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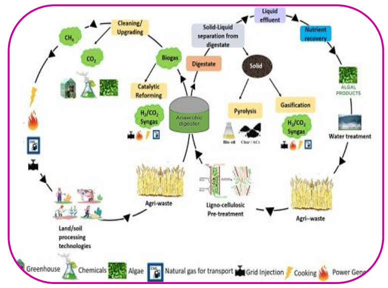
A STUDY OF VALORIZATION OF AGRICULTURAL AND FOOD WASTES FOR CIRCULAR ECONOMY



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Abstract :

The management of food waste is the subject of several scientific investigations.The 17 Sustainable Development Goals of the United Nations were established to promote global economic development and aid nations in resolving the most urgent problems impacting society and the environment.It requires cutting-edge redesign and technological improvements to reduce waste utilizing closed-looped systems that pioneer a cradle-to-cradle and waste as food logic because a "circular economy's main purpose is to move away from "linear" systems.Preventing waste generation is the initial method of waste management.Depending on consumer habits, economic levels, and levels of development, the countries implement a variety of rules for individuals, organizations, and corporations to manage or eliminate food waste.A possible source for the production of high-value chemicals is agricultural wastes.The potential marketable compounds found in food wastes and byproducts should be separated using a combination of methods, including biochemical, chemical, and physical steps.Food waste can be used to produce energy, biofuels, enzymes, antioxidant extracts, novel biodegradable materials, and other commercial items because it is cheap and renewable.

Key Words: Agricultural waste, food waste, valorization, management, bioactive compounds.

Introduction:

Due to the negative consequences that agricultural waste has on the environment, economy, and society, agricultural and food wastes are a major problem on a global scale. The management of food waste is the subject of several scientific investigations. Food loss is characterized as a reduction in the quantity and quality of food brought on by choices and actions made by the food chain's suppliers.[1] The 17 Sustainable Development Goals (SDGs) of the United Nations were established to promote global economic development and aid nations in resolving the most urgent problems impacting society and the environment. The rapid increase in global population and food consumption patterns are the main causes of food loss and waste. The bulk of SDGs are based on the fundamental principle of using resources responsibly and optimally in order to achieve goals that convincingly drive society towards a circular economy.[2]In an era of wasteful manufacturing and a warming climate, one mechanism to do that has been the creation of techniques to help industry and policymakers reach circular economy aspirations. It requires cutting-edge redesign and technological improvements to reduce waste utilizing closed-looped systems that pioneer a cradle-to-cradle and waste as food logic because a "circular economy's main purpose is to move away from "linear" systems. One third of the food produced for human consumption is lost or wasted worldwide each year, totaling 1.3 billion tonnes.[3]

Almost 30% of the world's agricultural land area is used to produce food waste. Mechanisms that permit balancing of industrial and economic development, environmental conservation and protection, and techniques for resource-efficient usage would be necessary for a successful transition to the circular economy. Food waste production, which mostly comes from households, is correlated with consumer purchasing power, which is dictated by global income levels. Rural farming communities may actually make a significant contribution to the effective utilisation of natural capital since they comprehend it better than any other community. Agricultural wastes are the leftovers from producing raw agricultural goods. Among these residues are manure and animal carcasses (which are considered animal waste), corn stalks, sugar cane bagasse, drops and culls from fruits and vegetables, and pruning (which are considered crop waste), pesticides, insecticides, and herbicides (which are considered hazardous and toxic agricultural waste), and food processing waste that is gathered during growing and processing and can take the form of liquid, slurry, or solid waste. Food waste is produced across the food chain, including 42% in households, 38% in food processing, and 20% in other activities, without taking agricultural food losses into account.[4] When the food supply chain is taken into account, the beverage industry generates 26% of the food waste. Dairy and ice cream production (21,3%), fruit and vegetable production and preservation (14,8%), grain and starch product manufacturing (12,9%), meat production, processing, and preservation (8%), production and preservation of vegetable and animal oils and fats (3,9%), production and preservation of fish and fish products (0,4%), and other food product manufacturing (12,7%) are the industries that come next.[5]

