



EXPERIMENT

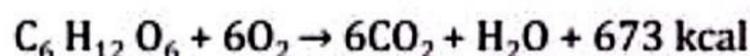
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Aim

To study the rate of respiration in flower buds or leaf tissues and germinating seeds.

Theory

Respiration is a vital process in all the living organisms that generates energy through breakdown of food materials in the presence or absence of O_2 . This energy is used to carry out all life processes. The amount of energy produced depends on the type of food material. 1 mole of glucose produce 673 kcal energy during aerobic respiration.



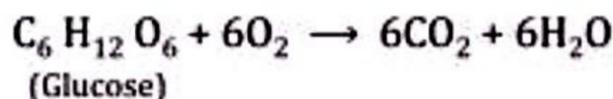
The rate of respiration can be measured by the amount of CO_2 evolved or O_2 consumed.

Respiratory Quotient/Respiratory Ratio

It can be defined as the rate of respiration for different respiratory substrates in terms of the ratio the volume of CO_2 evolved to the volume of oxygen consumed in respiration over certain period of time.

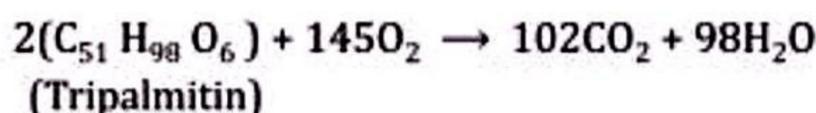
$$RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ consumed}}$$

