INTRODUCTION

Polymers or macromolecules are composed of very large molecules with molecular weights ranging from a few thousand to as high as millions of grams/mole. Natural polymers have been used by man since pre-history and have been modified and processed empirically over many centuries for various applications. Synthetic polymers now constitute one of the most successful and useful classes of materials and possess a broad range of physical properties.

The term "polymer" is derived from the Greek words "polys" meaning many and "meros" meaning parts, a term that aptly describes the structural nature of these substances. The most abundant organic molecules in the world are polymers. Cellulose and lignin (the main fibers in wood), starch (a natural storage form of sugar in plants), chitin (a key fiber in the cell walls of algae, fungi and arthropods), collagen (the fiber that holds soft tissues together in our bodies), DNA, RNA and proteins (key biological informational and structural molecules), and even cotton, wool, silk, and flax (natural fibers used in clothing) are polymeric in nature.

Gum exudates are amongst the oldest natural polymers. They are already being used as thickening and stabilizing agents from last several years. Pharmaceutical dosage forms contain many additives besides the active ingredients to assist manufacturing and to obtain the desired effect. The advances in drug delivery have simultaneously urged the discovery of novel polymers which are safe and fulfill specific functions and directly or indirectly influence the rate and extent of release.

Both synthetic and natural polymers are available but the use of natural polymers for pharmaceutical applications is attractive because they are economical, readily available and non-toxic. They are capable of chemical modifications, potentially biodegradable and with few exceptions, also biocompatible. Substances of
plant origin pose several potential challenges such as being synthesized in small quantities and in mixtures that are structurally complex, which may differ according to the location of the plants as well as other variables such as the season. This may result in a slow and expensive isolation and purification process. The specific application of plant-derived polymers in pharmaceutical formulations include their use in the manufacture of solid monolithic matrix systems, implants, films, beads, microparticles, nanoparticles, inhalations and injectable systems as well as viscous liquid formulations. Within these dosage forms, polymeric materials have fulfilled different roles such as binders, matrix formers or drug release modifiers, film coating formers, thickeners or viscosity enhancers, stabilizers, disintegrants, solubilizers, emulsifiers, suspending agents, gelling agents and bioadhesives.

Biopolymers are polymers formed in nature during the growth cycles; hence, they are also referred to as natural polymers. Their synthesis generally involves enzyme-catalyzed, chain growth polymerization reactions of activated monomers, which are typically formed within cells by complex metabolic processes.

Polymers have been used as a main tool to control the drug release rate from the formulations. Extensive applications of polymers in drug delivery have been realized because polymers offer unique properties which so far have not been attained by any other materials. Advances in polymer science have led to the development of several novel drug delivery systems.

Biodegradable polymers have been widely used in biomedical applications because of their known biocompatibility and biodegradability. In the biomedical area, polymers are generally used as implants and are expected to perform longer period.
These improvements contribute to make medical treatment more efficient and to minimize side effects and other types of inconveniences for patients.

They are also increasingly used as taste-masking agent, stabilizer, and protective agent in oral drug delivery. Polymers can bind the particles of a solid dosage form and also change the flow properties of a liquid dosage form. Polymers are macromolecules having very large chains, contain a variety of functional groups, can be blended with other low- and high–molecular-weight materials, and can be tailored for any applications. Polymers are becoming increasingly important in the field of drug delivery. Advances in polymer science have led to the development of several novel drug-delivery systems. A proper consideration of surface and bulk properties can aid in the designing of polymers for various drug-delivery applications. These newer technological development include drug modification by chemical means, carrier based drug delivery and drug entrapment in polymeric matrices or within pumps that are placed in desired body compartments. These technical development in drug delivery/targeting approaches improve the efficacy of drug therapy thereby improve human health. Use of polymeric materials in novel drug delivery approaches has attracted the scientists.

