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RESEARCH ARTICLE

Origin of life is chemical synthesis and evolution, Cyanobacteria (Spirulina): Cellulose is a living cell

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Today, with the remarkable development of science, various chemical substances that are the origin of life are being discovered through space planetary exploration. The study of the origin of life is a very active field of research and important discoveries and progress are being made, but the mission of scientific research is to provide life, natural phenomena and evidence. There are various hypotheses about the origin of life on Earth since its birth 4.54 billion years ago. Space planets and asteroids, Membranes first: Lipid world, clay hypothesis, RNA world, Peptide hypothesis, Iron–sulfur world, Pre–cells (successive cellularisation), Deep sea hydrothermal vents, Life "seeded" from elsewhere, Carbonate-rich lakes. Panspermia, "A warm little pond": primordial soup, Miller–Urey experiment, PAH world hypothesis, Nucleobases and nucleotides, Geothermal springs. Nine requirements for the origin of Earth's life: Not at the hydrothermal vent, but in a nuclear geyser system, (Maruyama, S., et al. 2019) A Nuclear Geyser Origin of Life Assembly Plant – Three-Step Model for the Emergence of the First Life on Earth and Cell Dynamics for the Coevolution of Life's Functions (Maruyama, S., et al. 2023). At the bottom of the ocean, where light can't reach. It was discovered that methane, the substance of life, was leaking from seep under the seafloor in Chile (Schmidt Ocean Institute. 2024). We describe and encompass all hypotheses about the origin of life. Cyanobacteria are the most abundant taxonomic group to have ever existed on Earth and have continuously produced and released oxygen for billions of years, dramatically changing the composition of life on Earth from the anaerobic, weakly reducing pre-biotic atmosphere of early Earth to one of free gaseous oxygen.We present evidence based on the structural colors and life cycles of prokaryotes and eukaryotes. The cellulose of prokaryotes (cyanobacteria: Spirulina) and eukaryotes (marine macroalgae: green seaweed) is a living cell and a living organism. These cells commonly hibernate or are active in 1. dry environments, 2. aerobic, 3. anaerobic, 4. alkaline, 5. high and low temperatures. The cellulose of the cyanobacteria Spirulina contains chemically synthesized phycocyanin and as a protein, it has the chemical structure of a peptide. The phycocyanin pigment appeared as 1. blue to white, 2. white to bright-orange and 3. blue to bright-brown by photosynthetic reaction. Refraction of light allows photosynthetic organisms to store color, reflect and absorb light. As a phycocyanin pigment, blue is converted to white, light-orange and light-brown. The colors blue, white and brown appear green due to the refraction of light. As a phycocyanin pigment, protein peptides act as catalysts in photosynthetic reactions. When mixing Spirulina and blue pigments, blue is converted to green by photosynthetic reactions. As the origin of life on Earth, protein peptides of chemically synthesized phycocyanin pigments are alive in green as biochemical catalysts.

Spirulina *phycocyanin* pigment, a protein peptide, was a biochemically synthesized catalytic substance that gave birth to various organisms in the Primitive Earth ecological environment.

Keywords: Origin of life, Chemical synthesis and evolution, Prokaryotes, Cyanobacteria, Spirulina, Structural color, Life cycle, Phycocyanin, Peptides, Eukaryotes, Cellulose is alive.

