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A REVIEW ON NATURAL POLYMER

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ABSTRACT:
In pharmaceutical formulation two main ingredients are required which is API and excipient. And excipient contains many components which plays vital role in manufacturing of dosage form as well as improve pharmaceutical parameters of the dosage form. Polymers used in any dosage form as excipient. Polymers have influencing capacity towards drug release and should be compatible, stable, non-toxic and economic etc. Generally, polymers are classified into three categories i.e natural, semi-synthetic and synthetic polymers. Nowadays, many pharmaceutical companies inclined towards using natural polymers due to many problems created with drug release and side effects. Polymers plays various application in formulation as excipient like to provide uniform drug delivery, rate controlling agent, taste masking agent, protective and stabilizing agents, etc. So that this review discuss about various natural polymers, there advantages over synthetic polymers and role of polymers in designing drug delivery system.

KEYWORDS: Polymer; Sustained Release; Dosage Forms; Plastic and Elastomers.

INTRODUCTION:
Polymers are a large class of high molecular weight compounds consisting of many small molecules (called monomers) that can be linked together to form long chains. Thus, they are known as macromolecules. A typical polymer may include tens of thousands of monomers1. In Greek, the word poly means 'many' and meros means 'units or parts'. They consist of different functional groups. Natural polymers are widely used in pharmaceutical and biomedical industries and their applications are growing at a fast pace. Basic knowledge of polymers will give us the opportunity to familiarize ourself with the function of drug products and also to develop new formulations or better delivery systems3. Natural polymers are used in pharmaceutical formulations in the manufacture of solid monolithic matrix systems, implants, films, beads, microparticles, nanoparticles, and injectable systems as well as viscous liquid formulations. Within these dosage forms, polymeric materials are widely used as binders, matrix formers or drug release modifiers, film coating formers, thickeners or viscosity enhancers, stabilizers, disintegrants, solubilisers, emulsifiers, suspending agents, gelling agents and bioadhesives.

HISTORY :

The possibility of polymers is one of the exceptional musings of the 20th century. It was created during the 1920s during deferred conversation and its affirmation is immovably related with the name of H. Staudinger who got the Nobel Prize in 1953.

PROPERTIES:

Polymer properties are broadly divided into several classes based on the scale at which the property is defined as well as upon its physical basis.The most basic property of a polymer is the identity of its constituent monomers. A second set of properties, known as microstructure, essentially describe the arrangement of these monomers within the polymer at the scale of a single chain. Chemical properties, at the nano-scale, describe how the chains interact through various physical forces. At the macro-scale, they describe how the bulk polymer interacts with other chemicals and solvents.

1) Chemical Property :-

The attractive forces between polymer chains play a large part in determining a polymer's properties. Because polymer chains are so long, these inter chain forces are amplified far beyond the attractions between conventional molecules. The intermolecular forces in polymers can be affected by dipoles in the monomer units. Polymers containing amide or carbonyl groups can form hydrogen bonds between adjacent chains; the partially positively charged hydrogen atoms in N-H groups of one chain are strongly attracted to the partially negatively charged oxygen atoms in C=O groups on another.

2)Mechanical properties:-

The bulk properties of a polymer are those most often of end-use interest. These are the properties that dictate how the polymer actually behaves on a macroscopic scale. The tensile strength of a material quantifies how much stress the material will endure before suffering permanent deformation.

3) Transport Property:-

Transport properties such as diffusivity relate to how rapidly molecules move through the polymer matrix. These are very important in many applications of polymers for films and membranes. The term melting point, when applied to polymers, suggests not a solid-liquid phase transition but a transition from a crystalline or semi-crystalline phase to a solid amorphous phase.

4) Elasticity:-

In most elastic materials, such as metals used in springs, the elastic behavior is caused by bond distortions. When force is applied, bond lengths deviate from the (minimum energy) equilibrium and strain energy is stored electro statically.

ADVANTAGES AND DISADVANTAGES OF POLYMERS:

Advantages:-

- Polymers are more impenetrable to manufactured mixes than their metal accomplices.
- Polymer parts needn't bother with post-treatment finishing tries, as opposed to metal.
- Polymer and composite materials are up to various occasions lighter than customary metals.

