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BIODEGRADABLE BIOPLASTIC PRODUCED BY MICROORGANISM

Mahesh Keshav mise Prof.Syed A.M and Dr.Prachi Udapurkar .Kishori College of Pharmcy, Beed
Dr.Babasaheb Ambedkar Technological University,Lonere

Abstract— Plastics offer a variety of advantages or benefits, due to its flexibility it has wide applications in modern world. However, use of too much plastic can put effect on the environment and human life. Need for the production of biodegradable plastic (plastic that can be decomposed in the environment by the action of naturally occurring microbes) has been increasing day by day. There is an extensive need to produce biodegradable plastic due to its ability to decompose itself in short period of time hence saving environment.

KEYWORDS

PHAs production PHAs applications
Therapeutic application Agricultural application
Cancer detection

The plastics have become an important part of each and every aspect of modern life. It offers a variety of benefits due to its flexible size, light weight and cheaper cost, which make it a material of choice in nearly all the applications of household and industries. But the excessive and unwise use of plastic results in deterioration of environment and has harmful effect on human health. In order to solve this problem, there is need to produce an alternative way such as production of Biodegradable Plastic Biodegradable plastic can be defined as plastic that can decompose in the environment by the action of microorganisms such as bacteria, fungi and algae. The advantage of using biodegradable plastic is its ability to undergo decomposition in short period of time without any harmful effect on the environment. It is eco-friendly plastic and made from potentially inexpensive raw material. Moreover, the manufacturing cost of biodegradable plastic is less as compared to

conventional plastic Agricultural waste contains various raw materials which can be used in production of bioplastics e.g. potato peel, tomato, cornhusk, wheat straw, rice straw and banana peel. Cheese whey is another major raw material. It is estimated that about 998 million tons of agricultural waste is produced yearly. So, management of agricultural waste is considered to great strategy for controlling environmental pollution(1)

Properties of Bioplastics

The biopolymers' capacity to make their way to the market is mainly due to their properties that are not at all inferior to those of the conventional petrochemical polymers. Bioplastics are mostly known for their environmentally friendly nature due to their lower persistence when abandoned in the environment. Through the utilization of renewable resources such as organic waste, there exist additional benefits by the valorization of solid waste that would be otherwise landfilled or used for energy recovery. Another property of the bioplastics is that they are non-toxic and compostable, which means that they are not harmful to living organisms. A crucial point is that biopolymers should have similar mechanical, chemical, and physical properties to conventional plastics. These include tensile strength, tensile elongation, elasticity, flexural strength, density, crystallinity, melting point, water vapor and oxygen permeability, and also UV resistance. However, the often low mechanical strength of bioplastics is the property that mostly limits their application and requires the use of synthetic fibers, such as glass or carbon, to increase this property. This leads to environmental problems due to reduction of their biodegradability.

As a replacement of synthetic fibers, environmentally friendly materials, such as lignocellulosic fibers, fillers derived from cellulosic materials starch can be added to biopolymers to reinforce the produced bioplastic. Nanomaterials, such as nanoclay or chitosan have been used to increase the thermal stability of bioplastics developed from starch which are known to have poor mechanical properties, due to their intra- and

intermolecular bonds [Moreover, in a study conducted by Masruri and co-workers the addition of .

essential oil from kaffir lime to starch from cassava peel waste to produce bioplastic was found to increase the stability in tensile strength and the plastic was able to elongate by 65–85%. The simple addition of glycerol at a concentration of 5% (w/w) produced a bioplastic with a higher tensile strength of 205.52 N mm⁻² and 42.69% of elongation

Advantages:- →

Biodegradable Plastics are Easy to Recycle:

- These types of plastics not only take less time to decompose when discarded but can also be easily recycled through an organic process. They are also non-toxic since they have no chemicals or toxins. Recycling helps to lessen landfill problems, and besides, the recycled bio-waste can be used as compost or as renewable energy for biogas. →

ADVERTISING:-

READ US Cities You Should Consider Moving To if You Are Eco-Conscious They Consume Less Energy During Their Manufacture It is true that the production of biodegradable plastics requires more investment, but finally, it is worth it. If the clean-up costs are taken into consideration, besides the harmful effects on the environment, biodegradable plastic products will definitely turn out to be a wiser choice. Less energy is needed in the manufacturing of biodegradable plastics compared to ordinary plastics. For instance, the manufacture of corn-based polymer requires 65% less energy compared to a similar polymer made from petroleum. Manufacturing bioplastics also do not require the process of finding, accessing, and transportation of hydrocarbons. This means fewer fuel fossils will be in use; hence, reduction of environmental pollution. Also, it produces 68% fewer greenhouse gases during its manufacture, posing a significant environmental benefit.

