A Review on Utility of Herbal Polymers in Pharmaceutical Formulation

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Introduction-

The word "polymer," or "macromolecule," comes from the Greek words poly, which means "many," and meres, which means "parts." The polymer molecule has a high molecular weight (between 10 000 and 1000 000 g/mol) and is made up of many structural units that are usually bonded by covalent bonds.**[1]**

Polymers are made by combining monomers in a chemical reaction. Monomers can create polymer chains by reacting with another molecule of the same kind or another type under the right conditions. Natural polymers have resulted from this process in nature, but synthetic polymers are man-made.**[2]**

The synthesis, mechanical behavior, processing characteristics, and morphology of polymers are all used to classify them. Natural, semi-synthetic, and synthetic polymers have all made major contributions to the enhancement of human health in the medical and pharmaceutical fields.

Polymers are capable of providing sustained release of an encapsulated drug ,within its therapeutic window .This leads to reduce peaks and valleys typically associated with immediate release dosage forms.Typically natural polymers or their derivatives(such as cellulose and methyl cellulose)as well as synthetic nondergradable polymers [suchas Poly(vinyl pyrrolidone) and polymethylacrylates] are used for Oral Controlled Release (CR) applications.Due to this generic status of polymer,the emphasis in novel oral CR systems is geared more toward the mixing and matching of polymers and fabrication of the solid dosage forms ,rather than design of novel polymers. On other hand ,use of polymers for injectables and/or implantable CR systems is relatively new and more in frequent In such situation ,the polymers must not only permit CR of the Drug ,but also be biocompatible and Nontoxic.Several drugs delivery applications also require the polymer to be biodegradable(degrading into byproducts that are safe and can be cleared from the body).Thus Polymers serves as key excipients in Oral and Parenteral CR formulations.**[3]**

Polymers have been around us in the natural world since the very beginning (e.g., cellulose, starch, and natural rubber). Man-made polymeric materials have been studied since the middle of the nineteenth century. Today, the polymer industry has rapidly developed and is larger than the copper, steel, aluminum and some other industries combined.

Both natural and synthetic polymers are remarkably involved in comfort and facilitation of human life and are responsible for medication, nutrition, communication, transportation, irrigation, container, clothing, recording history, buildings, highways, etc. In fact, it is difficult to imagine human society without synthetic and natural polymers.**[2]**

Natural polymers have received attention as economical, readily available and non-toxic materials. They are capable of chemical modifications, potentially biodegradable and with few exceptions, also biocompatible.
Biopolymers are available in large quantities from renewable sources, while synthetic polymers are produced from non-renewable resources.
The polysaccharides represent one of the most abundant industrial raw materials and have been the subject of intensive research due to their sustainability, biodegradability and bio-safety .We review here a selection of the most important natural polymers that have been studied and exploited in several fields.**[4]**

Shifting towards the herbal Polymer

Natural polymers and their derivatives widely used for the development of novel drug delivery system for their compatibility with other ingredients and biodegradability, availability, and ability for chemical modification. Natural polymers are given most preference because synthetic excipients cause unwanted side effects in human body. Moreover, herbal products are safer to use so now patients and researchers looking for the natural herbal constituents instead synthetic or semi-synthetic polymers.

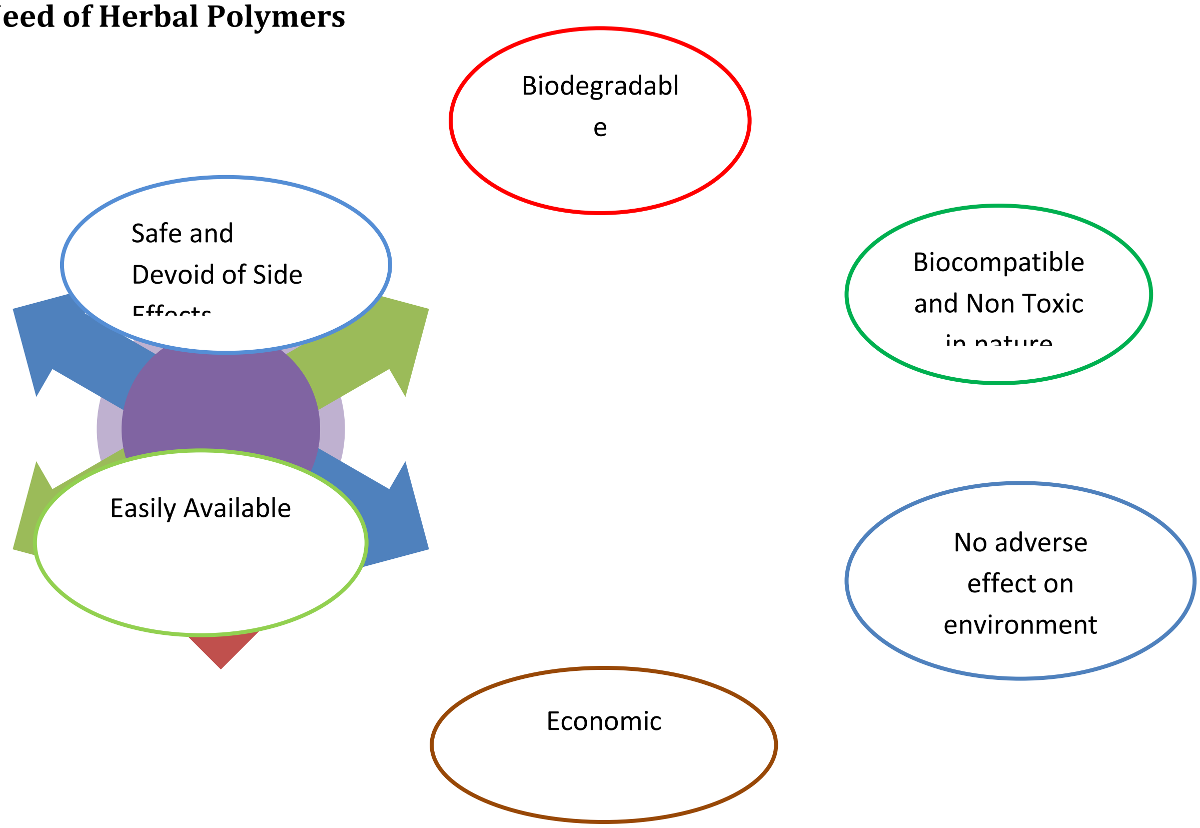
Several studies showed that natural polymers containing formulations release activities of drug influenced by the physiochemical properties, morphology, and release pattern of polymer, shape of dosage form and particle size.