Management of food wastes

Preventing waste generation is the initial method of waste management. Food is lost or wasted at every stage of the food supply chain, including production, processing, storage, distribution, and consumption by individuals and the food service industry. Reusing and recycling are seen as secondary solutions in the management of food waste. 3.9% go to oils and fats, 0.4% to the production and preservation of fish and fish products, and 12.7% to the production of other food items.[6] Several approaches have been developed to manage food waste, including reduce-reuse-recycle, extended producer responsibility, and sustainable management.

A third of the mass of edible food produced for human consumption, or around 1.3 billion tonnes, is lost or squandered each year globally. Several initiatives to reduce food waste have been developed and put into action over the past few years. In low-income nations, local investments, education, assuring the cold chain, better packaging, and market facilities can also prevent food losses. Enhancing supply chain communication, optimising purchase and consumption planning, and raising consumer awareness of best-before dates are all potential strategies for high-income countries to avoid food loss. Depending on consumer habits, economic levels, and levels of development, the countries implement a variety of rules for individuals, organizations, and corporations to manage or eliminate food waste. According to food waste management techniques, prevention or reduction of food waste are the best solutions, but when those strategies aren't feasible, one of the best options is to valorize the food waste. The term "valuation" describes the conversion of previously wasted food into food and feed goods.[7]It also entails transforming food waste into extracted materials for food and feed while taking its quality, strength, and composition into account. It is necessary to assess the market conditions in terms of technological viability, economic viability, legislative reportability, and environmental sustainability and utility in order to convert food waste.

Food wastes are made up of a variety of components, including nutraceuticals, lipids, proteins, and carbs. Rice and vegetable-based food waste is the main source of carbohydrates, whereas meat and egg waste is the main source of proteins and lipids.[8] Instead of being viewed as an unmanageable waste stream, food waste is now being evaluated as valuable biomass that may be used to create commercial products. Food waste can be used to produce energy, biofuels, enzymes, antioxidant extracts, novel biodegradable materials, and other commercial items because it is cheap and renewable. At the production level, choosing not to harvest every crop could be a wise move if market prices are low or if the yield of the following season will be improved by the residual harvests. At the corporate level, the transaction costs of preventing food waste may be so expensive that it is "rational" to let food go to waste. This might be the case if delivery frequency is increased and smaller purchases are made, or if the supply and demand of food are properly balanced. Consumers may prefer to buy more items all at once at the household level rather than more frequently, running the risk of some of them not being consumed in time.

Various technologies for valorization of agricultural wastes

By using food waste as a substrate, it is possible to recover value-added products such as fine chemicals, nutraceuticals, antioxidants, bioactives, biopolymers, biopeptides, antibiotics, industrial enzymes, bionanocomposites, single-cell proteins, polysaccharides, activated carbon adsorbent, chitosan, corrosion inhibitors, organic acids, pigments, sugars, wax esters, and xanthan gum. Environmental, financial, and societal issues are brought on by the traditional methods of handling food waste, such as landfilling and incineration.[9] As a result, there are a number of available valorization techniques that can be used to manage food waste and are more sustainable and financially rewarding. The potential marketable compounds found in food wastes and byproducts should be separated using a combination of methods, including biochemical, chemical, and physical steps. This will allow for the selective extraction of the desired components and their modification into higher-value food products and additives. To prevent microbiological risks, ensuring that the final goods are aesthetically pleasing to consumers, and are created in accordance with food standards, care should be taken when using these procedures.

Without a suitable pretreatment, agro-waste cannot be used since modified agro-waste is more efficient and beneficial.

