An in-Depth Study on the Application of Gum Arabic: A Biopolymer

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Abstract--- Gum Arabic (GA)is a natural polymer extracted from Acacia Seyal tree and Acacia Senegal tree having high commercial value. Gum Arabic is generally harvested in Africa and Western Asia. GA is one among the oldest natural gum introduced by the Arabic traders and introduced it to the European world. GA is water soluble, appears as pale white or light-yellow powder,harmless and is generally used in food products. Present studies imply that it has cardio-,reno-, gut-, and dental- protective, antimicrobial, satiety-inducing, anti-inflammatory and anticoagulant applications. The aim of this review is to reveal the structure, properties andapplications of this heteropolysaccharide.

I. INTRODUCTION

Gum Arabic is generally harvested in Africa and Western Asia. GA is one among the oldest natural gum introduced by the Arabic traders and introduced it to the European world. GA appears as pale white or light-yellow powder and is water soluble.

II. STRUCTURE

GA is a complex heteropolysaccharide consisting of 1,3-linked β-D-galactopyranosyl units. The other constituents found in this polymer includes L-arabinose, D-glucuronic and L-rhamnose acids. The side chains contain two to five 1,3- linked β-D-galactopyranosyl units attaching to the leading chain by 1,6 linkages.

Fig. 1: Gum Arabic exudate from Acacia senegal tree (A), Exudate made into granules form (B) and(C)

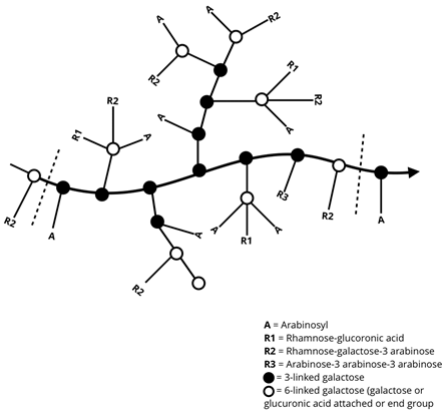

Fig. 2: Molecular Structure of GA

III. PROPERTIES AND APPLICATION

The biopolymer is inexpensive, hydrophilic, nontoxic, biocompatible and biodegradable. The properties of GA can be enhanced by adding a suitable filler material thus modifying it to show a desired property for a particular application. The electrical conducting property can be enhanced by adding magnetite nanoparticles [1].The complex polymer can reduce the surface energy and facilitate uniform distribution of a guest compound added to it. GA can be used as a thickening agent, stabilizer, binder and emulsifier making it suitable for use in food industry[2]. The presence of protein content is the reason for emulsifying property of GA. As a result of its extraordinary binding effect, it is widely used in printing, traditional lithography and water colour paints. GA can be used to enhance the tensile strength of a material finding its application in the textile industry. GA has film forming property making it suitable for coating and cosmetics.

It has been reported by Nasiret al that the solution of GA consists of especially high amount of Mg^{2+}, Ca^{2+} and K^{+} ions[3]. Polymerization of GA can be done by irradiating with ionizing radiations even without the use of additives. A bio based light-weight GA aerogels were synthesized with Sodium montmorillonite clay by Liang Wang et al and studied the mechanical and thermal properties of the prepared samples [4]. On adding 40% of Sodium montmorillonite clay to pure GA, the value of specific modulus and energy absorbed by the composite increased by 1.6 and 4.2 times respectively. With the addition of clay to GA, the initial decomposition temperature has been increased and heat release rate has been decreased. GA is widely applied in the medical field as it has positive effect on nephrotoxicity. GA has the capacity to raise the disposal rate of creatinine from the body, it improves the renal excretion of antidiuretic hormone, decreases the plasma cholesterol concentration and blood pressure [5]. GA as a good antioxidant and is effective in the treatment of diarrhea because of its pro-absorptive property[6]. GA has a negative impact on vitamin D, electrolyte balance and rarely causes hypersensitivity[7].

GA exudate can be used to preserve fresh fruits and vegetables. 10%GA added as coating material has shown retardation in the ripening rate of fruits stored at 10ºC when compared to the uncoated one [8]. The XRF studies conducted by Adam et al revealed that GA contained calcium, strontium, iron, lead and copper [9]. The conductivity of GA is proportional with frequency.

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The recognition of a specific type of gum from different gum exudates requires a number of analytical examinations for using as a food additive. The major parameters among them includes specific optical rotation, ash content, the amount of nitrogen present, moisture content, absence of tannins etc. The characteristic property of gum which differentiate it from other polysaccharides is its high water solubility and low viscosity [10]. The fluorescent property of GA is due to the presence of amino acid moieties in the aqueous phase which is a result of the breakdown of aqueous solution of GA under acidic condition. The fluorescence spectral characteristics of GA is due to the presence of tyrosine amino acid [11].From the FTIR spectral studies of GA, characteristic band was observed in the range between 3290 and 3305 cm^{-1} showing the presence of hydrogen bonded OH group. GA also shows C=C stretching and N-H bending. From the differential scanning calorimetrythermogram of GA, it can be seen that an endothermic peak appears between 100ºC and 150ºC and an exothermic peak between 300ºC and 315ºC. The endothermic peak appears as a result of evaporation of water content from GA[12]. The main properties of GA that makes it a suitable thickener and gelling agent includes the intrinsic characteristics like ionization degree, branching, molecular weight etc. and extrinsic characteristics like PH value ionic strength , concentration and temperature

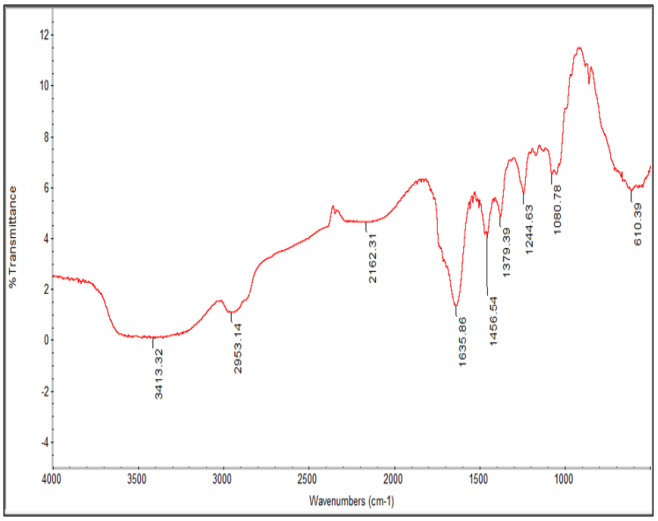

Fig. 3: FTIR spectra of Gum Arabic

IV. CONCLUSION

The complex polysaccharide has wide application in the field of medicine, biotechnology, electronics. GA is a non-toxic hydrophilic phytochemical glycoprotein which is used as a stabilizer in the pharmaceutical and food industries. The refractive index of GA is 1.3337. GA is an important ingredient in lithography, paint manufacturing, glue for sticking, ink production and textile industry. It is regarded as a good polysaccharide material to interact with radiation and posses very high photo response. The higher value of optical conductivity at high photon energy is because of high absorbance of GA and electron excitation of photon energy in GA.

Thus GA is a multifunctional complex polysaccharide material which attracts the interest of researchers.worldwide.

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