Natural gums have diverse applications as a binders, suspending agents, disintegrant, swelling nature, emulsifying agents and mucoadhesive.They are also useful in the preparation of sustained release and immediate release formulations properties now exists, polymers can be tailor made for specific purposes.

In recent years as a result of better understanding of polymer structure property relationship, introduction of new polymerization techniques and availability of new and low cost monomers, the concept of a true tailor made polymer has become reality. In the years ahead, polymers will continue to grow. The growth from all the indications will be not only from the development of new polymers, but also from the chemical and physical modification of existing ones.

Polymers have become a crucial part of life, especially biodegradable polymers are of special interest since they do not accumulate in or not harm the environment and thus can be considered as green. To date, due to versatility of polymeric materials, specifically biodegradable ones, they are rapidly replacing other biomaterial classes, such as metals, alloys, and ceramics for use in biomedical application.**[5]**

Need of Herbal Polymers



• Biodegradable- Naturally occurring polymers produced by all living organisms. They show no adverse effects on the environment or human being.

• Biocompatible and Non-Toxic- Nearly all of these plant materials are carbohydrates in nature and composed of repeating monosaccharide units.

• Economic- they are cheaper and their production cost is less than synthetic material.

• Safe and Devoid of Side Effects- They are from natural source and hence, are safe to use.

• Easy Availability In many countries, they are produced due to their application in many industries.

Disadvantages of Herbal Polymers

• Microbial Contamination During production- they are exposed to external environment and hence, there are chances of microbial contamination

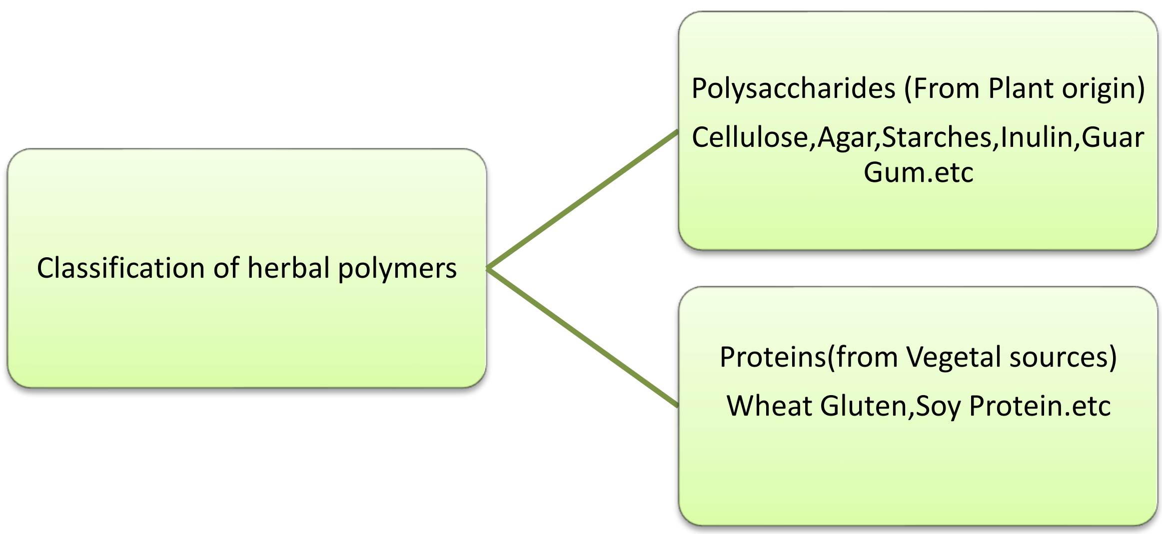
. • Batch to Batch Variation- Synthetic manufacturing is controlled procedure with fixed quantities of ingredients while production of natural polymers is dependent on environment and various physical factors.

