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Problems of Soil Organic Matter Studying

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Abstract

The components of soil organic matter (SOM) are briefly described: humic substances (HS), melanins, lipids, pigments, hydrophobins, glomalin and kerogen. In the traditional assessment of SOM composition quality, all these listed substances and products of hydrolytic destruction of particulate organic matter are dissolved in alkaline solution. It is suggested to work out a new method based on affinity of SOM different components to various organic solvents and allowing separation off HS and melanins from glomalin and hydrophobins.

Keywords: Soil Organic Matter; Humic Substances; Melanins; Glomalin; Hydrophobins, Lipids; Kerogen; Particulate Organic Matter

Mini Review

Soil organic matter is a complex of individual compounds and humic substances (HS), as well as products of interaction between themselves and the mineral part of the soil [1]. At present, a lot of organic compounds as lipids, pigments (for example, tetrapyrroles and related compounds, and carotenoids), hydrophobins, glomalin and kerogen have been identified in the composition of SOM excluding HS and melanins. Humic substances are dark-colored natural amphiphilic organic nitrogen-containing randomized redox heteropolymers of the aryl glycoprotein composition. They, like colloidal disperse systems, can form not only a tertiary, but also a quaternary structure [2]. Melanins are macromolecular dark-colored pigments that are formed during the life of fungi, actinomycetes and bacteria found in soils [3-7]. These pigments, being complex heteropolymers, differ both in the set of monomeric units and in the types of bonds [4].

Lipids are a group of natural compounds, united by a common property, their practical insolubility in water and good solubility in organic solvents. In the composition of soil lipids, in addition to free fatty acids, their triglycerides, waxes can enter into small amounts and other substances entering the soil from living organisms, the latter include resin acids, pigments, and so on [3,8]. Pigments are a group of colored soil biogenic substances that transform into alcohol-benzene extracts, which include oxyanthraquinones and related substances, tetrapyrroles and related compounds, carotenoids and some others [8-10]. In soils, there is some reserve of tetrapyrroles, which can be reversibly fixed and preserved without destruction [3,11].

Hydrophobins are small (7-9 kDa) amphiphilic proteins, found exclusively in mycelial fungi and consisting of approximately 100 ± 25 amino acid residues. The structure of hydrophobins is represented by two structural domains, each of which contains four cysteine residues involved in the formation of intramolecular disulfide bridges [12,13]. Glomalin is a natural glycoprotein hydrophobic compound of red color, characterized by immunoreaction properties, it capable of binding iron. It has many similarities with other biomolecules, such as hydrophobins and HS [14,15]. Kerogen is a part of the dispersed organic matter of sedimentary rocks (low conversion stages), the association of heterogeneous detrital and finely dispersed organic remains, largely transformed under anaerobic conditions. Insoluble in organic solvents, but soluble in alkaline solutions [16].

Particulate organic matter is a fraction of SOM ranging in size from 0,053 to 2 mm [17], it is isolated by sieving. Particulate organic matter includes partially decomposed soil detritus and plant material, pollen and other materials [18]. In the practice of Russian soil scientists, the assessment of the SOM qualitative composition is based on the determination of the so-called humus state [19,20]. The humus state is characterized on the alkaline extraction and fractionation of so-called humus acids (humic, fulvic and hymatomelic acids). However, such a system for assessing the SOM qualitative composition is not satisfactory. The lipids, pigments, hydrophobins, glomalin, and kerogen are transferred to the alkaline extract besides HS and melanins. In addition, as a result of hydrolytic degradation, detritus components and particulate organic matter pass into the liquid phase of the alkaline solution (Figure 1).

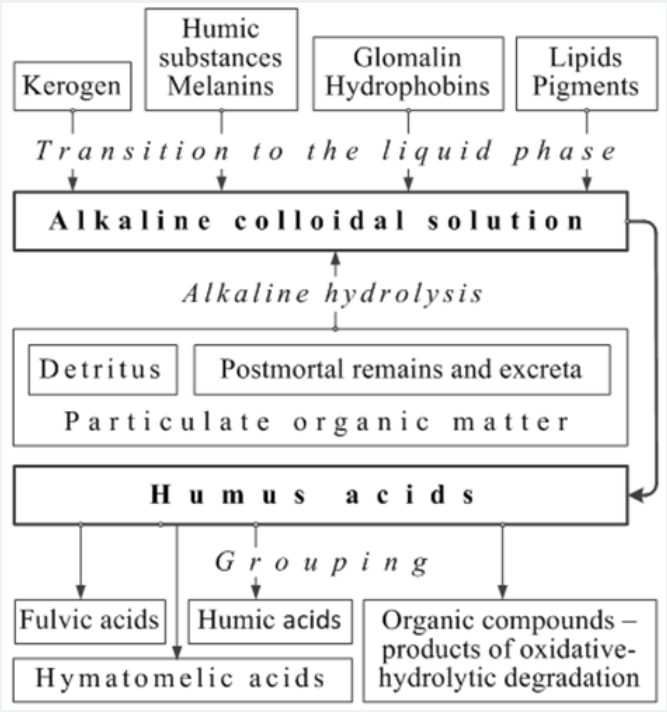

Figure 1: The transition to alkaline solution of soil organic matter components and grouping of humus acids.

In our opinion, the only solution for studying the SOM qualitative composition is the development of a relatively simple and adequate analysis that allows separation of HS and melanins from glomalin, hydrophobins, lipids, kerogen and oxidation-hydrolytic degradation products. Such, obviously, will be a method based on the affinity of the SOM components to certain organic solvents. And most importantly, we need to revise the methodology for extracting HS and other SOM components.

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