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RESEARCH ARTICLE

Extraction of humic acid from biological matrix – dry cow dung powder

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The increased local and global concern, for alarming environmental pollution, offers incentives to explore new green and clean materials and methods for safeguarding the environment. The generation of benign alternate routes for any step in chemical processes, is the need for today and tomorrow. In the present work, humic acid (HA) has been extracted from a green source, ''dry cow dung powder'', using simple, cost effective, and eco-friendly methods. HA has been extracted, isolated, and characterized by employing different spectroscopic methods. The process investigated herein imparts a boost to ''Green Chemistry'' a promising solution to many global environmental problems.

Keywords: humic acid; dry cow dung powder; green chemistry

Introduction

Humic acid (HA) is the fraction of humic substance (HS) which is insoluble in water under acidic condition (pH <2) and is a polydisperse macromolecule comprising of amino acids, amino sugars, peptides and aliphatic compounds etc. HS are made up of HA, fulvic acid (FA), and other organic residues. Most of the data on HA, FA, and humins refers to the average properties and structure of a large assembly of components of diverse structure and molecular weight. HA is documented to interact with over 50 elements (*1*) from the Periodic Table, carcinogenic moieties, nutrients, radionuclides, toxic metals, and anthropogenic compounds.

Hence, it is employed in varied facets in veterinary medicine, in agriculture, industries, environment, and even in medicine. HA is known to play a vital role as a chemotherapeutic agent and exhibits anti-viral, anti-microbial, anti-inflammatory, and anti-coagulant properties (*2*). A derivative of HA has potent HIV-1 (*3*) and Herpes inhibiting properties.

The structure of HA is shown in Figure 1. It forms aggregates of elongated bundles of fibers at a low pH and an open and flexible structure perforated by voids at a high pH. The voids can trap and adsorb both organic and inorganic entities if the charges are complementary. This inherent property imparts to HA the characteristics of a natural adsorbent. HA sequesters anthropogenic organic compounds, photosensitizes chemical reactions, and complexes with heavy metals as well as with carcinogens.

HA originates mostly in the abiotic niche of the lithosphere and hydrosphere due to the humification of biodegradable entities. Humification is highly sensitive to pH, temperature, and climatic conditions. Hence, some degrees of differences are observed in the physical and structural properties of HA, if geographical origin differs. Deep lithosphere-based HA (*4*) (Lignite) contains low rank coal which is undesirable and performs poorly as a growth stimulator. Surface lithosphere-based HA (Leonardite) contains contaminants such as clay, shale, silica, gypsum, and other anthropogenic pollutants. Hydrosphere-based HA (*5*) (Marine or River) contains a very low percentage of HA, abundant undesirable micro flora, and water pollutants. In addition, the pre and post-process for the concentration of the raw material is time consuming and requires a higher degree of purification. This leads to the generation of many undesirable chemical steps, adding to the cost of the actual extraction process as well as questioning the statutory norms for environmental safety.

In the present work, we have achieved the green process for the extraction of HA, from the biological matrix of dry cow dung powder following the principles of green chemistry (*6*). The process is cost and energy efficient due to renewable and freely available feed stock, simple reagents used at room temperature and ambient pressure. In addition, a catalyst or auxiliary substance of any kind is not applied throughout the process. The dry cow dung powder is a bio-organic, polymorphic fecal residue of

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