WORLD JOURNAL OF PHARMACY AND PHARMACEUTICAL SCIENCES
SJIF Impact Factor 7.421
Volume 7, Issue 3, 544-550 Research Article ISSN 2278 – 4357

DEVELOPMENT AND EVALUATION OF POLYMERIC PLANTDERIVED EXCIPIENTS BASED COMPOSITE BIODEGRADABLE FILM FOR PHARMACEUTICAL/FOOD PACKAGING APPLICATIONS

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Article Received on
30 Dec. 2017,
Revised on 20 Jan. 2018,
Accepted on 09 Feb. 2018
DOI: 10.20959/wjpps20183-10898

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ABSTRACT

Utilization of plastics as packaging material has to be controlled to protect environment. A supporting pollution free environment can be created by use of eco-friendly packaging. Consequently, the idea of biodegradability has the benefits of both user-friendly and eco-friendly features. There are various packaging materials to pack different dosage forms. Starches are widely used as eco-friendly packaging material, as it is from natural resources. Biopolymers have been considered as the most promising materials for this purpose. Use of natural biopolymers for diversified applications in life sciences has several advantages, such as availability from replenishable agricultural or marine food resources, biocompatibility, biodegradability, therefore leading to ecological safety and the possibility of preparing a variety of chemically or enzymatically modified derivatives for specific end uses. So the present study aimed to find out suitable bio plastic solutions beside the petroleum based plastics. For environmental reasons; both pharmaceutical industry and food industry, would like to use biodegradable materials but these have to fulfill the requirements and the costs has to be in a reasonable range.

KEYWORDS: Plasticizer, Biodegradable, Biopolymers, Films, Additives

INTRODUCTION

The term "polymer" derives from the ancient Greek word polus, meaning "many, much" and meros, meaning "parts", and refers to a molecule whose structure is composed of multiple repeating units. A polymer Greek *poly* ("many" *mer*"parts") is a large molecule, or macromolec, composed of many repeated subunits. Because of their broad range of properties, both synthetic and natural polymers play an essential and ubiquitous role in everyday life. A polymer is a large molecule (macromolecules) composed of many repeated subunits, known as monomers. monomers can be linked together in various ways to give linear, branched and crosslinked polymers.

Biodegradable or Biobesed Polymer

Biodegradable polymers are defined as polymers comprised of monomers linked to one another through functional groups and have unstable links in the backbone. They are broken down into biologically acceptable molecules that are metabolized and removed from the body via normal metabolic pathways. Biodegradable polymers are a specific type of polymer that breaks down after its intended purpose to result in natural byproducts such as gases ($CO2$, $N2$), water, biomass and inorganic salts. These polymers are often synthesized by condensation reactions, ring opening polymerization and metal catalysts. There are vast examples and applications of biodegradable polymers.

Biodegradable Process

Step I

The long polymer molecule are reduced to shorter and shorter length and undergo oxidation (oxygen group attach themselves to the polymer molecule) this process is triggered by heat elevated temperature found in land fills UV light.