- Polymer materials handle far better than metals in misleadingly severe circumstances. This assembles the future of the plane and keeps up a vital good way from costly fixes accomplished by burning-through metal parts.
- Polymers are ordinarily radar light similarly as thermally and electrically ensuring.
- In clinical Facilities, polymer and composite materials are easier to clean and purify than metal.
- Polymer materials license the oil and gas industry to explore further profundities than at some other time by offering gadget weight decline without lost quality similarly as materials which offer unmatched fixing

Disadvantages:-

- Polymers are more invulnerable to produced blends than their metal accessories.
- Polymer parts needn't waste time with post-treatment completing attempts, as opposed to metal.
- Polymer and composite materials are up to various events lighter than regular metals.
- Polymer materials handle far unmatched than metals in misleadingly furious conditions. This builds the fate of the plane and keeps up a crucial decent ways from exorbitant fixes achieved by eating up metal parts
- Polymers are consistently radar flexible comparatively as thermally and electrically making sure about.
- In clinical Facilities polymer and composite materials are less mind-boggling to clean and decontaminate than metal.
- Polymer materials award the oil and gas industry to investigate further profundities than at later by offering device weight decrease without lost quality likewise as materials which offer unequaled fixing

CLASSIFICATION OF POLYMERS:

1)Natural polymers:- These polymers are found in nature generally from plants and animals sources. **Examples** are proteins, cellulose, starch, resins.

2)**Semi-synthetic polymers:-** These polymers are obtained from natural polymers by simple chemical treatment to change the physical properties of natural polymers like Starch, silicones.

3)Synthetic polymers:- The fibers which are synthesized in laboratory by polymerization of simple chemical molecules are called synthetic polymers.**Example:** Nylon, polyethene, polystyrene, synthetic rubber, PVC, Teflon etc.

CLASSIFICATION OF NATURAL POLYMERS:

Natural polymers are classified in three main categories, such as.

- **Plants origin**
- **Animal's origin**
- **Microbes origin**

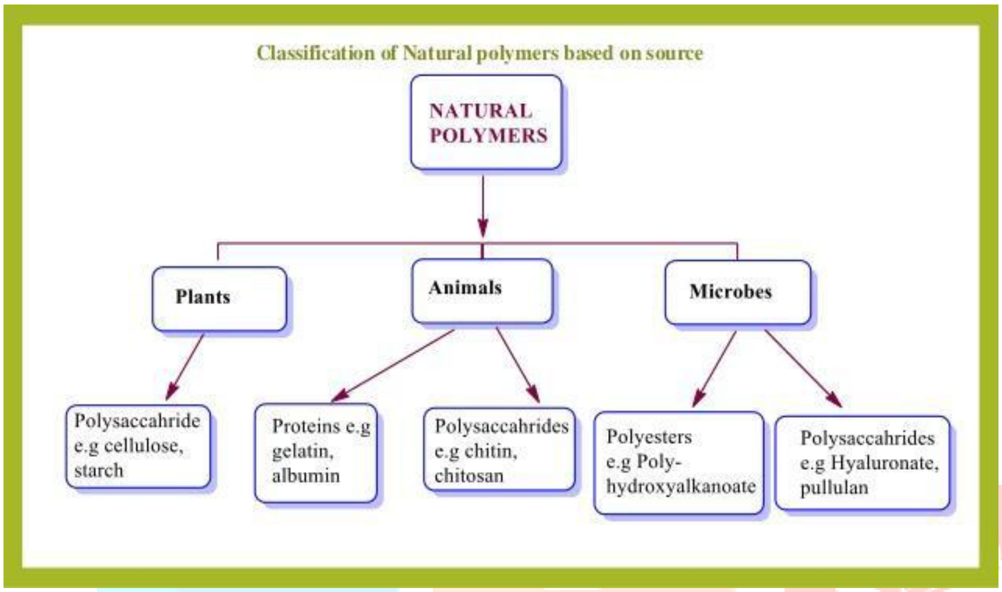

Fig No. 1: Classification of natural polymers.

