THE SIGNIFICANCE OF BIODEGRADABLE POLYMERS IN OUR DAILY LIFE

M.MUNIPRASAD,
Department of Chemistry, Sri Subbaraya & Narayana college, Narasaraopet, Guntur (dt), A.P.

M.S.SUDHIR,
Department of Chemistry, Sri Subbaraya & Narayana college, Narasaraopet, Guntur (dt), A.P.

G.V.S.VALLINATH,
Department of Chemistry, Sri Subbaraya & Narayana college, Narasaraopet, Guntur (dt), A.P.

Y.RAJAREDDY,
Department of Chemistry, Sri Subbaraya & Narayana college, Narasaraopet, Guntur (dt), A.P.

R.VENUMADHAV,
Department of Botany, Sri Subbaraya & Narayana college, Narasaraopet, Guntur (dt), A.P.

ABSTRACT

In the recent years, bio-based and biodegradable products have raised great interest since sustainable development policies tend to expand with the decreasing reserve of fossil fuel and the growing concern for the environment. These polymers bring a significant contribution to the sustainable development in view of the wider range of disposal options with minor environmental impact. We make an attempt to discuss the significance of biodegradable polymers in this paper.

Keywords: *biodegradable materials-classification- trade names-uses.*

INTRODUCTION:

Polymers play a very important in our daily life with their wide range of applications in diverse fields such as packaging, agriculture, consumer products, medical appliances, building materials, industry, aerospace materials etc. , Nevertheless, the resistance of synthetic polymers to chemical, physical and biological degradation has become a serious problem when used in areas such as surgery, pharmacology, agriculture and the environment, and as a result time resistant polymeric wastes are becoming less and less acceptable. Naturally, the necessity for polymeric materials satisfying the conditions of biodegradability, biocompatibility and release of low-toxicity degradation products, as an alternative to these existing polymers is highly needed. The severe environmental problems like Waste disposal, alarming threat of global warming caused by the non-biodegradability of polyethylene (used in packaging and agriculture field) have raised concerns all over the world. We must fight against them in order to build a new society and economy free of plastic pollution in the present scenario. The use of biodegradable polymers as an alternative to non-biodegradable polymers is need of the hour.

Polyethylene can be made to an eco friendly polymer by introducing sugar moieties that will increase the hydrophilicity and the number of active sites for the microbial attack on polyethylene backbone. In recent years, biodegradable polymers from renewable resources have attracted much attention for environmental and medical applications because of their desirable properties of biodegradability, biocompatibility and natural abundance. Polylactides (PLA) is one of the leading candidates among these biomaterials. However, certain limitations of PLA such as low hydrophilicity and degradation rate, poor soft tissue compatibility, low thermal and physical properties, lack of processability hinders their wide utilization. These limitations of PLA along with its increased use in medicinal field generated more research interest for new materials by copolymerization of PLA with suitable monomers and/or polymers, so that some of the problems associated with them can be solved for wider applications. A controlled solvation and degradation could be done by graft copolymerization of lactide onto chitosan, an amino polysaccharide present in the nature.

Biodegradation is carried out by either microorganism (i.e. bacteria, fungi) or by enzymes (*in vivo* degradation).

Such processes typically need water and oxygen i.e. aerobic conditions.

Deep inside landfills, the environment will be dry and anaerobic..

Types of Biodegradable Polymers

Biodegradable polymers can be divided into three categories based on the origin of the raw materials and the process used in their preparation.

I. Natural Biodegradable Polymers

II. Synthetic Biodegradable polymers

III. Biodegradable polymer blends

I. Natural Biodegradable polymers: The natural polymers or polymers from renewable resources are again classified into four broad groups:

1. Polysaccharides (starch, cellulose, lignin, chitin and chitosan)

2 Proteins (wool, silk, collagen, gelatin and casein)

3. Bacterial polyesters (polyhydroxyalkanoates (PHAs))

4 Others (lignin, shellac, natural rubber etc.)

II. Synthetic Biodegradable Polymers

Polymers produced from feed stocks derived from petrochemical or biological resources such as polyesters, polycaprolactone (PCL),polyamides, polyurethanes, polyureas, polyanhydrides, poly(vinyl alcohol)(PVA), poly(vinyl esters) etc. generally come in this category. The higher cost of production is the main impediment for the wide utilization of these polymers.

