GUM POLYSACCHARIDES AND THEIR BIOLOGICAL ACTION IN HUMAN BEINGS: REVIEW

Dr. Arnab Kanti Ojha,
Department of Chemistry, Mahishadal Girls' College,
Email: arnab.ojha@yahoo.com

ABSTRACT: Polysaccharides are composed of many monosaccharide residues that are joined one to the other by O-glycosidic linkages. The great diversity of structural features of polysaccharides, which originates from difference in the monosaccharide composition, linkage types and patterns, chain shapes, and degree of polymerization, dictates their physical properties including solubility, flow behaviour, gelling potential, and surface or interfacial properties. The structural diversity also dictates the unique functional properties exhibited by each polysaccharide. Polysaccharides, which are commercially available for use in food and non-food industries as stabilizers, thickening and gelling agents, crystallization inhibitors, and encapsulating agents etc., are called hydrocolloids or gums. Polysaccharide gums occur in nature as storage materials, cell wall components, exudates, and extracellular substances from plants or microorganisms. Exudate gums are obtained as the natural exudates of different tree species and exhibit unique properties in a wide variety of applications. This review covers the chemical structure, occurrence and production of the different gums. It also deals with the size and relative importance of the various players on the world market. Furthermore, it gives an overview of the main application fields of the different gums, both food and non-food. Now a day's many of scientists and researches are interested about the synthesis of the nanoperticals about these gums and study their applications as well as different kinds of their functions. The information presented in this review is helpful in exploring and understanding the different gum polysaccharides and their structures, different types of activities.

KEYWORDS: Exudate gums, stabilizers, thickening, crystallization inhibitors, encapsulating agents

INTRODUCTION:

Exudate gums are polysaccharides produced by plants as a result of stress, including physical injury and/ or fungal attack. They are amongst the oldest natural gums: about 5,000 years ago they were already being used as thickening and stabilizing agents. The three major exudate gums—gum arabic, gum tragacanth, and gum karaya—possess a unique range of functionalities [1]. They have been important items of international trade in the food, pharmaceutical, adhesive, paper, textile, and other industries for centuries. Generally, these gums are structurally related to arabinogalactans, galacturonans, or glucuronomannans. They all contain a high proportion of glucuronic or galacturonic acid residues.

Gum arabic is the oldest and best known of all natural gums. It is exuded from the bark of *Acacia nilotica* trees which was called the "Gum Arabic tree", [2] in the present day, gum Arabic is predominantly collected from two related species, namely *Acacia Senegal* [3] and *Vachellia (Acacia) seyal*, that grow primarily in Africa. The thorny trees grow to a hight of 7 to 8 meters, and the gum is obtained by cutting sections of the bark from the tree. . Its use can be traced back to the third millennium B.C., the time of the ancient Egyptians. Early Egyptian fleets shipped gum arabic as an article of commerce. It was used as a pigment binder and adhesive in paints for making hieroglyphs, and ancient inscriptions refer to it as *kami*.

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

Furthermore, it was used as a binder in cosmetics and inks and as an adhering agent to make flaxen wrappings for embalming mummies.

Gum tragacanth is a natural gum obtained from the dried sap of several species of middle Estern legumes of the genus *Astragalus*, including *A. Adscendens*, *A. Gummifer*, *A. Brachycalyx,* [4,5] and *A. Tragacanthus*. Some of these species are known collectively under the common names “goat’s thron” and “locoweed”. The gum is sometimes called Shiraz gum, shiraz gum elect or gum dragon. Iran is the biggest producer of the best quality of this gum. It is collected by hand, then graded, milled, and sifted to remove impurities. Gum tragacanth contains a water-soluble fraction and water-insoluble fraction and the water-soluble fraction is accounted for 30 to 40 % of the total gum.

Gum karaya is a vegetable gum produced as exudates by trees of genus Sterculia. Chemically, gum karaya is an acid polysaccharide composed of the sugars – galactose, rhamnose and galacturonic acid. It is used as a thickener and emulsifier in foods, as laxative, and as denture adhesive. It is also used to adulterate Gum tragacanth due to their similar physical characteristics [6]. Gum karaya is defined by JECFA as: ′a dried exudation from the stems and branches of *Sterculia urens* Roxburgh and other species of *Sterculia* (Fam. Sterculiaceae) or from *Cochlospermum gossypium* A.P. De Candolle or other species of *Cochlospermum* (Fam. Bixaceae)′ [7].

