Journal of Plant Biochemistry & Physiology
ISSN: 2329-9029

Dolai, J Plant Biochem Physiol 2016, 4:1
DOI: 10.4172/2329-9029.1000165

Rapid Communication Open Access

Complete Procedure of Biochemical Reaction in Photolysis

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Abstract

The complete procedure of photolysis in photosynthesis is discussed in this paper. The complex ion tetrachloridomanganate (II) ion and the compound urea can play the roles in the analysis of water (H_2O).

Keywords: Photolysis; Complex ion; Photon; Photosystem; Electron; Chlorophyll; Water molecule

Introduction

Photolysis is an important part of photosynthesis. A complex compound $[Mn^{2+}Cl^-]$ of Mn^{2+} and Cl^- ions can help to progress this process. But the nature of $[Mn^{2+}Cl^-]$ and the pathway of photolysis are not known clearly at all. However modern inventions already show that to produce one molecule O_2, 2 molecules H_2O are analyzed; as well as $4H^+$ ions and 4e are also generated side by side in the complete procedure.

$$2H_2O \rightarrow 4H^+ + O_2 + 4e$$

Here the mechanism of progressive pathway of photolysis is entirely discussed by the way of photoactive biochemical reactions.

Photolysis

The complex ion tetrachloridomanganate (II) ion i.e., $[MnCl_4]^{2-}$ of Mn^{2+} and Cl^- ions and the compound urea i.e., $CO(NH_2)_2$ are located in PS-II. $[MnCl_4]^{2-}$ is photoactive and occurs photolysis by the helps of $CO(NH_2)_2$ and photon(hν) of light.

Chl-b (P_{680}) emits an electron (e) to convert itself as active chlorophyll i.e., Chl-b* (P^+_{680}) by absorption of photon and creates a strong electron-affinity in time of photosynthesis.

$$P_{680} + h\nu \rightarrow P^+_{680} + e$$

The above electron is accepted by electron- carrier plastoquinone (PQ) to stabilize active chlorophyll in PS-I i.e., Chl-a* (P^+_{700}) as the form Chl-a (P_{700}) via other electron-carriers (cytochrome b_6f complex and plastocyanine i.e., PC).

$$PQ + 2e + 2H^+ \rightarrow PQH_2^-$$

It is remembered that the H^+ ion of above reaction can be accepted from stroma and thrown into lumen of chloroplast due to the electron-flow inside PQ for ATP synthesis by chemiosmosis.

In this situation, to decrease that electron-affinity $[MnCl_4]^{2-}$ absorbs photon from light and converts itself as active tetrachloridomanganate (III) ion i.e., $[MnCl_4]^-$ by emission of an electron (e).

$$[MnCl_4]^{2-} + h\nu \rightarrow [MnCl_4]^- + e$$

This electron can enter into PS-II to stabilize that active chlorophyll i.e., Chl-b* (P^+_{680}) to convert it into its stable state i.e., Chl-b (P_{680}).

$$P^+_{680} + e \rightarrow P_{680}$$

Now four active $[MnCl_4]^-$ ions can react with 8 molecules $CO(NH_2)_2$ and 2 water (H_2O) molecules to produce four diureamanganese (II) ions i.e., $4[Mn\{CO(NH_2)_2\}_2]^{2+}$, four molecules hydrochloric acid i.e., 4HCl and twelve chlorine ions i.e., $12Cl^-$ for formation of one molecule oxygen i.e., O_2.

$$4[MnCl_4]^- + 8CO(NH_2)_2 + 2H_2O \rightarrow 4[Mn\{CO(NH_2)_2\}_2]^{2+} + O_2 + 4HCl + 12Cl^-$$

Then HCl attracts H_2O to generate hydronium ion i.e., H_3O^+ and Cl^- in its hydrolysis.

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

After production of H_3O^+, it is broken as H^+ and H_2O to throw H^+ into lumen cavity of chloroplast from PS-II.

$$H_3O^+ \rightarrow H^+ + H_2O$$

As a result, pH level inside PS-II can be increased; as well as concentration of Cl^- ion also be increase. In this situation, $4[Mn\{CO(NH_2)_2\}_2]^{2+}$ ions and $16Cl^-$ ions can react with each other to reproduce $4[MnCl_4]^{2-}$ ions and 8 molecules $CO(NH_2)_2$.

$$4[Mn\{CO(NH_2)_2\}_2]^{2+} + 6Cl^- \rightarrow 4[MnCl_4]^{2-} + 8CO(NH_2)_2$$

Photoactive $[MnCl_4]^{2-}$ again absorbs photon of light by the influence of the electron-affinity of active chlorophyll P^+_{680} (produced again from stable chlorophyll P_{680} by absorption of photon of light and emitted electron again; which is again accepted by PQ in time of photosynthesis). In this way, the procedure of photolysis is going on in PS-II at the time of light reaction of photosynthesis [1-5].

Summary

The mechanism of the pathway of photolysis is clearly known in the above discussion. It is shown that finally 2 molecules H_2O is analyzed through this process to develop $4H^+$ ions and one molecule O_2. As well as four electrons (4e) are emitted by absorption of photons (hν) of light to restore the stability of active chlorophyll P^+_{680} as the form P_{680}. The complete reaction-pathway of photolysis is drawn by the following way:

$$4P_{680} + 4h\nu \rightarrow 4P^+_{680} + 4e$$

$$2PQ + 4e + 4H^+ \rightarrow 2PQH_2^-$$

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Received February 08, 2016; **Accepted** March 21, 2016; **Published** March 29, 2016

Citation: Dolai U (2016) Complete Procedure of Biochemical Reaction in Photolysis. J Plant Biochem Physiol 4: 165. doi:10.4172/2329-9029.1000165

$4[MnCl_4]^{2-}+4h\nu \rightarrow 4[MnCl_4]^{-}+4e$

$4P^{+}_{680}+4e \rightarrow 4P_{680}$

$4[MnCl_4]^{-}+8CO(NH_2)_2+2H_2O \rightarrow 4[Mn\{CO(NH_2)_2\}_2]^{2+}+O_2+4HCl+12Cl^{-}$

$4HCl+4H_2O \rightarrow 4H_3O^{+}+4Cl^{-}$

$4H_3O^{+} \rightarrow 4H^{+}+4H_2O$

$4[Mn\{CO(NH_2)_2\}_2]^{2+}+16Cl^{-} \rightarrow 4[MnCl_4]^{2-}+8CO(NH_2)_2$

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