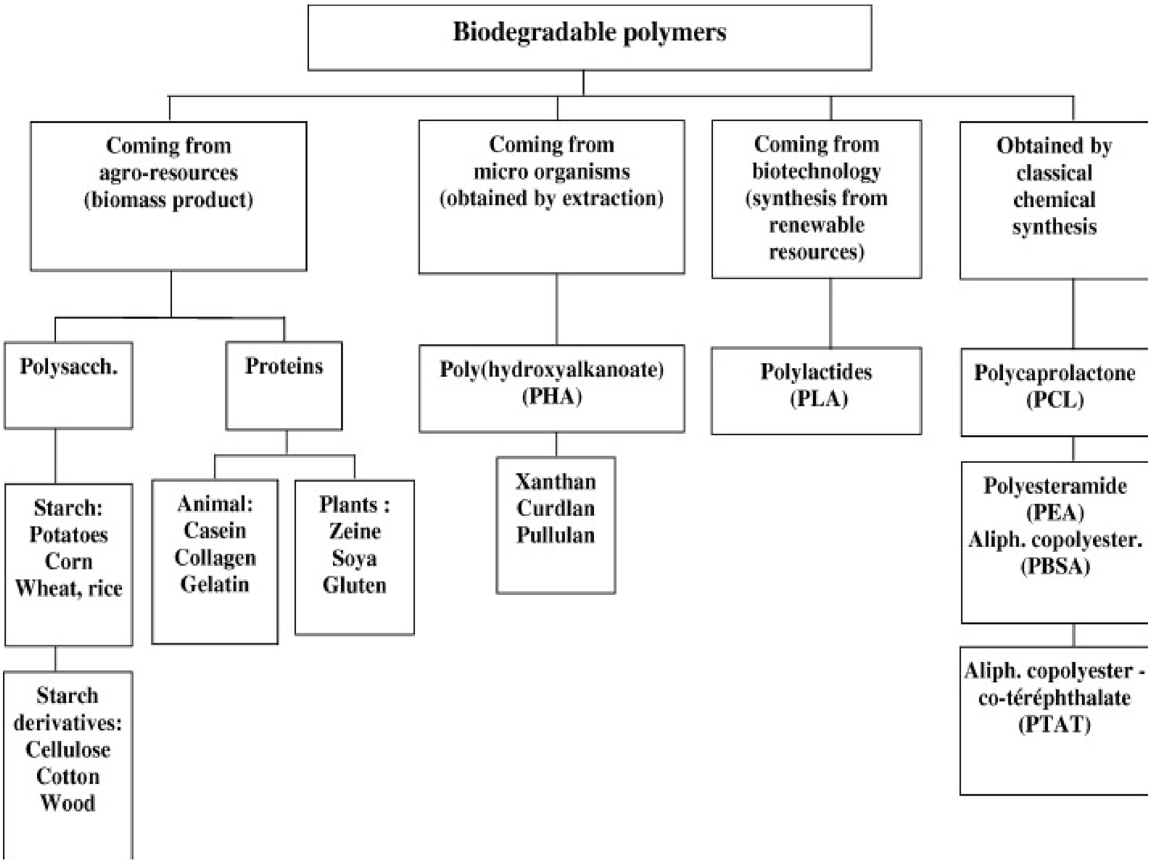
Step II

Biodegradation occurs in the presence of moisture and microorganism typically found in the environment. The plastic material is completely broken down into the residual product of the biodegradation process.

Step III

As microorganism consume the degraded plastic carbon dioxide water and biomass are produced and returned to nature by way of the biocycle.

Classification of biodegradable polymers



There are two primary mechanism throug which biodegradationcan occur. One is through physical decomposition through reaction such as hydrolysis and photodegradation, which can leads to partial or complete degradation. The second mechanistic route is through biological process which can be further broken down into aerobic and anaerobic process. The first involes aerobic biodegradation, where oxygen is present and important.

$C^{polymer} + O2 \longrightarrow$ C residue + C Biomass + CO2 + H2O.

$C^{polymer} \longrightarrow$ C residue + C Biomass + CO2 + H2O + CH4.

Biodegradable Film

Film biodegradable naturally, over a long period of time. method are available to make it more degrade under certain conditions of sunlight, moisture, oxygen and enhancement of biodegradation by reducing the hydrophobic polymer and increasing hydrophilic properties. Plastic recycling improves usage of resources. Biodegrdable film need to be kept away from the usual recycling stream to prevent contaminating the polymer to be recycled.

MATERIALS AND METHODS

Materials

Guar gum, Tragacanth, Polyethylene glycol 4000, polyethylene glycol 600, Paraffin wax, Sodium hydroxide, etc were purchased from Loba Chemical Pvt. Ltd. India. All ingredients were tested for there purity and and are 99% pure. All chemicals used in this work were of analytical grade.

Films preparation

Table no.1.1: Preparation of Biodegradable film.

Batch no.	Guar gum (g)	Tragacanth (g)	Paraffin wax (g)	PEG 4000 (ml)	PEG 600 (ml)	Water (ml)
F1	2	1	0.5	1	-	70
F2	2	1.5	0.5	1.5	-	70
F3	1	0.5	0.5	-	0.5	70
F4	1	0.5	0.5	-	1	70
F5	1	0.5	0.5	0.5	-	70
F6	1	0.5	0.5	-	0.5	70
F7	1	0.5	0.5	1	-	70

The filmogenic solution was prepared by mixing the ingredients at various rations for the formulation of the film. In order to degas the polymeric material, the resulting mixture was centrifuged at 4000 rpm for 10 min at room temperature. films were obtained by means of a casting-solvent evaporation method using flat polypropylene Petri dishes of 55 mm of diameter. Petri dishes were placed at 50ºC for 1 h in an oven and then kept under atmospheric conditions for 1 week in a chamber until constant weight.