Gum Ghatti is the amorphous translucent exudate of the *Anogeissus Latifolia* tree of the Combretaceae family. The tree occurs throughout the greater part of India; more commonly in the dry deciduous forests. It is a large erect deciduous tree, 9-15 meters (sometimes 24 m) with a smooth light colored bark. The tree is leafless during the whole of the cold season; new leaves in April-May. The gum, locally called *Dhavda* when first exuded is in a soft plastic form. The colour varies from whitish yellow to amber depending on factors like the proximity of the tear to the bark, the length of time it has remained on the tree before being picked and the age of the product in storage. It is also an excellent emulsifier and has been used to replace gum Arabic in more complex systems, e.g.; gum ghatti is used as an emulsifier and stabilizer in beverages and butter-containing table syrups. Gum ghatti is used to encapsulate and stabilize oil-soluble vitamins. It is also used as a binder in making long-fibered, light weight papers.

Gum Katira [8,9] has assumed great importance in recent years and exported annually from India for use in the cigar paste and ice-cream industry. The gum is sweet, thermogenic, anodyne, sedative and useful [10] in cough, diarrhoea, dysentery, pharyngitis, gonorrhoea, syphilis and trachoma. It is exudate of the *Cochlospermum religiosum* which is a small or medium sized, deciduous, soft wooded tree. The tree occurs all over India from Garhwal to west sub- Himalayan tracts to West- Bengal, Bihar, Orissa and Decan peninsula. This gum is pale and semi-transparent, insoluble in water, but swells into a pasty transparent mass with water.

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

CHEMICAL STRUCTURES:

Table: 1. Main Botanical and Structural Characteristics of Exudate gums [11]

Gum	Species of Origin	General Structure
Gum Arabic	*Acacia senegal*	Substituted acidic arabinogalactan
Gum Tragacanth	*Astagalus gummifer*	Mixture of arabinogalactan and glycano-rhamnogalacturonan
Gum Karaya	*Sterculia urens*	Glycano-rhamnogalacturonan
Gum Ghatti	*Anogeissus latifolia*	Glycano-glucuronomannoglycan

The chemical composition of these gums is complex and varies to some extent depending on the source and its age. Therefore, it is not possible to provide defined structural formulas of these biopolymers.

GUM ARABIC:

Gum Arabic is a low viscosity gum and its solutions exhibit Newtonian flow behaviour even at high concentrations. It is extremely soluble in water and the solubility can be as high as 55%. The highly branched molecular structure and relatively low molecular weight of this polymer are responsible for thise properties. Another unique feature of gum Arabic is its covalent association with a protein moiety. Gum Arabic is a surface active gum that is able to stabilize oil-in-water emulsions. The protein-rich high molecular weight fraction of gum Arabic is preferentially adsorbed onto the surface of oil droplets while the carbohydrate portion inhibits flocculation and coalescence by electrostatic repulsions and steric forces.

Gum arabic is a branched, neutral or slightly acidic, complex polysaccharide obtained as a mixed calcium, magnesium, and potassium salt. The structure of gum Arabic is relatively complex. The main chain of this polysaccharide is built from (1→3) and (1→6) – linked β-D-galactopyranosyl units along with (1→6)- linked β-D-glucopyranosyl uronic acid units. Side branches may contain α-L-rhamnopyranose, β-D-glucuronic acid, β-D- galactopyranose, and α-L-arabinofuranosyl units with (1→3), (1→4), and (1→6) glycosidic linkages.

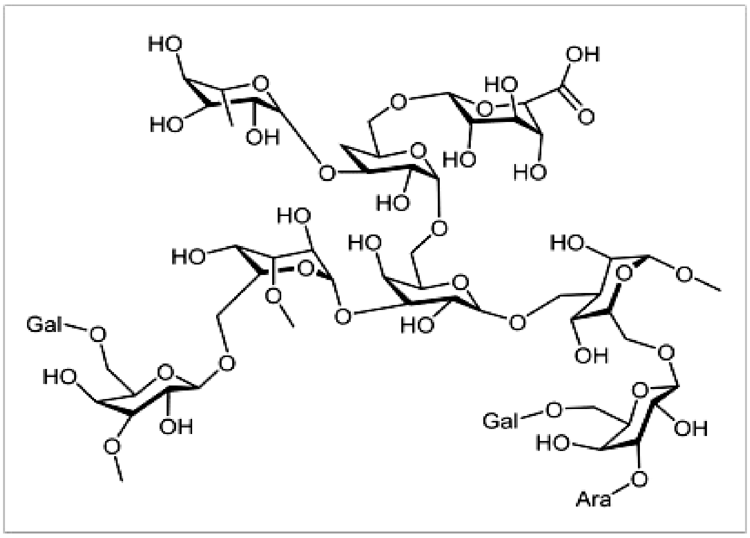


Fig.1: Gum Arabic

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

Table: 2. Analytical data for the gum obtained from *Acacia Senegal* [12]

Parameter	Range
Moisture content (%)	12.5–16.0
Specific rotation	–32.7 ° to –27.0 °
Nitrogen (%)	0.22–0.39
Protein (%)	1.5–2.6
Galactose (%)	39–42
Arabinose (%)	24–27
Rhamnose (%)	12–16
Glucuronic acid (%)	15–16
Equivalent mass (Da)	1,118–1,238

The characteristics may vary significantly, depending on the geographical origin and age of the trees, climatic conditions, soil environment, and even on the place of exudation on the tree [13,14]. Because of its heterogeneous nature, gum arabic was described by Anderson and Stoddart [15] as heteropolymolecular, on the one hand having a variation in monomer composition and/or in the linking and branching of the monomer units and on the other hand having a molecular mass distribution.