• The Uncontrolled Rate of Hydration- Due to differences in the collection of natural materials at different times, as well as differences in region, species, and climate conditions the percentage of chemical constituents present in a given material may vary.

• Slow Process- As the production rate is depends upon the environment and many other factors, it can't be changed, and thus natural polymers have a slow rate of production.

• Heavy Metal Contamination There are chances of Heavy metal contamination often associated with herbal excipients.**[6]**

Classification of Herbal Polymers-



1. Cellulose

Source-Cellulose is an organic polysaccharide located within the fiber walls of plants. This natural polymer is the most important and fascinating biopolymer**.[4]**

Diiferent sources for Cellulose:

Natural Source

1.Natural Fibers:-

Natural fibers are made from plant, animal and mineral sources. Natural fibers can be classified according to their origin. Vegetable fiber Vegetable fibers are generally composed mainly of cellulose: examples include cotton, jute, flax, ramie, sisal, and hemp. Cellulose fibers serve in the manufacture of paper and cloth. This fiber can be further categorized into the following:**[12,13]**

Category	**Description**	**Example**	**% of Cellulose**
Seed fiebers	Fibers collected from seed cases or seeds	Cotton,Kapok	90
Leaf fibers	Fibers collected from leaves	Sisal,fique,agave	33
Bast fibers	Fibers are collected from the skin or bast surrounding the stem of their respective plants.	Flax,jute,kenaf,Hemp, Ramie,rattan and vine fibers.	33
Skin			
Fruit fibers	Fibers are collected from the fruit of the plant	Coconut(coir) fiber	30-50
Stalk fibers	Fibers are actually the stalks of the plant.	Rice,barley,wheat,straws,bamboo, Grass,tree wood	40-50

Cellulose fibers Cellulose fibers are a subset of man-made fibers, regenerated from natural cellulose. The cellulose comes from various sources. Modal is made from beech trees, bamboo fiber is a cellulose fiber made from bamboo, sea cell is made from seaweed, etc. Bagasse is cellulose fiber made from sugarcane.

The most used vegetable fibers are - cotton, flax and hemp, although sisal, jute, kenaf, bamboo

Description-

These carbohydrate polymers consisting of tens to hundreds to several thousand monosaccharide units.(Glucose). Cellulose is the main building material out of which plants are made, and plants are the primary or first link in what is known as the food chain (which describes the feeding relationships of all living things), cellulose is a very important substance. Most abundant naturally occurring biopolymer.Various natural fibers such as cotton and higher plants have cellulose as their main constituent. It consists of long chains of anhydro-D-glucopyranose units (AGU) with each cellulose molecule having three hydroxyl groups per AGU,(DevabaktuniLavanyaetal)**[7]**

Advantages-

1. It is used in various surgical procedures, by direct application to the oozing surface except when used for homeostasis.

2. It used in the development of variety of cosmetic, pharmaceutical, agricultural, and consumer products. Topical formulations (cream, lotion, or spray) prepared using the oxidized cellulose material, are bioadhesive, can be applied on the human skin or hair; can be included in cosmetics

3. Oxidized cellulose dispersion uses in antiacne cream, anti-acne lotion, sunscreen sprays, anti-fungal cream also.**[8]**

Disadvantages- 1.oxycellulose is not recommended as a surface dressing for open wounds.

2. Microcrystalline cellulose used as a emulsifier and stabilizer and also Used as anti-caking and dispersing agent.**[8]**

Applications-

1. Cellulose based polymers in development of amorphous solid dispersions(Rahul. B.Chavan*et.al.)***[9]**
2. Bioactive and drug-delivery potentials of polysaccharides and their derivatives (Ashok .K.Singh*et.al)***[10]**
3. Cellulose as a Nanostructured Polymer: a short review (Michael Ioelovich*)**[11]**

2. Agar

Source-Agar or agar-agar consists of dried gelatinous substance obtained from *Gelidiumamansii*(*Gelidaceae*) and it is also obtained from several other species of red algae like, gracilaria (*Gracilariaceae*) and Pterocladia (*Gelidaceae*).**[14]**

According to the US Pharmacopeia, agar can be defined as a hydrophilic colloid extracted from certain seaweeds of the Rhodophyceae class. It is insoluble in cold water but soluble in boiling water. A 1.5% solution is clear and when it is cooled to 34-43°C it forms a firm gel which does not melt again below 85°C. It is a mixture of polysaccharides whose basic monomer is galactose. These polysaccharides can be sulphated in very variable degrees but to a lesser degree than in carrageenan. For this reason the ash content is below those of carrageenan, furcelleran (Danish agar) and others. 5% maximum ash content is acceptable for agar although it is normally maintained between 2.5-4%.

