Available online at
www.agrospheresmagazine.com

ISSN: 2582 – 7022

Agrospheres:e-Newsletter, (2021) *2*(3), 24-27

Agrospheres: e-Newsletter

Article ID: 191

Biodegradable Packaging from Agro-Waste

Alisha Ahmad* and Owais Yousuf

Department of Bioengineering, Integral University, Lucknow-226026

Open Access

*Corresponding Author
Alisha Ahmad*
E-mail: alisha0699@gmail.com

Article History
Received: 6. 03.2021
Revised: 17. 03.2021
Accepted: 22. 03.2021

INTRODUCTION

Agriculture based industries produce a vast amount of agro-waste from various agricultural activities. One-third of the total food produced globally per year for consumption remains unutilized and therefore wasted as stated by Food and Agricultural Organization (FAO). Food waste is one of the arduous tasks the world is facing currently. Major food losses occur during the post-harvest stage. Fruits and vegetables contribute to a significant amount of waste. As stated by the FAO, 20-30% of fruits and vegetables are disposed of as waste during post-harvest handling and processing operations. Agriculture waste include field residues such as stems, stalks, leaves, seedpods, and process residues like husks, seeds, roots, bagasse, molasses. Waste from food processing units consists of organic residues such as fruit seeds, citrus peels, potato peels, coconut shells, wheat straw, rice husks, pomace, etc. These wastes are commonly disposed of at landfill sites or employed in preparing compost. Due to the varied composition of cellulose, hemicelluloses, proteins, lipids, these wastes serve as a raw material for the production of biodegradable and sustainable packaging material.

Need for Biodegradable Packaging

Packaging waste adds to a major portion of solid waste and has raised environmental concerns over the years. Development of biodegradable packaging materials from natural bases such as agro-waste is the need of hour. Utilization of agro-waste is an economical and effective step taken for development of sustainable and eco-friendly, biodegradable packaging materials. Using Biodegradable packaging minimizes waste and lessens the environmental consequences of using petro-chemical based synthetic packaging materials.

Biodegradable films can easily disintegrate into the environment by natural factors such as microbes (bacteria, fungi, etc) or abiotic components of the ecosystem thus has least impact on the environment and ecosystem.

Biodegradable packaging

Biodegradable packaging options include biopolymers and bioplastics. Biopolymers are the polymers derived from natural sources which are sustainable, biodegradable, non-toxic, non-carcinogenic, and non-immunogenic. Proteins (casein, soy, whey) and polysaccharides (cellulose, starch, chitin) are two major classes of food biopolymers. Bioplastics are made from different sources such as plant oil, cellulose, corn starch, potato starch, sugarcane, hemp, etc. Biodegradable films have certain obstructions that are associated with low gas barrier properties, high solubility, and low mechanical strength for packaging purpose. To overcome this problem, biodegradable composite films for food packaging are being developed by incorporation of nano-particles to improve the efficiency of packaging materials.

Bio-polymers from agro waste

Bio-polymers are derived from biomass by-products. They are obtained from renewable sources. Biodegradable polymers of agricultural origin (Figure 1) with lipids, plant-based proteins- zein, soy, pea, gluten, and polysaccharides- starch, chitosan, sodium alginate, pectin, gums, and lignocelluloses (straws and wood) are emerging.

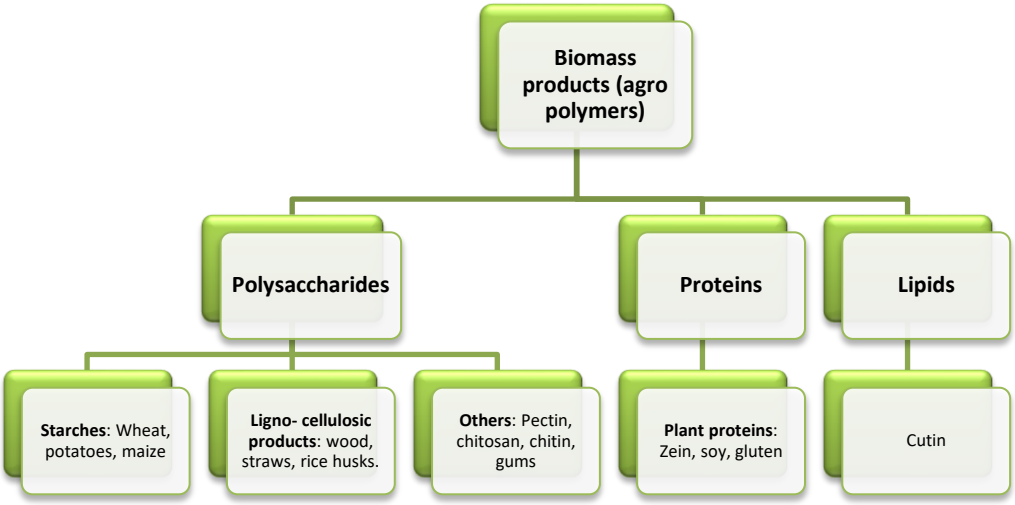

Figure 1: Main polymers of agricultural origin from renewable resources

Applications of Agro-waste for development of Biodegradable Packaging

Starch which is mainly extracted from cassava, potato peels, rice husk, wheat bran, is rich in amylose, exhibit thermoplastic property that could be used in development of packaging material. These can be easily obtained from agriculture waste at zero cost. Corn starch-based biocomposites added with rice husk and walnut shell were effective in enhancing the physical, mechanical, and thermal properties of biocomposites and could be of advantage as a sustainable packaging material (Singh et al., 2019).

