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Editorial

Sustainable Utilization of Humic Substances and Organic Waste in Green Agriculture

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Organic wastes (OW) comprise biodegradable plant, animal, and industrial and municipal waste; billions of tons are generated annually worldwide, and they are continuously produced as a result of prosperity, the increase in population, and the escalation of anthropogenic activities. Conventional indiscriminate dumping and burning dissipate the energy content of OW, creating soil and water pollution and posing threats to the environment and human health. Waste management processes mostly include reduction, reuse, and recycling, as well as physical, biological, and chemical treatments (e.g., composting). During composting, the transformation of organic matter into nutrient-rich humus is mainly achieved by microorganisms; amended OW are rich in humic substances (HS) and extremely beneficial to plant growth and soil fertility. Humic substances—omnipresent in terrestrial and aquatic ecosystems, representing a major source of organic carbon and nitrogen—are redox-active, refractory, dark-colored mixtures of heterogeneous organic compounds produced via physicochemical and microbial processes during the early diagenesis in biomass decay [1].

On this basis, recycling and the subsequent reutilization of OW appear as a benignant and ecologically sound route, contributing to both sustainability and circular economy objectives. Besides nutrient preservation, OW recycling strategies support energy conservation, as electricity and bio-based energy carriers (e.g., biogas and biohydrogen) can be produced.

The sustainable utilization of humic substances and organic waste is particularly advantageous in green agriculture; processed OW may serve as soil conditioners and nutrient pools for plants. Together with HS, they affect plant metabolism; regulate nutrient availability and transport, reducing the need and side effects of chemical fertilizers; support microbial growth; enable pollutants sequestration; and improve the physicochemical properties of degraded soils (e.g., increase pH, improve water retention and cation exchange capacities, and ameliorate bulk density). Thus, they assist in soil restoration and remediation and sustainable plant growth.

The *Agriculture* Journal Special Issue "**Sustainable Utilization of Humic Substances and Organic Waste in Green Agriculture**" focuses on the green production processes, properties, and uses of HS and OW; the interaction/complexation of HS with compounds promoting sustainable agriculture; the impact of HS, HS-containing materials, and organic waste on the environment (soil, plants, and living organisms, domestic animals and cattle included); OW from industrial processes (e.g., molasses, cheese whey, slaughterhouse, leather); physical, chemical, and biological OW treatments and recycling (e.g., retention, adsorption, composting, and decomposer microorganisms) that support green agriculture; and the management of pollutants [2] (e.g., chemicals, pharmaceuticals, drugs, dyes, pesticides, and food additives) that accompany OW.

In the review article "Biostimulant Effects of Waste Derived Biobased Products in the Cultivation of Ornamental and Food Plants", E. Montoneri, A. Baglieri, and G. Fascella describe the application of soluble bio-based substances (SBS), derived from composts and urban waste anaerobic digestate, as sustainable and efficient biostimulants in ornamental and vegetable species. A wide variety of SBS tailored for the cultivation of specific plants may assist plant growth, fruits, and ornamental qualities, and they can be used as alternatives to existing fossil-sourced agrochemicals [3].

The article entitled "Advances in Applications of Cereal Crop Residues in Green Concrete Technology for Environmental Sustainability: A Review" by M. A. Suhail, S. Shrivastava, K. Paritosh, N. Pareek, A. A. Kovalev, D. A. Kovalev, Y. V. Litti, V. Panchenko, V. Bolshev, and V. Vivekanand [4] presents the potential use of waste agricultural residues (with significant mechanical properties) from cereal farming in green concrete manufacturing as partial substitutes for cement, sand, coarse aggregates, and fiber reinforcements. The appropriate methods of treatment, selection, and blending ratios of cereal waste resources, as well as innovations in cereal farming residues that allow their potential use in the green construction industry, which are all compatible with circular bioeconomy strategies, are discussed.