Agar is the phycocolloid of most ancient origin. In Japan, agar is considered to have been discovered by MinoyaTarozaemon in 1658 and a monument is Shimizu-mura commemorates the first time it was manufactured. Originally, and even in the present times, it was made and sold as an extract in solution (hot) or in gel form (cold), to be used promptly in areas near the factories; the product was then known as tokoroten. Its industrialization as a dry and stable product started at the beginning of the 18th century and it has since been called kanten. The word "agar-agar", however, has a Malayan origin and agar is the most commonly accepted term, although in French- and Portuguese-speaking countries it is also called gelosa.**[16]**

Description

Agar is highly heterogenous in nature and is one of the major structural components in the cell wall of red seaweeds that forms highly viscous solution and strong gels. Molecular weight of agar polysaccharide ranges from 80,000 to 140,000 daltons with polydispersity lower than 1.7. Agar is mainly composed of D-galactose, and its anhydride 3,6-anhydro-Lgalactose (Rees, 1972).

Chemical structure of agar was solved by Araki and Percival in 1938. Later, Araki (1956) showed that, agar is composed of neutral agarose and highly sulfated agaropectin. Being a sulfuric acid ester of a linear galactan, agar is insoluble in cold but soluble in hot water.**[16]**

Advantages

1.Its great gelling power in an aqueous environment allows it to form gels which are more resistant (stronger) than those of any other gel-forming agent, assuming the use of equal concentrations.

2.It can be used over a wide range of pH, from 5 to 8, and in some cases beyond these limits.

4. It withstands thermal treatments very well, even above 100°C which allows good sterilization.

Agar gives gels without flavour and does not need the additions of cations with strong flavours (potassium or calcium), it can be used without problems to gel food products with soft flavours.

7.It assimilates and enhances flavours of products mixed with it and acts as a fragrance-fixer permitting their long term fixation.

8. Its gel has an excellent reversibility allowing it to be repeatedly gelled and melted without losing any of the original properties.

Applications-

1.In-vitro dissolution profiles of tablets of all polymer types had shown that all Agar-gelatin blend matrix tablets had a better control on salbutamol release compared to tablets made of pure agar or pure gelatins**.**

Effect of agar—gelatin compositions on the release of salbutamol tablets(Anita Saxena, A)**[17]**

2.Agar-coated film shown high compressive and tensile stresses(T Rajesh Kumar dora*etal.*)**[18]**

3.It is useful in an economic way, and is biodegradable and non-toxic. This biodegradable Agr/GE-co-MA/AA hydrogel can be applied as a promising absorbent as a water-holding agent in agricultural applications. (Jyotichaudhary*et.al*)**[19]**

2.<u>Pectin</u>

Source-

Pectin (derived from Greek meaning - "congealed, and curdled") is a structural heteropoly saccharide contained in the primary cell walls of terrestrial plants.**[20,21]**

Pectin is a complex mixture of polysaccharides that makes up about one third of the cell wall of dry substance of higher plants. Much smaller proportions of these substances are also found in the cell walls of grasses. The highest concentrations of pectin are found in the middle lamella of cell wall, with a gradual decrease as moving through the primary wall toward the plasma membrane.**[20,21]**

Description –

Pectin, a multifunctional constituent of cell wall is a high value functional food ingredient widely used as gelling agent and as stabilizer.**[22]**

Properties - Pectin is soluble in pure water. Monovalent cation (alkali metal) salts of pectinic and pectic acids are usually soluble in water; di- and trivalent cations salts are weakly soluble or insoluble. Dry powdered pectin, when added to water, has a tendency to hydrate very rapidly, forming clumps.**[23]**

Applications-

Different types of pectin were characterized for gastrointestinal (GI) mucoadhesion.(NartayaThirawong*etal*)**[24]**

Pectins are mainly used as gelling agents, but can also act as thickener, water binder and stabilizer**[25]**

In medicine, pectin increase viscosity and volume of stool that it is used against constipation and diarrhoea. Until 2002, it was one of the main ingredients used in Kaopectate, along with kaolinite. Pectin is also used in throat lozenges as a demulcent. In cosmetic products, pectin acts as stabilizer. Pectin is also used in wound healing preparations and especially in medical adhesives, such as colostomy devices.

Pectin hydrogels have been used in tablet formulations as a binding agent and have been used in controlled-release matrix tablet formulations.

Pectin has a promising pharmaceutical uses and is presently considered as a carrier material in colon-specific drug delivery systems (for systemic action or a topical treatment of diseases such as ulcerative colitis, Crohn's disease, colon carcinomas), as indicated by the large number of studies published over the last few years.

Pectin acts as a natural prophylactic substance against poisoning with toxic cations. It has been shown to be effective in removing lead and mercury from the gastrointestinal tract and respiratory organs.