When the drug is delivered to the site of action by using polymer based drug delivery approaches the safety and bio compatibility is questionable. The characterization of biocompatible polymers is more focused in the field of formulation development and drug delivery approaches etc. The biodegradable polymers have properties of degrading in biological fluids with progressive release of dissolved or dispersed drug. Numerous polymer based novel drug delivery approaches are being developed. The bio-safety and biocompatibility are the important
characteristics required for the use of polymers in the field of pharmaceutical formulation and in novel drug delivery approaches.

A proper consideration of surface and bulk properties can aid in the designing of polymers for various drug-delivery applications. Biodegradable polymers find widespread use in drug delivery as they can be degraded to nontoxic monomers inside the body. Novel supra molecular structures based on polyethylene oxide copolymers and dendrimers are being intensively researched for delivery of genes and macromolecules. Hydrogels that can respond to a variety of physical, chemical and biological stimuli hold enormous potential for design of closed-loop drug-delivery systems. Many opportunities exist for the application of synthetic biodegradable polymers in the biomedical area particularly in the fields of tissue engineering and controlled drug delivery. Degradation is important in biomedicine for many reasons. Degradation of the polymeric implant means surgical intervention may not be required for removal at the end of its functional life, eliminating the need for a second surgery. In tissue engineering, biodegradable polymers can be designed in a suitable way for providing a polymer scaffold that can withstand mechanical stresses, provide a suitable surface for cell attachment and growth, and degrade at a rate that allows the load to be transferred to the new tissue. In the field of controlled drug delivery, biodegradable polymers offer tremendous potential either as a drug delivery system alone or in conjunction to functioning as a medical device. Biodegradable polymers find widespread use in drug delivery as they can be degraded to nontoxic monomers inside the body. Novel supramolecular structures based on polyethylene oxide copolymers and dendrimers are being intensively researched for delivery of genes and macromolecules.
Design and synthesis of novel combinations of polymers will expand the scope of new drug delivery systems in the future. Biodegradable polymers have been widely used in biomedical applications because of their known biocompatibility and biodegradability. Biodegradable polymers could be classified into synthetic and natural (biologically derived) polymers. Both synthetic and natural biodegradable polymers have been used for drug delivery, and some of them have been successfully developed for clinical applications\(^\text{11}\). This entry focused on various biodegradable polymers that have been used in development of drug delivery systems. Advances in organic chemistry and nano/micro fabrication/manufacturing methods enable continuous progresses in better utilization of a wide range of novel biodegradable polymers in drug delivery\(^\text{12,13}\).

From the solubility standpoint, pharmaceutical polymers can be classified as water-soluble and water-insoluble (oil soluble or organic soluble). The cellulose ethers with methyl and hydroxypropyl substitutions are water-soluble, whereas ethyl cellulose and a group of cellulose esters such as cellulose acetate butyrate or phthalate are organic soluble. Hydrocolloid gums are also used when solubility in water is desirable\(^\text{14}\). The synthetic water-soluble polymers have also found extensive applications in pharmaceutical industries, among them polyethylene glycol, polyethylene glycol vinyl alcohol polymers, polyethylene oxide, polyvinyl pyrrolidone, and polyacrylate or polymethacrylate esters containing anionic and cationic functionalities are well-established\(^\text{15}\).

Various hydrocolloids or polysaccharide gums have originated from a variety of sources. Most gums are hydrophilic and contain very long polymeric chains as well as different functional groups. These features are very attractive in many pharmaceutical processes such as coating, stabilization, thickening, binding,
solubilization, and disintegration. Gums behave differently in water and aqueous solutions. Almost all display thickening property, whereas some show gelling property. Although thickening is a desirable property for solution, suspension, and emulsion dosage forms, gelling property is utilized in drug encapsulation for controlled delivery applications\textsuperscript{16}. Gums such as guar gum can provide excellent thickening property, whereas gums including alginate and chitosan can offer a gelling property in the presence of ions. Similar to synthetic polymers, gums can be blended to provide superior properties through synergy, which cannot be achieved by individual gum alone.

