**Photosynthesis: What is Chlorophyll F and what does it change for plants?**

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 **Plant species are plentiful on the planet, with every one of them thriving in various environments. Earth is full of many places that all have diverse properties in their temperatures, rainfall, amount of sunlight, and various other things. Plants have adapted to the area that they are in by way of evolution. This is evident from the biological make of various plants and the functions that they serve. Photosynthesis is a process that all plants go through in order to live and remain thriving where they are and allows light energy from to sun to be converted into chemical energy. This process is very important to us, as it is this process that gives us the oxygen we need to breath. It also removes the carbon dioxide we exhale from the air, which can be toxic to us if an excess of it is left in an area. Another major factor that plants impact is our food source. The world's food supply depends and thrives on the wellbeing of plants. For years, we have known that the spectrum of light used to perform photosynthesis in plants is the one that is red and used by Chlorophyll type A in the plants. Others light spectrums were found to be too harsh to fulfill the needs of the plant to perform photosynthesis. Recently, scientists have discovered a new type of light spectrum that allows certain plants to perform photosynthesis.** 

**Introduction**

I will be getting into what this discovered light spectrum is called, what plants it works with, and what this means for us. This photosynthesis was found first in the cross sections of beach rock found on the Island of Herm, Australia. As of now, scientists are using this discovery to make theories of how it can be useful in our lives. One overall way it will help is by making it possible to be able to make more things concerning plants and their growth plausible. This astounding form of photosynthesis will greatly change how we view photosynthesis, and how plants thrive from this point forward. Cyanobacteria were the first organisms found by scientists to use the newly discovered photosynthesis process. They can be grown in very shaded areas that don’t receive much light, that would otherwise give off the red-light spectrum. It was tested that, when in the vicinity of near-infrared light, the standard system called Chlorophyll A shuts down because the red light it uses to function is not present. A new form of Chlorophyll then arises. Chlorophyll F beings to function under the presence of the near-infrared light. “Chlorophyll A photochemistry, using red light (680 to 700 nm), is near universal and is considered to define the energy “red limit” of oxygenic photosynthesis. We present biophysical studies on the photosystems from a cyanobacterium grown in far-red light (750 nm). The few long-wavelength chlorophylls present are well resolved from each other and from the majority pigment, Chlorophyll A. Charge separation in photosystem I and II uses chlorophyll f at 745 nm and Chlorophyll F at 727 nm, respectively. Each photosystem has a few even longer-wavelength Chlorophylls F that collect light and pass excitation energy uphill to the photochemically active pigments. These photosystems function beyond the red limit using far-red pigments in only a few key positions” (Nurnberg, D). Scientists have come to call this phenomenon ‘beyond the red limit’. It takes photosynthesis beyond the use of only the red-light spectrum. It was first believed that Chlorophyll-F only harvested the red light that the organism might have encountered, but we are now told otherwise by scientists. Many experiments were conducted to be sure that what was occurring was genuine. One that was done was testing the process on other strains of the cyanobacteria. They did this to find out if this type of photosynthesis was only possible in this one stain, or if other stains had the same effect under the right conditions. It was found that the process still worked on these other stains. Scientists began to then theorize that this process was available in other plants as well. “Finding a type of photosynthesis that works beyond the red limit changes our understanding of the energy requirements of photosynthesis,” said co-lead author Dr. Andrea Fantuzzi, from the Department of Life Sciences at Imperial College London (News Staff). A lot of progress has been made in this discovery in the last few years. Just two years before it was discovered, scientists believed that Chlorophyll F was dependent on light just as Chlorophyll A is. Experiments showed that Chlorophyll F permits some cyanobacteria to expand the spectral range for photosynthesis by absorbing far-red light. “The data from both experimental approaches demonstrate that light is required for the synthesis of Chlorophyll F by Chlorophyll F/sr-PsbA4. Thus, we conclude that Chlorophyll F is a photo-oxidoreductase. Chlorophyll F synthase is the second light-dependent enzyme of Chlorophyll biosynthesis, the other being light-dependent protochlorophyllide oxidoreductase” (Ho, M). This was the conclusion up until it was discovered that the opposite was true. Chlorophyll F did not store any light from the red spectrum in light. It instead ran off another light spectrum altogether.

**Recent Progress**

Recently, scientist have come to some big hypotheses. From this discovery they have theorized that life on other planets is more so possible. At this time, scientists are mostly using the discovery to figure out what good they can do to our environment and what ways it can be manipulated into doing better things for ourselves. Nothing more has been mentioned outside of the now known phenomenon that photosynthesis can be done in a different light spectrum than previously concluded.

**Discussion**

 The results found leads the world to truly believe that we as humans don’t know everything there is about this world. There is so much more that we can learn every day. The findings of those who discovered the new type of photosynthesis that is possible in green alga, are valid and will help the world in many aspects. The results address how plants can withstand more conditions that we were not before aware of. We must take advantage of this discovery full on, and with an open and creative mind. Plants are very important organisms to us and all life on earth. They provide a source of food supply, medicine, protect habitats, air supply, and other factors we don’t really think about. One example of this would be how plants take out toxic properties that are found in some soils around the world that result from our own wrongful doing. “Soils in some areas are unusable as human activities have resulted in them becoming contaminated with heavy metals, radioactive elements and other toxins. Plants can be used to clean up such soils as they have the capacity to concentrate toxic elements in their tissues without harm (O'Connell, J). This shows that plants help to cleans our environments by coming behind us and absorbing toxins we leave behind. This purpose of some plants leads into the most know purpose; that being a source for our food supply. For any living thing to gain the energy they need to survive; a plant must be put into play first. This means plants need to be able to thrive without the factor of our toxins hindering its growth. The food chain always starts with plants. This means that plants must be produced at an efficient rate to be able to sustain all life. The discovery of this new photosynthesis will make it possible for certain plants to complete the process of photosynthesis without the need of sunlight. Plants could begin to be made by humans to do photosynthesis. They could be harvested in rooms that don’t need the factor that’s always been needed, sunlight. A simple dark room could have hundreds and hundreds of healthy plants in it for livestock, without having to be sure that the land could handle the environment the area was in. Winters and lack of sunlight would no longer affect how much food supply was available to us anymore. Still unanswered is when we will utilize the discovery. Who can manipulate the process of plants, and when will it be necessary to do so? Will the world wait until it's absolutely needed, or will we start to experiment with the different things we can do and apply then to our environments sooner than later?

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