GUM TRAGACANTH:

Gum tragacanth is a complex, highly branched, heterogeneous polysaccharide, naturally occurring as a slightly acidic calcium, magnesium, and potassium salt. The composition of the gum obtained from different *Astragalus* species shows considerable variation. Hence, commercial gum tragacanth is a highly variable product. In table-3 the composition of Turkish samples of gum tragacanth from the two commercially most important species (*A. microcephalus*, *A. gummifer*) are compared. Important differences are found in sugar composition, methoxyl content, and relative proportion of soluble and insoluble components. Analytical data for the exudates from Turkish *Astragalus* species [16]

Table: 3. The sugar composition was assessed after hydrolysis:

Parameter	***Astragalus microcephalus***	***Astragalus gummifer***
Loss on drying (%)	12.7	9.9
Total ash (%)	3.2	2.9
Nitrogen (%)	0.58	0.46
Total protein (%)	3.65	2.84
Methoxyl (%)	3.3	0.9
Ratio of soluble:insoluble components	65:35	40:60
Galacturonic acid (%)	11	3
Galactose (%)	14	23
Arabinose (%)	37	63
Xylose (%)	22	5
Fucose (%)	12	2
Rhamnose (%)	4	4

Gum tragacanth consists of two fractions. Tragacanthic acid or bassorin is insoluble in water, but has the capacity to swell and form a gel. The other fraction is called tragacanthin and is water-soluble. The water-soluble fraction is a highly branched neutral polysaccharide

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

composed of (1→6)-linked D-galactosyl backbones with L-arabinose side chains joined by (1→2), (1→3), and /or (1→5)-linkages. The water-insoluble fraction (~60 to70%), is tragacanthic acid which is consisted of D-galacturonic acid, D-galactose, L-fucose, D-xylose, L-arabinose and L-rhamnose. It has a (1→4)-linked α-D-galacturonopyranosyl backbone chain with randomly substituted xylosyl branches linked at the 3 position of the galacturonic acid residues. It is the most viscous natural water-soluble gum and is an excellent emulsifying agent with good stability to heat, acidity, and aging.

GUM KARAYA:

Gum karaya is a complex, partially acetylated polysaccharide obtained as a calcium and magnesium salt. It has a branched structure and a high molecular mass of approximately 16×10^6 Da [17]. The backbone of the gum consists of α-D-galacturonic acid and α-L-rhamnose residues. Side chains are attached by 1,2-linkage of β-D-galactose or by 1,3-linkage of β-D-glucuronic acid to the galacturonic acid of the main chain. Furthermore, half of the rhamnose residues of the main chain are 1,4-linked to β-D-galactose units [18]. The chemical composition of gum samples obtained from different *Sterculia* species and from different places of origin was found to be quite similar [19,20]. Commercial gum karaya contains about 13–26% galactose and 15–30% rhamnose, which is considerably higher than the rhamnose content of other commercial exudate gums. However, the protein content of about 1% is lower than that of other exudate gums. Gum karaya contains approximately 40% uronic acid residues and 8% of acetyl groups, from which free acetic acid is released on aging. Due to the presence of these acetyl groups, native gum karaya is insoluble and only swells in water [21]. Le Cerf et al. [17] distinguished three fractions in gum karaya, based on their solubility in water. Only 10% of the native gum was solubilized in cold water, increasing to 30% in hot water. After deacetylation with dilute ammonia, 90% of the native gum dissolved in water. The equivalent weight of the deacetylated-soluble fraction was higher than that of the cold-water-soluble fraction. This indicates that only lower-molecular-weight molecules are able to dissolve in cold water, while deacetylation leads to the solubilization of material of higher molecular weight [17].