Pectin has numerous benefits as formulation because it can be easily tailored in to hydrogels, films, scaffolds, microparticles, and nanoparticles.(R.K. Mishra *etal*)**[26]**

3.<u>Starch</u>

Source-

Starch is the most abundant naturally occurring, biodegradable, inexpensive and abundantly available polysaccharide and carbohydrate reserve in plants and is found in leaves, flowers, fruits, seeds, different types of stems and roots. Starch is used by plants as source of carbon and energy. The main location of starch synthesis and storage in cereals is the endosperm. Major starch sources are cereals (40 to 90%), roots (30 to 70%), tubers (65 to 85%), legumes (25 to 50%) and some immature fruits like bananas or mangos, which contain approximately 70% of starch by dry weight.**[27]**

Starch is the reserve carbohydrate in plants tubes and seed endosperm plants (Otman, 2011) and occurs as granules in the cell in plastids, separated from the cytoplasm.**[28]**

Description-

Strach is composed of glucose molecules. Starch is composed of a mixture of two polymers called as Amylose and Amylopectin. Amylose is a linear polymer with molecular weight which is less than 0.5 million Dalton, depending on its biological source.**[29]**

Several types of starches are known as “waxy” starches due to the waxy appearance of the endosperm tissue from which they are derived; these tissues contain a minimal amount of amylose in their granule composition (30%); these starches can also contain other polysaccharide molecules and exhibit a slight deformation in granule appearance.**[30]**

Properties

Starch is a natural polymer which is renewable from carbon dioxide, water and sunlight by the photosynthesis. It is biodegradable, physically or chemically modified and inexpensive. Some of the prospects of starch have been highlighted and looking potential direction for future research. Therefore, different approaches or strategies are needed to develop starch based biodegradable polymers industry for enhancing their biocompatibility, biodegradability and physical properties for their diverse applications.**[31]**

The largest source of starch is corn and rice. Starch is a white soft amorphous powder and without sweetness. It is insoluble in water, alcohol and ether and it is non reducing carbohydrate (Jain et al., 2014)**[32]**Starch granules are simple or compound, of varying size (2-150 μm), size distribution, and shape (Belitz&Grosch, 1999)**[33]**.Starch is a mixture of two glucans, amylose and amylopectin. Most starches contain 10-20% water soluble amylose and 80-90 % water insoluble amylopectin depending on the source (Ramesh et al., 1999). **[34]**)Waxy or glutinous starch from corn and other cereals contains little or no amylase, while a sugary mutant corn and some of the legumes contain amylose in greater abundance than amylopectin (Meyer, 1960)**[35]**

Advantages – The main advantages of starch is Natural ,Renewable,Widelyavailable,nontoxic,biodegradable and cheap.

Disadvantages – The main disadvantage as mentioned below-

Hydrophobicity,Fragility,HighViscosity,Poor resistance to external factors, Poor mechanical properties.**[36]**

Applications-

Starch can be used in different ways:

- Pure starch as thermoplastics

- its various derivatives
- starch through different reactive groups
- as blends by combining with other polymers**[37]**

as a copolymer with synthetic polymers Starch is used as filler in blends to improve strength, minimize costs and increase the biodegradability of the materials.

The recent advancements in starch-based materials were specially tailored for controlled release of anticancer drugs by such polymeric micelles, polymeric capsules, graft, and hydrogel.

Hence, apart from drug delivering properties, starch based systems were profoundly investigated for probiotic delivery.(V.Gopinathetal.)**[38]**

4.<u>Inulin</u>

Source-

Inulin is a water soluble storage polysaccharide and belongs to a group of non-digestible carbohydrates called fructans.**[39]**

Synthetically, inulin type fructans are prepared from sucrose (Cooper et al., 2015). Inulin is widely used in the processed foods as a fat or sugar replacer or to impart desirable characteristics and it gives only 25-35% energy as compared to digestible carbohydrates. The sweetness level of inulin is about 10% of the sucrose. It is a versatile ingredient owing to its health benefits, specifically increased mineral absorption and also considered as Fermentable Oligo-,Di-, Monosaccharides and Polyols (FODMAP), group of carbohydrates which are readily digested in the colon by drawing water into colon to manage constipation and related ailments. It also promotes the growth of microflora in digestive tract and is considered as an appropriate ingredient to prepare low caloric foods for diabetics to manage blood sugar levels.

Description

Commercially most of the inulin is produced from chicory, however, dahlia and Jerusalem artichoke are also considered as good sources for industrial production in temperate areas (Flamm, Glinsmann, Kritchevsky, Prosky&Roberfroid, 2001)

Commonly, Inulin is used as a prebiotic, fat replacer, sugar replacer, texture modifier and for the development of functional foods in order to improve health due to its beneficial role in gastric health.

