iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** V **Month of publication:** May 2022

DOI: https://doi.org/10.22214/ijraset.2022.42784

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue V May 2022- Available at www.ijraset.com

Waste Vegetable Peals as Bioplastics: A Review

Suresh B[1], Poojitha[2]
[1, 2]*Department of Civil Engineering, M. Tech Programme in Environmental Engineering, Biotechnology, Bapuji Institute of Engineering and Technology, Davanagere - 577004, Karnataka, India*

Abstract: ***Bio-plastic is a significant role in our ecosystem as it is eco-friendly and compatible, when matched to plastic carry bags. Bio-plastic are produced by organic waste in environment and it degrading faster than plastic which was made of chain of polymers. Plastic made our environment poisonous, aquatic animals to die and many more. Environmental friendly plastic is made of many organic wastes like banana peel, sugarcane bagasse, newspaper, shrimps etc. Bio-plastic mostly utilised in food packaging so that they are edible to humans and doesn't cause any disease and disintegrates fast. Bio-plastic is helpful to mankind and useful to reduce environmental pollution. Bio-plastics are not affected to nature ecosystem because it can changes back into carbon dioxide. The plastics are substituted by number of varieties of bio-plastics. In this research paper chiefly discussed on utilization of substrates like vegetable waste, fruit and green leaves including water hyacinth as alternate substrate as bio- plastics. Market demand for bio-plastic is developing due to consumer-friendly products. It is less related with conventional plastics production than other bio-plastics.***
Keywords: bio-plastic, environmental friendly, organic substance.

I. INTRODUCTION

Plastics are long chain artificial polymeric molecules that are low-cost, lightweight and durable (Scott, 1999). The species in the ocean and the ecosystem get affected everyday due to the addition of plastic substance and the effects is called Trash islands also garbage patches (Jefferson, et al., 2009). The macro-plastics are renewed into micro-plastics, to convert into still small fragments takes nearly about 400 years (Ezeoha, et al., 2013). The plastics which contains chlorine releases the destructive chemical substance into the soil then enters into ground water through water cycle. This changes in the food chain and also harmful to species that intake through mixed water (Kathiresan, et al., 2003).

II. EXPERIMENTS OF BIO-PLASTICS

Literate survey summarises, collected, represented and analytical data by academic and industrial researchers from bio-plastcs and their effects on the ecosystem. The scholar's relevant work searched by placing the relevant studied to discuss in the present study. Bio plastics prepared using petroleum based, biomass based, biodegradability, disposal as waste, recycling and life cycle appraisal. Industrial research work done by the researchers like primary data accessible on company and agencies websites, was included from this review as such data gives information about the bio-plastic as economic, cutting-edge research and development activties. To specifically meet the objectives of the current review, discussed presenting a new categories of bio-plastics including its positive and negative impact on ecosystem were also discussed. The outcome of this literature review are represented in four parts. The first part is Plastics and Ecosystem, discusses currently using conventional plastics, their bio-degradability including impact on the natural and artificial systems. The second part consists about bio-plastics and replacement of currently using plastics including some of the significance of bio-plastics for commercial and industrial activities. The third part presents advantages and disadvantages of bio-plastics including effects on materials. The fourth part defines the life cycle assessment including the eco-friendliness of bio-plastics with reference to primary analysis reported by the various authors.

III. CURRENT TRENDS OF BIO-PLASTIC

Bio-plastics are one of the supreme innovative substances that are bio-degradable and bio-based, which is created from waste, renewable sources and bio-mass are used by many authors like as jackfruit (Lothfy, et al., 2018), banana peels (Mohapatra, et al., 2015), organic waste (Goswami, et al., 2015), agriculture waste (Zulkafli, 2014), paper waste (Joshi, et al., 2015), oil palm hollow fruit bunch (Isroi, et al., 2017), sugar cane (Khosravi-Darani and Bucci, 2015), corn starch (Keziah, et al., 2018), potato (Schon, et al., 2014), rice straw (Agustin, et al., 2014), rapeseed oil (Delgado, et al., 2018),vegetables oil, cellulose from floras, starch, cotton, bacteria (Shamsuddin, et al., 2017) and occasionally from several Nano-particles like polysaccharides (carbohydrate chains) (Jabeen, et al., 2015).