Prior to use, agricultural waste goes through a number of treatment processes. Agro-waste residues are composed of lignocellulosic components, which call for chemical, physical, and biological processing to reduce their complexity. Agro-waste processing often entails the conversion of the complex molecular structures into simpler monomers. Mechanical, thermal, and sonic pretreatments can speed up the biodegradation of wheat straw, but they come with a significant energy cost. By reducing the size of the biomass and increasing its accessible surface area, this technique promotes hydrolysis due to improved heat and mass transfer. Chemical pretreatment causes the internal connections of lignin and hemicellulose to be disrupted (e.g., the use of acids, alkalis, ozonolysis, organosolv, and wet oxidation).[10] Compared to unpretreated bagasse, pretreatment dramatically reduced the weight of the cassava bagasse and increased the cellulose yield. The H2SO4 pretreatment led to the highest possible cellulose yield. Exoenzymes are involved in the biological process (which uses bacteria), which includes hydrolysis and saccharification. It is necessary to ferment employing whole-cell systems or just enzymatic digestion of a solid or liquid substrate. This process is eco-friendly, less energy-intensive, and doesn't create any inhibitors. Ionic liquids (ILs), deep eutectic solvents, and organic deep eutectic solvents are all used in green treatments.[11] By raising cellulose crystallinity and reducing particle size and lignin content after pretreatment with ILs, enzymatic hydrolysis of the cellulose produced more glucose.

Conversion of agricultural wastes into bioactive compounds

Bioactive compounds (BCs) are defined as natural substances that can interact with one or more elements of living tissues and have a variety of effects in the scientific literature. Moreover, the distinctions between the definitions of nutraceuticals, functional foods, and dietary supplements are occasionally misunderstood. Nutraceuticals and functional foods, as opposed to dietary supplements and food additives, are also significant. In a nutshell, functional foods have higher concentrations of bioactives than typical diets, which may benefit health. These chemicals, which are thought to be superior to regular foods, may help provide the better health advantages. Food additives are compounds that are added while food is being processed to enhance the food's quality and shelf life.

Interest in adding functional and natural food additives has grown significantly over the past several years as a result of consumers' growing understanding of the health-promoting effects of nutraceuticals and dietary supplements. Similar to this, consumer interest in health and wellness has fueled the growth of the nutraceutical and dietary supplement industries. A wide range of goods with health advantages can be referred to as nutraceuticals and dietary supplements.However, because they contain pharmaceutical-grade ingredients but are exempt from the same testing criteria as medicines, nutraceuticals are a unique subgroup of dietary supplements.[12]As more study is done to ascertain the health benefits and potential uses of these compounds, which are generally derived from natural sources, as well as public and consumer interest, the demand for BCs for diverse culinary applications continues to rise. They were mostly obtained from plants, vegetables, and microbes and were sold as medicines due to their pharmacological qualities.

Future Prospects

A possible source for the production of high-value chemicals is agricultural wastes. In the future, high-value bioproducts will be extracted from agricultural waste using biotechnological technologies. Integrated nano- and biotechnological approaches are favoured for industrial waste valorisation due to their low cost and low energy needs.Moreover, biotechnology techniques for valorizing agricultural waste offer practical answers for creating distinctive bioproducts for a range of businesses.Consequently, it is essential to develop cascade conversion systems that are both economical and environmentally beneficial. Agricultural waste is considered to be a nutrient-rich and useful raw material that can be used in a variety of applications, making it an effective remedy for both economic and environmental problems.[13]They can be used directly as nutritional sources of protein, fat, vitamins, fibre, carbohydrates, minerals, and antioxidants. It is possible to physically or chemically extract more biomolecules from agricultural waste for use as nutritional and functional components. The unitary drying process is necessary to avoid microbial risks and maintain the physicochemical and microbiological stability of bioproducts during the valorization of these agricultural wastes. Governments should encourage the development of the infrastructure and technology needed for the utilisation of agricultural waste and leftovers in production and storage areas. Other risks, such harmful chemicals and antinutritional elements, must also be eliminated.

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