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Humic Acids of Low Peat and Brown Coal of Transbaikal (Russia)

D. B. Andreeva, G. D. Chimitdorzhieva

Institute of General and Experimental Biology,Siberian Division, Russian Academy of Sciences, ul. M. Sakh'yanovoi 6, Ulan-Ude,670047 Buryat Republic, Russia (andreevad06@rambler.ru)

By now, a large body of experimental data about characteristics of humine substances (HSs) of soil has been accumulated in the literature. Although little is known about humine substances of nonsoil origin isolated from peat, brown coal, sapropel, bottom sediments, etc., information about these substances is important both for the general theory of humification and for practical use of these substances in medicine, agriculture, industry, etc. The objects of this study were chosen based on the fact that local raw materials of various types (e. g., low peat and brown coal) serve as sources of biologically active humic acids, which can be used for plant growing. It should be noted that local raw materials might have different age and formation conditions.

The goals of this work was to study the composition and properties of preparations of humic acids (HAs) isolated from low peat and brown coal samples formed in different geological epochs and to assess the possibility of the use of this information for monitoring the properties of HAs as biological stimulators of plant growth.

The elemental composition of humic acids reflects the conditions of their formation. The content of carbon in HAs of peat and coal was 50.5 and 56.5%, respectively. The carbon content in peat HAs was lower than in coal HAs, whereas the contents of hydrogen, nitrogen, and oxygen in peat HAs (4.6, 2.7, and 42.3%, respectively) were higher than in coal HAs. A low content of nitrogen (0.7%) and a high content of carbon are specific features of coal HAs.

The degree of benzoidicity reaches its minimum (5%) and maximum (30%) level in peat and coal HAs, respectively.

Infrared spectroscopy provides evidence that the most distinctly pronounced bands in the absorption spectra of coal and peat HAs are due to aromatic carbon and the carbon of the aliphatic series, respectively. The conclusion on a low content of aromatic structures in peat HA molecules is also supported by the results of 13 C-NMR spectrometry, which reveals three low-amplitude peaks of the arbon signal at 117 and 128 ppm in hydrogen- and carbon-substituted zones, as well as nitrogen- and oxygen-substituted aromatic atoms.

An aromatic carbon signal with two structural peaks at 115 ppm and a strong peak at 127 ppm was found to be dominant in the NMR spectra of coal HAs. A slightly decreased content of oxygen- and nitrogensubstituted aryl groups is reflected in lower amplitudes of peaks at 163 ppm compared to peat.

Because of the high degree of benzoidicity, the rate of coal HP hydrolysis is relatively low (11.3%). The rate of acid hydrolysis of weakly condensed peat Has is slightly higher (34.2%). In ccordance with the rate of HP hydrolysis, the gross amino acid content in peat HAs was much higher than in coal HAs (251.39 and 32.15 mol/g, respectively). Therefore, it may be concluded that the highest physiological activity is inherent in peat HPs.

The structure of HAs from low peat and brown coal suggests that these compounds are stable and have a common nature. It may also be concluded that the “natural status” of this system of substances has been conserved during the long history of their development. The results of comparative analysis of the peat and coal HS structure obtained by various modern analytical methods showed that the inert core structure of coal HAs is resistant to biodegradation.