POLYSACCHARIDES FROM PLANT ORIGIN:

1) CELLULOSE

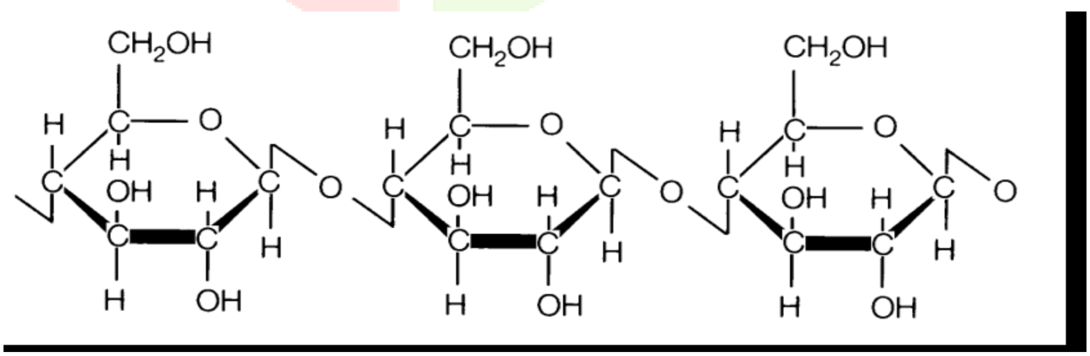

Fig. No. 2: Image of cellulose.

Composition:-

It is an organic polysaccharide consisting of a linear chain of several hundred to over ten thousand β (1→4) linked D-glucose units having the formula (C6H10O5)n. The plant cell wall mainly consists of cellulose, hemicelluloses and pectin.

Applications:-

Microcrystalline cellulose is mainly used in the pharmaceutical industry as a diluent/binder in tablets for both the granulation and direct compression processes. Carboxylated methyl cellulose is used in drug formulations, as binder for drugs, film-coating agent for drugs, ointment base etc. Cellulose acetate fibers are used in Wound dressings

2)AGAR

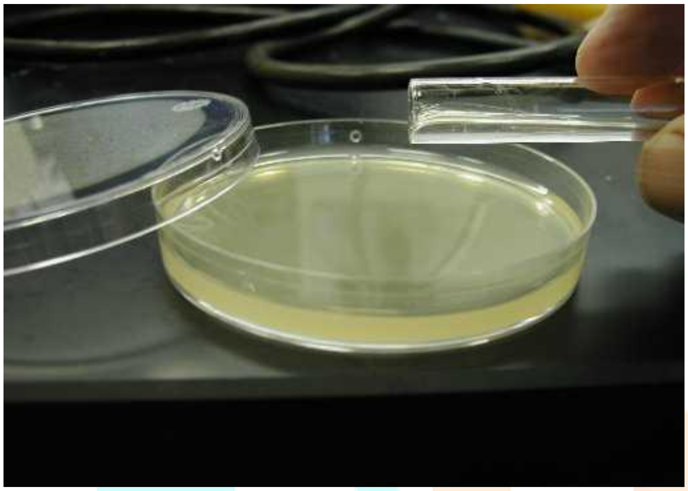

Fig No. 3: Image of agar.

Source:-

Agar or agar-agar consists of dried gelatinous substance obtained from Gelidium amansi (Gelidaceae) and it is also obtained from several other species of red algae like, gracilaria (Gracilariaceae) and Pterocladia (Gelidaceae).

Composition:-

Agar consists of a mixture of agarose and agaropectin. The agarose is a linear polymer which is made up of the repeating monomeric unit of agarobiose. Whereas, Agarobiose is a disaccharide made up of D-galactose and 3, 6 - anhydro-L-galactopyranose. Agaropectin is a heterogeneous mixture of smaller acidic molecules.

Applicatons:-

Agar is used as Suspending agent, emulsifying agent, gelling agent in suppositories, surgical lubricant, tablet disintegrants, medium for bacterial culture, laxative. It is also used for the preparation of jellies, confectionary items, tissue culture studies, and in microbiology study.

