Evidence of the Microbiological Origin of Uronides in the Soil

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Uronic acids may be defined as reducing monocarboxylic sugar acids formed by the oxidation of the terminal carbinol group (C atom 6) of the sugar. Polyuronides are polysaccharides that contain one or more uronic acid groups. Both pentose and hexose groups may be present as component parts of polyuronides. Uronic acid units are found widespread in nature. All plants contain polyuronides in the form of encrusting hemicelluloses and pectins. Polyuronide gums and mucilages may also be found in plants. Uronides have been found associated with the mucoids in the digestive and absorbing membranes of animal intestines (4). Considerable work has been done on utilization, excretion, and function of uronic acids in animal physiology (2, 7).

Bacterial uronides seem to be associated with the gelatinous coating surrounding the cells. This gelatinous sheath probably functions to protect the cell from a hostile environment as well as in selective absorption in cell feeding. Fungi are also capable of producing uronic substances.

Uronic acid residues have been reported to constitute a considerable part of soil organic matter. Evidence for their existence in soil is based on the evolution of carbon dioxide upon boiling with 12% hydrochloric acid, a method first elucidated by Lefèvre and Tollens (3). Uronic derivatives have not been isolated or identified from soil, nor has the nature of their association or linkage to other constituents been worked out.

One-tenth to one-third of the soil organic carbon has been reported by various investigators (6, 8, 9) to be uronic. If these figures represent true uronic carbon, an investigation into the nature of soil organic matter must include a study of the soil uronides before a proper evaluation of soil organic matter can be reported. The origin of uronides in soils is still a matter of speculation. Uronic substances are supplied to the soil mainly by plants and microorganisms. Inasmuch as plant polyuronides are readily available to biological attack, it is difficult to believe that they can accumulate to any appreciable extent in soils. It appears quite likely that apparent soil uronic units originate as products of soil microorganisms. Perhaps, as Norman and Bartholomew (6) have suggested, uronides in soils may be stabilized somewhat by “association or combination with some other organic or inorganic groupings just as nitrogen appears to be stabilized to give a resistant complex”.

The quantitative liberation of carbon dioxide from uronic units by boiling in 12% hydrochloric acid has been worked out. The quantitative liberation of carbon dioxide from uronic units by boiling in 12% hydrochloric acid has been worked out. The quantitative liberation of carbon dioxide from uronic units by boiling in 12% hydrochloric acid has been worked out. The quantitative liberation of carbon dioxide from uronic units by boiling in 12% hydrochloric acid has been worked out. The quantitative liberation of carbon dioxide from uronic units by boiling in 12% hydrochloric acid has been worked out. The quantitative liberation of carbon dioxide from uronic units by boiling in 12% hydrochloric acid has been worked out.

MATERIALS AND METHODS

Miami silt loam (0 to 8 inches, 2859260, and 18 to 28 inches, 2859262) was obtained from St. Joseph County, Ind., and the kelgum and mesquite gum were purchased from the Kelco Company, Brookland, N. Y., and the Martin Drug Company, Brookland, N. Y., respectively. The lemon pectin came from Van Landin Bain Field, Belle Glade, Fla.

The rye grass was sampled when the heads were beginning to emerge, the clover and alfalfa were cut at flowering stage, whereas the wheat straw was collected after threshing. The oak leaves were picked from Beltsville, Md., during the first part of October. All the plant materials were air dried before grinding in a Wiley mill using a fine-mesh screen.

Alfalfa was composted in bottles for 5, 10, 20, and 30 days with enough water to keep the material wet, but not saturated. The comports were dried at 90°C after incubation and ground in a Wiley mill before analyses were made for uronic carbon.

Since there is some evidence that oven drying influences the yield of uronic carbon, air-dry samples, except for the comports, were used in the uronic determination. All analyses were made on separate samples.

Polyuronide gums from pure culture of Sporomyces myxococoides and Rhizobium trifolium were prepared aerating inoculated liquid mineral nutrient solution containing finely ground filter paper as a carbon source, then sonically treated and sucrose for the latter organism. Aerating, sterilized air was continued until a maximum amount of gum was produced. The crude cytophaga gum was separated from the undecomposed cellulose fibers by filtering through finely ground filter paper as a carbon source for the former organism. After incubation and ground in a Wiley mill before analyses were made for uronic carbon.

Cyanobacteria are used in the uronic determination. All analyses were made on separate samples.