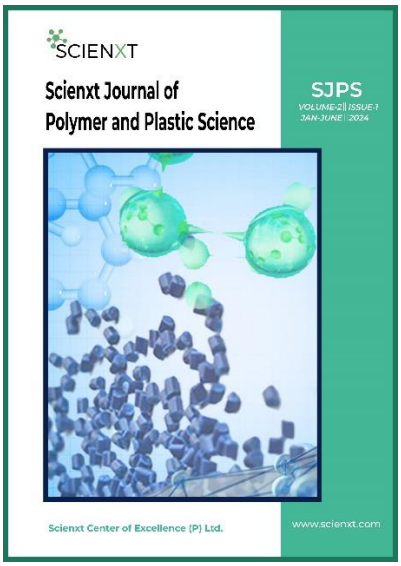

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Synthesis and characterization of bio-degradable plastic

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Abstract:

Much of the plastic waste found in nature consists of conventional, non-biodegradable plastics, and their harmful effects on terrestrial and marine organisms when ingested or entangled are largely documented. Biodegradable and compostable shopping has recently been developed as an alternative to traditional shopping. These plastics are specially designed to break down in composting facilities and produce a product that is non-toxic to soil and crops. In this study, mucilage is prepared from the seeds, which is used as a protein containing large molecular proteins. Monosaccharide units of xylose, arabinose, rhamnose and galactoronic acid with traces of galactose and glucose in basil seed. Because basil seeds are rich in fiber, they act as a strong binding element. These slimes, after dewatering and adding plasticizers (eg, ionic liquids) and fillers (eg, cellulose nanocrystals), cross-link to increase the strength of the bio-plastic.

Other samples of Isabgol/psyllium plant seeds are also used. Isabgol, also known as psyllium husk, is derived from the seeds of the Plantago ovata plant. It is often used as a dietary supplement because it is high in soluble fibre. The seeds contain a gelatinous substance that forms a gel-like compound when mixed with water. The aim of this research is to find an alternative to the use of plastic in relation to seed plants.

Keyword:

Seeds, Mucilage, Bio-plastic, Basil, Isabgol, Psyllium.

1. Introduction:

Global production of plastics remains at the high level despite the hazardous causes of their use that can degrade many aspects of human life. Biodegradable plastics can completely degrade in landfills, sewage or composter treatment plants by the action of naturally occurring micro-organisms. Truly biodegradable plastics leave of no toxic, visible or distinguishable residues after following degradation stages. Several countries have banned traditional plastic bags and replaced them with a new generation of bags labelled as biodegradable and compostable. Plants naturally create a variety of polymers such as rubber, starch, cellulose, and storage proteins, all of which are utilized in the production of biodegradable plastics... Biodegradable plastic is plastic that's designed to break up when exposed to the presence of micro-organisms. Typically crafted from natural by- products, it undergoes stringent monitoring of temperature and humidity within industrial settings.

Most biodegradable and compostable plastics are called bio-plastic and they are generally made from plants (such as bamboo or sugarcane) rather than fossil fuels. For these bio-plastics to be fairly and effectively biodegradable, their compostability needs to be confirmed. In accordance with international standards; ensuring suitability for processing in industrial composting facilities is a priority. Biodegradable plastics represent a promising and innovative solution to the pervasive environmental issues associated with conventional, non- biodegradable plastics. As society grapples with the escalating challenges posed by plastic pollution, the development and adoption of biodegradable plastics have gained significant attention as a potential remedy to mitigate environmental harm. Biodegradable plastics are polymers that can naturally decompose into by- products through the action of microorganisms such as bacteria, fungi, or other living organisms. In contrast to conventional plastics; which endure in the environment for centuries, biodegradable plastics... offer the prospect of reducing the longevity of plastic waste and minimizing its ecological impact.

2. Bio-degradation:

Biodegradation is the natural process by which organic substances are broken down into simpler compounds by living organisms, typically microorganisms like bacteria and fungi. This ecological process involves the enzymatic actions of these microorganisms, leading to the decomposition of complex organic molecules into smaller, environmentally benign components. In the context of biodegradable plastics, the material undergoes a Biodegradable

materials process when exposed to microbial activities, ultimately transforming into non-toxic by-products, water, carbon dioxide, and biomass. Biodegradation plays a crucial role in recycling organic matter and minimizing environmental impact by returning substances to their natural, harmless state. Through enzymatic processes, these organisms metabolize complex molecules into simpler, environmentally safe components. [4] Bio-based materials may not inherently possess biodegradability; this hinges on the specific chemical processes employed during their manufacture and the proportion of bio-based raw materials utilized. Nonetheless, bio-based materials generally exhibit superior environmental performance compared to their fossil- based counterparts. [5] Their usages are expanding across diverse industries, including plastics, chemicals, fashion, and footwear. Enhancing biodegradability is a significant focus, driving innovation towards more sustainable solutions. Notably, the biodegradable plastic sector is experiencing a notable growth, spurred by global governmental efforts to mitigate the environmental repercussions of single-use plastics.

