

Alginic Acid – A Traditional Pharmaceutical Biopolymer with Modern Applications in Novel Drug Delivery

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Abstract:- Polymer is a class of natural or synthetic substance or material which composed of many repeated subunits of macromolecules. Polymers are basically classified into two groups namely natural polymers and synthetic polymers. Natural biopolymers play essential roles than synthetic due to its unique properties like biodegradability, biocompatibility, and safety. Alginic acid is a biopolymer which is extracted from seaweed-algae sources; mainly from *Laminaria*. Due to its excellent film formation, biodegradability and biocompatibility nature, alginic acid has a widespread of applications in the drug delivery system.

Keywords:- Polymers, Natural Polymers, Alginic Acid, Application.

I. INTRODUCTION

Polymer is a class of natural or synthetic substance or material which composed of many repeated subunits of macromolecules. It is a high molecular weight compound range from 5000 to one million. Polymers are classified based on the i) Origin of source ii) Structure iii) Molecular Forces iv) Mode of Polymerization.

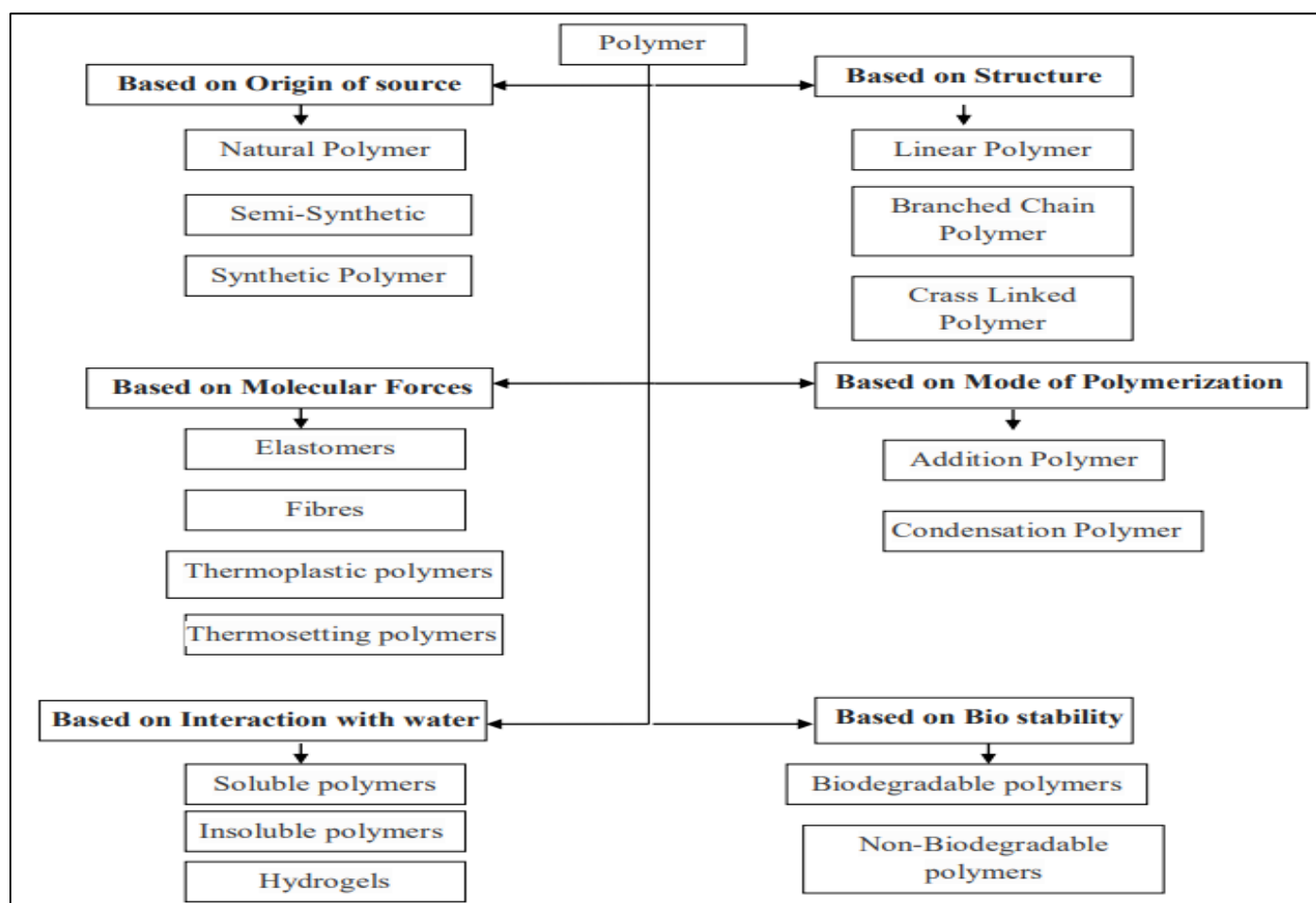


Fig 1 Classifications of Polymer

Thus, naturally occurring biopolymers from plants and animals play essential roles than synthetic due to its unique properties like biodegradability, biocompatibility, and safety (1).

Alginic acid (also as align) is a biopolymer occurs naturally as polysaccharide which is extracted from seaweed-algae sources, mainly from *Laminaria* genus belonging to the family *Phacophyceae* (2). Various biological sources include *Laminaria digitata*, *Laminaria hyperborea*, *Ascophyllum nodosum*, *Laminaria japonica*, and *Macrocystis pyrifera*. The nature of alginic acid is hydrophilic and with water it forms a viscous gum. With calcium and sodium metals, it forms alginates salts like calcium alginate and sodium alginate. It has a promising effect in field of drug delivery systems. Natural biopolymers play essential roles than synthetic due to its unique properties like biodegradability, biocompatibility, and safety (3).