In their article "Taif's Rose (*Rosa damascene* Mill var. *trigentipetala*) Wastes Are a Potential Candidate for Heavy Metals Remediation from Agricultural Soil", T. M. Galal, A. Majrashi, H. M. Al-Yasi, E. A. Farahat, E. M. Eid, and E. F. Ali examine the bioaccumulation of heavy metals in Taif rose shrubs [5]. With the exception of Al, plant stems retained higher quantities of all heavy metals studied than leaves; Co and Ni were mostly contained in the stems of 10- and 12-year-old plants, while Cd, Cr, Cu, Fe, Mn, Pb, and Zn accumulated in older Taif's rose shrubs stems, demonstrating the possibility of using Taif roses as a promising, viable, and safe crop for heavy-metal phytoremediation.

A biochar-based fertilizer (BF) was prepared from distillers grains via oxygen-limited cracking [6]. The application of BF in eggplant cultivations positively affected the yield and quality of fruits, reduced fertilizer utilization, and proved to be economically profitable to farmers as "Biochar-Based Fertilizer Enhances the Production Capacity and Economic Benefit of Open-Field Eggplant in the Karst Region of Southwest China" (M. Zhang, Y. Liu, Q. Wei, L. Liu, X. Gu, and J. Gou). Specifically, these eggplants exhibited higher nutrient uptake and their fruits possessed lower nitrate content and elevated vitamin C and soluble sugars, which are all beneficial for eggplant quality.

The Taif Damask rose's pruning waste from plants of different ages is discussed in "Evaluating the Nutrient Contents and Nutritive Value of Taif's Rose (*Rosa damascene* Mill var. *trigintipetala*) Waste to Be Used as Animal Forage or Soil Organic Fertilizers", authored by T. M. Galal, E. F. Ali, E. M. Eid, H. M. Al-Yasi, A. Magrashi, F. Althobaiti, and E. A. Farahat [7]. The morphological characteristics, the N, P, K, Ca, Mg, Na, and ash contents in the stems and leaves, and parameters associated with the nutritional value of the wastes, i.e., fibers, lipids, carbohydrates, and energy, were measured to demonstrate the inorganic and organic nutrients' abundance, which is useful for the potential application of Taif's rose waste as a fertilizer and/or animal forage.

The topic of the article by M. Lanno, M. Klavins, O. Purmalis, M. Shanskiy, A. Kisand, and M. Kriipsalu is the "Properties of Humic Substances in Composts Comprised of Different Organic Source Material". FTIR and EEM spectroscopic techniques were employed to observe the effect of the compost's origin on humic substance contents; the composts containing animal byproducts proved to be richer in humic substances compared to those from kitchen biowaste. Besides organic matter and nutrient contents, the role of humic substances in the comprehensive evaluation of composts is emphasized, especially when the composts are intended for fertilizing applications [8].

Taif Damask rose organs and floral solid distillation waste (SDW) were examined for their chemical composition and biological functions in "Chemical and Nutritional Characterization of the Different Organs of Taif's Rose (*Rosa damascene* Mill. var. *trigintipetala*) and Possible Recycling of the Solid Distillation Wastes in Taif City, Saudi Arabia" by E.F. Ali, H.M. Al-Yasi, A. Majrashi, E.A. Farahat, E.M. Eid, and T.M. Galal [9]. Soluble carbohydrates, cardiac glycosides, total flavonoid contents, and total phenolic compounds were determined, as well as mineral and organic nutrients, nutritional value, and antimicrobial activity toward bacteria and fungi. Both organs and SDW seem to be suitable for mature dry gestating beef cows and health applications.

Animal byproducts can be used for growing media preparation, as reported by R. Li, H. Wang, E. Duan, J. Fan, and L. Wang in their article "Rabbit Manure Compost for Seedling Nursery Blocks: Suitability and Optimization of the Manufacturing Production Process". Nursery blocks obtained by mixing rabbit manure compost, vermiculite, rice straw, and peat were found to improve the transplanting efficiency and survival rate of seedlings. The effect of cold pressing parameters on block quality was also examined. Thus, eco-friendly resource recycling management with respect to rabbit manure is achieved [10].