Introduction

Spirulina *Arthrospira* is a prokaryotic plant of the Spirulinaceae, Cyanophyceae and Cyanobacteriota families and is a microalgae that is widely distributed worldwide. Spirulina is the dried biomass of blue-green algae (cyanobacteria) that can be consumed by humans and animals. The three species are *Arthrospira platensis*, *A. fusiformis* and *A.* maxima.Today, Spirulina is cultivated on land in various parts of the world, including North America, Africa, Europe and Asia and the dried product is packaged and sold as food. The drying temperature of Spirulina is 40-70°C and the drying method includes low-temperature drying and spray hot air drying. We are experiments were conducted by adding 0.01-0.2g of dried Spirulina to 1,000 cc of seawater or water and occasionally adding more water. When dried Spirulina is placed in seawater and water, the cells live and carry out vital activities through photosynthesis. (27-31 °C). The structural colors of Spirulina include green chlorophyll-a, b, blue, bright red (pink), orange, yellow, white, gray, brown and black. Based on environmental conditions, Spirulina lives by changing its structural colors into various colors under the influence of ultraviolet rays and temperature. The blue-green of Spirulina releases blue pigment through photosynthesis and the separated green is alive. The change in the structural colors of Spirulina is the signaling system of the chromosomes within the cells and changes to white, orange, yellow, brown, etc. and returns to green again. Spirulina produces a foul odor under anaerobic conditions and changes from green to black and when aerobic conditions occur, it begins to carry out vital activities with the cell's resilience. They change from green to white-gray-brown-black and then back to green. Spirulina is alive at 85-90 °C.

(Green-white, brown-green or green-green) Spirulina is alive at pH 3.5-3.7 and appears white or brown and then back to green. Dried Spirulina at 75-80 °C and then put it in water, it will change to white or brown and then back to green. The average period for Spirulina to change to various colors and back to green is about 10-20 days. The life cycle of Spirulina is constantly reproducing offspring through generational changes. Spirulina is a living organism composed of carbohydrates, proteins, lipids, nucleic acids and minerals and cellulose is a living organism. We have observed various changes in the ecological environment through structural colors and life cycles from Spirulina.

Structure and phycocyanin pigment of the cyanobacteria Spirulina

Information about the chemical structure and formula of phycocyanin:Structure: Phycocyanin is a monomer made up of an alpha (α) and beta (β) polypeptide. The α subunit is connected to a phycocyanobilin and the β subunit is connected to two phycocyanobilins through covalent bonds. Formula: The molecular formula for phycocyanin is $C_{13}H_{11}N_2O$. Phycocyanin is a phycobiliprotein, which is a protein complex that absorbs and transfers specific wavelengths of light. Phycobiliproteins are part of phycobilisomes, which are large light harvesting antennae protein complexes. The shape of phycobilisomes can vary, but in species that lack phycoerythrin, they usually have at least two disks of phycocyanin per rod. Phycocyanin has many practical applications, including in food, cosmetics, pharmaceuticals and biomedical industries. It has antioxidant, anti-inflammatory and anti-aging properties (Fig. 1).

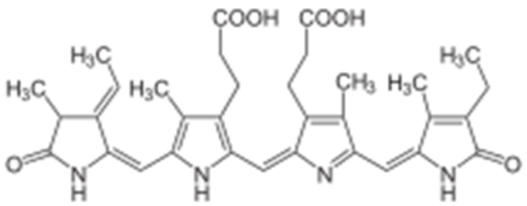

Fig. 1. Chemical structure of phycocyanobilin.

Phycocyanin separation from Spirulina

Phycocyanin is a type of blue pigment protein contained in algae (cyanobacteria (blue-green algae), red algae, cryptoalgae), marine macroalgae: green seaweed. (Ahn MG. 2021).The structural colors of phycocyanin pigments are 1. Blue to white. 2. White to light-orange. 3. Blue to light-brown. Biochemically synthesized phycocyanin pigments store, reflect and absorb color through the refraction of light (Fig. 2).