➤ **Synonyms:**

- Algin
- Alginate
- Acidum alginicum
- Kelacid
- L-gulo-D-mannoglycuronan
- polymannuronic acid
- Protacid
- Satialgine H8

• **Empirical Formula:**

Alginic acid is a linear polymer consisting of a mixture of b-(1, 4)-D-mannosyluronic acid and a-(1, 4)-L-gulosyluronic acid residues.

• **Molecular Weight:**

The molecular weight of Alginic acid ranges are 20,000–2,40,000 grams per mole.

➤ **Structural Formula:**

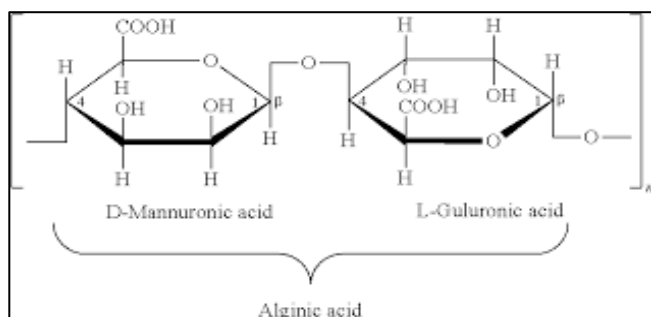


Fig 2 Structure of Alginic Acid

➤ **Description:**

- Colour: white powder or yellowish white powder
- Odour: odourless
- Taste: tasteless
- Nature: fibrous powder

➤ **Solubility:**

- It is readily soluble in alkali hydroxides and yields viscous solutions after dissolving in it.
- It is insoluble in ethanol and other organic solvents.
- In water, it swells and absorbs about 200 to 300 times of its weight.

➤ **Viscosity (Dynamic):**

In respect to the molecular weight and viscosity of the alginic acid, different grades are available commercially. The Viscosity of the alginic acid directly proportional to the concentration and inversely proportional to the temperature.

Table 1 Viscosity with Respect to Concentration of Alginic Acid

| Concentration of Alginic acid(% w/w) | Viscosity (mPa s) |
|--------------------------------------|-------------------|
| 0.5 | 20 |
| 2.0 | 2000 |

➤ **Stability of Alginic Acid:**

Alginic acid hydrolyses at warm temperature and produces low molecular weight materials.

➤ **Storage Conditions of Alginic Acid:**

It should be stored in a air tight well-closed container in a cool and dry place.

➤ **Incompatibilities**

- It is incompatible with strong oxidizing agents.
- It forms insoluble salts in the presence of alkaline earth metals and group III metals with the exception of magnesium.

➤ **General Method of Preparation of Alginic Acid:**

Alginic acid is derived from various species of brown seaweeds belonging to the family Phacophyceae.

