## BRIEF COMMUNICATIONS

# CARBODHYDRATE COMPOSITION OF A BIOLOGICALLY ACTIVE COMPLEX FROM THE BLUE-GREEN ALGA *Nostoc muscorum*

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At the present time, it has been established that nitrogen-fixing algae can be used effectively in the agricultural industry [1]. The presowing treatment of cotton and rice seeds with algae increases the germinative capacity of the seeds and the length of the shoots by 10-15% and raises the yield of rice by $5\text{-}7\cdot10^2$ and of cotton by $3\text{-}4\cdot10^2$ kg/ha.

However, the question of precisely what substances from blue-green algae stimulate the development of higher plants has so far been studied inadequately.

We have investigated a biologically active complex from the blue-green algae *Nostoc muscorum* and have established the nature of the biological activities of some of its fragments. The cultivation of the algae and the isolation of the complex from the biomass were carried out as described in [2] using gel filtration on Molselekt. The yield of active complex was about 0.1% on the dry biomass.

The results of a study of the chemical composition of the complex by the chromatographic method [3] showed that it contained about 70% of carbohydrates, about 15% of protein, about 5% of lipids, 2.2% of nitrogen, and traces of phosphorus. Consequently, the active complex isolated was a compound of the type of phosphorus-containing glycolipoproteinases (GLPs).

To determine the monosaccharide composition, the carbohydrate fractions of the complex were subjected to complete acid hydrolysis. The hydrolysate was analyzed by paper and gas-liquid chromatography [4]. Rhamnose, xylose, mannose, and glucose were found in a ratio of 1:2.2:3.1:6.5, together with traces of galactose, arabinose, and a uronic acid. A change in the conditions of cultivation of the blue-green algae did not affect the qualitative composition of the carbohydrates, but the amounts of the individual monosaccharides changed somewhat. Of the monosaccharides identified, glucose and xylose predominated.

To investigate growth-stimulating activity under laboratory conditions on the germination capacity of seeds of a cotton plant of the Tashkent-1 variety, we used 0.01 and 0.001% solutions of the preparations. The cotton seeds were steeped in these preparations for 24 h and were then packed in moist filter paper and left in a thermostatted room for 2-3 days for

TABLE 1. Influence of the Complex and its Fragments (carbohydrate fraction in a concentration of 0.01%) on the Growth and Development of a Cotton Plant of the Tashkent-1 Variety

| Variant | Germination, % | Mean length of the shoots, cm | |
|---|---|---|---|
| | on the 3rd day | on the 5th day | on the 8th day |
| The complex (GLP) | 95±0.5 | 10.0±3,0 | 22.0±1,0 |
| The carbohydrate fraction | 98±1,0 | 12,0±2,0 | 25,0±0,5 |
| Control (water) | 84±0.5 | 9±2,5 | 19,0±1,0 |

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appearance of a rootlet. The activities of the substances tested were determined from the extent of growth. Control cotton seeds were kept in water. The trial showed that the greatest biological activity on germinative capacity (98%) and the growth of the plant was possessed by the carbohydrate fraction, the effects of the complex itself (95%) and of the control (84%) being smaller (Table 1). The length of the rootlet on the 8th day of growth of seeds that has been moistened in the carbohydrate fraction reached 25 cm, while it was 22 cm for the initial complex and 19.0 cm for the control. Shoots of the cotton seeds that had been treated with the carbohydrate fraction and with the complex (GLP) developed faster than the controls and subsequently had a more powerful root system — lateral rootlets appeared in them earlier than in the control specimens and in larger amount.

It must be mentioned that the preparations in a concentration of 0.01% gave a better stimulating effect than in a concentration of 0.001%.

Thus, a biologically active glycoliproprotein complex has been isolated for the first time from a culture of the blue-green algae of *N. muscorum* and its chemical composition has been studied. It has been shown that the growth-stimulating activity of the glycolipoprotein complex is probably connected with the carbohydrate fraction.

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## DETECTION OF BACTERIAL LIPOPOLYSACCHARIDES BY A GEL-FORMING REACTION

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Bacterial lipopolysaccharides, which are a component part of the outer membrane of the cell wall of Gram-negative microorganisms, possess a broad spectrum of biological action. It is known that on the intravenous administration of drugs contaminated with bacterial pyrogens (in their chemical structure, pyrogens are lipopolysaccharides) serious complications are possible, the most characteristic of which is a rise in the body temperature. In view of this, the pharmacopoeias of the majority of countries provide for the performance of tests for pyrogenicity by a biological method on rabbits. This method has a number of serious disadvantages and, moreover, it is unsuitable for practical use in pharmaceutical enterprises. Among other methods of detecting bacterial pyrogens, the Limulus test, which is based on a gel-forming reaction of lysed amebic cells of the crab *Limulus polyphemus* with pyrogens has come into wide use. Without touching on the question of the advantages and disadvantages of this method, we may note only that the species of crab required for the analysis is absent from the fauna of our country. The development of more modern methods of detecting bacterial pyrogens remains an urgent task.

The capacity of Gram-negative marine microorganisms for forming a gel has been reported in the literature [1]. It is known that lipopolysaccharides are located in the surface layer of the cell coat of bacteria, occupy a considerable part of its surface, and largely determine the physicochemical properties of bacteria and the nature of their interaction with the environment. We therefore suggested a possible participation of lipopolysaccharides in the formation of the gel.

Six lipopolysaccharides, isolated from *E. coli* 0111, *E. coli* 055, *S. typhi*, *S. paratyphi* 0901, *Bact. prodigosum*, and *Ps. aeruginosa* (a mixture of serotypes 0.2; 0.25; and 0.5) were investigated. These lipopolysaccharides were supplied by the I. M. Mechnikov Moscow

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