©IJRASET: All Rights are Reserved

Bio-plastic degraded by the natural microorganisms such as bacteria (Ali, et al., 2017, Pradhan, S. 2014, Das, et al., 2018), algae and fungi (Momani, B. 2009). In this research paper chiefly discussed on utilization of substrates like vegetable waste, fruit and green leaves including water hyacinth as alternate substrate as bio- plastics. Describes the classification of bio-plastics then followed by merits and demerits of bio-plastics. The article also includes the processing, applications, experiments of bio-plastics and finally describe on future scenarios of bio-plastics.

A. Types of Bio-plastics-Material and Methods

Bio-plastics classified based on the type of manufactured using raw materials and its properties which are available in the market. Bio-plastics are also considered under biodegraded by microbes within a period of time in the environment. Generally, bio-plastics are classified into biodegradable (Polylactic acid, Polyhydroxy alkanoates, Cellulose, Starch) and non-biodegradable (Biopolypropylene, Biopolyethylene) plastics (Emadian et al., 2017, Mohapatra, et al., 2015, Ilyas, et al., 2016, Soykeakaew, et al., 2017, Lackner, 2015, Sun, 2015 and Rugenstein, and Angelova, 2013). Depends upon this bio-plastics are classified into four types like biomass based polymers, monomers from polymers, polymers from microbial biodegradable including fermentation, monomers and recyclable and compostable bio-plastics. Bio-plastics available in global market is assumed to be growing about 20% to 25% per year. Nearly out of total available plastics, about 10% to 15% bio-plastics will increase its market share to 26% to 34% by 2021. The bio-plastic market attained over 75 billion rupees in 2008 and it will be over 750 billion by 2021. More and more establishments are entering and investing in this market (Krzan, et al., 2006, Kaith, et al., 2010).

B. Merits and Demerits of Bio-plastics

Plastic is one of the chief pollutant which causes pollution in the ecosystem and also used in the daily life (Pradhan, 2014). Therefore, to reduce the pollution in the system, find out a substitute for alternate as plastics material to change the practice of conventional plastics. The progress was observed in the nature and world the contribution of bio-plastics. Many environmental issues can be renewed by using with polymers based on natural renewable resources like biopolymers starch based, cellulose based and other polylactides and polyhydroxyalkanoates (Kalia, et al., 2011). The properties of bio-plastics makes a good alternatives for conventional plastics. Along with this bio-plastics is having a unique properties like eco-friendly, energy efficient and biodegradable including compostable (Shamsuddin, et al., 2017). Conventional plastics affects the environment, difficulty to recycle and also creates pollutants into the ecosystem and creates pollution have various hazardous effects to the environment (Kalia, et al., 2011). Therefore, there is urgently require to rethink about the usage of kind of materials is difficult to protect air environment. Hence, bio-plastics is a replacement of conventional plastic also revolutionary way for sustainable development since both plastic are showing similar properties. Moreover, in certain condition bio-plastic shows better properties with some mechanical and thermal properties also water transmission rate (Pandey, et al., 2014). Some of the Bio-plastics having advantage like sustainable, reduced carbon foot print, reduce energy efficiency and partly prepared with natural feedstock. Like that some of the disadvantages costly, thermal instability, recycling problem and brittleness. Comparatively, bio-plastic and conventional plastics are showing similar properties observed by previous researchers (Shamsuddin, et al., 2017, Chen, Y. J. 2014, Jabeen, et al., 2015, Ilyas, et al., 2016, Lackner, M. 2015, Shivam, P. 2016, Reddy, et al., 2013, El-kadi, 2014, Andrady, et al., 2009, Arikan, et al., 2015, Pandey, et al., 2014).

C. Bio-plastic as Packaging Material

The bio-plastics introduced in 2018, as packaging material and market accounted for roughly 68% of the world-wide manufacturing of bio-plastic (European Bioplastics, 2019). Some presently created and applied bio-polymers using renewable resources contains cellulose and starch, which are biopolymers that are obtained directly from agricultural waste (de Moura, et al., 2017). However, bio-based does not considered as biodegradable and compostable (Dammer, et al., 2016, European Bioplastics, 2019, Van Den Oever, 2017). Bio-based goods products contains raw materials that are renewable and can be recycled through natural processes (Niaounakis, 2015). Biodegradable products consists polymers which consumed by microorganisms through degradation process.

IV. PROCESSING AND APPLICATION

Bio-plastics produced using PHAs as biomass source can be used for packaging material and disposable products on the other hand biofuels can also be generated using PHAs. PHAs find countless applications in industry, agriculture, pharmaceuticals and health. Soon a whole variety of day-to-day products will be produced with bio-plastics; along with the things you might expect like packaging and food-services products but also components in consumer electronics and automotive components. In relation to the manufacturing of packaging, conventional plastics are being substituted by bio-plastics at a rapid pace.

