Extracellular products of blue-green algae

Extracellular products are compounds that are produced within the active cells of algae then excreted from the cell center to the outside through the cell wall. These substances different from the materials produced from the cells after death.

The rate of extracellular substances is dependent on:

1. Physiological and environmental factors that affect the permeability of cell membrane.
2. Concentration of these compounds inside cell and their ability to exit outside the cells.
3. The stage of growth phase, where it is believed that the best growth stage for the production of such substances is the stationary phase.

Effect of the environmental factors on the excretion rate of the extracellular products:

1. Light intensity:

The relationship between the secretion of compounds representative and the intensity of light is a positive correlation to some extent, which may be due to increased permeability of the

cell wall in response to increasing light intensity. The studies referred to some relationship between inhibition of photosynthesis and the proportion of extra-materials in the cases of extreme light intensity.

2. PH:

The low pH values leads to an increasing in the excretion rate of the exctracellular substances by a large number of algae. This may be due to a large proportion of materials being dissolved when the pH values are low.

3. Temperature:

The relationship between the rate secretion of cellular material and the temperatures is a positive correlation, i.e. the increase in the degree of temperature lead to an increase in the rate of excretion and vice versa.

4. Salinity:

Salinity leads to an increasing in the excretions of algae. It was reported also, when transferring cells from high salinity to media with less salinity, the rate of secretion was increased. This is due to high salinity levels that lead to the activation composition of proline, followed by an increase in the secretion of this amino acid.

5. Events mutations:

In some special cases, increase the secretion of various metabolites of the cells that have a mutation occurred, and the reason is the loss of cells to control the metabolic processes within them.

The nature of the extracellular substance by blue-green algae:

The extracellular substance by blue-green algae Include, nitrogen materials (amino acids and peptides), carbohydrates, organic acids, vitamins, growth regulators, antibiotics, enzymes and certain toxic compounds, which include toxins.

Nitrogen compounds

These compounds are present in high amount in blue-green algae which is characterized by its ability to secrete large amounts of them in their surrounding media.

As mentioned before the excretion of the extracellular substances was largest during the stationary phase, and less value to be during the phase of rapid growth (exponential phase).

The secretion of nitrogen contents was depended on the alagal species and some of the environmental factors. The proportion of nitrogenous material secrets reach to 5 to 35% of the

amount of nitrogen under favorable conditions, and up to 80% under unfavorable conditions.

The nitrogen-fixing algae secrete ammonia formed during the N_2-fixing process because the accumulation of ammonia has a toxic effect and the exit of excess ammonia activates heterocyst formation inside the fixer alga.

The amino acids such as glutamine, aspargine are the most nitrogen compounds secreted by blue-green algae, and the secretion of these substances are increased when you move the algae from their media to another new media, and is likely to be the reason for this is a temporary increase in the permeability of the cells.

The nitrogenous material secreted by algae installer of considered as important nitrogen source for some other algae, plants, fungi or bacteria that are symbiotic relationships with soil.

Carbohydrates

A numbers of algae species secrete simple and complex sugars during stationary phase. The secretion of carbohydrates through the algae cell to form the outer mucous sheath or external appendages, or for any other purposes.

Organic acids

Organic acids secreted by many algae and glycosides represent 10% of the total amount of the extracellular material, and the secretion of these materials increased under conditions of lack of CO_2 and thus lack the rate of photosynthesis.

The most common secreted glycosides are glycolic acid in addition to quantities of succinic and lactic acids and other organic acid. The secretion of these glycosides is increased by:

A. High Light intensity

B. Poor concentration of CO_2

C. High pH

Fatty substances

Represent a small percentage of the material secreted by algae and are often in the form of unsaturated fatty acids.

Enzymes

Some algae have the ability to live and grow on some complex substances such as starch and other substances with high molecular weights of carbon and the algae secrete certain enzymes that break down this complex material so that it can benefit from them.

Growth regulators

Some algae secrete some substances within their environments and the role of these materials may be stimulator or inhibitor to the growth of other organisms or may cause inhibition of growth of the algae itself.

Some studies has been discover materials similar to plant hormones (Auxines) leaky produced by a number of blue-green algae such as *Anabaena* and then *Oscellatoria*. Others reported that some unicellular blue greens produce some substances that toxic to bacteria such as toxins.