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An over view on chemistry and applications of Acacia Gums

Anurag Tewari

Assistant Professor, Department of Chemistry, Pranveer Singh Academy of Technology Kalpi Raod , Bhauti, Kanpur -208020

ABSTRACT

There are about 1,200 different species of acacia flowering tree and shrubs all over the earth. Some parts of the trees used specifically for their medicinal and soothing properties. Leaves, flower, pod seeds and the bark of the acacia tree have been used to stop bleeding; diarrohea and coughing, healing ulcers, open wound and soothe sore throats. Ancient Egyptians used acacia in paints and they used the wood to make wheels, dwellings and tools. Acacia tree are found in the NILE basin. They are indigenous to Ethiopia, Egypt, Angola; Americas are home to different types of acacia as well. Certain species of the acacia can be spotted growing wild in the Sinai Desert and in the area of Jordan. In spite of the tremendous quantity of gums employed in industry since the beginning of this century a real in sight into the chemistry of these substances has been obtained only during the last twenty or thirty years. Much work has been reported on the Gum Acacia, which is also known as Gum Arabic. The gum is exudates of the genus Acacia of the series Gummiferae of the sub family Mimosoidae, of the family Legumisae. An attempt is made to explain its utility and potential towards commercialization is made through this review.

Key words: Gum Arabic, Acacia decurrense, Species and Gum

INTRODUCTION

Gum Arabic is a complex polysaccharide, comprised mostly of glactose, arabinose, rhamnose and glucoronic acid with ~25% proteins as an integral part of its structure. It is naturally obtained from Acacia (Senegal and seyal) tree which are known to grow in the sub Sahara region of the Sudan. The composition of gum Arabic is dependent to some extend on the location and age of the tree. The material has many applications and uses i.e. in confectionary, beverages, pharmaceuticals, bakery, cosmetics etc [1]. During growth, harvesting, or transportation it could be environmentally contaminated buy some micro-organisms which consequently affects its properties and functionality and hence it's various uses. Properties of gum Arabic include emulsification, viscosity, color, molecular weight, absorption, and chemical structure. Recently decontamination of gum Arabic was tried by some research using ionizing radiation. Although there are more than 1100 species of Acacias botanically known distributed throughout the

tropical and subtropical areas of the world. Gum Arabic has been known for many thousand of years and there are no artificial substitutes that match it on quality or cost of production [2]. Chemically, gum Arabic consists mainly of high-molecular weight polysaccharides made up of rhamnose, arabinose, galactose, gluronic4-o-methoxyglucuonic acid and the salt of calcium, magnesium, potassium, and sodium of the two acids. The major gums of economic importance are gum Arabic, gum talha and Acacia polycantha gum. All gum exudates, from Acacia species received very little attention [3].

In practical term gums are either hydrophobic or hydrophilic. Hydrophobic gums are insoluble in water and include resins; rubber etc. where as hydrophilic gums are soluble in water and can be subdivided into natural, semi-synthetic and synthetic gums.

In order to identify a particular gum from a series of different gum exudates an extensive number of analytical test have to be performed (Anderson, 1986) [4]. This approach enables a finger print of each gum to be determined. The analytical test currently used includes determination of the total ash, nitrogen (hence protein) methoxyl contents, measurements of optical rotation, intrinsic viscosity, equivalent weight, analysis of the ratio of neutral sugars (galactose, arabinose and rhamnose) and glucronic acid content after hydrolysis and measurement of molecular mass [5].

Composition and Structure of Acacia Gums:

Acacia gums are polysaccharides and composed of L-arabinose, D-galactose, L-rhamnose and D-glucuronic acid in the approximate molar ratio of 3:3:1:1, this was confirmed by (Butler etal 1929) [6] studied the gum arabic and arabic acid from Acacia senegal (L) Willd, chemically and polarimetrically. They identified L-rhamnose, D-galactose and L-arabinose in the sugar fraction of hydrolyzed product. It was found that the acidic nucleus of the gum was an aldobiuronic acid whose components were D-glucuronic acids.

Charlson etal (1955) [7] made studies on the composition of Acacia cyanophylla gum. The gum on hydrolysis gave L-rhamnose, L-arabinose, D-galactose and D-glucuronic acid. They reported that the equivalent weight of the gum found was unusually low in comparison with that of other gums of Acacia species. Auto hydrolysis and partial hydrolysis of the resulting degraded polysaccharide showed the presence of 6-0-β-D-glucuronosyl-D-galactose, whereas the disaccharide, 3-0-α –D-galacto-pyranosyl-L-Arabinose occurred in the products of the auto hydrolysis [8].

Mukherjee et al (1957) [9] made structural investigations on Acacia sundra gum. Hydrolysis followed by cellulose-column chromatography with butanol-half saturated with water yielded L-rhamnose, L-arabinose and D-galactose. It was found that aldobioronic acid was a mixture of two compounds in which one was in a very small proportion.