There's a big demand for bio-plastic packaging and it is the largest segment of the European bio-plastic market- estimated at around 44% of 2.05 million tonnes in 2017.

Bio-plastics provide an alternative approach to packaging and are a real solution to the need for a reduction in conventional plastic use and waste. Plant based polymers are able to fully compost at the end of their useful life. Biodegradable plastics are also being used for medical devices. Dentist are also getting on board and are using bio-plastics for dental implants that fill in the hole that remains after a tooth has been extracted. The cosmetics products are another big creator of packaging for its products. Many of these products have a short life span once disposed of they end up in landfills.

Biodegradable polymers have been at the forefront of research for biomedical applications in the last 50 years. The advancements have been seen in the areas of using biodegradable polymers as delivery vehicles for controlled drug release (Lyu, et al., 2016, Sung, et al., 2019 and Maya, et al., 2017). Bio-plastics have been the great of motivating exploration like in construction and building activities. However not only builder but home owners are also attracted to use bio-plastics for different products such as in fencing, decking and so on (Souza, et al., 2012).

V. FUTURE SCENARIO OF BIO-PLASTICS

To control the disposal of plastic waste released from the various sources, most environmentally innovative and eco-friendly solution is adopt biodegradable plastic in daily life and applications. Currently non-biodegradable petroleum products are source for plastic pollution and main treats to the ecosystem especially in the absence of waste management. (Temoor Ahmed, et al., 2018) Now a day's bio and fossil based plastics are adopted as alternate for petrochemical plastics. The demand of these type of plastics are increasing constantly in certain applications. These type of materials focused in future especially for manufacturing and packaging industries including disposable medical waste. Moreover, bio-degradable plastics should be used where diffusion into the ecosystem is imminent and challenging to segregate the garbage (Vijaya and Reddy 2008 and Chen and Patel 2011). On the other hand, proper management of waste and littering control is required to take benefits of such polymers in the community.

VI. CONCLUSION

Bio-plastics have significant potential as substitutes of fossil-based plastics in many applications especially in food packaging and carry bags. They have been used in several food packaging units. Molenveld et al. [1] reported that PLA and bio-PE are adopted as bottles to cover fruits, milk, and dairy foodstuffs. PLA, starch based, and cellophane are used as films, trays/dishes, and bowls to store food, like vegetables including meats and other food items. Bio-plastics can be used as single-use plastic substances and packaging material, which was produced by seaweed as raw material. Significantly, however, bio-plastics are related with some deficiencies. It should be understood that many degradable bio-plastics end up with the landfills, which degrades slowly and releases methane gas. Hence, public are starting to use bio-plastics.