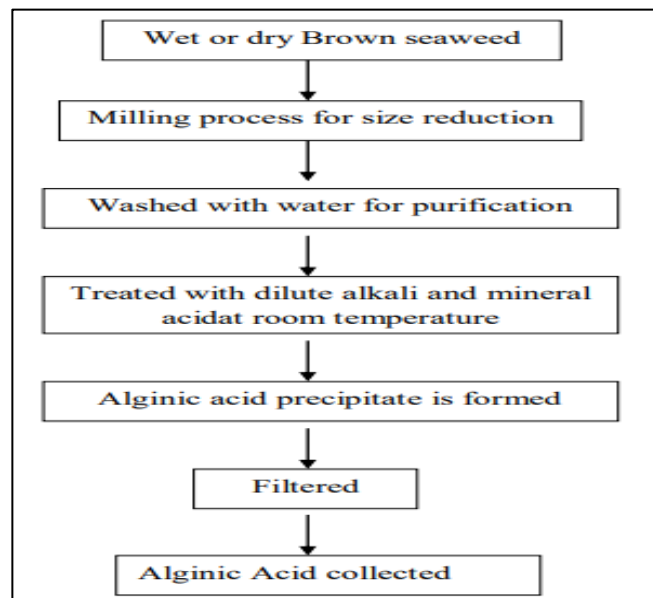


Fig 3 General Method of Preparation of Alginic Acid

➤ *Safety Concerns of Alginic Acid:*

It is safe for the oral route of administration of pharmaceutical products which contains alginic acid. But in nasal route, it may cause respiratory problems.

➤ *Applications of Alginic Acid in Pharmaceutical Field:*

Alginic acid has a wide range of applications in various oral and topical pharmaceutical formulations. Some of them are:

- Release-modifying agent
- Stabilizing agent
- Suspending agent
- Sustained release agent
- Tablet binder
- Tablet disintegrant
- Taste masking agent
- Viscosity-increasing agent.

➤ *In Solid Dosage Formulations:*

At the concentration ranges from 1 to 5 % w/w, alginic acid is used as a binding agent and disintegrating agent in most of the tablets and capsules (4,5). Alginic acid and calcium alginate were investigated for their super disintegrant functionalities for the design of Orodispersible mini tablets (6).

➤ *In Semisolid Dosage Formulations:*

In a variety of semisolid dosage forms like pastes, creams, and gels, alginic acid is used as a thickening agent and as suspending agent.

➤ *In Liquid Dosage Formulations:*

It is used as a stabilizing agent in liquid dosage forms like O/W type of emulsions.

➤ *In Ocular Formulations:*

Alginic acid has been investigated as a potential vehicle in an ocular drug delivery system for prolonging the effect of carteolol (7). In addition, sodium alginate has been incorporated into an ophthalmic drug delivery system for the property of in-situ formation in pilocarpine nitrate (8).

➤ *In Modified Drug Delivery Formulations:*

The sustained release indomethacin microparticles formulated with alginic acid (alginate)–gelatin hydrocolloid coacervate systems were investigated to reduce the problems associated with Indomethacin (9) and liposomes coated with alginic acid and poly-L-lysine membranes has also been studied for the controlled release of drugs (10).

Alginate gel beads are investigated for the property of buoyancy; it not only sustained release of drugs but also for targeting the gastric mucosa (11).

➤ *Therapeutic Applications of Alginic Acid:*

Alginic acid is used as an antacid therapeutically (12).

Alginic acid with H₂-receptor antagonist is used in the management of Gastro Intestinal problems like gastroesophageal reflux (13).

Alginic acid derivatives which are chemically modified have been investigated for their anti-inflammatory property, antiviral effect, and antitumor activities (14).

II. CONCLUSION

Natural polymers have an essential part in the drug delivery system mainly in the novel drug delivery. Opting natural polymers for the purpose of controlled release of drugs and for site targeting has major advantages like biodegradability, biocompatibility, and safety. A number of different related substances of Alginic acids which are commercially available are calcium alginate, sodium alginate, ammonium alginate; potassium alginate; propylene glycol alginate. To overcome the problems associated with Synthetic Polymers, Alginic Acid like natural polymers and its derivatives have great choice of approach in the drug development arena.

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