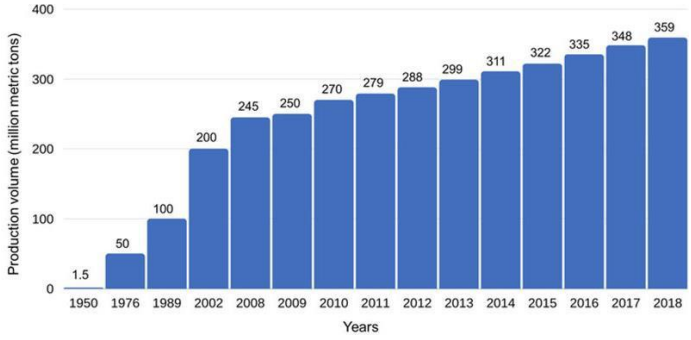

Figure. 1.1: Production of plastic waste worldwide

3. Bio-plastic:

Bio-plastics are plastic materials produced from renewable biomass sources, such as vegetable fats and oils, corn starch, straw, woodchips, sawdust, recycled food waste, etc. Some bio-plastics are obtained by processing directly from natural biopolymers including proteins, while others are chemically synthesized from sugar derivatives and lipids from either plants or animals, or biologically generated by fermentation of sugars or lipids. In contrast, common plastics, such as fossil-fuel plastics, are from petroleum or natural gas. Bio- plastics represent a transformative approach to plastic production, offering a more environmentally friendly alternative to traditional petroleum-based plastics. These innovative materials are derived from renewable resources, such as plants, bacteria, or other biological matter, and are designed to address the escalating concerns surrounding plastic pollution. Bio-plastics represent a transformative approach to plastic production, offering a more environmentally friendly

alternative to traditional petroleum-based plastics. [8] These innovative materials are derived from renewable resources, such as plants, bacteria, or other biological matter, and are designed to address the escalating concerns surrounding plastic pollution. The manufacturing process of bio-plastics involves the extraction or fermentation of organic feed stocks to obtain polymers. These polymers are then processed using techniques similar to those employed in traditional plastic manufacturing. The resulting bio-plastic products exhibit diverse properties, ranging from rigid structures suitable for packaging to flexible films used in various applications. [9]

3.1. Bio-plastics using seeds germination:

The recent study conducted [Ewa Liwarska-Bizukoj, 2022 Feb: 289:133132], we could plot that Bio-plastics do not affect seed germination of higher plants even at the high concentrations in the soil environment. Dicotyledonous plants are more sensitive to the exposure of plastics than monocotyledonous plants. Subsequently, they are better bio-indicators for the assessment of the effect of plastics on the early growth of higher plants.

The study [Vimal Priya S, 2022] shows, bio-plastic have attracted increasing interest due to their wide application in food packaging and in the biomedical science. These eco-friendly bio-plastics reduce rapidly and replace the usage of the petroleum based plastic due to their safety and biodegradability. This research focuses on starch based bio plastic making from Amaranthus cruentus. It aims to characterize the resulted bio-plastic. The bio-plastic preparation takes place by mixing of starch from Amaranths cruentus and glycerol. The research result concluded that the synthesis of starch based bio-plastic from Amaranthus cruentus seed starch was feasible solution.

3.2. Developments of starch based bio-plastic:

Jackfruit seedlings were selected as source for starch because their huge availability, low-priced or even free, and high starch capacitance. Afterward, a starch-based bio-plastic fabrication process was proposed. Conducting preliminary tests, plasticizers were sufficiently selected, including water, glycerin, nutri-bicarbonate, and citric acid. Until different combinations of these plasticizers, four type's bio-plastics were then fabricated to study the effect of the plasticizers as well as characterizing the properties of corresponding bio-plastics. The bio-plastic specimens were fully plasticized. Though the fabricated bio-plastic has lower mechanical properties than petroleum-based plastics, its environmental friendliness and high potential added value promise to be a future material [Trieu Khoa Nguyen, 2022].

In the conducted research [Nayem Hossain, 2022], starch-based bio-composite films with

varying percentages of fenugreek was successfully developed, using vinegar and glycerin. The properties of bio-composite films were significantly affected by the concentration percentages of fenugreek. The results of biodegradability testing showed that up to 62.5% of the bio-composite film had degraded within just 30 days. Lower percentages of fenugreek distributed correctly in the film resulted in higher mechanical strength. Higher percentages of fenugreek led to the formation of an amorphous structure of bio-composite films, confirmed with XRD analysis. Thermal stability was insured for synthesized bio-composites by thermal analysis. Some samples showed antimalarial activity against Staphylococcus aureus bacteria, which confirmed usability the synthesized bio- composites in packaging applications. [10].