VII. ACKNOWLEDGEMENTS

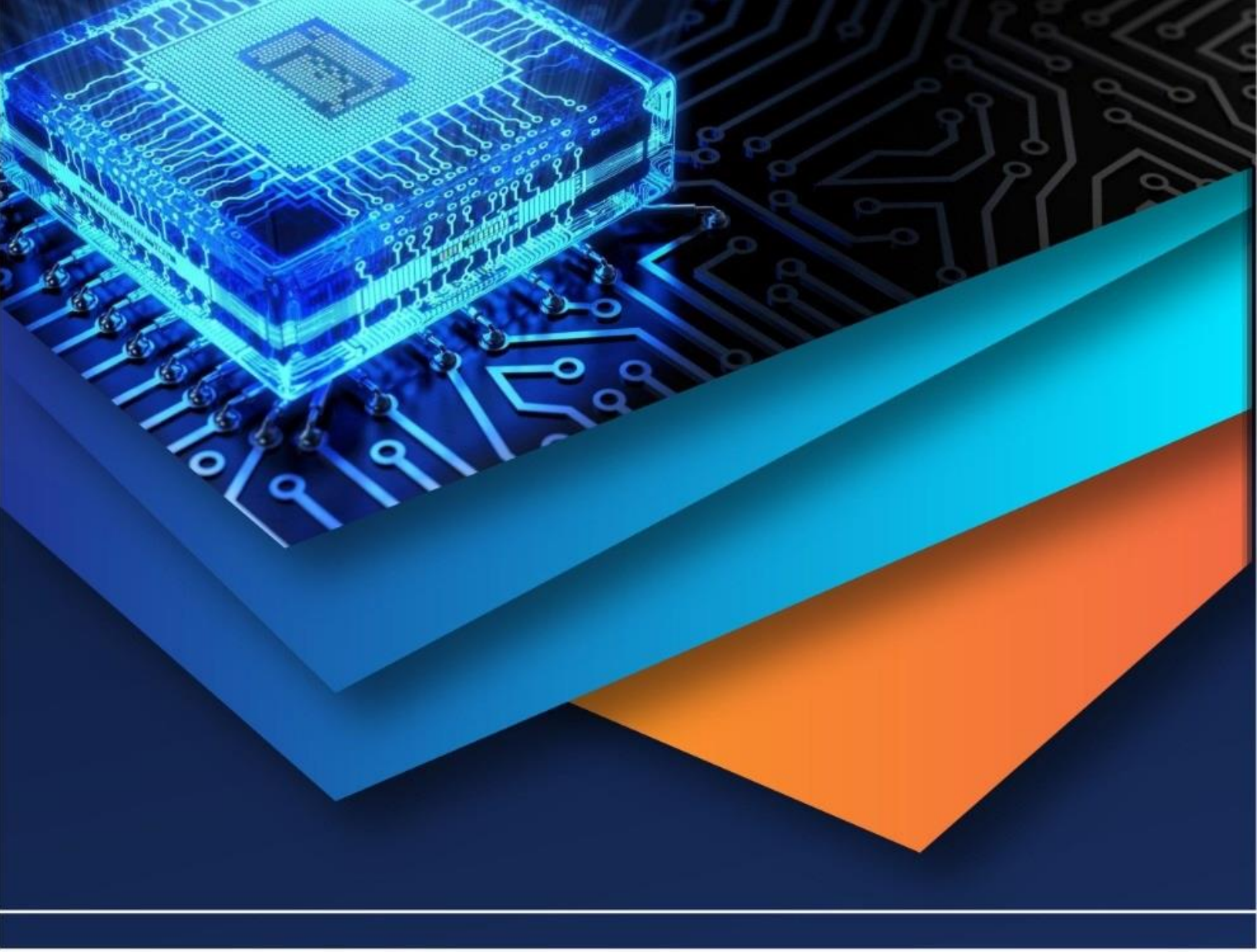
The authors gratefully acknowledge Bapuji Institute of Engineering and Technology, Davangere – 577005, Karnataka for the library and support through this work.

REFERENCES

[1] Agustin, M. B., Ahmmad, B., Alonso, S. M. M and Patriana, F. M. 2014. Bio-plastic based on starch and cellulose nanocrystals from rice straw. Journal of Reinforced Plastics and Composites. 33(24), 2205–2213.
[2] Ali, S., Zaki, N. H., Yassen, N and Obiad, S. 2017. Production of bioplastic by bacteria isolated from local soil and organic wastes. Current Resouces in Microbiology and Biotechnology. 5 (2), 1012–1017.
[3] Andrady A. L and Neal, M. A. 2009. Applications and societal benefits of plastics. Philosophical Transactions of the Royal Society B: Biological Sciences. 364 (1526), 1977–1984.
[4] Arikan, E. B and Ozsoy, H. D. 2015. A Review: Investigation of Bio-plastics. Journal of Civil Engineering and Architecture. 9, 188–192.
[5] Chen G Q and Patel M K. 2011. Plastics derived from biological sources: present and future: a technical and environmental review. Chem Rev 112:2082–2099.
[6] Chen, Y. J. 2014. Bio-plastics and their role in achieving global sustainability. Journal of Chemical and Pharmaceutical Research. 6 (1), 226–231.
[7] Dammer L and Partanan A. 2016. The EU Ecolabel and bio-based products. Bioplastics Mag 11:44–46.
[8] Das, S. K., Sathish, A and J. Stanley, J. 2018. Production of Biofuel and Bio-plastic from Chlorella Pyrenoidosa. Materials Today: Proceedings. 5 (8), 16774–16781.
[9] De Moura IG, de Sá AV and Sofia A. (2017) Bio-plastics from agro-wastes for food packaging applications. In: Grumezescu AM, Food Packaging, Academic Press, 7: 223–263.
[10] Delgado, M., Felix and M., Bengoechea, C. 2018. Industrial Crops and Products Development of bio-plastic materials : From rapeseed oil industry by products to added-value biodegradable bio-composite materials. Industrial Crops and Product. 125, 401–407.
[11] Rugenstein, E and E., Angelova, D. 2013. Bio-plastics: an alternative with a future. International Trade Fair No.1 Plastics Rubber Worldwide. 1–11.
[12] El-kadi, S. 2014. Bio-plastic production from inexpensive sources. 1-144.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