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

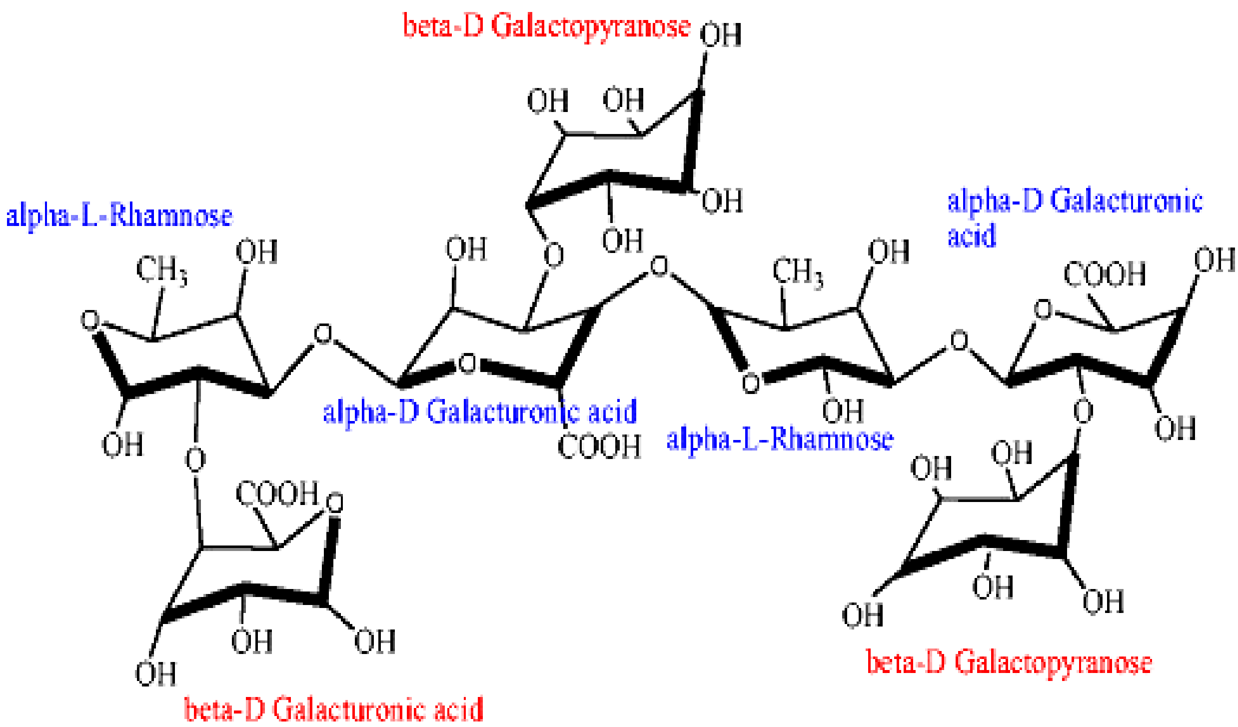


Fig.2: Gum Karya

Table: 4. The sugar composition was assessed after hydrolysis

Parameter	Range
Protein (%)	Lower than 1% of other Exudate gum
Galactose (%)	13–26
Rhamnose (%)	15–30
Uronic acid (%)	40
Acetyl group (%)	8
Equivalent mass (Da)	16×10^6

GUM GHATTI:

Gum Ghatti is a complex polysaccharide of high molecular weight. It occurs in nature as a mixed calcium, magnesium, potassium and sodium salt. Complete hydrolysis has shown that it is composed of L-arabinose, D-galactose, D-mannose, D-xylose and D-glucoronic acid in a molar ratio of 10:6:2:1:2 plus traces less than 1% of 6-deoxyhexose. Gum Ghatti does not dissolve in water to give a clear solution but rather over 90% of the gum disperses in water to form a colloidal dispersion. At the same time it does not form a true gel. It forms viscous solutions at concentrations of about 5% or higher and exhibits typical non-Newtonian behaviour. Gum Ghatti is a moderately viscous gum lying intermediate between Arabic and Karaya. This viscosity profile gives it a unique status in the spectrum of hydrocolloids. The emulsifying properties of Gum Ghatti are excellent and considered to be better than Gum Arabic and thus used in more difficult-to- handle systems. The normal pH of the dispersion is 4.8. Gum Ghatti solutions are sensitive to alkali. Viscosity increases sharply with pH upto a maximum at about pH 8 and above that the solutions tend to become stringy.

