Brief Report
Volume 12:3, 2022

Journal of Bioengineering & Biomedical Science

ISSN: 2155-9538

Open Access

Valorization of Food Waste

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Introduction

Large volumes of trash are produced during the industrial processing of agricultural or animal products. These wastes, which are produced in vast quantities throughout the year, can be considered the most plentiful renewable resources on the planet. Because of the wide availability and diversity of components in these raw materials, there is a lot of interest in reusing them, both economically and environmentally. This commercial interest stems from the fact that a large quantity of such wastes might be employed as low-cost raw materials for the development of new value-added compounds, lowering production costs even more. The environmental problem stems from their content, particularly agro-industrial wastes, which might contain potentially harmful substances that can lead to environmental degradation when uncontrolled wastes are burned, permitted to decay naturally in the soil, or buried underground. Furthermore, these materials have high Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) values, and if not appropriately removed, they can cause major pollution problems. By converting food wastes into value-added products through the fermentation process, recycling and transformation of food wastes can help to support sustainable development [1].

At both the local and global levels, food waste is becoming a major and pressing issue. According to the United Nations' Food and Agriculture Organization (FAO), one-third of all food production is lost or wasted to 1.3 billion tons of food meant for human consumption squandered each year, resulting in an economic loss of EUR 800 billion. Fruit, vegetable, meat, and fish produced each year and wasted account for 44–47 percent. Food waste recycling and valorisation are becoming more popular as a result of its wide availability and diverse composition.

Description

Appropriate waste management is acknowledged as a necessary component of long-term growth and contributes to the achievement of global sustainability goals (SDGs 12 and 13). The study focused on promotion policies and regulatory measures for the valorization of mandatory recyclable food waste from industrial sources in Taiwan, where the central governing agencies jointly promulgated some regulatory measures for promoting the production of bio-based products such as animal feed, soil fertilizer, and bioenergy from the valorization of industrial food waste [2].

Food waste also has a great potential due to its chemical composition, which is mostly made up of carbohydrate polymers including starch, proteins, lipids, cellulose, and other microelements. It can be categorized as a low-cost, high-potency second-generation feedstock because of its composition. Food waste recycling and bioconversion offer a great opportunity to support sustainable development by converting waste into value-added products such as enzymes, feed and food additives, fertilizer, biofuels, animal feeds, as well as other useful chemicals or products, food grade pigments, and Single Cell Protein (SCP) through a microbial fermentation process, thereby improving food security and environmental sustainability [3].

Biofuel and bioenergy production valorize food waste

Food waste has been used as an ideal feedstock for the generation of biofuel and bioenergy *via* microbial conversion due to its high moisture, carbohydrate polymers, and other elements. The creation of bioenergy from food waste would not only eliminate the environmental risks associated with plant incineration and sanitary landfill sites, but it would also reduce greenhouse gas emissions by replacing fossil fuels with bioenergy.

Rice husk, one of the most important crop leftovers in the world, may be transformed into usable chemicals using biochemical and thermochemical techniques. Pyrolysis is one of the most widely utilized thermochemical conversion processes, which involves the decomposition of biomass at a high temperature in the absence of air or oxygen. Depending on its eventual applications, biochar can be utilized as a solid fuel, carbon material, soil amendment, environmental adsorbent (biosorbent), functional catalyst, or chemical feedstock. Rice husk-based biochar could be employed in environmental applications such as water saving, wastewater treatment, and soil amendment [4].

The production of bioenergy from various forms of agro-industrial wastewaters and agricultural residues using the microbial fuel cell (MFC), as well as the techno-economics and lifecycle assessment of MFC, commercialization, and obstacles. For bioelectricity production in MFC, the use of various agricultural wastes and wastewater including various industrial by products appears to be a potential and alternative source of sustainable energy generation. Furthermore, it has been demonstrated that a variety of agricultural wastes and wastewater may be used to boost bioenergy output utilizing a variety of MFCs; hence, both biochemical and thermochemical MFC methods can be used to convert agro-waste to bioenergy.

The substrate composition and nutrients available for the microorganisms used in food waste biovalorization for bioethanol production are also critical considerations. Although it is well understood that ethanol production is primarily influenced by glucose concentration (the theoretical alcohol yield is about 0.5 g of ethanol per g of glucose) and yeast inoculum concentration, nutrient supplementation is also an important factor to consider, as an adequate amount of specific nutrients, such as trace elements, vitamins, and nitrogen, which are often lacking in agricultural waste, can significantly improve yeast viability and resistance.

Biopolymers production from food waste

Agricultural or animal food wastes can be an essential substrate for enzymes, food-grade pigments, vitamin supplements, or biopolymers because of their natural makeup. In terms of industrial processes, the production of high-added value products, such as enzymes and organic acids, for use in food processing as well as other areas of relevance, such as the development of functional foods or the production of volatile compounds to improve the aroma of food products, in particular from grape, apple, and olive.

The ability of "generally regarded as safe" (GRAS) microorganisms to produce enzymes extracellularly, as well as other features like high catalytic activity and reaction rate. Through fungal solid-state fermentations with *Aspergillus awamori*, a two-stage operation was constructed to manufacture crude enzymatic consortia. Fermentation conditions were tweaked, and a new

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Received: 04 March, 2022, Manuscript No. Jbbs-22-61442; **Editor assigned:** 06 March, 2022, PreQC No. P-61442; **Reviewed:** 20 March, 2022; QC No. Q-61442; **Revised:** 25 March, 2022, Manuscript No. R-61442; **Published:** 31 March 2022, DOI: 10.37421/2155-9538.22.12.292

biocatalyst was successfully produced and used to hydrolyze whey lactose, forming a nutritional substrate for fermentative bioconversions. To complement the sustainability and circularity of the process, bacterial cellulose production was also envisioned as a transitional ingredient for later functional food formulations, along with the protein fraction [5].

Future Prospective

As a result, alcoholic fermentation is a complex biological process involving a variety of operating factors, and boosting the ultimate yield using the traditional "one component at a time" strategy could be time-consuming due to the vast number of tests required. In this regard, to design and develop a central composite design coupled with response surface methodology (CCD-RSM) statistical approach to investigate the effect of three fermentation process parameters (initial sugar, yeast, and nutrient concentrations) on ethanol productivity while considering several operating parameters, to implement an efficient fermentation process using industrial by-products, to optimize the production of ethanol from non-treated sugar beet molasses by designing and developing a central composite design coupled with response surface methodology (CCD-RSM).

Acknowledgement

None.

Conflict of Interest

The author shows no conflict of interest towards this manuscript.

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How to cite this article: Stefanov, Martin. "Valorization of Food Waste." J Bioengineer & Biomedical Sci 12 (2022): 292.