lower Petroleum Consumption

Oil is a significant ingredient in the manufacturing of traditional plastics. Petroleum is known to have negative impacts on the environment, the amount of waste produced during refinement and also during the extraction of oil from the earth. It is surprising to note that, in the United States alone, 3% of petroleum so produced is used in the manufacturing of plastics. What we must remember is that, like other fossil fuels, petroleum is a non-renewable resource that ought to be conserved. Biodegradable plastics use the idea of natural products; therefore, the use of bioplastic can profoundly reduce the amount of petroleum used and consequently lessen its environmental hazards. →

Compostability

Composting of bioplastic products can make the soil fertile, thereby enhancing soil fertility. The reason for this is because plastic is not made using artificial chemicals but from natural materials. The materials decay and improve the soil's water and nutrient retention and help in the growth of healthier plants with no need for pesticides and chemical fertilizers.

Disadvantages of Biodegradable Plastics:-

→ Engineering Problems Biodegradable plastics are made from plants such as soybeans and corn. Therefore, there is a risk of contamination as the crops are typically sprayed with pesticides when on the farm and can easily be transferred or included in the end product.

→ Need For Costly Equipment For Both Processing and Recycling A downside of biodegradable plastic is that there is a need for costly industrial processors and composters, especially those that require high industrial-scale temperatures to be broken down. Apart from cost, there is a for the availability of equipment, which may be a problem.

→ Risk of Contamination Due to Confusion Differentiating Between Biodegradable and Non-Biodegradable Plastics These bioplastics should not be mixed with non-biodegradable plastic when discarded. The challenge today is that many people do not know how to distinguish between the two.

→ READ 30+ Surprising and Innovative Ways For You To Save Rainforests Therefore, these bioplastics may end up getting contaminated and may not be easily recyclable anymore. The outcome is adding up to the waste volume.

→ Biodegradable Plastics May Produce Methane in Landfills Some biodegradable plastics produce methane when decomposing in landfills. The amount of methane produced each year is high. Methane is 84 times more potent than carbon dioxide, and it absorbs heat faster; therefore, it can accelerate climate change.

Surprisingly, Biodegradable Plastics do not Solve Ocean Pollution Problems These types of plastics cannot decompose in the ocean waters as it is too cold. Therefore, these plastics will either float on water or create micro-plastics which pose health hazards to marine life. Thus, the use of these kinds of plastic cannot solve all pollution problems.

→ There is a Need For More Crops and Croplands to Produce Biodegradable Plastics Adequate production of these kinds of plastic will require the use of cropland to provide the natural materials required instead of producing food. With food scarcity and hunger affecting 1 out of 5 families in the developed nations and much more in developing countries, there is an ethical question whether it is right to expand this industry.

→ Biodegradable Products Come at a Higher Cost It costs 20 – 50% more to produce bioplastic than to produce traditional plastic. With improved technologies and more access to materials, however, this cost can reduce significantly

. → Biodegradable Plastics May Contain Metals Some of these plastic products, for example, plastic bags, may release some amount of heavy metals during

decomposition. For example, the Guardian reported high levels of cobalt and lead in one brand of this kind of plastic. It raised issues about the toxicity left after decomposition.

Objective:-

→ Microbial degradation: The primary purpose of biodegradable plastics is to replace traditional plastics that persist in landfills and harm the environment. Therefore, the ability of microorganisms to break down these plastics is an incredible environmental advantage.

→ Elimination of waste management: Our biodegradable plastics will break down naturally on land (with OK biodegradable SOIL certification) so removal and transportation of the waste will no longer be needed. Costs of management for farmers/growers and the environmental problems associated with landfills and incineration will be eradicated.