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

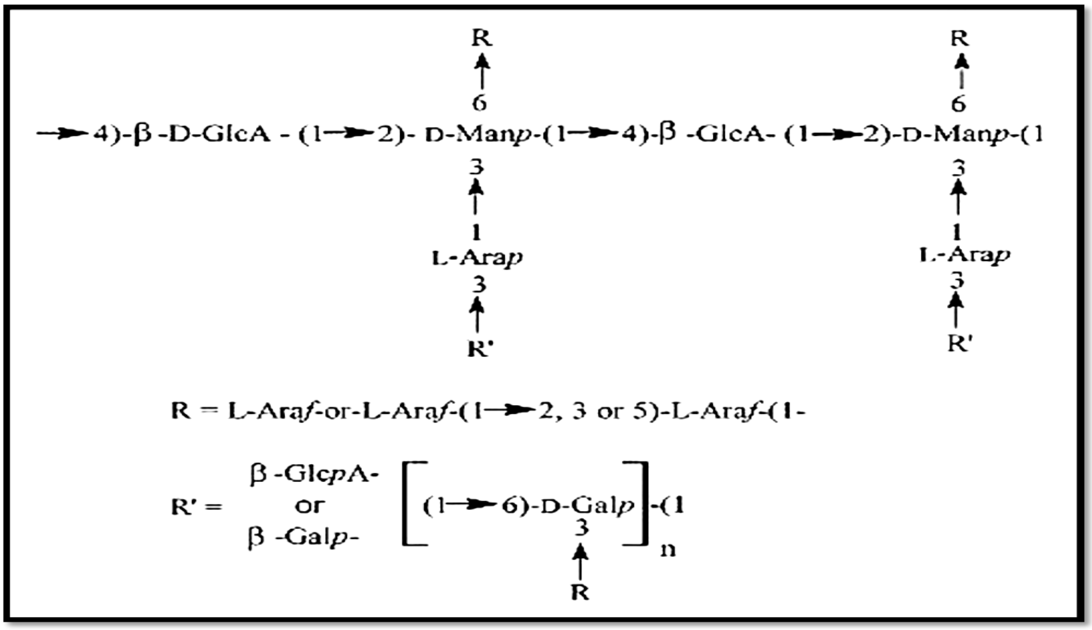


Fig.3: Gum Ghati

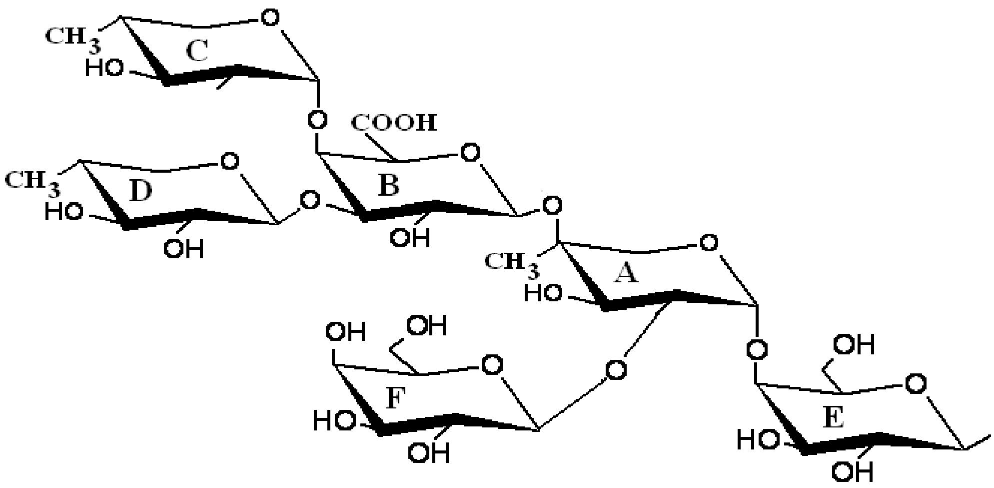
GUM KATIRA:

In 1953, E.L. Hirst et.al [22] first time attempted to establish the structure of the polysaccharide of this gum and showed that, it consists of equimolecular proportion of L-rhamnose, D-galactose and D-galacturonic acid, together with traces of a ketohexose. From methylatyion study, he established the presence of the fragments; terminal L-rhamnose, terminal D-galactose, 1,2 linked L-rhamnose, 1,4-linked D-galactose, 1,2,4-linked L-rhamnose and a mixture of methylated uronic acid but no detailed structure was established. In 1962, Aspinall et.al [23] again attempted to establish the detailed structure. He observed the presence of 1,2,4-linked D-galacturonic acid in the inner chain of this polysaccharide with similar residues of neutral sugars. But in recent years, the detailed structure of this polysaccharide was established [24]. The methylation results indicated the presence of terminal D-galactopyranosyl, (1→4)-linked D-galactopyranosyl, (1→2)-linked L-rhamnopyranosyl, terminal L-rhamnopyranosyl and (1→2,4)-linked L-rhamnopyranosyl moieties in the polysaccharide. Again, the carboxyl-reduced methylated PS indicated that (1→2,4)-linked D-Gal*p*A was also present in this polysaccharide. From the result of periodate-oxidation study it was observed that the terminal D-galactopyranosyl, terminal L-rhamnopyranosyl, (1→2)-linked L-rhamnopyranosyl, and (1→4)-linked D-galactopyranosyl moieties were consumed during oxidation. From the NMR analysis (^{1}H, ^{13}C, DQF-COSY, TOCSY, NOESY, HMBC and HSQC) the presence of hexasaccharide repeating unit in the polysaccharide isolated from the gum of *Cochlospermum religiosum* is assigned as;

```
        C               B                  A                E
→2)-α-L-Rhap-(1→4)-α-D-GalpA-(1→4)-α-L-Rhap-(1→4)-β-D-Galp-(1→
                        2                  2
                        ↑                  ↑
                        1                  1
                    β-L-Rhap           β-D-Galp
                        D                  F
```