3.3. Bio-composite film:

In this study [Reza Ahmadi, 2020] and his fellow's members, the physical, thermal and mechanical properties of a novel editable film based on psyllium hydrocollide (PH) were investigated. PH films were prepared by incorporation of three levels of glycerin. As glycerin concentration increased, water vapor permeability, percentage elongation and water solubility of PH films increased whilst tensile strength, surface hydrophobicity and glass transition point decreased significantly. This study revealed that the psyllium hydrocollide had a good potential to be used in producing editable films with interesting specifications.

In recent years, environmental disorder, consumer health conceits, and economic restrictions associated with synthetic plastics have led to application renewable, biodegradable, and editable resources for developing foot packaging. Editable packaging can be important maintain the food quality and preventing the microbial and chemical spoilage of foods. Several seeds can produce 'seed-based muscular' with different techno-functional properties for application in various foot products. In the field of packaging, this muscular can be extruded into coating and films and improve barrier properties against transfer oxygen and moisture. Likewise, bioactive ingredients can also be incorporated into these muscular which will extend shelf life foot products. This research gives overview of various seed muscular, their production and characteristics of the films/coating prepared with them for successful applications in different food products.

3.4. Usage in crop production

Bio-based and biodegradable plastics could contribute largely to the sustainability crop production by replacing the current fossil fuel-based, non-biodegradable plastics and contributing to the development of new approaches, that could improving the efficiency applied

agricultural inputs of energy and materials. All these applications have led some authors to adopt term "plasticulture" when discussing the use plastic materials in agriculture and related industries. Regrettably, the sustainability of utilizing plastics in this manner is limited, with terms like renewability and degradability emerging as pivotal points in discussions about sustainable plastic production and usage.

3.5. Mucilage derived from seeds:

The aim of the study [Pavel Vostrejs, Magdalena Daria Vaverkova, Vojtech Enev 2021] was to find out the possibility of using grape seed lignin to convert polyhydroxyalkanoates using its antioxidant capacity in packaging films. For this purpose, polymer films based on a mixture of highly crystalline poly (3- hydroxybutyrate) (PHB) and amorphous polyhydroxyalkanoate (PHA) were prepared. The incorporation of grape seed lignin into PHB/PHA films had a positive effect on their gas barrier properties, antioxidant activity and biodegradability. The rate of degradation of PHA films in the compost during the experimental period reflected the change in semi-crystalline nature and varied according to the lignin content. From a toxicological point of view, the composts obtained after the biodegradation of PHA films showed the non-toxicity of PHB/PHA/GS-L materials and their degradation products had a positive effect on the germination of garlic seeds. [11]

The field of the invention concerns biodegradable plastic. Specifically, it concerns a biodegradable plastic made from starch from a non-edible source (Tamarind seed) and its production method. The present invention provides a biodegradable plastic made from non-edible starch (tamarind seeds) containing by weight tamarind powder gelatin, microcrystalline cellulose and vinegar and glycerol. The product of the present invention has a wide industrial application, e.g. in the production of biodegradable art objects/household objects, carrier bags, packaging materials etc. and also in the field of biomedicine, e.g. bandages, bandages, sutures. Other possible applications are biodegradable diapers and biodegradable sanitary napkins.

Psyllium seed glue consists of a posliuronide mixture: these bodies consist of d-galactoronic acid with I- arabinose. The latter sugar is linked to chains of d-xylose molecules of 8 to 35 molecules and a small amount of X body. Plantago ouata Forsk. The seeds contain fatty oil, protein and mucilage in such large quantities that 1 part of the seeds mixed with 20 parts of water forms a tasteless jelly in a few minutes. Two polysaccharide fractions were separated from the mucus component. One fraction dissolves in cold water, and hydrolysis yields d-xylose, aldobiuronic acid, I-arabinose and an insoluble residue; the other fraction dissolves in hot water to form a very viscous solution that gels on cooling.

4. Conclusion:

A literature review on bioplastics provides a comprehensive overview of the research and development of biodegradable and sustainable plastics from biological sources. The research covers a wide range of topics, including types of bioplastics, their production methods, applications, environmental impacts and challenges to their widespread adoption. The research highlights the versatile applications of bioplastics, from packaging materials to agricultural films, disposable cutlery and even medical implants. Scientists are actively researching new ways to use bioplastics in various industries. Bioplastic environmental impact assessment is an essential part of the literature review. The literature review includes an overview of the regulatory framework and standards related to bioplastics. This section highlights the need for standardized test methods to assess the performance and environmental impact of bioplastics. The research examines the biodegradability and compostability of bioplastics, comparing them with traditional oil-based plastics. A life cycle assessment is performed to understand the total environmental footprint. Overall, the bioplastics literature review provides a

Comprehensive overview of the current state of research in the field and highlights the opportunities and challenges that will shape the future of sustainable plastic materials.

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