Drug products designed to reduce the frequency of dosing by modifying the rate of drug absorption have been available for many years. Continuous research is going on in field of use of natural occurring biocompatible polymeric material in designing dosage form for oral controlled release administration. Natural gums are biodegradable and nontoxic, which hydrate and swell on contact with aqueous media, and these have been used for the preparation of dosage form.
NEED FOR THE STUDY

Polymer chemists and chemical engineers, pharmaceutical scientists are engaged in designing predictable controlled delivery of bio active agents. Extensive applications of polymers in drug delivery have been realized because polymers offer unique properties which so far have not been attained by any other materials.

The pharmaceutical applications of polymers range from their use as binders in tablets to viscosity and flow controlling agents in liquids, suspensions and emulsions. Polymers can be used as film coatings to disguise the unpleasant taste of a drug, to enhance drug stability and to modify drug release characteristics. Pharmaceutical polymers are widely used to achieve taste masking; thickening (rheology modifier), gelling (controlled release), adhesion (binding), pH-dependent solubility (controlled release), controlled release (e.g., extended, pulsatile, and targeted), barrier properties (protection and packaging), enhanced stability, and improved bioavailability.

The traditional use of excipients in drug formulations was to act as inert vehicles to provide necessary weight, consistency and volume for the correct administration of the active ingredient, but in modern pharmaceutical dosage forms they often fulfill multi-functional roles such as modifying release, improvement of the stability and bioavailability of the active ingredient, enhancement of patient acceptability and ensure ease of manufacture. New and improved excipients continue to be developed to meet the needs of advanced drug delivery systems.

Polymers have been successfully investigated and employed in the formulation of solid, liquid and semi-solid dosage forms and are specifically useful in the design of novel drug delivery systems. Both synthetic and natural polymers have been investigated extensively for this purpose. Synthetic polymers are toxic,
expensive, have environment related issues, need long development time for synthesis and are easily available in comparison to naturally available polymers. However, the use of natural polymers for pharmaceutical applications is attractive because they are economical, readily available, non-toxic and capable of chemical modifications, potentially biodegradable with few exceptions and also biocompatible.

A large number of plant-based pharmaceutical excipients are available today. Many researchers have explored the usefulness of plant-based materials as pharmaceutical excipients. Ability to produce a wide range of material based on their properties and molecular weight; natural polymers became a thrust area in majority of investigations in drug delivery systems. Natural gums can also be modified to meet the requirements of drug delivery systems and thus can compete with the synthetic excipients available in the market.

The fact for increase in importance of natural plant based material is that plant resources are renewable and if cultivated or harvested in a sustainable manner, they can provide a constant supply of raw materials.

Recent trend towards the use of vegetable and non-toxic products demands the replacement of synthetic additives with natural one. Many natural polymeric materials have been successfully used in sustained-release tablets. These materials include: guar gum, isapghula husk, pectin, galactomannon from *Mimosa scabrella*, *Gleditsia triacanthos Linn* (honey locust gum), *Sesbania* gum, mucilage from the pods of *Hibiscus esculenta*, tamarind seed gum, gum copal and gum dammar, agar, konjac, chitosan etc.

The present work envisages the feasibility of *Kondagogu gum* and *ghatti gum* for drug delivery. They are obtained as gummy exudates from the plants *Cochlospermum gossypium* and *Anogeissus latifolia* respectively.
By developing such novel biopolymer based drug delivery systems, the side effects caused due to the use of synthetic polymers can be reduced. Such polysaccharide based drug delivery systems will have better patient compliance. It also increases revenue of tribal people who make their living by collecting these natural polymers as gum exudates from forests, which if channelized properly, may lead to socio economic development.

Very unique features of these polymers are presence of optimal proportion of the hydrophobic and hydrophilic parts respectively and the number of free hydroxy groups in the polymeric molecule.

Natural polysaccharides hold advantages over synthetic polymers because they are non-toxic, less expensive and easily available. Natural polymers can be tailor-made for preparing drug delivery systems and thus can compete with synthetic biodegradable materials available in the market.

Hence, there is a need to develop new carriers which are safe, economical and non-toxic. In the present study, an attempt is made for the use of natural polymers, kondagugu gum and ghatti gum as carrier/ excipient for formulation of different drug delivery systems.