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

The structure of the repeating unit of the polysaccharide can be graphically presented as:



APPLICATIONS:

GUM ARABIC:

Gum arabic has excellent emulsifying properties, particularly thanks to its AGP fraction. The hydrophobic polypeptide backbone strongly adsorbs at the oil–water interface, while the attached carbohydrate units stabilize the emulsion by steric and electrostatic repulsion. Fractionation studies show that, although emulsifying properties generally improve with increasing molecular weight and protein content, the best results are obtained with mixtures of different fractions [25]. Seemingly, the heterogeneous nature of the gum makes it an excellent emulsifier. Buffo et al. [26] found that stability of beverage emulsions is influenced by a number of processing factors, such as pasteurization and demineralization, and by the pH of the emulsion.

The use of gum arabic in foods has to be in accordance with the FDA Code of federal regulations (Table 6). Gum arabic is mainly used in the confectionery industry, where it is incorporated in a wide range of products. It has a long tradition of use in wine gums, where it produces a clarity that is higher than can be obtained with other hydrocolloids [27]. Furthermore, it prevents sucrose crystallization, provides a controlled flavor release, and slows down melting in the mouth, making the wine gum long-lasting [21]. It also provides the appropriate texture to these candies, which are easily deformed in the mouth but do not adhere to the teeth. In lower-calorie candy, gum arabic is used to compensate for the loss of texture, mouthfeel, and body, resulting from the replacement of sugars by artificial sweeteners [28]. It is also used in chewing gum as a coating agent and as a pigment stabilizer [29,30]. In aerated confectionery products, such as marshmallows, nougats, and meringues, gum arabic acts as a whipping and stabilizing agent. It is also used in toffees and caramels as an emulsifier, to maintain a uniform distribution of the fat across the product. In jelly products, it is used to provide a fibrous, fruit-like texture [31]. Gum arabic glazes are used as coatings for nuts, dragees, and others.

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

Table 6. Maximum usage levels (%) of gum arabic permitted in accordance with the FDA Code of federal regulations

Food (as served)	Percentage	Function
Beverages and beverage bases	2.0	Emulsifier and emulsifier salt, flavoring agent/adjuvant, formulation aid, stabilizer/thickener
Chewing gum	5.6	Flavoring agent/adjuvant, humectant, surface-finishing agent
Confections and frostings	12.4	Formulation aid, stabilizer/thickener, surface-finishing agent
Dairy products analogues	1.3	Formulation aid, stabilizer/thickener
Fats and oils	1.5	Formulation aid, stabilizer/thickener
Gelatins, puddings, and fillings	2.5	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Hard candy and cough drops	46.5	Flavoring agent/adjuvant, formulation aid
Nuts and nut products	8.3	Formulation aid, surface-finishing agent
Quiescently frozen confectionery	6.0	Formulation aid, stabilizer/thickener
Snack foods	4.0	Emulsifier, emulsifier salt, formulation aid
Soft candy	85.0	Emulsifier, emulsifier salt, firming agent, flavoring agent/adjuvant, formulation aid, humectant, stabilizer/thickener, surface-finishing agent
Other food categories	1.0	Emulsifier, emulsifier salt, flavoring agent/adjuvant, formulation aid, stabilizer/thickener, surface-finishing agent, texturizer

Gum arabic is widely used as an emulsifier in the manufacture of soft drinks. Due to its stability in acid conditions and its high solubility, gum arabic is well suited for use in citrus and cola flavor oil emulsions [32].

Gum arabic was once extensively used in the pharmaceutical industry, but is now replaced by celluloses and modified starches in many applications. It is still used as a suspending agent, emulsifier, adhesive, and binder in tabletting and in demulcent syrups [33,34,35]. In cosmetics, gum arabic functions as a stabilizer in lotions and protective creams, where it increases viscosity, imparts spreading properties, and provides a protective coating and a smooth feel. It is used as an adhesive agent in blusher and as a foam stabilizer in liquid soaps [20]. It is used as a dispersant in paints and insecticidal/acaricidal emulsions, respectively keeping the pigments and active components uniformly distributed throughout the product [36,37,38]. In the textile industry, it is used as a thickening agent in printing pastes for the coloration of knitted cellulose fabrics [39]. Other applications are ink and pigment manufacture, ceramics, and polishes.