→ Development of new biodegradable plastics films with a very low carbon footprint impact: Conventional agricultural plastic films have an enormous environmental impact in terms of CO₂ emissions during their life-cycle. We will significantly reduce this impact, since our biodegradable polymers and additives will be made from renewable raw materials that are not petrobased and do not compete in food markets. Also, biomass for these biodegradable plastics will come from trees and crops which extract CO₂ from the atmosphere as they grow

→ Improvement of soil and product quality: Conventional agricultural films present toxic components and contaminate the soil in a number of ways. Multibiosol bioplastics will not only avoid these harmful components, they also will add value through Oligo Elements (trace minerals as natural fertilizers) and micro-perforation functionalities that contribute to agriculture à la carte and help improve the health of the soil and the quality of the final product

PRODUCTION OF BIODEGRADABLE PLASTIC FROM CHEESE WHEY

:- Whey is the byproduct of cheese production. It has high importance in the dairy industry. It is the liquid Released during cheese making after coagulation and separating casein from milk.

It has various properties such as high nutritional composition and high BOD (Biological Oxygen demand) and COD (Chemical Oxygen demand). Whey production is estimated at around 180 - 190 x 10⁶ton per annum.

According to survey only 50% of worldwide cheese whey product can be transformed into various other food products It can be used for production of various other products like animal feed, can consumed as whey protein and use as an additive in various processed food through bacterial and yeast fermentation.

But it play major role in production of Poly-hydroxy alkonoates which is biodegradable plastic). PHA has various properties such as biodegradability, biocompatibility and non-linear optical activity which give rise to intensive research to use these polymers in high value added applications such as packaging material.

Several factors which affect the economics of PHA production is the substrate cost. Sweet whey attains approximately 5% lactose, 0.2% lactic acid and 1% protein as well as fats, minerals and vitamins

METHOD:-

For the production of biodegradable plastic from the cheese whey following requirements are there which includes bacterial strain like T. thermophilus HB8 and media which is basal rich medium. There is a skimming takes place from the pasteurized milk after skimming Ultrafiltration is carried out for whey concentrate. Facultative up stream process of substrate is further carried out with whey permeate . The following requirement such as lactose, glucose and galactose can be provided.

METHOD FOR PRODUCTION OF BIODEGRADABLE PLASTICS FROM CHEESE WHEY:

I. Bacterial Strain and media

: T. thermopiles HB8 was grown in basal rich medium, For PHA production under nitrogen limitation, cultivation was carried out in 2 liter Erlenmeyer flasks containing 700 ml mineral salt.

II Determation Of lactose

glucose and glucose Take 2ml of growing culture in different time intervals and centrifuged at 6000 xg for 15 min at 40c using a commercial kit, determine the lactose residue. Then, hydrolyze the lactose to D-glucose and β-galactose in the presence of βgalactosidase. D- Galactose is oxidized by nicotinamide adenine dinucleotide (NAD) to galactonic ac

Biomass Determation:

Cell Concentration, defined as dry weight of cells per liter of culture broth. For this, 10ml of culture broth rapidly Cooled to 40c, filtered under vacuum and rinsed with an equal volume of cold 10mm MgSo₄. The filtered were dried for at least 43hours at 800C until stable weight has reached. **PHA extraction and estimation:**

The efficient production of biodegradable plastic depends upon cost of substrate used. It depend upon quality of Source we used. In conclusion, it is concluded that.:'

PRODUCTION OF BIODEGRADABLE PLASTICS FROM CASSAVA STRACH: Cassava is also a major product which is used in the production Biodegradable Plastic. It is one of the richest sources of starch. The roots of cassava contain up to 35% starch, soluble carbohydrates and fats that make starch extraction from cascara very easier. During the bioconversion, cassava starch is converted into lactic acid by bacteria and then there is a polymerization of the lactic acid by the thermochemical reactions leading to the production of biodegradable plastics Cassava is one of greatest raw material used because it is nontoxic, biodegradable and biocompatible. In today's world, 66% of the global biodegradable plastic is based on the starch. Cassava is mainly a vegetatively propagated shrub. Starch can constitute two polymers i.e amylose and amylopectin. Amylose can contain about 20-30% and amylopectin contain about 70-80% of the total amount. Research on starch-based materials has been widespread in recent years with many university and laboratories. High amylose content in starch signifies lower gel strength and gel stickiness and on the other hand, high amylopectin level provides a better binding power. Nigeria is currently, the only country which is world's largest producer of cassava with an estimated annual

METHOD:

