Recycling of Agricultural Waste by Implementation of Biotechnology

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ABSTRACT: ***The improper management of waste agricultural biomass is becoming an alarming problem as rotten waste agricultural biomass emits methane and leachate, and open burning by the farmers to clear the lands generates CO_2 and other local pollutants, which are contributing to climate change, water and soil contamination, and local air pollution. To circumvent these problems considerable efforts are being made by many governments as well as other entities especially to manage waste agricultural biomass and to convert it into a material resource. Largely accessible organic wastes can be turned into valuable compost product for raising crops organically on one hand, and get them disposed off safely at the other end. There is a lack of awareness that diverting most of the waste for material and energy recovery would possess the capacity to reduce the costs for waste disposal and would also generate revenue from the sale of the recovered materials and energy.Biotechnology is the field that plays a major role in bringing cellulosic ethanol technology to the ground of reality from dreams. The present era needs eco-friendly technologies to flourish so as to protect our earth. This review article brings together the current information regarding biotechnology that can help reduce organic wastes from different origins with diversified characteristics under various situations.***

Keywords: Agriculture, Bioconversion, Biomass, Residues, Waste, Ecology, Environment concerns.

INTRODUCTION

Due to various intensive farming activities to feed the increasing population, the amount and forms of waste farm biomass have grown exponentially. Every year, 140 billion metric tonnes of biomass are produced from agricultural practices. This biomass volume can be transformed into an immense quantity of raw materials and energy, equal to about 50 billion tonnes of oil, and clean energy can be provided to billions of people in developed countries who already lack access to electricity. Biomass waste as a raw material has an enticing potential for large-scale manufacturing and businesses at the community level. With regard to energy and material recycling, such industrial wastes are of great importance [1].

The United Nations Environment Program has made substantial strides to raise awareness and has begun to implement its Comprehensive Solid Waste Management Programme on the basis of the 3R concept (reduce, reuse, and recycle). This entails pollution from all streams, and here we concentrate only on products of agricultural residues[2].

Agricultural remains, like those that are primarily dry, like grass, and those that are muddy, like animal slurry, are of a number of forms. Table 1 lists large farm crops and their waste during harvest.

Table 1. Crops and their left over residues.

Sl.No.	Crop	Waste
1.	Rice	husks, straw, stalks
2.	Wheat	Hull husks, straw, stalks
3.	Pulses	Stalks, shells
4.	Peanuts	Shells
5.	Coconut	Fronds, husks, shell
6.	Coffee	Hull, husks, grounds
7.	Cotton	Stalks

8.	Corn	Cobs, stover, stalks, leaves
9.	Sugarcane	Bagasse, tops
10.	Nuts	Hulls
11.	Chilli	Chilli stalks

Residues are provided by many agricultural crops and procedures and the possible sources include:

1. Residues from arable crops like straw or husks

2. Slurries and cow dung

3. Animal bedding, like compost for livestock

4. Most organic material, like grass silage, from surplus production or inadequate demand[3]

There are mainly two types of agricultural crop residues:

1. Land residues are products left after the grain has been harvested in an agricultural field or orchard. Stalks and stubble (stems), leaves, and seed pods contain these residue. It is possible to plough these residues straight into the earth or burn them.

2. Process residue are considered process residue, that are remaining after the harvest is turned into a usable resource, like husks, nuts, bagasse, molasses, and roots. As livestock manure and soil alteration, as fertilisers, and in production, they could be used. Many of the agricultural residues alluded to above have defined markets.Many such residues have, in fact, been commonly used for soil nutrient recovery and enhancement purposes. They will also displace large volumes of synthetic fertilisers or other products. Because the processing of many of these goods requires considerable CO2 emissions and energy inputs, their replacement with agricultural products[4].

It is not appropriate to take residue lightly, rather it may be a general game changer in ecological prospective.We are focusing on solid agricultural residues in this study. Most agricultural wastes either are cellulosic or starchy in nature, and if not taken care of, they appear to decay gradually. The procedure is called "mineralization," in which the components found in the waste are released back into the atmosphere. For agricultural crops, manure collected during this process is very important.

DISCUSSION

Role of Biotechnology in Managing the AgriculturalResidues

In nature, agricultural wastes are typically starchy or cellulosic and some are even nitrogen-rich. In its content, the biomass varies greatly. With regards to bioconversion, cellulosic agricultural waste is of considerable importance. About 40 percent cellulose, 30 percent hemicellulose, and 25 percent lignin comprise much of these agricultural wastes. Based on the type of biomass, these components might well differ. These are omnipresent and are an inexhaustible raw material available to humans for use. On the other hand, as livestock feed, starchy agricultural residue has promising utility.Starches are dietary polymers made up of glucose connected together at branching points by alpha1-4 linkages as well as alpha 1-6 linkages. These are simple to absorb as well as provide power. Although cellulosic biomass is used by direct combustion as livestock feed and a source of energy, the surplus quantity accessible may be used as the raw resources for bioconversion into value-added products[5].