GUM TRAGACANTH:

Gum tragacanth is used in the preparation of low-viscosity, pourable dressings and sauces. Because of its high acid stability, the gum is well suited for use in these low pH products. It lowers the interfacial tension due to its surface active properties and acts as a thickener in the continuous water phase, thus stabilizing the emulsion and providing long shelf-life. In low-calorie, an oil-free dressing, gum tragacanth is used to imitate the creamy mouthfeel and body of dispersed oil droplets. In fish and citrus oil emulsions with a long shelf-life, gum tragacanth is used in combination with gum arabic. It has been used in the pharmaceutical and personal care industries as an emulsifier and stabilizer in medicinal emulsions, jellies, syrups, ointments, lotions, and creams. It is also used in milkshakes as a viscosity control agent, providing texture and stabilizing incorporated air [40].

Table 8. Maximum usage levels (%) of gum tragacanth permitted in accordance with the FDA Code of federal regulations

Food (as served)	Percentage	Function
Baked goods and baking mixes	0.2	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Condiments and relishes	0.7	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Fats and oils	1.3	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Gravies and sauces	0.8	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Meat products	0.2	Formulation aid, stabilizer/thickener
Processed fruits and fruit juices	0.2	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Other food categories	0.1	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener

GUM KARAYA:

Due to its acid stability, high viscosity, and suspension properties, gum karaya is well suited for stabilizing low pH emulsions, such as sauces and dressings [41]. In French dressings, gum karaya functions as a stabilizer, increasing the viscosity of the aqueous phase of the oil-in-water emulsion [42]. In cheese spreads, gum karaya is used as a binder to provide texture and spreadability and to prevent water separation. In salads, the gum acts as a stabilizer and prevents the weeping of the water from the oil-in-water emulsion [43]. It is also incorporated in aerated dairy desserts and whipped cream, where it acts as a foam stabilizer. Gum karaya significantly reduces the bioavailability of calcium in milk-based foods, as demonstrated by [44].

Table 7. Maximum usage levels (%) of gum karaya permitted in accordance with the FDA Code of federal regulations

Food (as served)	Percentage	Function
Frozen dairy desserts and mixes	0.3	Formulation aid, stabilizer/thickener
Milk products	0.02	Stabilizer/thickener
Soft candy	0.9	Emulsifier, emulsifier salt, stabilizer/thickener
Other food categories	0.002	Formulation aid, stabilizer/thickener

Most gum karaya is consumed in the pharmaceutical industry, where it is used in diverse applications. It functions as an adhesive in leakproof sealing rings for post-surgical drainage pouches or ostomy bags [45,46,47]. Powdered gum karaya is widely applied on dental plates as an adhesive [48]. When brought in contact with the moist surfaces of the mouth, the gum does not dissolve but swells and provides a more comfortable and tighter fit of the plate. Furthermore, it is very resistant to bacterial and enzymatic degradation. In tampons, gum coatings form a gelatinous medium in contact with body fluids, preventing irritation of the mucous membranes and facilitating removal after use [49]. Deacetylated gum karaya is used as a binding agent in the production of long-fiber, lightweight papers [20]. It effectively prevents the fibers from forming flocks and keeps them homogeneously distributed, resulting in a lightweight sheet of improved formation and strength. The gum is deacetylated in order to expose more active carboxyl and hydroxyl groups and improve the association with the cellulose fibers. For textile applications, the solubility of gum karaya is increased by cooking an aqueous dispersion under pressure. It is then used as a thickening agent for the dye in direct color-printing on cotton fabrics.

GUM GHATTI:

Following are some of the applications of Gum Ghatti:

- As an emulsifier and stabilizer in beverages and butter containing table syrups.
- As a flavour fixative for specific applications.
- Used in the preparation of powdered, stable, oil-soluble vitamins.
- As a binder in long-fibered light weight papers.
- As an emulsifier of petroleum and non petroleum waxes to form liquid and wax paste emulsions.
- Used in combination with polyacrylamide to aid in the polymerization and formation of uniform and discrete prills of cross-linked polystrene.
- Used as drilling mud conditioner and the acidizing of oil wells.
- Used in powdered explosives to improve resistance to water damage.

GUM KATIRA:

This gum has assumed great importance in recent years and exported annually from India for use in the cigar paste and ice-cream industry [8,9]. The gum is sweet, thermogenic, anodyne, sedative and useful [10] in cough, diarrhoea, dysentery, pharyngitis, gonorrhoea, syphilis and trachoma. Recently, green syntheses of gold nanoparticals (AuNPs) are established using aqueous solution of a hetero polysaccharide, extracted from the gum [50]. These gold nanoparticals function as an efficient heterogeneous catalyst in the reduction of 4-nitrophenol. This gum has also been applied as excipient in drug delivery devices and may have the potential of of exploration in novel drug delivery development [51].

