Effect of temperature on plasma membrane red cabbage

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The major model associated with this experiment is the fluid plasma membrane structure. It is a phospholipid bilayer, where has hydrophilic (polar) head and hydrophobic (non-polar) tail (Pickering, 2000). As non-polar tail does not dissolve in water, that structure controls the function, by making a barrier between two aqueous environments and selectively controlling the materials movement into or out of the membrane. Pickering (2000) said that due to the different solubility properties of the two side of phospholipid, large molecules and aqueous containing ions can not pass the membrane freely. Small and uncharged molecules, like water and oxygen, can go across by passive diffusion. Diffusion is an automatic and passive process where molecules and ions dissolved in water move randomly from high concentration region to lower one and no energy is required. Fluidity is another essential property of a membrane, lipid composition includes unsaturated fatty acids and participates in increasing membrane fluidity.

Proteins makes up a massive proportion of the membrane approximately exceeds 50% (Raven & Johnson, 2008a). proteins are primarily employed for

the materials movement control. Protein channels and carrier proteins are favorable for ions and large molecules transportation, particularly, from low concentration to higher one against gradient. In addition, denaturation will happen to protein if the environmental temperature increases to a high degree (Raven & Johnson, 2008b). The change of unfolded structure and distortion can ensue. All of the properties of the plasma membrane will determine results of this experiment.

The main pigment of red cabbage is anthocyanins which makes the body appears purple (IHW, 2003). The pigments are found in the vacuole, which is surrounded by plasma membrane called the toroplast. The membranes have approximately 68% proteins have similar structure to cell membrane and prevent the pigments leaving the cell (Marty & Branton, 1980).

Method

Apparatus

7 test tubes

Cork borer

Thermometer

Small beaker

Large beaker

Mounted needle

Burner

Tripod

Gauze

Sample: red cabbage

Procedure

Firstly, fresh red cabbage tissues were cut into discs with almost same shape (approximately 3 mm wide) by cork borer. After 42 red cabbage discs were collected, they were washed with water in a small beaker.

Then 7 test tubes were labeled 30â„ ƒ, 40â„ ƒ, 50â„ ƒ, 60â„ ƒ, 70â„ ƒ, 78â„ ƒ and 97â„ ƒ. The same amount of water was added to each tube. Meanwhile a large beaker with about 200cm3 water was heated, using burner, tripod and gauze. A thermometer was used to measure temperature of each tube.

6 red cabbage discs were impaled together on a mounted needle, then put in the large beaker when the water inside reached 60â„ ƒ (the beaker was preheated to 50â„ ƒ). After 1 minute in the water bath, 6 red cabbage discs were dropped into the test tube labeled 60â„ ƒ then the tube was removed to a rack.

This process was repeated until finishing the tube labeled 97â„ ƒ. The 4 test tubes were shaken and observed their colour. The discs were left into the tubes until the end of this experiment.

Finally, the temperature of water in big beaker was waited to decrease to 50â„ ƒ, 40â„ ƒ and 30â„ ƒ successively in order to rework following correct process.

Discussing

The results are out of expectations that the colour of the solution gets darker as the temperature increases. The observations suggest that the leakage of pigment from the red cabbage was at 70â„ ƒ, precisely in the range between 60â„ ƒ and 70â„ ƒ. Afterwards, the leakage continued to 100â„ ƒ, however, the colour of solution was not consequently darker.

From 30â„ ƒ to 50â„ ƒ, the colour of both samples and solution did not change at all. The plasma membrane under this condition is likely to be functional and available for the control of materials movement. The temperature may sustain the cooperation of all the composition of membrane. As a consequence, there was little noticeable change in the external solution at these temperatures.

These result can roughly help to infer that high temperature (may be 65â„ ƒ) is likely to denature proteins in membrane structure or to allow pigments (large molecules) to go across uncontrollably.

Around this temperature, energy may be given to the plasma membrane, molecules including water molecule consequently collide more actively and strongly. Similarly, lipid becomes more active as energy is added allowing activation energies for active transportation and the whole phospholipid bilayer therefore increases in fluidity. As a result, the rate of materials transportation tends to rise. Proteins within the membrane are also influenced substances. Although they can withstand slightly higher temperature, once they are heated intensely their structure will decomposed to become unfolded and then destroyed (Raven & Johnson, 2008b). Since

proteins make up a massive proportion of permeable membrane (Marty & Branton, 1980), the destruction of them can result in the formation of large holes in the membrane. Therefore, the ruined membrane of the cell and the vacuole can not control materials movement as usual, and begin to leak the anthocyanins pigments from red cabbage to outer environment.

Actually, its colour is not obviously dark and did not became darker from 70â„ ƒ to 100â„ ƒ. One crucial factor that may cause this phenomenon may be that the sample were placed in the water for excessive time (an example of not following the instructions carefully) so that the pigments were released during this period. As a consequence, there are not sufficient pigments present in the test tubes. Another possibility is that proteins in the membrane were completely denatured and destroyed; the pigments were therefore totally released at these temperature.

Pigments in plant cells seem not to be so temperature sensitive. IHW (2003) said that the colour anthocyanin pigments is changed by different PH. They can sustain under not so high temperature.

To evaluate this experiment, a serious mistake is that a half process was wrong and result in waste of time and inaccuracy of following process. Moreover, the time of the practical (about 1 hour) is not sufficient. That may mainly result from that the heating process takes considerably time as the environment sustain the loss of heat. It took at least 15 minutes to heat water from 70â„ ƒ to 80â„ ƒ. Therefore, the experiment may be improved if the samples preparation time is shortened that a preheated 100â„ ƒ water

bath may be necessary. In addition, the discs should not have left into tubes for long time and the stay time need exact calculation.

Conclusion

It can be concluded that temperature can have a substantial effect on membrane. Pigments of the samples in aqueous were released without control from the phospholipid bilayer. Higher temperature seems to increase permeability of membrane. The normal structure of membrane may alter after 60â„ƒ, involving protein denaturation.