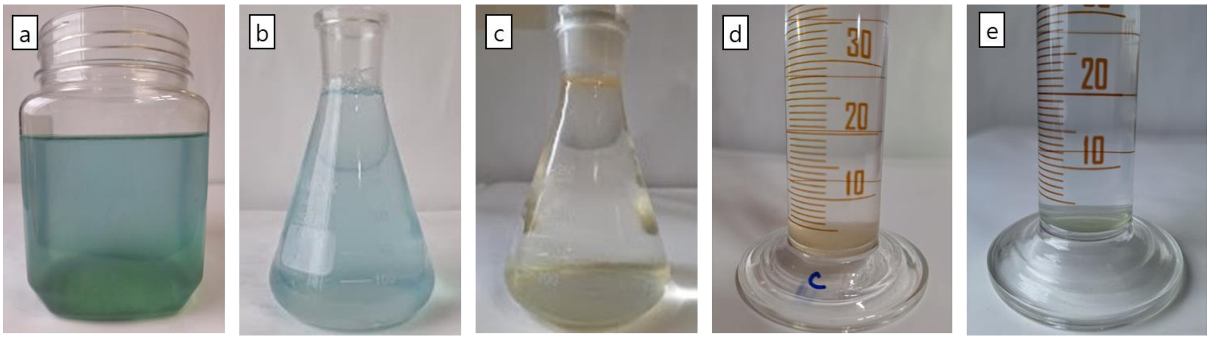

Fig. 2. (a) Bright blue and precipitated green isolated from Spirulina by photosynthetic reaction, **(b)** Bright blue, **(c)** White and brown, **(d)** White and bright orange, **(e)** White appears green due to refraction of light.

After separation of phycocyanin, the green is living

The green appears as white and brown through photosynthesis and then returns to green again (Fig. 3).

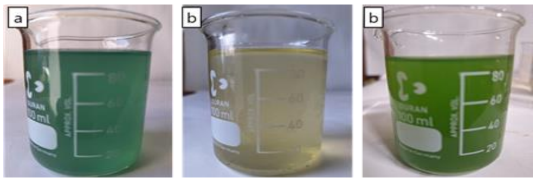

Fig. 3. (a) Green, **(b)** White, brown and **(c)** Green.

When Spirulina is mixed with picocyanin pigment, it transformed green (Fig. 4)

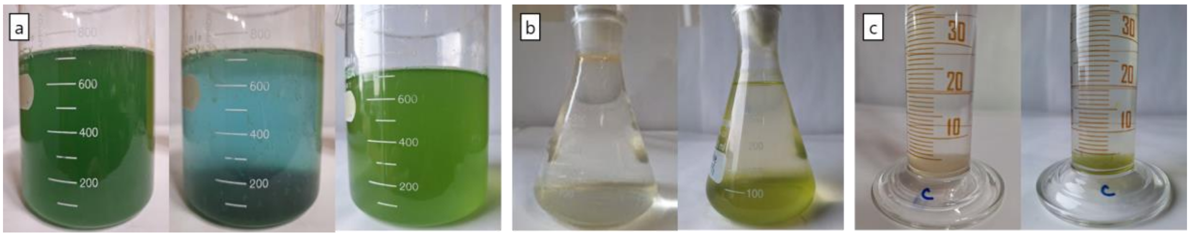

Fig. 4. (a) Spirulina blue-green is separated into blue and green by photosynthesis. When mixed again, it is transformed into green. **(b)** Phycocyanin pigment is transformed from blue to white and brown. When 20 ml of Spirulina liquid is mixed, white and brown are transformed into green. (Erlenmeyer flask: 250 ml) **(c)** Phycocyanin pigment is transformed into white and light-orange.When 7-10 ml of Spirulina liquid is mixed, it is transformed into green.

What is the feature of cyanobacteria Spirulina?

The structural colors of Spirulina transforming physiologically and perform vital activities under the influence of ultraviolet rays and temperature.1. Green to blue-green, 2. Green to bright red (pink), 3. Green to orange, 4. Green to yellow, 5. Green to white,6. Green to brown, 7. Green to white, 8. Green to gray, brown, black and back to green. 9. The bright red (pink) color of Spirulina appears when the cells are colonized. 10. The blue-green of dried Spirulina sometimes appears white when placed in seawater or water and then turns green again (Fig. 5).

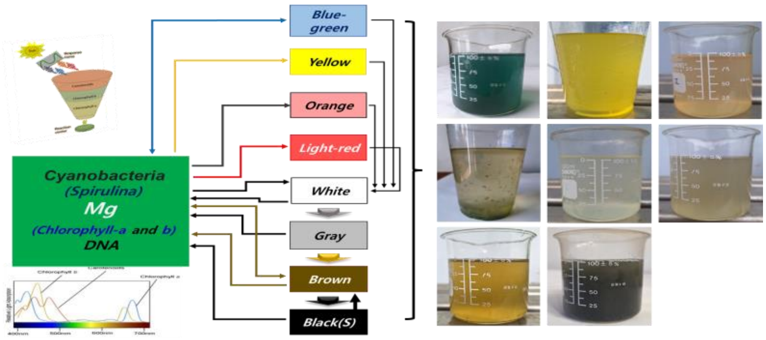

Fig. 5. Photoreaction and signal transformation system in intracellular plastids of photosynthetic Spirulina.

