Compound microscope
- Sodium chloride 5% solution
- Sodium chloride 0.1% solution
- Needle
- Forceps
- Droppers

Procedure:

- Place two glass slides on a table
- From the Petri dish, take a rhoeo leaf
- Make a fold on the leaf so as to tear it from the lower side of the leaf
- Extract two small fragments of a fine and transparent layer with the help of forceps from the lower surface of the epidermis of the rhoeo leaf.
- Now set up the epidermal peels on each of the glass slides
- With the help of a dropper from the beaker, add some sodium chloride 0.1% solution
- Add 1-2 drops of the solution on one of the slides
- With the help of another dropper from the beaker, add some sodium chloride 5% solution
- Add 1-2 drops of the solution to another slide
- Set a coverslip on the peel of both sides with the help of a needle
- Observe each slide one by one under a compound microscope.

Result:

Discussion: Based on the result obtained

Safety precautions: Students should maintain hygiene

Practical 6: Study of transpiration in leaves

Objective: Study of transpiration in leaves

Principle: When it's a hot day, you might get a little sweaty. Plants "sweat" as well. Similar to how we lose water through our skin, plants lose water through their leaves. Although you might not be able to see them, plants have small **pores,** or holes, on their leaves. Take a look at the bottom of a leaf under a microscope, and you will be able to see these holes, which are known as **stomata**. This is where plants can lose water through transpiration. Even though it's an invisible process, the loss of water from plants through transpiration is an important part of the water cycle because it adds a lot of water to our air. In just one year, every leaf on earth can send out much more than its own weight in water. In fact, a large oak tree can contribute 40,000 gallons of water a year to the air! You probably water the plants in your house so that they'll stay healthy—so if plants need water, then why do they lose it? Transpiration happens in part because plants need to breathe. Plants need to take in carbon dioxide, and to do this, they need to open their stomata. When this happens, water comes out. You've probably experienced this when you breathe as well: on a cold day, you can even see the water from your breath as it makes clouds in the air. Transpiration also helps plants by cooling them down, much like how sweating helps us regulate our body temperatures. Transpiration also plays a big role in helping water move around the plant by changing the water pressure in plant cells. This helps minerals and nutrients move up the plant from the roots.

Materials Required:

- Three small, thin-leafed plants
- Three small, broad-leafed plants
- Small watering can

- Scale
- 6 plastic bags large enough to fit completely around each plant pot
- Masking tape

Procedure:

1. Get six small plants, three with wide leaves and three with narrow leaves. Use the masking tape and pen to give each one a number.
2. Water the plants until water comes out of the bottom of the pot. If the plants are really dry when you start, water them thoroughly and wait a few minutes. Then, water them again. When the water has soaked in and the pot is full of water like a squishy sponge, it's time to weigh the plants. Create a table that shows how much each plant weighs before and after the experiment.

3. Create a hypothesis by addressing these questions:

- *If you water plants and then put them in the sun, what will happen to the water?*
- *Would anything change if you put a plastic bag around the base of the plant?*
- *How would adding the bag change your experiment?*
- Put the plants in full, warm sunlight for an hour, then take off the plastic and weigh each plant again. Record the weight in the table. *Is the weight different? The same? Why do you think that this is the case? Did different plants lose different amounts of weight, or did they lose around the same amount? Why?*
- Dry off the inside of each plastic bag. Re-seal the bags over the plants, return the plants to the sunny spot, and continue timing and weighing for several hours without adding any more water. *What happens?*

Result:

Discussion: Based on the result obtained

Safety precautions: Students should maintain hygiene

Practical 6: Study of Photosynthesis

Objective: Study of Photosynthesis

Principle: Photosynthesis, the process by which green plants and certain other organisms transform light energy into chemical energy. During photosynthesis in green plants, light energy is captured and used to convert water, carbon dioxide, and minerals into oxygen and energy-rich organic compounds. It would be impossible to overestimate the importance of photosynthesis in the maintenance of life on Earth. If photosynthesis ceased, there would soon be little food or other organic matter on Earth. Most organisms would disappear, and in time Earth's atmosphere would become nearly devoid of gaseous oxygen. The only organisms able to exist under such conditions would be the chemosynthetic bacteria, which can utilize the chemical energy of certain inorganic compounds and thus are not dependent on the conversion of light energy. Energy produced by photosynthesis carried out by plants millions of years ago is responsible for the fossil fuels (i.e., coal, oil, and gas) that power industrial society. In past ages, green plants and small organisms that fed on plants increased faster than they were consumed, and their remains were deposited in Earth's crust by sedimentation and other geological processes. There, protected from oxidation, these organic remains were slowly converted to fossil fuels. These fuels not only provide much of the energy used in factories, homes, and transportation but also serve as the raw material for plastics and other synthetic products. Unfortunately, modern civilization is using up in a few centuries the excess of photosynthetic production accumulated over millions of years. Consequently, the carbon dioxide that has been removed from the air to make carbohydrates in photosynthesis over millions of years is being returned at an incredibly rapid rate. The carbon dioxide concentration in Earth's atmosphere is rising the fastest it ever has in Earth's history, and this phenomenon is expected to have major implications on Earth's climate. Photosynthesis also applies to other organisms besides green plants. These include several

prokaryotes such as cyanobacteria, purple bacteria and green sulfur bacteria. These organisms exhibit photosynthesis just like green plants. The glucose produced during photosynthesis is then used to fuel various cellular activities. The by-product of this physio-chemical process is oxygen. A visual representation of the photosynthesis reaction

Materials Required:

- Compound microscope
- Leaves from a jade plant (or others)
- Microscope slides
- cover slips
- 1 clean 250 ml beaker
- 1 clean 500 ml beaker
- Alcohol solution (80% ethanol)
- Variegated geranium leaf with a section wrapped in foil Petri dish
- Hotplate and tongs IKI solution

Procedure:

- As demonstrated by the instructor, snap the leaf in half leaving the epidermis on the
- underside of the leaf unbroken. Carefully peel the epidermis from the lower side of the leaf
- by gently separating the two halves.
- Transfer a portion of the epidermis to a slide, add a drop of distilled water, and cover with a
- cover slip.
- Observe the leaf under low power first and locate a stoma. Increase the power you are
- using to observe and try to differentiate the guard cells.

- Sketch a stoma with guard cells in your lab notebook.
- Prepare a second peel and add a drop of 0.5 M NaCl to this prep instead of distilled water.
- Obtain a 500 ml beaker and a 250 ml beaker.
- Fill the 250 ml beaker half full with alcohol.
- Fill the 500 ml beaker half full with tap water and then create a water bath for the alcohol by placing the beaker of alcohol into the 500 ml beaker.
- **Before continuing to 5, practice using the tongs to move the beaker of alcohol in and out of the water bath. We do not want any burns to occur in the next steps!**
- Place the beakers on your hotplate and then turn it on. **(Warning: do not place the beaker of alcohol directly on the hotplate; it should only be heated in a water bath)**
- Have one lab member in charge of the hotplate. The setting on the hotplate should b adjusted so that the water in the beaker stays at a gentle boil.
- Obtain one foil-covered leaf from a variegated geranium plant at the side of the room.
- **Before removing the foil**, sketch a simple outline of the leaf in your lab notebook. Do not use shading or color, just make a simple basic outline. Next, using dotted-lines, sketch the outline of both the foil and the boundaries of the green and white colors. Later
- you will shade in the areas that were stained with IKI.

Result:

Discussion: Based on the result obtained

Safety precautions: Students should maintain hygiene