3)STARCHES

Source:-

Starch is the principal carbohydrate reserved material in green plants and it is mainly present in seeds and underground organs. Starch occurs in the form of granules (starch grains). A number of starches are recognized for pharmaceutical use and these include maize (*Zea mays*), rice (*Oryza sativa*), wheat (*Triticum aestivum*), and potato (*Solanum tuberosum*).

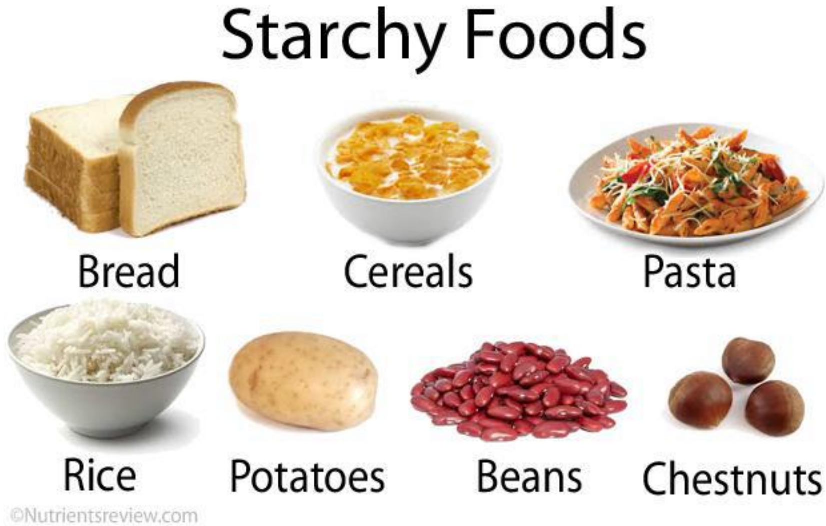

Fig No. 4: Image of Starchy foods.

Composition:-

Starch or amylum is a carbohydrate consisting of a large number of glucose units joined together by glycosidic bonds. It consists of two polymers, namely amylose (a non-branching helical polymer consisting of α-1, 4 linked D-glucose monomers) and amylopectin (a highly branched polymer consisting of both α-1,4 and α-1,6 linked D-glucose monomers).

Application:-

Thermoplastic starch is used in packaging, containers, mulch films, textile sizing agents, adhesives.

4)INULIN

Fig. No. 5: Image of insulin foods.

Source:-

It is a polysaccharide obtained from the bulbs of Dehlia, *Inula Helenium* (Compositae), roots of Dendelion, *Taraxacum officinale* (Compositae). Burdock root, *Saussurea lappa* (Compositae) or chicory roots, *Cichonium intybus* (Compositae).

Applications:-

Inulin with a high degree of polymerization was used to prepare biodegradable colon-specific films in combination with Eudragit® RS that could withstand break down by the gastric and intestinal fluids.

5)GUAR GUM

Fig. No. 6: Image of guar gum.

Source:-

Guar gum is also called guaran, clusterbean, Calcutta lucern, Gum cyamposis, and Cyamopsis gum, Guarina, Glucotard and Guyarem. Guar gum is the powder of the endosperm of the seeds of *Cyamopsis tetragonolobus* Linn. (Leguminosae).

Composition:-

Chemically, guar gum is natural polysaccharide composed of the sugars galactose and mannose. It is a galactomannans which is a linear polysaccharide consisting of (1→4)-diequatorially linked β-D- mannose monomers, some of which are linked to single sugar sidechains of α-D-galactose attached. Guar gum has a backbone composed of β-1, 4 linked- D-mannopyranoses to which, on average, every alternate mannose an α-D galactose is linked 1→6.

Applications

- Several modifications of guar gum is used for drug delivery system.
- Carboxymethyl guar film is used for the formulation of transdermal therapeutic system.