Materials and Methods

We applied dried Spirulina as a food product certified as organic in the United States. USDA: Spirulina: Powder Certified Organic Herbal Supplement. Various blue green algae. www.frontiercoop.com. 2020 Frontier Co-op. Norway, IA 52318 USA . 800-669-3275. S618888. Spirulina is a food product and the drying temperature is generally 40-70 degrees. The dried powder is a product dried by hot air. Spirulina is a biomass of cyanobacteria that can be consumed by humans and animals. There are three species: *Arthrospira platensis*, *A. fusiformis*, *A. maxima* (Fig. 6).

Fig. 6. USDA: Spirulina Powder and A single *Arthrospira platensis* colony Arthrospira Sitzenberger ex Gomont, 1892.

Results and Discussion

Dried Spirulina is alive

Dried Spirulina appears blue-green when placed in seawater or freshwater and is alive. When Spirulina is placed in seawater or freshwater, dormant cells slowly become active and then become very active at a temperature of 30-31 °C. Spirulina transforms from green to white and then turns green again and is alive (Fig. 7).

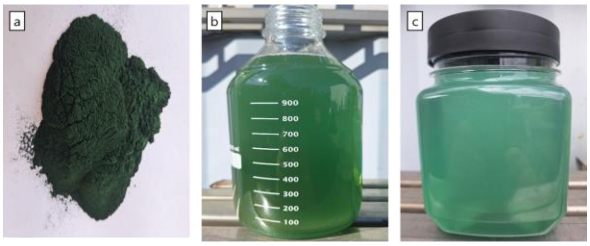

Fig. 7. (a) Powder, **(b)** Seawater: blue-green, **(c)** Water: blue-green.

Spirulina is alive at 85-90 ℃

After adding Spirulina to water and stirring, 80 ℃ water and 100 ℃ water were mixed and it appeared from green to white and then back to green again. The average temperature of the water tested was 85-90 ℃ (Fig. 8).

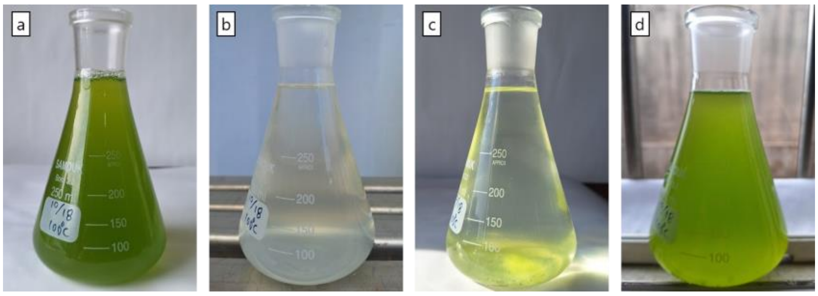

Fig. 8. **(a)** Green, **(b)** White and gray, **(c)** Light-green, **(d)** Green.

The cellulose in dried Spirulina is living cells

Spirulina was de-greened with a sulfuric acid solution at pH 3.5-3.7. It appeared white and brown and then turned green again. The drying temperature of Spirulina is 75-80°C and the Spirulina that appeared from green to white or brown changed back to green (Fig. 9).

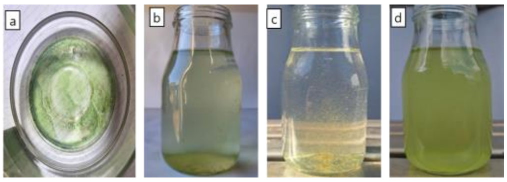

Fig. 9. (a) Green **(b)** Green, white, brown **(c)** White and orange **(d)** Green.

