

AN OVERVIEW OF SUSTAINABLE USES OF PLANT WASTE

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Abstract

There are all kinds of residues, from either plant processing or harvesting and although some of them can be integrated into the soil in order to enrich its nutritious content for further crops, there are a large number of uses for the seemingly unimportant parts left. From fodder to water filtering systems, plant residues have a variety of uses, some more surprising than others, and they contribute to the sustainability of crops and ecosystems to a larger extent than commonly known.

Key words: bioeconomy, plants waste, valorization.

INTRODUCTION

There are several sources of plant waste: crop harvesting, weed management, autumnal leaf drop, pruning, fruit thinning, etc. Although the vast majority of these byproducts are discarded, they can be used sustainably in several ways. The main uses are as fertilizer, compost and biofuel, but there are other, innovative uses such as construction, packaging, basketry, crafting, water filtration systems and art.

MATERIALS AND METHODS

Use of plant waste as fertilizer

It is typical to leave the leaves, pods, roots, stalks and stubble of herbaceous cultures in the field, post harvest. These residues can be incorporated into the soil through tillage. Rye, wheat, corn are great examples of this. As far as green manure is concerned, the weeds that grow between rows can be harrowed and left on the ground to decompose.

Use as animal fodder

Stover, the leaves and stalks of field crops such as corn, sorghum and soybean has been used as fodder since time immemorial. Straw, which makes about half of the yield of cereal crops

such as barley, oats, rice, rye and wheat can be used in the mix fed to cattle and other raised animals.

Use of plant waste as compost

Post-harvest residues as well as process residues can be used to produce compost by adding them to other composted materials which include products of fruit thinning, damaged fruit, etc in order to achieve a carbon: nitrogen ratio of 30:1 (Ayesha, 2017). Another use when it comes to compost is mushroom compost preparation as straw can be successfully used for their substrate.

Use in basketry

Straw that is coiled and bound together can be made into baskets through a technique known as lip work. Other materials that can be used in basketry are: pine needles, various plant stems, tall grasses and fine wooden splints which can be the result of harvesting or processing of different plant cultures.

Use in bedding

Crop residue, specifically straw, can be used both for human and animal bedding. For animals it is used as such, while for humans it

can be used as a mattress filling, also known as palliasse.

Use as biofuel, biogas and biomass

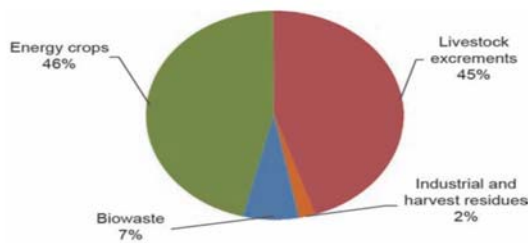


Figure 1. Feedstock of biogas (Achinas, 2017)

Straw can be used for the production of biobutanol and straw briquettes can be used instead of coal. It can also be used to feed a biogas plant. As far as biomass is concerned, crop residues can be used as pellets or as bales of straw.

Use as construction material

Straw has been used for millennia to bind clay and concrete. It is still being used as such in many parts of the world and it is required in the production of cob, which is gaining more and more popularity in the building process of ecofriendly constructions. Straw can also be used as bales in construction, either plastered with earth or not. "It was also found that nearly all plastered bales tested had higher strengths than would be required in typical residential construction" (Vardy, 2006). Wheat straw can be combined with polymers to make composite lumber and they represent a class of materials initially developed to provide an alternative to mineral oil-based plastics (Vaisanen, 2016). Straw can also be used to make enviroboard. Thatching can use straw to create a waterproof roof with good insulation properties.

Use in crafts

Belarusian straw dolls are made using straw, corn dollies require corn husks, straw can be used for marquetry, painting and plaiting as well as scarecrows and to make Japanese traditional cat houses. Hats can be made using straw as well. Another use of straw is in rope making. Koreans wear Jipsin, sandals made of straw. In some parts of the world people wear straw shoes at home or for special events.

Targets in archery are made of compacted and bound straw.