POLYSACCHARIDES FROM ANIMAL ORIGIN:

1)CHITIN

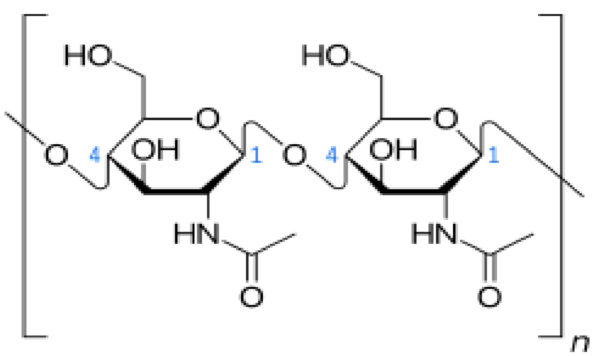

Fig. No. 7: Image of chitin.

Source:-

Chitin is the polysaccharide derivative containing amino and acetyl groups and are the most abundant organic constituent in the skeletal material of the invertebrates. It is mainly found in mollusks, annelids, arthropods. It is also a constituent of the mycelia and spores of many fungi.

Applications:-

- Chitosan and their derivatives (*N*-trimethyl chitosan, mono-*N*-carboxymethyl chitosan) are safe and effective absorption enhancers to improve mucosal, nasal, peroral drug delivery of hydrophilic macromolecules such as peptide and protein drugs and heparins.
- Chitosan nanoparticles and microparticles are also suitable for controlled drug release.

2)XANTHAN GUM

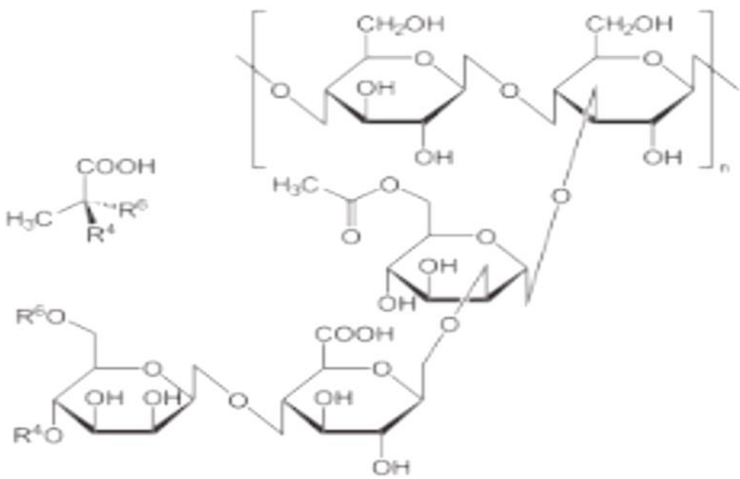

Fig. No. 8: Image of xanthan gum.

Source:-
Xanthan gum is a high molecular weight extracellular polysaccharide produced by the fermentation of the gram-negative bacterium *Xanthomonas campestris*.

Composition:-
The primary structure of naturally produced cellulose derivative contains a cellulose backbone (-D-glucose residues) and a trisaccharide side chain of D-mannose - D gluronic acid -D-mannose attached with the main chain of alternate glucose residues.

Applications:-

- Xanthan gum is widely used in oral and topical formulations, cosmetics, and in food industry as a suspending and stabilizing agent.
- It has also been used to prepare sustained release matrix tablets.