It is a polysaccharide obtained from the bulbs of Dehlia, *InulaHelenium*(*Compositae*), roots of Dendelion, *Taraxacumofficinale*(*Compositae*). Burdock root, *Saussurealappa*(*Compositae*) or chicory roots, *Cichoniumintybus*(*Compositae*

Properties-

Inulin, being a distinctive food element, offers many important dietary benefits along with certain industrial properties for its extensive use in food applications (Roberfroid, 2005). Chicory inulin is a white powder with fine particles having greater clarity. The neutral flavor of the inulin offers no aftertaste. Although, long-chain inulin is not sweet, however, regular chicory inulin when compared to sucrose carries a sweetness level of about 10% (Valluru& Van den Ende, 2008). Inulin behaves similar to bulking ingredients and along with high levels of artificial sweeteners like aspartame and acesulfameK, it provides a good mouth feel with a little aftertaste (Franck, 2002). Such blends can also show an important quantitative sweetness recipe.

Applications

Novel colon targeted drug delivery system using natural polymers

V. Ravi etal**.**

This review focuses on the various types of inulin drug delivery systems such as hydrogel, conjugates, nanoparticles, microparticles, micelles, liposomes, complexes, prodrugs, and solid dispersion(Franklin Afinjuomo *et al*)

7.Rosin

Source-Colophony (rosin) is the resin remaining in the still after removal of the volatile turpentine oil from the oleoresin of species of *Pinus*(see Turpentine Oil). Generally, the resin obtained from trees during their first year of tapping is of a lighter colour than that obtained subsequently

Properties –

Besides the polymer activity it also act as a active ingredients, such as derivatives of dehydroabietic acid the major component of disproportionated rosin have been reported as anti-tumour compounds. Studies have been shown that rosin films shown inflammatory reactions similar to PLGA. Rosin has good emulsifying properties and rosin based creams show good spreadability and homogeneity. Rosin has good quality to enhance skin permeability so the future of transdermal drug delivery looks brighter . Polymer form of rosin derivative shows the nonlinear thermal stability

Applications-

Rosin polymers has been used to prepare spherical microcapsules,film coating material(coated pellets),Transdermal Drug delivery system,Prolong drug release, sustained release microspheres (as encapsulating polymer).(Om Prakash Pal *etal*)

8.Guar Gum

Source-Guar gum is derived from the seeds of the drought tolerant plant *Cyamopsistetragonoloba,* a member of *Leguminosae* family.

Description-

The guar plant is essentially a sun-loving plant, tolerant of high environmental temperatures but very susceptible to frost (Whistler and Hymowitz 1979; Kay 1979). Guar gum is a novel agrochemical processed from endosperm of cluster bean.
The common names used in the scientific literature for the bean, guar gum flour and the galactomannan fraction are Indian cluster bean, guar and guaran, respectively.

Almost90% of world's guar is grown in India and Pakistan.
Guar is also cultivated in the southern hemisphere in semi-arid zones in Brazil, Australia, South Africa and Southern part of the USA like Texas or Arizona. India accounts for 80% of the total guar produced in the world and 70% of it is cultivated in Rajasthan. India is the
World leader for production of guar, which is grown in the northwestern parts of country encompassing states of Rajasthan, Gujrat, Haryana and Punjab.

Properties

The biological properties of guar galacto mannan and other such polysaccharides are dependent on their behavior in anaqueous medium. Guar gum swells and or dissolves inpolar solvent on dispersion and form strong hydrogenbonds. In non-polar solvents it forms only weak hydrogenbonds. The rate of guar gum dissolution and viscositydevelopment generally increases with decreasing particle size, decreasing pH and increasing temperature. Hydrationrates are reduced in the presence of dissolved salts andother water-binding agents such as sucrose (BemillerandWhistler1993).
Guar gum is an uncharged natural gum. It contains 41 % dry weight and acetone insoluble solids of the seeds. At least 75 % of acetone insoluble solids of the endosperm are galactomannose and 12 % being accounted for pentosan, protein, pectin, phytin, ash and dilute acid insoluble residues.

Advantages –

- Guar gum is a potential candidate for many pharmaceutical applications by virtue of its ability to form viscous dispersions or gel in aqueous media.
- The increasing popularity of this gum is also assisted by its non-toxic and biodegradable nature. Moreover, it is cost effective and is obtained from renewable natural resources, so its supply meets its demand in pharmaceutical industries.
- As an excipient this gum and its derivatives have occupied unique position in almost all areas of drug delivery.
- Guar gum plays its role as excipient in solid, liquid and semisolid dosage forms. The various excipient roles of guar gum are disintegrating agent, binding agent, film forming agent, matrix former, release modifier (retardant), viscosity enhancing or thickening or gelling agent, stabilizer, emulsifier, suspending agent, bio adhesive agent etc.
- Guar gum and its derivatives are widely used as binder and disintegrating agent in tablet dosage form, which provides cohesive nature to the drug and other excipients present.
- The formulations like inhalations, injectable, beads, microparticles, nanoparticles, solid monolithic matrix films, implants also facilitate the use of guar gum in these novel dosage forms.(Surendra T. *et al* Guar Gum)

Disadvantages-

Side effects include increased gas production, diarrhea, and loose stools. These side effects usually decrease or disappear after several days of use. High doses of guar gum or not drinking enough fluid with the dose of guar gum can cause blockage of the esophagus and the intestines.

