OPEN ACCESS Freely available online

ISSN: 2167-7662
Bioenergetics: Open Access

Short Communication

Significance of Water Splitting in Photosynthesis and its Impact on the Environment

Wohuku Tohamo*

Department of Applied Plant Science, Tohoku University, Sendai, Japan

DESCRIPTION

Photosynthesis is the process by which plants, algae, and some bacteria convert light energy into chemical energy, which is stored in the form of organic molecules such as glucose [1]. This process involves the use of two distinct reactions, namely the light-dependent reaction and the light-independent reaction. The light-dependent reaction is the first stage of photosynthesis, and it occurs in the thylakoid membrane of chloroplasts [2]. This reaction involves the splitting of water molecules, which results in the release of oxygen gas, protons, and electrons.

Water splitting in photosynthesis is a complex process that involves the transfer of electrons and protons from water molecules to the electron transport chain, which is located in the thylakoid membrane [3]. This process is known as photolysis, and it occurs in the presence of light energy. The primary purpose of photolysis is to generate Adenosine Tri Phosphate (ATP) Nicotinamide Adenine Dinucleotide Phosphate (NADPH, which are used in the subsequent stage of photosynthesis known as the light-independent reaction. The process of photolysis involves the following steps:

Absorption of light energy: The first step in photolysis is the absorption of light energy by the Photosystem II (PSII) located in the thylakoid membrane [4]. The PSII contains a network of pigments, including chlorophyll a, chlorophyll b, and carotenoids, which are responsible for absorbing light energy [5].

Electron transfer: Once the light energy is absorbed, it is transferred to the reaction center of PSII, which contains a special pair of chlorophyll a molecules called P680. The absorbed light energy causes P680 to become excited and lose an electron. This electron is then transferred to the primary electron acceptor, a molecule called pheophytin, and then to a series of electron carriers in the electron transport chain [6].

Water splitting: As the electrons are transferred through the electron transport chain, they are used to pump protons (H^+) from the stroma to the thylakoid lumen, creating a proton gradient. This gradient is used to generate ATP through a process called chemiosmosis [7]. In addition, the electrons from the electron transport chain are transferred to Photosystem I (PSI) *via* the electron carrier Plastoquinone (PQ). This transfer results in the reduction of $NADP^+$ to NADPH, which is used in the light-independent reaction [8].

As the electrons are transferred from water molecules to the electron transport chain, the water molecules are split into oxygen gas (O_2), protons (H^+), and electrons (e^-). This process is known as water splitting or photolysis [9]. The overall reaction for water splitting is as follows:

$$2H_2O + \text{light energy} \rightarrow 4H^+ + 4e^- + O_2$$

The protons generated during water splitting are pumped into the thylakoid lumen, creating a proton gradient that is used to generate ATP. The electrons are transferred to the electron transport chain and are ultimately used to reduce $NADP^+$ to NADPH. The oxygen gas produced during water splitting is released into the atmosphere as a byproduct of photosynthesis [10].

CONCLUSION

The process of water splitting is critical for the overall process of photosynthesis, as it generates the necessary electron and proton carriers that are used in the light-independent reaction. In addition, the oxygen gas produced during water splitting is essential for the survival of most organisms on Earth, as it is used in cellular respiration to generate ATP. One of the key factors that affect the efficiency of water splitting in photosynthesis is the availability of light energy. The rate of water splitting increases with increasing light intensity up to a certain point, beyond which it becomes saturated. This saturation point is determined by the rate of electron transfer in the electron transport chain.

Correspondence to: Wohuku Tohamo, Department of Applied Plant Science, Tohoku University, Sendai, Japan, E-mail: tohamow@gmail.com

Received: 02-Jan-2023, Manuscript No. BEG-23-20597; **Editor assigned**: 04-Jan-2023, PreQC No. BEG-23-20597 (PQ); **Reviewed:** 18-Jan-2023, QC No. BEG-23-20597; **Revised:** 25-Jan-2023, Manuscript No. BEG-23-20597 (R); **Published:** 02-Feb-2023, DOI: 10.35248/2167-7662.23.11.197

Citation: Tohamo W (2023) Significance of Water Splitting in Photosynthesis and its Impact on the Environment. J Bio Energetics.11:197.

REFERENCES

1. Natale S, Tomasella M, Gargiulo S, Petruzzellis F, Tromba G, Boccato E, et al. Stem photosynthesis contributes to non-structural carbohydrate pool and modulates xylem vulnerability to embolism in Fraxinus ornus L. Environ Exp Bot. 2023:105315.
2. Rosa RM, Machado M, Vaz MG, Dos Santos RL, do Nascimento AG, Araújo WL, et al. Urea as a source of nitrogen and carbon leads to increased photosynthesis rates in Chlamydomonas reinhardtii under mixotrophy. J Biotechnol. 2023.
3. Li C, Huang W, Han X, Zhao G, Zhang W, He W, et al. Diel dynamics of multi-omics in elkhorn fern provides new insights into weak CAM photosynthesis. Plant Physiol Commun. 2023.
4. Feng X, Liu R, Li C, Zhang H, Slot M. Contrasting responses of two C4 desert shrubs to drought but consistent decoupling of photosynthesis and stomatal conductance at high temperature. Environ Exp Bot. 2023:105295.
5. Peng M, Gan F, Lin X, Yang R, Li S, Li W, et al. Overexpression of OsNF-YB4 leads to flowering early, improving photosynthesis and better grain yield in hybrid rice. Plant Sci. 2023:111661.
6. Zhou Z, Struik PC, Gu J, van der Putten PE, Wang Z, Yin X, et al. Enhancing leaf photosynthesis from altered chlorophyll content requires optimal partitioning of nitrogen. Crop and Environment. 2023.
7. He Y, Matthews ML. Seasonal climate conditions impact the effectiveness of improving photosynthesis to increase soybean yield. Field Crops Res. 2023;296:108907.
8. Xie Y, Khoo KS, Chew KW, Devadas VV, Phang SJ, Lim HR, et al. Advancement of renewable energy technologies *via* artificial and microalgae photosynthesis. Bioresour Technol. 2022;363:127830.
9. Robbins LJ, Fakhraee M, Smith AJ, Bishop BA, Swanner ED, Peacock C, et al. Manganese oxides, Earth surface oxygenation, and the rise of oxygenic photosynthesis. Earth Sci Rev. 2023:104368.
10. Yoshida H, van Oossanen S, Barbosa MJ, Janssen M. Light and carbon limited photosynthesis of Chlorella sorokiniana. Algal Research. 2023;69:102934.