Functional evaluation of extracellular polymer substance (EPS) produced by cyanobacterium *Arthrospira platensis*

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Cyanobacteria, which manifest oxygen-producing photosynthesis similar to plants, lives in various environments and contributes greatly to maintenance of the global environment. The *Arthrosphira platensis*(commonly known as spirulina) isolated from Chad Lake in Africa has been used as a health food and pigment material. Since spirulina favors high-salt alkalophilic condition, it can be easily cultured in open system.

Extracellular polymeric substances (EPS), secreted from microorganisms, is mainly composed of polysaccharides and proteins. EPS has a role of protecting cells from environmental stress. In addition, EPS attracts attention in the materials industry, because it shows high-viscosity and water retention. Especially, EPS produced by spirulina is called spirulan. Spirulan has been shown to have health functionalities for humans, such as immunomodulatory activity, however there are many unclear points concerning the molecular mechanism of spirulan production.

We have found that spirulina promotes EPS production under the continuous high-light condition. We analyzed the mechanism of the EPS production. pH of the culture increased under the high-light condition with the consumption of bicarbonate from medium. Transcriptome analysis revealed the up-regulation of photosynthetic genes in the high-light condition and they decreased in the long-term cultivation under the high-light. These results indicate that spirulina synthesizes a large amount of sugar and metabolites to consume excess reducing power generated by continuous high-light stress condition. Those are exported and aggregated as EPS. We also analyzed the metabolites in spirulina EPS using CE-TOF-MS. Comparing to the spirulina powder, the amount of the amino acids, nucleic acids significantly increased in EPS, suggesting that spirulina EPS is more valuable as a nutrient source.

Keywords: Cyanobacteria, Spirulina, Extracellular Polymeric Substances