"Deteriorating Harmful Effects of Drought in Cucumber by Spraying Glycinebetaine" by E.-S.E. Metwaly, H.M. Al-Yasi, E.F. Ali, H.A. Farouk, and S. Farouk proposes the use of glycinebetaine (GlyBet), a vital osmoprotectant produced in crops, to improve drought tolerance in non-accumulating plants, such as cucumbers, by enhancing their water use efficiency [11]. GlyBet could act as a cost-effective and eco-friendly biostimulant, and exogenous spraying demonstrated a beneficial effect on moderating water deficit damage on plant growth and productivity.

J.L. Villalpando-Aguilar, D.F. Chi-Maas, I. López-Rosas, V.Á. Aquino-Luna, J. Arreola-Enríquez, J.C. Alcudia-Pérez, G. Matos-Pech, R.C. Gómez-García, J.F. Martínez-Puc, and W. Cetzal-Ix suggest the development of sustainable alternatives for edible fruit production in "Urban Agriculture as an Alternative for the Sustainable Production of Maize and Peanut". In this context, maize and peanut plants—cultivated in compost originating from organic residues irrigated with temporary rain—exhibited higher yields compared with plants grown in soil and compost [12].

"Sustainable Utilization Strategy of Organic Waste via Fabrication of Bioelastomer with Antibacterial and Antioxidant Activities Using Mandarin Peel Extracts" by K.H. Lee, Y. Chun, J.H. Lee, J.U. Lee, T. Lee, and H.Y. Yoo [13] aims to incorporate bioactive compounds recovered from mandarin peels into a functional bioelastomer without affecting its physical properties. The bioelastomer displayed radical scavenging activity and antibacterial properties against Gram-positive, Gram-negative, and antibiotic-resistant bacteria, and it is expected to be utilized in the food packaging, pharmaceutical, and medical industries, thus upcycling food waste.

The need for chemical fertilizers substitutes is imminent; in "Response of Maize Yield and Nutrient Uptake to Indigenous Organic Fertilizer from Corn Cobs" by M.T.S. Budiastuti, D. Purnomo, B. Pujiasmanto, and D. Setyaningrum, an organic fertilizer prepared from corn cob waste was applied to suboptimal land to increase the harvested corn area [14]. The prepared corncob fertilizer meets the standards for organic fertilizers, positively affects leaf area and root length, and increases chlorophyll a and b and phosphate uptake, supporting the growth, yield, and nutrient uptake of corn plants.

Another organic fertilizer for corn plants was synthesized from the anaerobic digestion of swine wastewater and tested as a nitrogen substitute in comparison with the conventional chemical treatment. The results of the article "Fertilizer Performance of a Digestate from Swine Wastewater as Synthetic Nitrogen Substitute in Maize Cultivation: Physiological Growth and Yield Responses" by E.L. Buligon, L.A.M. Costa, J. de Lucas, Jr., F.T. Santos, P. Goufo, and M.S.S.M. Costa [15] show that the basal application of this liquid biofertilizer completely substituted the mineral nitrogen in corn plants, allowing the minimization of chemical fertilizers without yield penalties.

"The Effect of Dietary Humic Substances on Cellular Immunity and Blood Characteristics in Piglets" was studied by L. Bujňák, A.H. Šamudovská, D. Mudroňová, P. Nad', S. Marcinčák, I. Maskaľová, M. Harčárová, V. Karaffová, and M. Bartkovský [16]. Natural humic substance supplementation increased the proportion of CD4 + CD8- lymphocytes and serum alkaline phosphatase; the phagocytic activity and engulfing capacity of phagocytes and other lymphocyte subpopulations were slightly increased. These observations demonstrate that humic substances stimulate cellular immunity in piglets without negatively affecting their hematological and biochemical parameters.

I would like to express my deepest appreciation to all authors who selected this Special Issue in which to publish their fine papers.

All these articles summarize scientific progress and imprint recent developments in the field. Therefore, I believe that this Special Issue will meet the needs of researchers who focus on humic substances and organic waste valorization without foreclosing the needs and options of the broad readership devoted to sustainability.

Conflicts of Interest: The author declares no conflicts of interest.

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