Films characterization

Films thickness determination: Films thickness was determined using a digital hand micrometer Schwyz (Argentina, ± 0.001 mm). Each film was measured in five different positions including the center. An average value was reported and used in permeability and mechanical properties determinations. All the films were conditioned at 25ºC for 48 h, inside a desiccator containing a saturated saline solution of sodium bromide which provided a relative humidity of 57.7%.

Moisture content

Moisture content of films was determined measuring weight loss of the films, upon drying in an oven at 110 C. Untill a constant weight was reached (dry sample weigt).

Water vapour permeability coefficient test

Standard method E 96 was used to determine WVPC with a 75 relative humidity (RH) gradient at 25 C. Diffusion cells containing anhydrous calcium chloride desiccant (0% RH, were sealed by the test film (0.00287 m2 film area). To maintain a 75% RH gradient across the film, a sodium chloride-saturated solution (75% RH) was used in the desiccator. The RH inside the cell was always lower than outside. This difference in RH corresponds to a driving force of 1753.55 Pa, expressed as water vapour partial pressure. Standard method E 96 was used to determine WVPC with a 75 relative humidity (RH) gradient at 25 C. Diffusion cells containing anhydrous calcium chloride desiccant (0% RH, were sealed by the test film (0.00287 m2 film area). To maintain a 75% RH gradient across the film, a sodium chloride-saturated solution (75% RH) was used in the desiccator. The RH inside the cell was always lower than outside. This difference in RH corresponds to a driving force of 1753.55 Pa, expressed as water vapour partial pressure. All WVPC values were corrected for air gap distance between calcium chloride and film surface by correcting the values of WVTR.

Film solubility in water

Pieces of film of 1 _ 3 cm2 were cut from each film and weighedto the nea 0.0001 g. The solubility in water of the different biodegradable films was measured from immersion assays under constantagitation in 50 ml of distilled water fo6hat2CTheremaining pieces of film after immersion were dried at 110 C toconstant weight (Final dry weight). The initial dry weight was determined by thermal processing at 110 C to constant weight. Solubility in water (%) was calculated by using the following equation.

$$\text{Solubility in water (\%)} = \frac{(\text{Initial dry weight - Final dry weight}) \times 100}{\text{Initial dry weight}}$$

Determination of mechanical properties of films

The mechanical properties of films including tensile strengt and elongation at break(%) were performed at 25 C and51% RH. In preparing samples, films were cut into 1 _ 10 cm2 strips. The films were held parallel with an initial grip separation of 5 cm and then pulled apart at a head speed of 25 mm/min. Elongation at break (deformation divided by initial grip separation and multiplying by 100) and maximum force were obtained.

RESULT AND DISUSSION

Thickness and Diameter

The thickness of film of various formulation was found to be 0.05 mm, 0.07mm, 0.08mm respectively. And the diameter of the film was found to be 5.3-5.1 cm.

Moisture Content

Moisture content of film was found to be – 1.162

Water vapour permeability coefficient test

Glass vials of equal diameter used as transmission cells were washed and drived in oven.about 1 gm fused calcium chloride was taken in the cells and patch of area equivalent to brim of the vials was fixed with the help of an adhesive. the cell were weighed accurately and kept in close desicator containing saturated solution of potassium bromide (200ml). The cells taken out and weighted after 24 hr.

Sr.No.	Formulation code	WV.gm(Cm224 h)-1
1	F1	0.034
2	F2	0.050
3	F3	0.042
4	F4	0.012
5	F5	0.041
6	F6	0.042
7	F7	0.0191

In all humidity condition the absorption increase as the humidity increases, there is increase in moisture absorption and this increase linearly.

Solubility of Film: Film was soluble in water.

Soil Biodegradable test

Weigh accurately of film, cut pieces of film & Dissolve in soil and stand for Two days. after two days completely dissolve of film.

Film was found to be completely Degrade after Two days.

SUMMARY CONCLUSION

The Prepared of biodegradable film by using natural polymer ie.gaur gum and Tragacanth is helpful of degradation of film.

- To improve the flexibility in film, plasticizer were added in the formulation, in which PEG was found to be better Plasticizer.
- The film also had low WVTR and moisture absorption.
- The prepared biodegradable film it is very good for food packaging, it is completely degrade in the soil and it is helpful for decrease the enviorment pollution.

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