3)ALGINATE

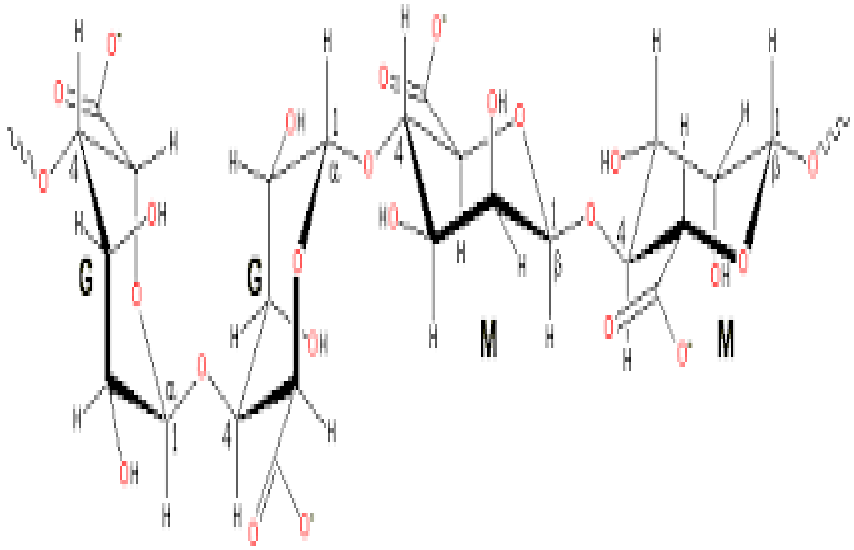

Fig. No. 9: Image of alginate

Source:-

Alginate is a water-soluble linear polysaccharide extracted from brown seaweed.

Composition:-

It is composed of 1–4 linked -L-glucuronic and –D - mannuronic acid residues.

Applications:-

- Alginate based mesalazine tablets are used for intestinal drug delivery system.
- Alginate is also as encapsulation materials for controlled drug delivery to mucosal tissue.
- It is also used to prepare mucoadhesive drug delivery systems.

4)PSYLLIUM

Fig. No. 10: Image of psyllium.

Source:-
Psyllium mucilage is obtained from the seed coat of *Plantago ovata* by milling the outer layer of the seeds.

Applications:-
- It has tablet binding properties.
- Psyllium husk was used in combination with other excipients such as hydroxypropyl methylcellulose to prepare a novel sustained release, swellable and bioadhesive gastro retentive drug delivery systems for ofloxacin.

PROTEINS FROM ANIMAL SOURCES:

1)COLLAGEN

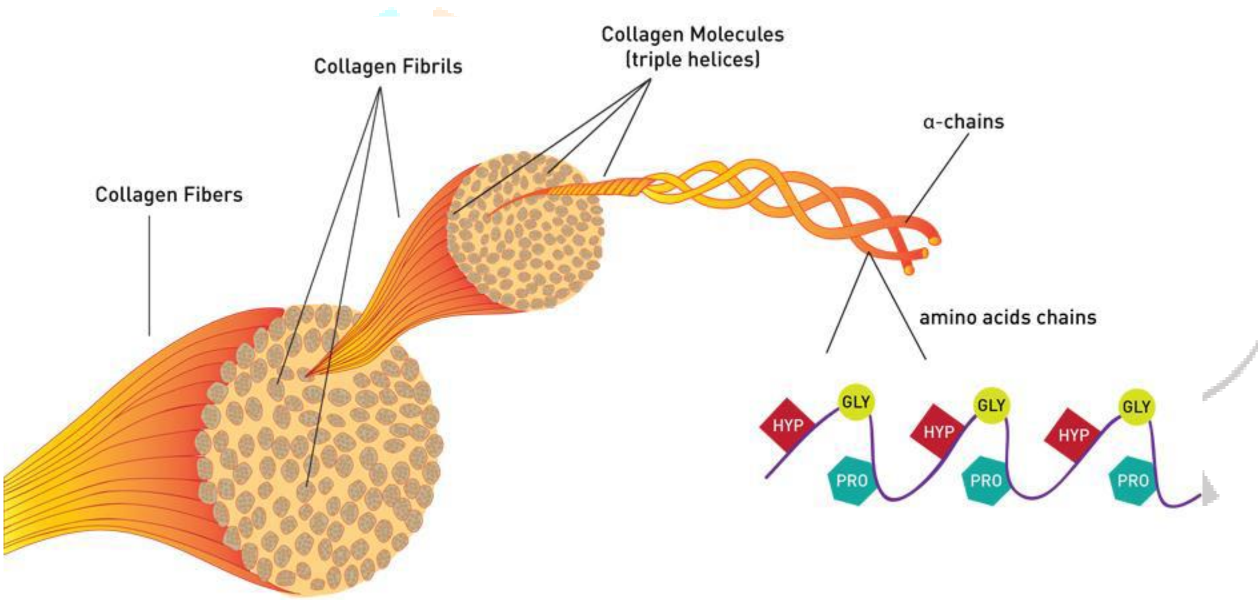

Fig. No. 11: Image of collagen.