[13] Emadian, S. M., Onay, T. T and Demirel, B. 2017. Biodegradation of bio-plastics in natural environments. Waste Management. 59, 526–536.
[14] European Bio-plastics, Applications for bio-plastics, 2019. Available from: https://www.european-bioplastics.org/market/applications-sectors/.
[15] European Bio-plastics, What are bioplastics. 2019. Available from: https://www.europeanbioplastics. org/bioplastics/.
[16] Ezeoha S L and Ezenwanne J N. 2013. Production of Biodegradable Plastics Packaging Film from Cassava Starch, IOSR Journal of Engineering, 3(10), 14-20.
[17] Goswami, G., Goswami, M. G and Purohit, P. 2015. Bioplastics from Organic Waste. International Journal of Engineering Research and Technology. 3 (23), 1–3.
[18] Ilyas, R. A., Sapuan, S. M., Sanyang, M. L and Ishak, M. R. 2016. Nanocrystalline cellulose reinforced starch-based nanocomposite: A review. Conference Paper. 82–87.
[19] Isroi, I,. Cifriadi, A. Panji, T., Nendyo, A. W and Syamsu, K. 2017. Bioplastic production from cellulose of oil palm empty fruit bunch. IOP Conference series: Earth and Environmental Science. 65.
[20] Jabeen, N., Majid, I and Nayik, G. A. 2015. Bio-plastics and Food Packaging: A review. Cogent Food and Agriculture. 42(1), 1-6.
[21] Jefferson Hopewell, Robert Dvorak and Edward Kosior, Plastics recycling: challenges and opportunities, Philosophical Transactions of The Royal Society Biological Sciences, 364, 2009, 1526.
[22] Joshi, S., Sharma, U and Goswami, D. G. Bio-Plastic from Waste Newspaper. 2015.
[23] Kaith, B. S., Jindal, R., Jana, A. K and Maiti, M. 2010. Development of Corn Starch Based Green Composites Reinforced with Saccharum Spontaneum L Fiber and Graft Copolymers-Evaluation of Thermal, Physico-chemical and Mechanical Properties. Bio-resource Technology 101: 6843-5.
[24] Kalia S., Dufresne, A., Cherian, B. M., B. S. Kaith, B. S., Averous, L., Njuguna, J and Nassiopoulos, E. 2011. Cellulose-based bio- and nano-composites: A review. International Journal of Polymer Science. 2011, 35.
[25] Kathiresan. 2003. Polythene and Plastics degrading microbes from the mangrove soil, Research gate, Revista de biologia tropical, 51, 2003, 3-4.
[26] Keziah, V. S., Gayathri, R and Priya, V. V. 2018. Biodegradable plastic production from corn starch. Drug Invention Today. 10 (7), 1315–1317.
[27] Khosravi-Darani, K and Bucci, D. Z. 2015. Application of Poly (hydroxyalkanoate) In Food Packaging: Improvements by Nanotechnology. Chemical and Biochemical Engineering Quarterly. 29 (2), 275–285.
[28] Krzan, A., Hemjinda, S., Miertus, S., Corti, A and Chiellini, E. 2006. Standardization and Certification in the Area of Environmentally Degradable Plastics. Polymer Degradation and Stability 91: 2819-33.
[29] Lackner, M. 2015. Bio-plastics – Bio-based plastics as renewable and/or biodegradable alternatives to petroplastics. Kirk-Othmer Encyclopedia of Chemical Technology.
[30] Lothfy, F. A., Haron, M. F and Rafaie, H. A. 2018. Fabrication and Characterization of Jackfruit Seed Powder and Polyvinyl Alcohol Blend as Biodegradable Plastic. Journal Polymer Science Technology. 3 (2), 1–5.
[31] Lyu Y., Fang Y., Miao Q., Zhen X., Ding D and Pu K. 2016. Intraparticle Molecular Orbital Engineering of Semiconducting Polymer Nanoparticles as Amplified Theranostics for in Vivo Photoacoustic Imaging and Photothermal Therapy. ACS Nano. 10: 4472-4481. doi: 10.1021/acsnano.6b00168.
[32] Maya Vetencourt J. F., Ghezzi D., Antognazza M.R., Colombo E., Mete M., Feyen P., Desii A., Buschiazzo A., Di Paolo M and Di Marco S. 2017. A fully organic retinal prosthesis restores vision in a rat model of degenerative blindness. Nat. Mater. 16:681–689. doi: 10.1038/nmat4874.
