

The mechanism that had formed primitive liposome in the early Earth

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[Introduction]

Materials used for the experiment for investigation of first primitive liposome had existed in the early Earth. That is, bubbles were generated by injection of iron powder into carbonated water. The side chain of appropriate amino acid adsorbs on surface of the membrane. The life of the bubble became longer by injection of the appropriate amino acid, because thermal motion of the adsorbed amino acid is suppressed and degradation of peptide bond of the amino acid is suppressed. So, primitive protein is synthesized by incorporating into the membrane. The bubble rise to surfaces of water, and it will burst at the surface. As the result of repeating of bursts, the surface of water was covered with similar membrane. After stirring that water, the bubbles were generated again under atmosphere of CO₂. After some time, the vesicles that stayed long time at middle portion of the water between surface and bottom were generated. The vesicle must be produced at burst of the bubble. It is able to include the membrane and the water inside of it. The special vesicle with long life was made from the membrane and the amino acids. These experimental results gave the idea of mechanism on the formation of a primitive liposome.

[Experiments on effects of amino acid to the bubble made from carbonated water and iron]

By addition of amino acid, the life of bubble generated in carbonated water mixed with iron powder becomes longer and its number increases. These results were recorded by using a digital camera. Here, materials for these experiments are carbonated water: 75 cc, iron powder: 5g and amino acid (glutamine: 143mg, valine: 36mg, leucine: 71mg, isoleucine: 36mg).

After several days from the mixing, the bubbles and the substance that had floated on the surface of the water were dissolved in the water by stirring of the water. After this stirring, bubbles were generated again from bottom sediment, such as iron powder. Initially, the generated bubble rose up to the surface of the water. It burst at the surface. The material that had been brought up by the bubble fell down to the bottom. The rises-up and the fall-down were repeated. After some time, there emerged the vesicle that stayed in middle portion of the water. Since the life of the vesicle was long, the number of vesicle increased along the time progress. At this case, the atmosphere was filled with CO₂. Under strong ultraviolet irradiation in atmosphere of CO₂, these special vesicles were not generated, although floating materials at the surface of the water was generated up to thick. Generation of the vesicle that stayed in the middle portion of the water was confirmed by stopping the strong ultraviolet irradiation, together with addition of iron powder at the atmosphere of CO₂.

[Theoretical understandings]

The reason why bubbles are generated by injection of iron powder into carbonated water is as follows. The iron atom reacts with the oxygen atom of the carbon dioxide because the electronegativity of carbon atom is larger than that of hydrogen atom. The free carbon atom released from oxygen reacts with the iron atom by the same reason. The iron carbide that has been produced reacts with the water. As the result, the free carbon atoms and the free hydrogen atoms form the membrane of the bubble. If insoluble gas is generated in the water where suitable organic molecules exist, the appropriate molecule will be arranged at the interface of the gas to fit to the boundary conditions. The bubble made of the membrane rises up to the surface. The bubble will soon burst at the surface. The gas contained in the bubble is discharged to outside of the water. The organic molecule that had been organized membrane of the bubble will cover the surface of water. After that, the bubble also bursts at the surface that is covered with the organic molecules. Here, following phenomenon takes place at the burst of the bubble. The closed vesicle that includes the membrane and the water inside is produced by the mechanism to form the bubble.

The reason why a liposome is generated is as follows. Amino acid is soluble in water but not soluble in oil. Organic molecules exist in the membrane of the bubbles generated in carbonated water mixed with iron powder. Appropriate side chain of amino acid is able to adsorb on surface of the membrane. Thermal motion of the adsorbed amino acid is suppressed and degradation of the peptide bond of amino acids is suppressed. The amino acid molecules adsorbed to the membrane will be mutually linked by the peptide bond. Although the association of amino acid is sensitive to the environment, a primitive protein is synthesized by incorporating into the membrane. The bubble of which membrane incorporated with linked amino acids becomes robust. The number of vesicles with long life will be increased. The large number of vesicles makes possible to form complicate cell by using broken parts of the membrane as units of the organization. The closed vesicle is able to include plural of small liposome. In this way, the author proposes the mechanism by which the first primitive liposome was produced.

Keywords: Bubble, Membrane, Amino acid, Peptide bond, Protein, Liposome

[References]

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