Source:-
Collagen is the primary protein component of animal connective tissues. The most abundant sources of collagen are pig skin, bovine hide and pork and cattle bones.

Composition:-
There are 27 types of collagen exist and composed of different polypeptides, which contain mostly glycine, proline, hydroxyproline and lysine. The flexibility of the collagen chain depends only on the glycine content.

Applications:-
- Collagen films are used in ophthalmology as drug delivery systems for slow release of incorporated drugs.
- It was also used for tissue engineering including skin replacement, bone substitutes, and artificial blood vessels and valves.

2)GELATIN

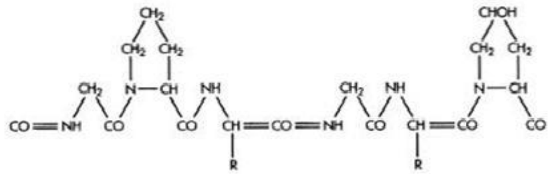

Fig. No. 12: Image of gelatin.

Sourse:-

By denaturation and/or physical–chemical degradation of collagen, a high molecular weight polypeptide is produced, called gelatin. Gelatin is also a protein and consists of 19 amino acids. It is water soluble. Elastin, albumin and fibrin are other proteins from animal sources.

Applications:-

These widely include emulsifiers, foaming agents, colloid stabilizers, biodegradable film-forming materials, and microencapsulating agents.

PROTEINS FROM VEGETABLE SOURCES:

1)WHEAT GLUTEN:-

Sourse:-

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

Fig. No. 13: Image of wheat gluten.

Advantages:-

- Wheat gluten materials have the fastest degradation rates.
- Gluten is fully biodegradable and the products obtained are non-toxic.
- It is readily available in high quantity and at low cost.

Applications:-

Wheat gluten has been proven to be an excellent film forming agent.

2)SOY PROTEIN :-

Fig. N0. 14. Image of Soy protein.

Source:-

According to the production method different categories of soy proteins exist: soy protein isolate, soy protein concentrate and textured soy protein.

Composition:-

Soy protein isolate is the most refined form of soy protein and contains about 90 percent protein. Soy protein concentrate is basically soybean without the water soluble carbohydrates. It contains about 70 percent of protein.

Application:-

It has been used since 1959 as an ingredient in a variety of foods for its functional properties, which include emulsification and texturizing. Recently the popularity of soy protein has been increasing, mainly because of its health benefits. It has been proven that soy protein can help to prevent heart problems.

CONCLUSION:-

Polymers play a vital role in the drug delivery system. So, the selection of polymer 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 natural polymers can be good substitute for the synthetic polymers and many of the side effects of the synthetic polymers can be overcome by using natural polymers.

