Insights into the photosynthesis process

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Abstract: In this Review, some fascinating and essential concepts of photosynthesis were described. There is much information about photosynthesis, which is widely known, considering the importance of this process. However, there is also a range of information about photosynthesis that is unknown and not often mentioned. Photosynthesis is the name given to the set of biochemical reactions that change carbon dioxide and water into sugar, glucose, and oxygen. Sunlight is often harnessed by chlorophyll, which is green because it reflects green light. This Review will give a deeper insight into some parts of the photosynthesis process.

Keywords: Photosynthesis; Plants; Beech-drops; Indian pipe; Glucose.

1. Introduction

Photosynthesis is the process plants, algae, and some bacteria use to make food by taking in carbon dioxide (CO_2) and water (H_2O) from the air and soil. Within the plant cell, the water is oxidized, meaning it loses electrons, while the carbon dioxide is reduced, meaning it gains electrons. This transforms the H_2O into O2 and the CO_2 into glucose, meaning sugar. The plant then releases the O_2 into the air and stores energy within the glucose molecules [1,2]. Photosynthesis also enables life on Earth. Without this process, oxygen wouldn't be released into the air for living organisms to breathe. Because of this, without photosynthesis, life on Earth, as we know it, wouldn't be possible [3]. Photosynthesis occurs inside the chloroplasts that sit in the mesophyll of the leaves. The thylakoids sit inside the chloroplast, containing chlorophyll which absorbs the different colors of the light spectrum to create energy [4]. Photosynthesis uses mentioned green pigment chlorophyll. This pigment is a molecule with a particular color and can absorb light at different wavelengths, depending on the color. There are many kinds of pigments in nature, but chlorophyll is unique in enabling plants to absorb energy. This is used to build tissues [5].

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2. Plants aren't the only organisms that perform photosynthesis

The ability to photosynthesize is found in both eukaryotic and prokaryotic organisms. The most well-known examples are plants. But very few known that parasitic or mycoheterotrophic species contain chlorophyll and produce their food. Algae are the other dominant group of eukaryotic photosynthetic organisms. All algae, which include massive kelps and microscopic diatoms, are important primary producers [6,7]. Now, if other organisms can do photosynthesis, some plants can not. These plants are called "Non-photosynthetic plants". A plant with no chlorophyll is equal to a plant that does not produce its food via photosynthesis. There are approximately 3000 non-photosynthetic plants around the world. Rather than producing their food, they can parasitize other plants or fungi. Some examples are broomrape, beechdrops, indian pipe, etc. [8].

Beechdrops (*Epifagus Americana*), a holoparasitic plant, live off beech trees. Its genus name *Epifagus* means "upon beech." Beechdrops has neither leaves nor chlorophyll. Instead, its haustoria connect to the roots of the beech below ground. What you see of this plant above ground is just the flowering part of the plant. It becomes dormant in the winter with its host beech tree to avoid exhausting its only food supply [8].

Figure 1. The appearance of Indian pipe in nature[1]

[1] Figure is original work of MMartin1202, available at Pixabay. Please consider supporting this author by visiting the following link https://pixabay.com/photos/mushroom-indian-pipe-fungi-close-1853282/

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Indian pipe (Monotropa uniflora, Fig. 1), ghost plant, or corpse plant is also a holoparasitic plant. Its hosts are mycorrhizal fungi, mutualists that derive their energy from a host tree. So the Indian pipe is ultimately feeding off a host tree, but it does so through an intermediary. It is not clear whether this relationship harms the mycorrhizal intermediary, or it benefits in some way from this. Indian Pipe has no chlorophyll and, in fact, no pigments. It says that its waxy, corpulent white, although rare variants are a deep red color, is a genetic vestige of its ancestral coloration. Its tiny, scale-like leaves are also without pigmentation. It grows only 2–12 inches tall, with one drooping, bell-shaped flower per stem. Indian pipe prefers shaded sites with rich soils. It is often found close to decaying matter, tree roots, or leafy mulch. It could be found with beech or sometimes pines or oaks [8].