Materials used in this production can be obtained from local market such as cassava tubers, vegetable oil, filter cloth, plastic wrap, aluminium foil, chemicals such as glycerol and ethanol. Equipment required are vacuum oven, drying tray, magnetic stirs, centrifugation. Cassava starch has been expanded under the very extrusion conditions. It has a bulk density, Due to this a little modification is required so that the moisture content can be increased. Cassava starch can be expanded in moulds, at 200-2400c for 1-3 minutes. As a major source of starch in tropical and subtropical regions, cassava is promising raw material for the production of Biodegradable Plastic in these areas (Avella, 2005). Starch extraction from cassava: The cassava tubers are available in the local markets worldwide. These tubers need proper washing so as to remove any unwanted particles. These tubers are then peeled off to makes a fine mash. In the mashed mix, high volume of the clean water was added, removed the fibre from mash by sieving the mash through the muslin cloth . Sedimentation of starch particles can be done by the centrifugation. Washing of starch can be done to obtain a fine, odourless and clean starch. Dried the starch and removed the unwanted particles. Boiled the solution on hot plate and then after some time removed from hot plate

BIODEGRADABLE PLASTICS FROM BANANA PEEL:

- Banana peel has been found to be a suitable raw material for the production of biodegradable plastic. It can be used to create plastic products with high biodegradable capacity. Banana becomes a best raw material for plastic

production due to its fast production, high starch content, its fast growth cycle and universal availability. The raw or green banana has higher starch content as compared to yellow fruit (Rossell, 2002). Bioplastic made from banana peel has various desirable properties such as low cost of production, easy availability and degradability. According to the Packaging Bulletin magazine's report, it has been proved that banana starch is the suitable and important raw material for synthesis of biodegradable plastic. Banana peel contain starch which can be used to produce propane-1,2,3triol which is as an additive used to improve plasticity and elastic behavior of material (Manimaran, 2016). Growth cycle of banana is fast and it is the basic reason for the industries to use banana most as a raw material. Plastic made from banana peel exhibit same properties as the plastic made by petroleum manifest. However, the biggest difference between plastic manufactured from banana peel and one produced by petroleum is that, the latter of Bioplastic is completely non- toxic, once it is degraded it can be used in various fields such as fertilizer (Mooney, 2009). There is a high content of starch in green banana.

METHOD TO OBTAINED BIODEGRADABLE PLASTICS FROM BANANA PEELS

: Used material:

This process is an easy approach in development of bioplastic as it uses following simple material and equipment

- Blender
- Oven
- Banana peels
- Sodium hydroxide (Solid)
- Petridish
- Sodium metabisulfate
- Hydrochloric acid
- Beaker
- Gauze pads
- Lab weights
- Flask • Beakers

CONCLUSION:-

The future of microbial/organic production of biodegradable plastic is very promising. As day by the solid waste in form of various plastics is piling up worldwide and there is no technology only available for its readily degradation, the biodegradable plastic can solve the problem of bulk requirements at domestic and industrial levels. At industrial levels, two bacterial strains have been mainly used for the production of bulk

biodegradable plastic. These strains are namely the *Bacillus licheniformis* and *Bacillus megaterium*. In 100%

Reference:-

[1] Albuquerque, P. B., and Malafaia, C. B. (2018). Perspectives on the production, structural characteristics and potential applications of bioplastics derived from polyhydroxyalkanoates. *International Journal of Biological Macromolecules*, 107:615-625.

[2] Aminabhavi, T. M., Balundgi, R. H., and Cassidy, P. E. (1990). A review on biodegradable plastics. *Polymer-Plastics Technology and Engineering*, 29(3):235-262.

[3] Avella, M., De Vlieger, J. J., Errico, M. E., Fischer, S., Vacca, P., and Volpe, M. G. (2005). Biodegradable starch/clay nanocomposite films for food packaging applications. *Food Chemistry*, 93(3): 467-474.

[4] Bosco, F., and Chiampo, F. (2017). Production of PHA from Whey by Indigenous Microflora and Activated Sludge: Preliminary Investigation. *Chemical Engineering Transactions*, 57: 1975-1980. [5] Carvalho, F., Prazeres, A. R., and Rivas, J. (2013). Cheese whey wastewater: Characterization and treatment. *Science of the Total Environment*, 445: 385-396.

[6] Dahman, Y., and Ugwu, C. U. (2014). Production of green biodegradable plastics of poly (3-hydroxybutyrate) from renewable resources of agricultural residues. *Bioprocess and Biosystems Engineering*, 37(8), 1561-1568.

[7] Dufresne, A., Dupeyre, D., and Vignon, M. R. (2000). Cellulose microfibrils from potato tuber cells: processing and characterization of starch-cellulose microfibril composites.

