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[GROUP- C]

(i) OSMOSIS

Group - 'C'

Osmosis

Osmosis [Osmos : a push] → "The phenomenon, whereby, when a solution is separated from a weaker one by a semipermeable membrane, the weaker solution diffuses through the membrane into the stronger solution in an effort to equalise the strength of the two solutions."

The word semipermeable membrane is used for a membrane that allows the passage for certain substances while checking the passage of others. If in a semipermeable membrane partitioned pot, sugar solutions of equal concentration are kept on either sides, osmosis does not occur but if a pinch of sugar is added on one side, the water molecules of other side diffuse to enter in that part. The concentration of water does not reduce by addition of sugar. The concentration of water means the number of molecules per unit volume. If the sugar (solute) is added in the same volume of water, no difference in

the number of molecules per unit of volume will occur as sugar molecules occupy the intermolecular spaces of water molecules. The addition of sugar will lower the amount of free energy as compared to that of sugar solution. of other part, but the concentration of water will remain unchanged. This gradient of free energy levels will result in osmosis and water will diffuse into low free energy level solution from high free energy level solution.

Thus osmosis depends upon the solute rather than solvent, i.e. osmosis is dependent on number of solute molecules (sugar) than the number of solvent (water) molecules and independent of any volume change in water. This theory is now called "free energy theory of osmosis."

The osmotic pressure of solution is governed by -

i) The concentration of solution
ii) ionisation of the solute molecules
iii) temperature and
iv) hydration of solute molecules

The osmotic pressure of solution is proportional to its molecular

If the solute is a non-electrolyte the osmotic pressure directly proportional to the molar concentration, because the osmotic pressure depends upon the number of soluble particles present. The solution of electrolyte is in an ionised condition within a solution and the increased number of ions causes a higher osmotic pressure. In case of electrolytes the value of osmotic pressure obtained experimentally is to be multiplied by the degree of ionisation to get the exact value of osmotic pressure. Increase in temperature causes an increase in the osmotic pressure.

The water associated with the particles of hydrophilic solutes or colloid is known as "water of hydration." In case of solution of hydrophilic solutes due to water of hydration the solution remains for more concentrated than it seems to be an consequently shows higher osmotic pressure values.

Osmotic pressure of different solutions as calculated by Arevis's formula.

Osmotic Pressure (atm. or bars)

molarity (wt. molar)	NaCl	KNO3	Sucrose	Glycerol
0.01	0.5	0.5	–	–
0.10	4.5	4.3	2.6	2.4
0.20	8.9	8.2	5.1	4.8
0.30	13.2	11.9	7.7	7.2
0.40	17.6	15.4	10.2	9.6
0.50	21.9	18.8	12.9	12.1
0.60	26.2	22.0	15.5	14.5
0.70	30.5	25.1	18.3	17.0
0.80	34.9	27.9	21.1	19.4
0.90	39.2	30.6	23.9	21.8
1.00	43.6	33.2	26.9	24.3
2.00	88.8	–	56.9	–
3.00	138.2	–	92.9	–
4.00	–	–	137.0	–

The osmotic pressure of solution is also said to be equal to the gas pressure which the solute will exert if it were present as a gas at that temperature in a volume equal to the solution. An ideal molar solution at 0°c has an osmotic pressure 22.4 atmosphere. At higher temperature osmotic potential increases.

In nature endosmosis is common occurrence and responsible for the absorption of water. In contrast to this natural process exosmosis may also occur where the cell loses its water contents due to being placed in hypertonic solution (more concentrated solution). This loss of water brings down the turgor pressure of cell and the protoplasm begins to with draw from the cell wall. It tends to collect as irregular mass in centre. This shrinkage of protoplast is called plasmolysis. In extreme cases of plasmolysis, the plant cell dies.

Some plants (mangrove plants) grow in saline water. The concentration of saline waters being very high, creates difficulty in absorption and the plant has to adopt accordingly. Halophytes (mangrove plants) have high osmotic pressure of the cell sap.

Ohtmer (1964) prepared a table of approximate osmotic pressure found among the various plants as shown below-

Plant group	Osmotic Pressure (Atmosphere)
(1) Summer Ephemerals	8 - 42
(2) Succulent and water Ephemerals	4 - 24
(3) Xerophytes	14 - 57
(4) Hydrophyte	8 - 13
(5) Epiphytes	3 - 6
(6) Halophytes	30 - 115
(7) Porasites	14 - 17
8. Hosts	11 - 14

Thus a cell acts an Osmotic System implied in which are different forces such as Osmotic pressure, Suction pressure, turgor pressure and wall pressure. These different forces working simultaneously bring out absorption of water in a cell.

Importances of Osmosis to the plants

The following processes evidently support the importance of Osmosis in the plants-

» Growth is influenced by osmotic pressure and turgor pressure.

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