As Raw Material for Bioconversion into Energy

While there is an interesting field in the use of technology for converting biomass from the burning of rice husk and sugarcane bagasse to the gasification of other agricultural wastes, biomass is still largely underutilised and left to rot or burn freely in the farms, mainly in developing nations that don't have strong

regulatory instruments to regulate such polluting activities. Direct burning of crop waste, as a common method, contributes in air pollution, posing risks to human health and environment.Biomass is a commodity that is environmentally friendly, creating issues if not used. Consequently, the obstacle is to turn biomass into an asset for electricity as well as other productive uses[6].

Nations are already searching for renewable forms of energy to minimise greenhouse gas (GHG) emissions through the global campaign to combat global warming. The use of biomass energy, aside from being carbon neutral, reduces dependence on fossil fuel consumption, thus contributing to energy pollution and sustainability mitigating climate change[7].

As Carbon Source in Bioprocesses

In maximizing the price of agricultural waste, biotechnology has played a prominent part in using them as a source of carbon for different bioprocesses. Starchy residues could be easily used through fermentation for the development of different metabolites, including enzymes, organic acids, etc. Starchy waste contains wheat bran, rice bran, cassava bagasse, etc., with small amounts of other elements, rendering it an ideal source of carbon for various bioprocesses. Agricultural cellulosic residue are in high demand for the processing of solid-state and submerged fermentation cellulolytic enzymes.A abundant amount of nutrition and natural ammonia is oil cakes. These are also incorporated as a cheap nitrogen supply in different bioprocesses, which then in addition makes the system commercially feasible[8].

Novel Application of Agricultural Residues(Xylooligosaccharides)

Worldwide attention has been drawn to prebiotics by increasing requirements for new food products for well-being and age-related problems combined with an increasing healthcare costs. At the end of the 20th century, huge concern has been raised about the transfer of genes of antibiotic resistance from animals to humans thru the food sources which led to the idea of "preventive medication." Xylooligosaccharides (XOS) are the only nutraceutical that can be generated from lignocellulosic biomass. XOS production from agricultural wastes gives the nutraceutical industry tremendous reach as the raw material is affordable and readily available.Other than selective growth enhancement of beneficial gut microflora (Bifidobacteria), the key benefits of XOS ingestion comprise reduction of blood glucose and cholesterol, decreased procarcinogenic enzymes in the gastrointestinal tract, increased large intestinal mineral absorption, and immune stimulation. XOS's soft flavour allows them being used as chemical sweeteners. XOS may be future options to protect the gastrointestinal tract against the invasion by pathogenic microflora leading to the prohibition of antibiotics as a feed substitute in livestock. In order to meet the requirements of value-added livestock goods, this would maintain production and boost the efficiency of animal products. XOS may also be the sought-after future of preventive medicine molecules. As enzyme are very unique in nature, enzymatic processing of XOS may be practicable, so they sell specific products, cutting the price of purifying[9][10].

Advantages

There is an enormous potential for agricultural waste to be used as raw material for bioconversion into value-added goods, especially renewable energy, like bioethanol, biogas, etc. The use of biomass in the above-mentioned applications provides many benefits, such as the following:

1. With regard to energy and material recycling, these industrial wastes are of high importance.

2. It uses wood, that otherwise includes compost, thus reducing areas of landfill.

3. It helps to reduce the cost of biomass conversion technologies to bioenergy using cheaper, even negative, raw materials.

4. Effective field residue management can improve the efficiency of irrigation and prevent degradation.

5. It might have added benefit for farmers, since they may not require any labour to extract crop residues from the farm and those who have it may gather the waste, or they could pay farmers to extract those residues that could act as their new technologies raw resources.

CONCLUSION

There has been a need to increase people's consciousness of the adverse effects of direct burning of agricultural residues on fields, as well as the possibility for bioconversion into power from these residues. This are a natural resource with renewable abundance, which should be exploited instead of adversely impacting the ecosystem for the good of humanity. Such agricultural waste has tremendous capacity to illuminate villagers which are in the darkness since they have little fuel.Biotechnology has played a significant role in delivering the technology of cellulosic ethanol from dreams to the foundation of reality. In order to preserve our earth, the current century needs eco-friendly technology to thrive. In this ambition, biotechnology plays an important role, but internationally it needs concerted efforts.

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