REFERENCES:-

1. Dorel Feldman Polymer History, Designed Monomers and Polymers, 2008; 11:1:1-1
2. Krushnakumar J Gandhi, Subhash V Deshmane and Kailash R Biyan. Int. Polymers in pharmaceutical drug delivery system: a review. Int J Pharm Sci Rev Res 2012; 14(2):57-66.
3. Thakur VK and Thakur MK. Review: Processing and Characterization of Natural Cellulose Fibers/Thermoset Polymer Composites. Carbohydrate Polymers 2014.
4. Nicholas Leventis, Anna Palczer and Linda Mccorkle. Nanoengineered Silica- Polymer Composite Aerogels with No Need for Supercritical Fluid Drying Journal of Sol-Gel Science and Technology 2005; 35:99–105.
5. https://www.ques10.com/p/29070/give-advantages-and-disadvantages-of-polymers-over/
6. Bhatia S. Natural polymer drug delivery systems. Basel, Switzerland: Springer international publishing; 2016. DOI 10.1007/978-3-319-41129-3_3
7. Alina Sionkowska. Current research on the blends of natural and synthetic polymers as new biomaterials: ReviewProgress in Polymer Science 2011; 36 :1254–1276
8. S. Harsha Rao, B. Harini, R. Pranav Kumar Shadamarshan, K. Balagangadharan and N. Selvamurugan. Natural, and Synthetic Polymers/Bioceramics/Bioactive Compounds-mediated
9. Cell Signaling in Bone Tissue Engineering, International Journal of Biological Macromoleculeshttp://dx.doi.org/10.1016/j.ijbiomac.2017.09.029
10. Liu X and Ma PX. Polymeric Scaffolds for Bone Tissue Engineering. Annals of Biomedical Engineering 2004; 32:477–486. https://doi.org/10.1023/B:ABME.0000017544.36001.8e
11. Murugesh Shivashankar, Mandal Badal Kumar. A review on interpenetrating polymer network. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2012; 4(5): 1-7.
12. Parth N Patel, Parmar G Khushboo, Alpesh N Nakum, Minul N Patel. Biodegradable Polymers: An Eco Friendly Approach in Newer Millenium. *Asian Journal of Biomedical and Pharmaceutical Sciences*, 2011; 1(3): 23-39.
13. Werle Martin. Natural and synthetic polymers as inhibitirs of drug efflux pumps. *Pharmaceutical Research*, 2008; 25(3): 500-511.
14. Aggarwal Swati, Achhrish Goel, Singla Sandeep. Drug delivery: Special emphasis given on biodegradable polymers. *Advances in Polymer Science and Technology: An International Journal*, 2012; 2(1): 1-15.
15. B Sujitha, B Krishnamoorthy, M Muthukumaran. Role of natural polymers used in the formulation of pharmaceutical dosage forms. *International Journal of Pharmacy and Technology*, 2012; 4(4): 2347-2362.
16. Bozena Karolewicz (2016). A review of polymers as multifunctional excipients in drug dosage form technology. *Saudi Pharmaceutical Journa*, 2016; 24(5): 525-536.
17. Jeevana Jyothi, Dondiparthi Jyosna. Multiparticulate drug delivery systems using natural polymers as release retardent materials. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2014; 6(10): 61-65.

18. Leja, Katarzyna, Lewandowicz, Grazyna. Polymer biodegradation and biodegradable polymers: A review. *Polish Journal of Environmental Studies,* 2010; 19(2): 255.

19. Mahammad Rafi Shaik, Korsapati Madhuri, Panati Dinakar (2012). Polymers in controlled drug delivery systems. *International Journal of Pharma Sciences*, 2012; 2(4): 112-116.

20. Nirma Paswan, Bhupendra Vyas, YS Sarangdevot, K Pradeep Goyal et al (2015). A review on naturalpolyceutics: The science of utilising natural polymers for drug delivery. *International Journal of Pharmaceutical Erudition*, 2015; 5(1): 35-44.

21. SA Umoren, MM Solomon (2014). Recent developments on the use of polymers as corrosion inhibitors: A review. *The Open Materials Science Journal,* 2014; 8(2): 39-54.

22. TD Hapuarachchi. Fire retardancy of natural fibre reinforced sheet moulding compound. *Applied Composite Materials*, 2007; 14(4): 251-264.

23. Wadher J Kamlesh, Kakde B Rajendra, Milind J Umekar (2011). Formulation of sustained release metformin hydrochloride matrix tablets: Influence of hydrophilic polymers on the release rate and in vitro evaluation. *International Journal of Research in Controlled Release,* 2011; 1(1): 9-16.

24. Prakash Pawan, Porwal Mayur, Saxena Ashwin. Role of natural polymers in sustained release drug delivery system: Applications and recent approach. *International Research Jounal of Pharmacy*, 2011; 2(9): 4-10.

25. Jaimini Manish, Kothari Abhay. Sustained release matrix type drug delivery system: A review. *Journal of Drug Delivery And Therapeutics*, 2012; 2(6): 142-148.

26. DR Lu, CM Xiao, SJ Xu. Starch based completely biodegradable polymer materials. *Express Polymer Letters,* 2009; 3(6): 366-375.