1. For carbohydrates, $RQ = 1$.



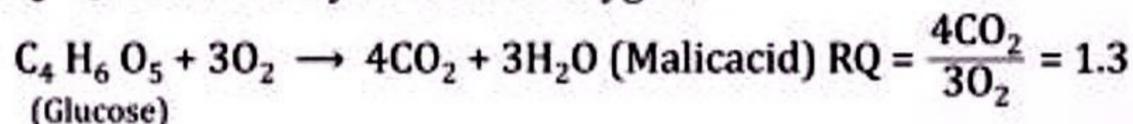
$$RQ = \frac{6CO_2}{6O_2} = 1$$

2. For fats, $RQ < 1$.



$$RQ = \frac{102CO_2}{145O_2} = 0.7$$

3. For organic acids, $RQ > 1$, because they are rich in oxygen.



4. For proteins, RQ is variable (ranges from 0.5-0.9, i.e. $RQ < 1$) depending upon the oxygen content of substrates

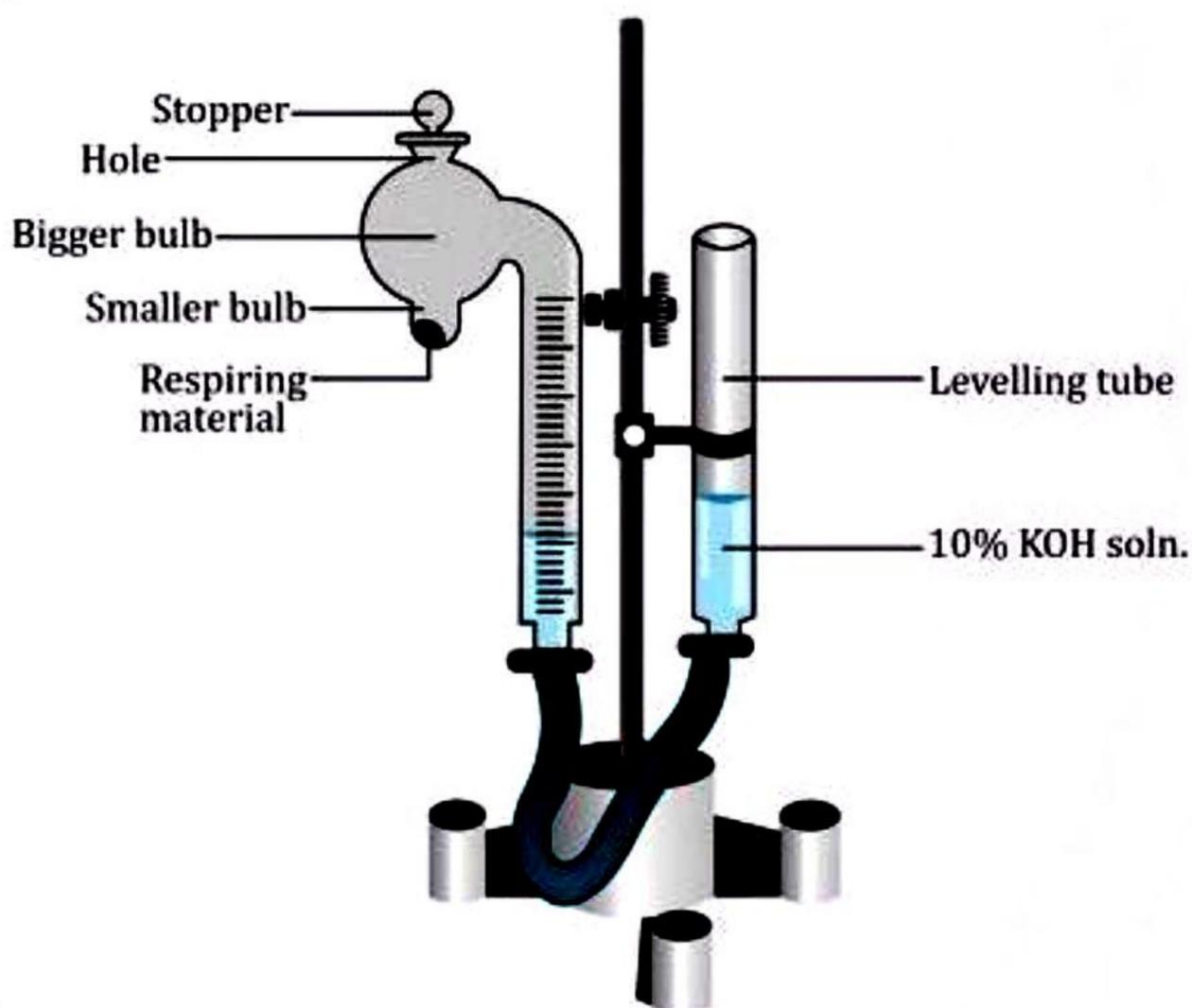
Requirements

Germinating seeds/Flower buds/Leaf tissues, conical flask, hollow glass tube bent twice at right angle, rubber cork with a hole, beaker containing water, potassium hydroxide(KOH) solution, small test tube, string, pencil, practical notebook, etc.

Procedure

1. Take some germinating seeds or flowering buds in a conical flask.

2. Hang a small test tube containing KOH in the conical flask with the help of a string.
3. Pass a hollow glass tube (bent twice at right angle) through the hole of the cork, in such a way that one end of the tube is in the beaker containing water and the other end is in the conical flask.
4. Make the apparatus airtight.
5. Note the initial level of water as 'a' in the bent tube.
6. Keep the apparatus undisturbed for few hours.
7. Note the final position of water as 'b' in the bent tube and record the data in the observation table.
8. Repeat the above procedure again to get two other readings.
9. Calculate average of the above readings and take it as your obtained result.



OBSERVATION

The volume of water rises in the capillary tube. It will be equivalent to the amount of CO_2 produced by the germinating seeds during aerobic respiration. The CO_2 thus evolved is absorbed by KOH in the test tube and some partial vacuum is created in the conical flask. To fill in this space, water rises up in the glass tube.

The observations can be noted in the observation table as follows:

S.No.	Initial level of water (a)	Final level of water (b) at room temp.)	Rise in the level of water ($b - a = h$)	Radius of capillary tubes(r)	Vol. of H_2O
1.					
2.					
3.					

The amount of CO_2 produced depends upon the respiratory rate of the germinating seeds. Therefore, by knowing the amount of water risen or the CO_2 produced in a given time interval, the rate of respiration for seeds can be calculated.

Note: To test that O₂ is consumed during aerobic respiration, take a burning splinter into the flask. If it gets extinguished, it means O₂ has been consumed.

RESULT

The rise in the level of water shows that seeds respire aerobically.

PRECAUTIONS

1. The apparatus should be airtight.
2. Fresh KOH should be used for the experiment.
3. The initial and final level of water should be noted carefully.
4. Only germinating seeds can respire aerobically, therefore, the seeds with broken seed coat should be used instead of the recently soaked seeds.

VIVA VOCE

Q1. The respiration is a vital process for living beings. Why?

Ans. It is a vital process because it provides energy for all biological activities of living beings.

Q2. What happens in the process of respiration?

Ans. In this process the food material (substrate) is oxidised (stepwise) and broken down to CO₂ and water and energy is released

Q3. Can the process of respiration happen in the absence of oxygen?

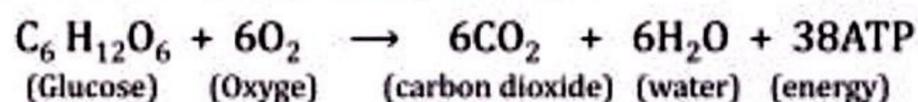
Ans. Yes, but energy released in this is very small. It is called anaerobic respiration.

Q4. Why are germinating seeds used in this experiment?

Ans. Germinating seeds are metabolically very active and respiration is very fast in them.

Q5. Give an equation to show the aerobic respiration

Ans. The equation showing aerobic respiration is as follows



Q6. What is the role of KOH used in the experiment?

Ans. KOH absorbs CO₂ that is released by the respiring seeds thus creating partial vacuum, which eventually leads to rise in level of water in the glass tube.

Q7. What is anaerobic respiration?

Ans. When respiration takes place in the absence of oxygen, it is called anaerobic respiration. e.g., respiration in yeast.

Q8. What is Respiratory Quotient (RQ)?

Ans. The ratio between the volume of CO₂ evolved and the volume of O₂ consumed is called respiratory quotient.

Q9. What are the other materials that can be used to study the rate of respiration in plants?

Ans. Flowering buds or leaf tissues can also be used in place of germinating seeds in the experiment for aerobic respiration because these plant tissues also respire actively and aerobically.

Q10. Why fermentation or anaerobic respiration yields less energy than aerobic respiration?

Ans. In fermentation or anaerobic respiration, the carbohydrate is incompletely oxidised to produce alcohol and CO₂ while, the complete oxidation in aerobic respiration yields more amount of energy. Therefore, less energy is produced in anaerobic respiration than aerobic respiration.