3. Glucose isn’t just food

As we know, glucose is the primary type of sugar in the blood and is the major source of energy for the body's cells. While sugar glucose is primary used for energy, it has other purposes. For example, plants use glucose as a building block to build starch for long-term energy storage and cellulose to build structure [9,10]. Chloroplasts are also an interesting and essential part of photosynthesis. In leaves and other green tissues, chloroplasts are the sites of photosynthesis. In daylight hours, most plant species accumulate starch (insoluble in water and not at all sweet to the tongue, think of potatoes or rice both enriched in starch) in their chloroplasts using enzymes that combine the products of photosynthesis, i.e., phosphorylated glucose molecules, together to produce the starch [4].

In the night hours, chloroplast starch is hydrolyzed back into phosphorylated glucose and then into sucrose (common table sugar, soluble in water) and exported into the phloem for translocation throughout the plant, particularly to the roots. Non-green recipient tissues contain organelles called amyloplasts that convert the incoming sucrose back into phosphorylated glucose molecules and then into starch for storage. As non-green tissues grow and develop, amyloplast starch is converted back into soluble sugars such as glucose to provide needed energy and substrate [11]. If you have a very sensitive-to-sugar tongue, you might be able to tell that raw green leaves stored overnight in the fridge taste sweeter than those left at room temperature in the light. However, starch, not glucose or sucrose, is favored as the storage reserve [12].

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4. Conclusions

Photosynthesis is the name given to the set of biochemical reactions that change carbon dioxide and water into sugar, glucose, and oxygen. In this Review, some fascinating and essential concepts of photosynthesis were described. Plants, cyanobacteria, algae, and some protists perform photosynthesis. Also, a few animals are photosynthetic, too. Photosynthesis may be the most important chemical reaction on Earth.

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References

1. What is Photosynthesis, online: https://ssec.si.edu/stemvisions-blog/what-photosynthesis (accessed on 1.12.2022.).
2. Photosynthesis: the basis of life on Earth, online: https://labassociates.com/photosynthesis-the-basis-of-life-on-earth (accessed on 25.11.2022.).
3. Where does photosynthesis take place?, online: https://lightsciencetech.com/where-does-photosynthesis-take-place/#:~:text=Photosynthesis%20takes%20place%20inside%20the,Source%3A%20Biology%3A%20LibreTexts (accessed on 7.12.2022.).
4. Chlorophyll, online: https://education.nationalgeographic.org/resource/chlorophyll (accessed on 9.12.2022.).
5. Will We Ever… Photosynthesise Like Plants?, online: https://www.nationalgeographic.com/science/article/will-we-ever-photosynthesise-like-plants (accessed on 15.12.2022.).
6. Which organisms can photosynthesize?, online: https://www.britannica.com/question/Which-organisms-can-photosynthesize (accessed on 15.12.2022.).
7. The Plant Without Chlorophyll, online: https://www.phipps.conservatory.org/blog/detail/biopgh-blog-the-plant-without-chlorophyll#:~:text=A%20plant%20with%20no%20chlorophyll,parasitize%20other%20plants%20or%20fungi (accessed on 12.12.2022.).
8. Non-Photosynthetic Plants, online: https://cortland.edu/waldbauer-trail/8-non-photosynthetic-plants.html (accessed on 9.12.2022.).
9. Definition: Glucose, online: https://kidshealth.org/en/parents/glucose.html#:~:text=Glucose%20is%20the%20main%20type,glucose%20levels%20in%20the%20blood (accessed on 25.11.2022.).
10. 10 Fascinating Photosynthesis Facts, online:r https://www.thoughtco.com/photosynthesis-facts-4169940#:~:text=Glucose%20isn't%20just%20food.&text=While%20the%20sugar%20glucose%20is,and%20cellulose%20to%20build%20structu (accessed on 29.11.2022.).
11. The Story of Chlorophyll and Chloroplasts, online: https://askabiologist.asu.edu/chlorophyll-and-chloroplasts#:~:text=Chlorophyll%20isn't%20the%20only,have%20the%20photosynthetic%20pigment%20fucoxanth (accessed on 14.12.2022.).
12. If plants produce glucose as their food why aren't leaves and most other plants sweet?, online: https://www.quora.com/If-plants-produce-glucose-as-their-food-why-arent-leaves-and-most-other-plants-sweet (accessed on 8.12.2022.).