[33] Mohapatra, A., Prasad, S and Sharma, H. 2015. Bio-plastics Utilization of Waste Banana Peels for Synthesis of Polymeric Films.
[34] Molenveld K, Van Den Oever M J A and Bos H L. 2015. Bio-based Packaging Catalogue, Wageningen: Wageningen UR-Food and Biobased Research.
[35] Momani, B. 2009. Assessment of the Impacts of Bio-plastics: Energy Usage, Fossil Fuel Usage, Pollution, Health Effects, Effects on the Food Supply, and Economic Effects Compared to Petroleum Based Plastics. Worcester Polytechnic Institute.
[36] Niaounakis M. 2015. Definitions of terms and types of biopolymers, Biopolymers: Applications and Trends, Oxford: William Andrew Publishing, 1–90.
[37] Pandey, A., Kumar, P and Singh, V. 2014. Application of Bioplastics in Bulk Packaging: A Revolutionary. University of Science & Technology, Hisar, Haryana, India.
[38] Pradhan, S. 2014. Optimization and Characterization of Bioplastic Produced by Bacillus Cereus SE1. National Institute of Technology Rourkela, Odisha
[39] Reddy, R. L., Reddy, V. S and Gupta, G. A. 2013. Study of Bio-plastics As Green & Sustainable Alternative to Plastics. International Journal of Emerging Technology and Advanced Engineering. 3 (5), 82–89.
[40] Schon, M and Schwartz, P. 2014. Production of Bioplastic.
[41] Scott G, Environmental stability of polymers- In Polymers and the Environment, Royal Society of Chemistry, 1999.
[42] Shamsuddin, I. M., Jafar, J. A., Shawai, A. S. A., Yusuf, S., Lateefah, M and Aminu I. 2017. Bio-plastics as Better Alternative to Petroplastics and Their Role in National Sustainability: A Review. Advances in Bioscience and Bioengineering. 5 (4), 63–70.
[43] Shivam, P. 2016. Recent Developments on biodegradable polymers and their future trends. Int. Res. J. Sci. Eng. 4(1), 17–26.
[44] Sivan, A. 2011. New Perspectives in Plastic Biodegradation. Current Opinion in Biotechnology 22:422-6.
[45] Souza, A.C., Benze, R., Ferrão, E.S., Ditchfield, C., Coelho, A.C.V and Tadini, C.C. 2012. Cassava starch biodegradable films: Influence of glycerol and clay nanoparticles content on tensile and barrier properties and glass transition temperature. LWT - Food Science and Technology. 46, 110–117.
[46] Soykeabkaew, N., Tawichai, N., Thanomsilp, C., O and Suwantong, O. 2017. Nano-cellulose Reinforced Green Composite Materials. Walailak Journal Science & Technology. 14(5), 353–368.
[47] Sun, Q. 2015. Development of Bio-based and Biodegradable Film from Carbon Dioxide Based Polymer and Poly (Lactic acid). University of Guelph.
[48] Sung Y.C., Jin P.R., Chu L.A., Hsu F.F., Wang M.R., Chang C.C., Chiou S.J., Qiu J.T., Gao D.Y and Lin C.C. 2019. Delivery of nitric oxide with a nanocarrier promotes tumour vessel normalization and potentiates anti-cancer therapies. Nat. Nanotechnol. 2019; 14:1160–1169. doi: 10.1038/s41565-019-0570-3.
[49] Temoor Ahmed, Muhammad Shahid, Farrukh Azeem, Ijaz Rasul, Asad Ali Shah, Muhammad Noman, Amir Hameed, Natasha Manzoor, Irfan Manzoor and Sher Muhammad. 2018. Biodegradation of plastics: current scenario and future prospects for environmental safety. Environmental Science and Pollution Research, 25:7287–7298
[50] Van Den Oever M, Molenveld K and Van Der Zee M. 2017. Bio-based and Biodegradable Plastics–Facts and Figures: Focus on Food Packaging in the Netherlands, Netherlands: Wageningen Food & Biobased Research.
[51] Vijaya C and Reddy R M. 2008. Impact of soil composting using municipal solid waste on biodegradation of plastics. Indian J Biotechnol 7: 235–239.
[52] Zulkafli, N. N. Production of Bioplastic from Agricultural Waste. 2014.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)