Use in horticulture

Straw can be used as protective layer in various cultures such as cucumber, strawberry, etc. Straw can be used as an insulator for sensitive trees and shrubs. Straw and woodchip can be used in mulching, which improves weed control processes, helps retain water in soil and can thus increase yield (Teame, 2017).

Use in packaging

Straw makes a good packing material and it can even be made into mats that are sealed in plastic sheets. Wheat straw is used in compostable food packaging and will biodegrade in a composting environment.

Recently, biofibers have become more and more attractive because they can be used in food packaging and in the biomedical sciences; these polymers can replace the use of petroleum-based synthetic polymers due to their safety, low production costs, and biodegradability (Mostafa, 2018).

Use in making paper

Rice straw can be used as an alternative raw material to obtain cellulosic pulp. It was done by using classic reagents as soda (with anthraquinone and parabenzoquinone as additives), potassium hydroxide and the Kraft process; the holocellulose, α -cellulose and lignin contents of rice straw are similar to those of pine and other trees, as well as other plant waste materials such as olive tree prunings, wheat straw and sunflower stalks. (Rodrigues, 2008).

Use in water filtration



Figure 2. Rice husk water filtration system (Viana, 2016)

Activated carbon and rice husk were successfully applied for the removal of Fe(III) and Mn(II) ions from El-Umum drain water, Alexandria coast, Egypt. “Langmuir and Freundlich adsorption isotherms were applied with good results. The rice husk was the best, as controlled from X_m and KF values” (Masoud, 2016).

Use in art

Plant waste was used and blended the contemporary trends of floral art with innovative ideas to raise awareness about suitability and environmental challenges (GCU, 2016). Thus fresh flowers, dry flowers, T-shirt painting and poster painting were all areas where plant waste was used to create beautiful arrangements.

Use in color, flavor and polyphenol extraction

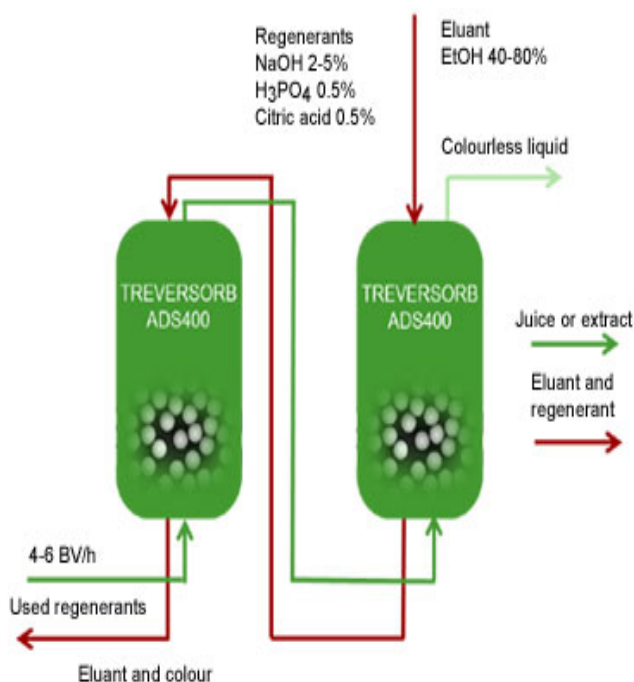


Figure 3. Extraction of color, polyphenols and flavor (<http://www.chemra.com/nutrition/colour-flavour-extraction.html>)

In the case of many cosmetic products and processing of agricultural products, there is a large amount of waste that contains vast amounts of valuable substances such as color, flavors and polyphenols, known for their antioxidant properties. Among these important substances, polyphenols are the major plant compounds that have a large antioxidant

activity, but they also display other biological properties such as anticarcinogenicity, antimutagenicity, antiallergenicity and antiaging activity. And there is increasing interest in recovering these substances from agricultural waste (Moure, 2001).

CONCLUSIONS

Although plant waste has been primarily used as either compost, biofuel or fertilizer, new innovative uses open up new possibilities for sustainable uses of plant waste such as arts, insulation, water filtration, extraction of valuable biomolecules and bioplastic.

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