Applications-

1.In vitro study shows that presence of guar gum significantly decreases the digestion of starch. It acts as a barrier betweenstarch and starch hydrolyzing enzymes (Dartois*etal.*2010).
2. Guar gum shows cholesterol and glucose loweringeffects because of its gel forming properties. It also helpsin weight loss and obesity prevention. Due to gel formingcapacity of guar gum soluble fiber, an increased satiation isachieved because of slow gastric emptying. Diet supplementedwith guar gum decreased the appetite, hunger anddesire for eating (Butt et al. 2007)
3.Mechanism behind cholesterol lowering by guar gum is due to increase in excretion of bile acids in faecus and decrease in enterohepaticbile acid which may enhances the production of bile acids from cholesterol and thus hepatic free cholesterol concentration is reduced (Rideout et al. 2008).

9. Karaya Gum

Source-

The karaya gum, also known assterculia, kadaya, katilo, kullo and kuterra, is native from India that is the main producer and exporter

The karaya gum is obtained asthe exudatesfrom *Sterculiaurens,* a large and bushy tree that belongsto the family*Sterculiaceae*, that usuallygrowsin dry and rocky forest regionsin central and northern of India, more than fifty percent of the gum is produced in the state of Andhra Pradesh,

Properties -Karaya gum has a fine dust appearance, a pink- grey color and slightly acetic flavor and smell; com-bined with some compounds as glycols, hasthe capacityto formsoftfilmswhen is plastifiedwith those com- pounds [6].

Advantages –

The hypocholesterolemic prop- erties were demonstrated by Behall, Lee, & Moser (1984). On the other hand,Afrose, Hossain, Maki, &Tsujii (2009), elaborated an comparative assay with severalsaponins and shown that karayarootsaponins had better effectsto reduce the blood and hepatic cholesterol, bloodlowdensityliproteinandatherogenic in- dex and to increase the serumhigh-densitylipoprotein and the high density lipoprotein/ cholesterol in com- parison with other saponins from tea, soy bean and quillaja in ratsfeedwith high-cholesterol diet

Disadvantages-

Karaya gums are generally recognized as safe (GRAS); the FDA recognizesitassafe after the realizationoftoxicological,teratogenic andmutagenic studies [45]. Dikshith et al.(1984)demonstratedthatkarayagum have no harmfulsignificative effectsin vital organs or biochemical alterationsin a study performed on male and female rats.

Applications-

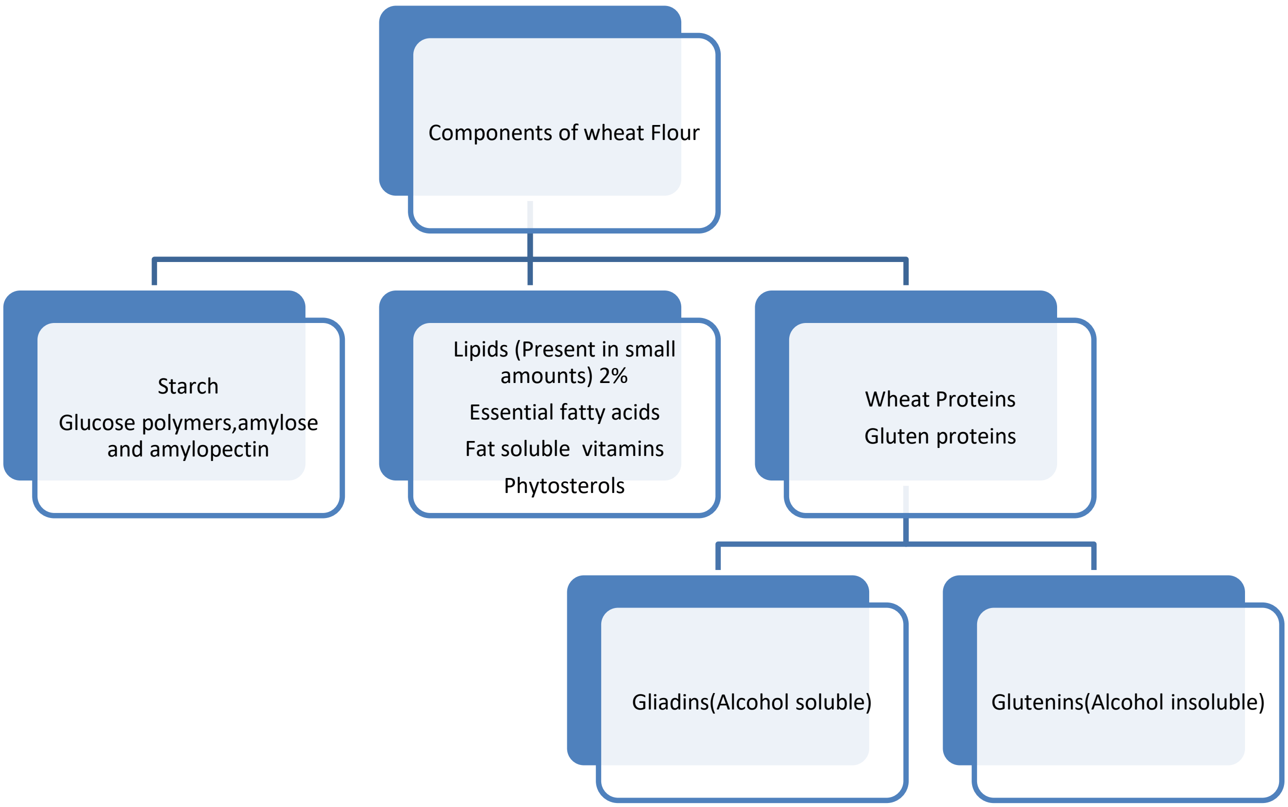
Gum Karaya is used extensively in various totally unrelated industries because of the properties such as water absorbing / moisture absorbing, gel and film forming, adhesiveness abilities. It is highly resistance to hydrolysis by mild acids and degradation by most of the microorganisms.(AnupamaSetiaetal.)