Spirulina living in anaerobic conditions

It can also occur during the process of greenery becoming polluted and emit a foul odor. When under anaerobic conditions, it appears from green to white, gray, brown and black.When under aerobic conditions, it appears again as green (Fig. 10).

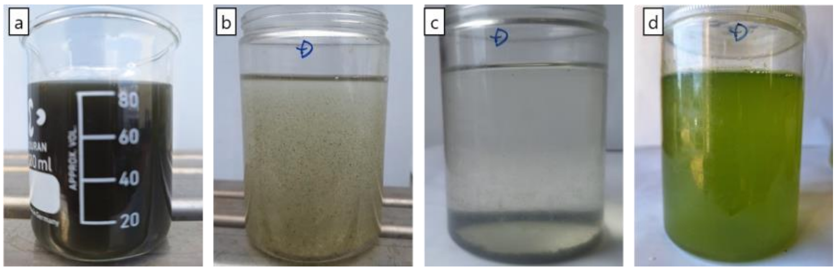

Fig. 10. (a) White, gray, brown, black **(b)** White, gray , brown , black **(c)** White, gray, brown, black **(d)** Green.

Structural colors and pigments of photosynthetic eukaryotic green seaweeds

The color of the cells is determined through a signal transmission system by nine types of genetic information in the mitochondria of green seaweed. (Ahn MG. 2021). The process chromaticity transformation of green seaweed.

1. Green-Blue-Yellow-White-Pink (Orange)-Red–red(Purple)-Brown-Black-Green
2. Green-white-pink-red-purple-brown-black-Green
3. Green-white-pink-red-purple-brown-Green
4. Green-white-pink–red (purple)-Green
5. Green-white-pink-red-Green
6. Green-white-pink-Green
7. Green-white-Green
8. Green seaweed is sometimes changing in chromatic depending on environmental conditions. (Green-brown-Green, Green-brown-white-Green, Green-blue-Green)

9. This is when green seaweed is in the upper layer of seawater. Green-yellow-white-Green. Green-yellow-Green

10. Marine macroalgae: Nine color of Green seaweed (Fig. 11).

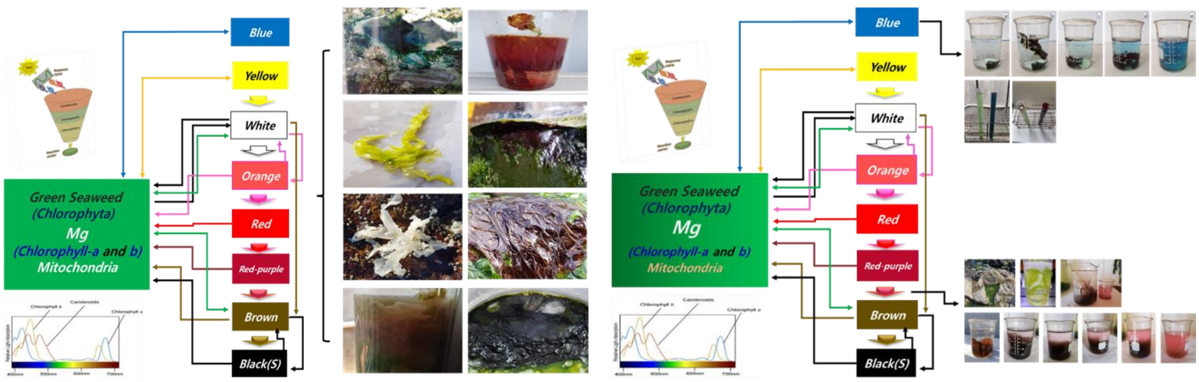

Fig. 11. Schematic diagram of signal transduction and structural colors and chromaticity transformation processes in intracellular chromophores of photosynthetic green seaweed.

Conclusion

There are various materials and hypotheses about the origin of life. The discovery and evidence of new organisms can further advance the understanding of the origin of life.

Acknowledgement

None.

Conflict of Interest

The authors declare no conflict of interest.

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