III. Biodegradable Polymer Blends

The blending of biodegradable polymers from renewable and nonrenewable resources is a method of reducing the overall cost of the material and offers a method of modifying both properties and degradation rates. Melt processability, humidity resistance and mechanical properties of starch can be improved by blending starch with synthetic polymers such as P\/A, PLAN, PCL, PHAs etc. to make these materials suitable for the production of biodegradable films, injection-molded items and foams.

Enzymatic Degradation Synthetic polymers can generally be attacked either chemically (enzymes) or mechanically by living organism. Enzymatic degradation of biopolymers in the living systems such polysaccharides, polynucleotides and even bacterial poly(β-alkanoates) were reported and widely accepted by scientific community. However the involvement of enzymes in degradation of synthetic polymers such PLA, PGA and PCL homo- and copolymers are much discussed. In the case of poly (hydroxybutyrate), it has been found that biodegradation occurs in aerobic and anaerobic microbially active environments (sewage sludges and compost, soil and sea water). The degradation rate generally depends on the moisture level, nutrient supply, temperature and P^H.

Hydrolytic Degradation

Hydrolytic degradation is caused by the interaction of water with unstable bonds, typically ester bonds, in the polymer chain. The reaction rate is generally connected with the ability of the polymer to absorb water. Hydrophilic polymers absorb up large quantities of water and degrade more fatly than hydrophobic moieties. Basically, the hydrolytic degradation of aliphatic polyesters proceeds through ester bond breaking according to the reaction: The ester bond on interaction with water yield acid and alcohol either through acid catalysis or alkali catalysis reaction.

Naturally occurring hydroxyl acids such as glycolic, lactic, and ε-caproic acids, have been utilized to synthesize many useful biodegradable polymers for a variety of medical product applications. For example, bioresorbable surgical sutures made from poly (α-hydroxy acids) have been in clinical use since 1970; other implantable devices made from these versatile polymers (e.g., inter fixation devices for orthopaedic repair) are becoming part of standard surgical protocol.

Many research groups reported that most polymers which are degradable contain in their backbone unstable linkages such as esters, orthoesters, anyhydrides, carbonates, amides, urethanes, ureas, etc. However, aliphatic polyesters containing flexible ester bonds, and those derived from lactic acid (LA) and glycolic acid (GA) in particular appear to be the most promising because of their excellent biocompatibility and variable degradability. Several end products are already on the market, such as Dexon®, Vicryl®, Maxon®, and Monocryl® sutures; Lactomer® and Absolok® clips and staples; Biofix® and Phusiline® plates and screws; as well as Decapeptyl®, Lupron Depot®, Zoladex®, Adriamycin®, and Capronor® drug delivery devices. Also another aliphatic polyester, poly(ε-caprolactone), a poly (ω-hydroxy acid) has been the focus of many researches lately and has shown to possess excellent biocompatibility and versatility.

Table 1. Commercially available biodegradable polymers

Trade name	composition	uses
Dexon&Medifit	Polyglycolic acid (PGA)	Absorbable sutures
Vicryl	PLLA(8%)Co-PGA (92%)C	Absorbable sutures
PDS ll	Poly(p-dioxanone)	Absorbable sutures
Lactomer pins	Poly(LLA/GA 70/30)	Ligating clips & bone
Monocryl	P0ly(GA-co-8-CL)	Absorbable sutures
Maxon	Poly(GA-co-trimethylene carbonate)	Absorbable sutures
Lupron Depot	PLA/PLGA	Drug delivery products
Zoladex	PLA/PLGA	Drug delivery products
Biopol	Poly(3-HB-co-3-HV)	Packaging & Agriculture
Bionolle	Poly(butylene succinate)	Agriculture & Packaging
	Poly(ethylene succinate)	Agriculture & Packaging
Biomax	PET modified	disposable items, bottles
Cereplast	Corn & potato starch	Biodegradable utensils
Mater-Bi	Starch & Vegetable oil	Disposable items,
		packaging, personal care and hygiene.

PLLA---Poly Lactic acid
PLGA-Poly(Lactic—Co—Glycolic acid)
PET---Poly Ethylene Terpthalate
CL------Capro Lactone
Poly(3-HB-Co-3HV)---Poly(3-hydroxybutarate-co-3 hydroxyvalerate)

CONCLUSION

It can be broadly noticed that the biodegradable polymers applications have attracted much interest all over the world in different sectors such as surgery, pharmacology, agriculture and the environment. The development of novel biodegradable polymers satisfying the requirement of degradability, compatibility with the disposed environment and the release of low-toxicity degradation products are the ultimate solution to the present problems . So the scientists, technocrats should work together to develop the most efficient novel biodegradable polymers to solve the present problems cause d by the usage of polymers.