Wheat Gluten

Source-

The major components in wheat are starch and protein. The protein component of Wheat Gluten (WG) is the area of interest.

Wheat gluten is a protein by product of the starch fabrication.



Classification of Proteins according to Osborne modified from Goesaert et al., (2005).

Osborne fraction	**Solubilty behavior**	**Composition**
Albumin	Water and dilute buffers	Non-gluten proteins (mainly monomeric)
Globulin	Dilute Salt	Non-gluten proteins (mainly monomeric)
Gliadin	Aqueous alcohols	Gluten proteins(mainly monomeric gliadins and low molecular weight glutenin polymers)
Glutenin	Dilute acetic acid	Gluten proteins (mainly HMW gluteninpolymers

The scientific study of wheat grain proteins extends back for over 250 years, with the isolation of wheat gluten first being described in 1745 (Beccari, 1745). Osborne classified wheat protein according to the basis of solubility and functionality in 1908. Proteins were divided into three major types: simple, conjugated and derived. Osborne concluded that the proteins present in plant tissues were “simple” and comprised of four major types: albumins (soluble in water and dilute buffers), globulins (soluble in salt solutions), prolamins (soluble in 70 - 90% ethanol) and 9 glutelins (soluble in dilute acid or alkali) .The gluten proteins of wheat classically fall into two of these groups, with the alcohol-soluble gliadins and the alcohol-insoluble glutenins. Glutenins are known being the biggest polymers in nature (Shewry and Halford, 2002). In 1970 the glutelin fraction was divided into two fractions according to solubility in dilute acetic acid. The fraction which was insoluble in dilute acetic acid corresponded to the fifth fraction according to the Osborne fractions (Chen and Bushuk, 1970).

Grain proteins of wheat can also be divided into structural/metabolic (non-gluten) and storage proteins (gluten) (Shewry, 2003). Structural/metabolic proteins consist of albumin, globulin and amphiphilic proteins. Non-membrane amphiphilic proteins have been reported to have large effects on grain hardness and dough rheological properties (Dubreil et al., 1998).

Wheat storage proteins are collectively known as prolamins because of their high content of the amino acids, proline and glutamine. Another system of classification divided prolamins into three groups: sulphur-rich, sulphur-poor and high molecular weight glutenin subunits (HMW-GS). Sulphur rich prolamins include β-, γ-gliadins, B- and C- low molecular weight glutenins (LMW-GS). Sulphur poor prolamins contain ω-gliadins and D- LMW-GS (Shewry and Halford, 2002).

Properties –

Wheat gluten materials have fastest degradation rates.

Gluten is fully biodegradable and the products obtained are the non-toxic.

It is readily available in high quantity and at low cost.

Applications-

Wheat Gluten: Composition and Health Effects(SlađanaŽilić*etal)*

Hydrothermal Treatments Cause Wheat Gluten-Derived Peptides to Form Amyloid-like Fibrils(Margarita MongeMorera*etal*)

Enzymatic Strategies to Detoxify Gluten: Implications for Celiac Disease(Ivana Caputo*etal*)

Preparation of electrospunnanofibers based on wheat gluten containing azathioprine for biomedical application(Soroushaziz)

Conclusion-

Polymers play a vital role in the drug delivery system.So, the selection of polymers plays an important role in the manufacturing of drugs.But,selection of polymers has to be taken with care regarding its toxicity,drug compatibility and degradation pattern.Thus we can say that herbal polymers can be good substitute for the synthetic polymers and many of side effects of the synthetic polymers can be overcome by using herbal polymers.

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