Pectin, extracted from citrus peels and by-products of juice processing has diverse functionalities in sustainable packaging applications. It is the most pliable polysaccharides suitable for the formation of an effective biomaterial film due to its biodegradability, biocompatibility, and non-toxicity (Nisar et al., 2018). Pectin films act as a good oxygen barrier and have decent hardness and adhesiveness properties

(Bermúdez-Oria et al., 2017). Packaging films formed with coconut water and lime peel extract possessing antioxidant properties have shown potential to extend shelf-life of food products with an improved water barrier property, and scale down the use of synthetic packaging material (Rodsamran & Sothornvit, 2019).

Among the plant proteins, soy- protein isolate is a fine alternative to develop new bio-based packaging materials. Soy protein isolate (SPI), obtained from soybean oil processing industry has excellent gelling, emulsifying ability, and strong water and oil holding capacity. SPI-based films usually show lower oxygen permeability as compared to films based on synthetic polymers, starch, hemicelluloses, and pectin (Nishinari et al., 2014).

Cellulose from agro-waste such as rice straw, wheat hull, wood chips, wood pulp, maize stalk, sorghum waste, is used as raw material for the formation of biodegradable film packaging. It is the most abundant polysaccharide biopolymer available worldwide. Multiple hydroxyl groups of cellulose in cellulosic materials can be modified either partially or wholly on treating with numerous chemicals to produce a variety of end products stated as cellulose derivatives (Israel et al., 2008). Cellulose Nanocrystals (CNCs) and cellulose nanofibers (CNFs) are non-toxic, biodegradable, have high strength and barrier protection. CNCs and Corn zein are utilized for the preparation of oxygen and water vapor barrier biocomposite films (Ben Shalom et al., 2021).

Plant cutin is the main element (80% w/w) of the skin fraction of tomato pomace. Cutin extracted from tomato waste is a non-toxic, compostable, waterproof, UV-blocking, amorphous, insoluble, and infusible lipid-based polymer made of esterified C16 and C18 hydroxy acids (Domínguez et al., 2011).

CONCLUSION

Food industry has seen significant advances in the packaging sector. One of which is the use of bio-polymers prepared from agro-waste for packaging applications. Food waste that generally ends up in landfills and causes environmental damage, can be transformed into biodegradable packaging material. Bio-based packaging could serve as an alternative to synthetic packaging materials. Use of agro-waste as raw materials for developing biodegradable packaging can be economical and contribute to recycling of waste and to a sustainable eco-friendly environment.

REFERENCES

Ben Shalom, T., Belsey, S., Chasnitsky, M., & Shoseyov, O. (2021). Cellulose Nanocrystals and Corn Zein Oxygen and Water Vapor Barrier Biocomposite Films. *Nanomaterials (Basel, Switzerland)*, *11*(1). https://doi.org/10.3390/nano11010247

Bermúdez-Oria, A., Rodríguez-Gutiérrez, G., Vioque, B., Rubio-Senent, F., & Fernández-Bolaños, J. (2017). Physical and functional properties of pectin-fish gelatin films containing the olive phenols hydroxytyrosol and 3,4-dihydroxyphenylglycol. *Carbohydrate Polymers*, *178*, 368–377. https://doi.org/https://doi.org/10.1016/j.carbpol.2017.09.042

Domínguez, E., Heredia-Guerrero, J. A., & Heredia, A. (2011). The biophysical design of plant cuticles: an overview. *New Phytologist*, *189*(4), 938–949. https://doi.org/https://doi.org/10.1111/j.1469-8137.2010.03553.x

Israel, A. U., Obot, I. B., Umoren, S. A., Mkpenie, V., & Asuquo, J. E. (2008). Production of Cellulosic Polymers from Agricultural Wastes. *E-Journal of Chemistry*, *5*, 436356. https://doi.org/10.1155/2008/436356

Nisar, T., Wang, Z. C., Yang, X., Tian, Y., Iqbal, M., & Guo, Y. (2018). Characterization of citrus pectin films integrated with clove bud essential oil: Physical, thermal, barrier, antioxidant and antibacterial properties.

International Journal of Biological Macromolecules, *106*, 670–680. https://doi.org/https://doi.org/10.1016/j.ijbiomac.2017.08.068

Nishinari, K., Phillips, G. O., Guo, S., & Fang, Y. (2014). Soy proteins: A review on composition, aggregation and emulsification. *Food Hydrocolloids.*, *39*, 301–318. https://doi.org/10.1016/j.foodhyd.2014.01.013

Rodsamran, P., & Sothornvit, R. (2019). Lime peel pectin integrated with coconut water and lime peel extract as a new bioactive film sachet to retard soybean oil oxidation. *Food Hydrocolloids*, *97*, 105173. https://doi.org/https://doi.org/10.1016/j.foodhyd.2019.105173

Singh, T., Gangil, B., Patnaik, A., Biswas, D., & Fekete, G. (2019). Agriculture waste reinforced corn starch-based biocomposites: effect of rice husk/walnut shell on physicomechanical, biodegradable and thermal properties. *Materials Research Express*, *6*(4), 45702. https://doi.org/10.1088/2053-1591/aafe45