Maslin, B.R. (1974) [10] had also studied the structures of auto hydrolysis degraded gum of Acacia catechu. The analysis indicated that the degraded gum was composed of D-galactose and D-glucuronic acid in the ratio of 4:1. These results were based on the hydrolysis of methylated degraded gum and a possible structure to the repeating unit of the degraded gum is proposed as under.

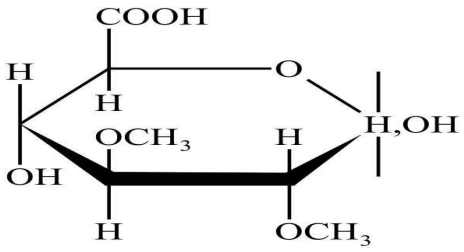

Fig: 1 Structure of Acacia Decurrense Gum polysaccharide

Analytical studied of Gums Acacia:

Anderson etal (1968) [11] Made an analytical study of some Acacia gum exudates of the series Botryocephalae. These studies were carried out on gum specimens from A.deanol, A.filicifolia and A leucoclada, A.parramathensis, A.parvipinnula.A.silvirtris, A.terminalis and A.trachyphola. It was found that the Bortryoccephalae species gave gum exudates of at least two chemicals distinct types. Type a species (A.deanel, A.parramathensis, A.parvipinnula, A.trachyphloia) and type B species (A. filicifolia, A.leucoclada, A.terminanalis and A.silvertris). Type A had low galactose-arabinose ratios (<2:1), strongly negative rotations, high intrinsic viscosities and molecular weights and relatively high nitrogen methoxyl uronic anhydride and rhamnose contents. Type B species had high galactose-arabinose ratios (74:1) but low negative or positive rotations, low intrinsic viscosities and molecular–weights, low nitrogen, methoxyl uronic anhydride and rhamnose contents.

Anderson etal (1972) also analyzed six Acacia gums of the species A.difformis, A.mabellae, A.calamifolia, A.falcata,A.retinodes and A.rubid. It was found that A. rubia was the most divergrent, with low content of rhamnose. (<2%), low acidity, intrinsic viscosities and high galactose: arabinose ratio. In the light of chemical data thus obtained. Acacia cyanophylla appeared to be a highly anomalous species within the phyllodineae series.

Gum Acacia-An Arabinogalactan Protein:

Kortt, A.A. (1985) [12] Analyzed the commercial gum from Acacia enegal for its similarity with the arabinogalactan-protein (AGP). The analyisis showed the presence of neutral sugars. Uronic acid protein linkages were also examined both the hydroxyproline oligoarabinoside and serine carbohydrate linkages were detected.

Churms et al (1984) [13] found that the gum exudates from Acacia robusta (sub. Subspecie calvigera) contained protein (18%wt/wt). bround to an arbinogalactan having structural features typical of the gum polysaccharides from Acacias of Bentham's series. The results thus obtained showed the nature of the linkage between the arabinogalactan and the 4-hydroxy-L-proline rich protein component of the gum.

Application of Acacia Gums:

The major uses of gum Arabic are in the food industry where it is used as food additive to impart desirable properties through its influence on the viscosity, body and texture of foods. In addition, it is nontoxic, odourless, colourless, tasteless, and completely soluble in water and does not affect the flavour, odour, colour of the food to which it is added.

In confectionery:

Gum Arabic is extensively used in the confectionary industry because it has ablity to prevent crystallization of sugar and also because of its thickening eddect. It is used as a glaze in candy products and as a component of chewing gum, cough drops and candy lozenges.

In Dairy Products:
Gum Arabic is used in frozen products such as ice creams, icos and sherbets as a stabilizer. It is used because of its water absorbing properties. In sime process it is also used in the preparation of packagable milk or cream.

In Bakery Products:
Gum Arabic is widely used in the baking industry for its viscosity and adhesive property.It is used in glazes and topping. It also adds smoothness when used as an emulsion stabilizer.

In flavour fixative:
They are used as a spray dried flavours into foods. An extensive use was found for gum Arabic as a fixative for flavours.

In beverages:
Gum Arabic is an effective foam stabilizer in beverages and a dry mixes are produced by spray dried combinations of vegetable oil and gumarabic, sold commercially as a clouding agent.

In Pharmaceuticals:
Gum Arabic is found to be best emulsifying and suspending agents for calamine suspensions, Kaolin suspensions, liquid petroleum emulsions and cod liver oils emulsions.

Gum Arabic's demulcent or soothing characteristics have led to its use in many pharmaceutical types of syrup. Gum Arabic syrup that contains benzoate, vanillin tincture and sucrose is recommended for use as a flavoured vehicle because of its demulcent effect. Various non sugars cherry syrups are based on gum Arabic

In cosmetics: Gum Arabic is used in lotions and protective creams, Harry described that gum Arabic can be used in hair dressings; it acts as a binder in face powder compacts, while in protective creams it is effectively used as a stabilizer.

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