

ABSORPTION AND FLUORESCENCE PROXIES TO CHARACTERISE HUMIC ACIDS ISOLATED FROM ORGANIC MATTER OF DIFFERENT ORIGIN

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Humic substances are natural organic compounds, formed during the transformation of dead biomass in natural environments: soils, peat, fossils (lignite), bottom sediments, natural waters and organic wastes. They are organic polymers of irregular structure, and their chemical and physical properties, as well as biological activity depend on composition of biomass and conditions of humification. Commercial humic products (HPs) manufactured from various humic resources are being increasingly used in agriculture and environmental technologies. The key factor influencing their chemical properties and biological activity is the organic matter genesis; therefore there is a need for diagnostic criteria for distinguishing between their organic matter sources. The objective of this study was to determine indicators using absorption and fluorescence spectroscopy in combination with derivative spectroscopy that might serve as advanced, fast and relatively inexpensive tools to compare HPs from various environments as bulk materials and their humic acids (HA) fractions.

HA fractions were isolated from Chernozem and commercially available humates industrially manufactured from a number of raw source materials: fossils materials (brown coal and leonardite), peat, lake bottom sediment, organic waste material (lignosulphonate); and analyzed using chemical, fluorescence and UV-vis measurements. Elemental composition and ash content were determined. "Blue shift" of fluorescence band was defined using excitation at 310 and 270 nm or 355 and 310 nm. From UV-Vis absorption spectra the following indexes have been calculated: specific absorbances normalized by the HA content, absorbance ratios E2:E3, E4:E6, $E_{270/400}$, $E_{280/472}$, $E_{280/664}$, $\Delta \log K$ and the slope ratio Sr. In addition we suggested new indexes: the ratio of amplitudes in the first-order (FDR_{280/240}) and in the second-order derivative spectrum (SDR_{267/280}).

Absorption spectra of HA isolated from HPs varying in organic matter origin demonstrated similar wavelength-dependent character (1). However for some HA samples weak maxima were observed in the derivative spectra with enhanced spectral resolution positioned around 230 and 280 nm, most probably due to presence of low molecular weight phenolic compounds, products of lignin decomposition. On average in HA isolated from peat- and lignosulphonate-derived HPs fluorescence maximum was accounted at shorter wavelengths than for HA from coal- and sapropel-derived HPs. Under excitation at 310 nm some peat-originated samples and lignosulphonate manifested significant "blue shift" of emission band. In contrast HA from coal- and sapropel-derived HPs, as well as soil HA exhibited practically constant fluorescence band position or a small shift to longer wavelengths.

We conclude that information extracted from absorption and fluorescence spectra can be useful to discriminate organic matter source for HPs from coalified materials, peat and lignosulphobate. Indices with the highest descriptive ability, showed strong loadings in principal component analysis, are specific absorbance SUVA₂₅₄, absorbance ratios $E_{270/400}$, $E_{280/472}$, derivative indices FDR_{280/240} and SDR_{267/280}, wavelength of fluorescence maximum and the presence of a "blue shift".

REFERENCES

1. Gosteva O Y, A Alzosimov, S V Patsaeva, V I Yuzhakov & O S Yakimenko, 2012. Fluorescence of aqueous solutions of commercial humic products. *Journal of Applied Spectroscopy*, 78(6): 884-891