SOME OTHER COMMON GUMS:

MUCILAGE GUMS: These gums are very viscous polysaccharides extracted from seeds or soft stem of plants: examples are okra mucilage (from Hibiscus esculentus), psyllium (from Plantago species), yellow mustard (from Sinapis alba), and flax mucilage (from Linum usitatissium). All of them are acidic polysaccharide with structures somewhat related to some of the exudates gums. Their utilization in certain food products is increasing due to their functional properties (viscosity, gelation, water binding) as well as to their bio-active role in prevention and treatment of certain diseases.

XANTHAN GUM: Xanthan gum is an extracellular polysaccharide produced by the bacterium Xanthomonas campestris [52]. It is used as food additive and rheology modifier, [53] commonly used as a food thinkening agent (in salad dressings etc.) and a stabilizer (in cosmatics products etc.). It is composed of pentasaccharide repeat units, comprising glucose, mannose and glucuronic acid in the molar ratio 2:2:1 [54]. The primary structure of xanthan

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

consists of the cellulose- like backbone of (1→4)-linked β-D-Glcp residues substituted, at O-3 of alternate glucose residues, with a trisacharide. The trisaccharide consists of the β-D-Manp- (1→4)- β-D- GlcpA- (1→2)-α-D- Manp-(1→unit). Noncarbohydrate substitutents include the acetyl group at O-6 of the inner Manp residue and the pyruvate group at O-4,6 of the terminal Manp.

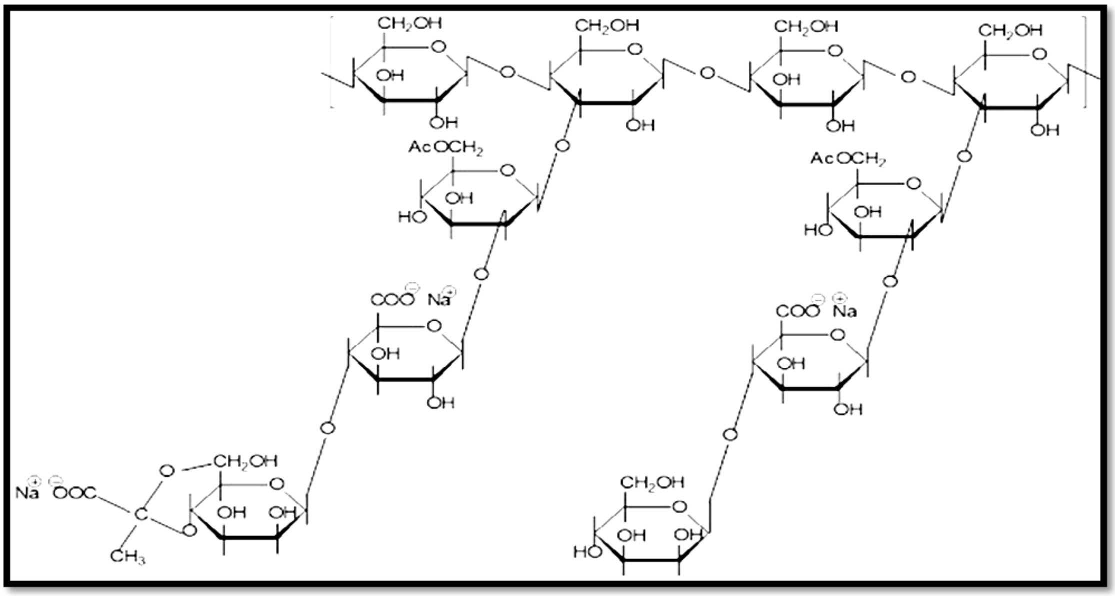


Fig.3: Xanthan gum

GELLAN GUM: Gellan gum is a deacetylated from of the extracellular bacterial polysaccharide from Auromonas elodea. It was initially idenfied as a substitute gelling agent at significantly lower use level to replace agar in solid culture media for the growth of various microorganisms [55]. Its initial commercial product with the trademark as 'GELRITE' gellan gum, was subsequently identified as a suitable as gelling agent in various clinical bacteriological media.() It has a repeating tetrasaccharide sequence of →3)-β-D-Glcp-(1→4)-β-D-GlcpA- (1→4)- β-D-Glcp- (1→4)-α-L- Rhap- (1→unit). In the native form gellan has anL-glyceryl substituent on O-2 of the (1→3)-linked glucose and an acetyl group on some of the O-6 atoms of the same residue; both groups are normally lost during commercial extraction. It is used as gelling agents in desert jellies, dairy products, and sugar confectionery. Gellan gum can also be used to prepare structured liquids [56].

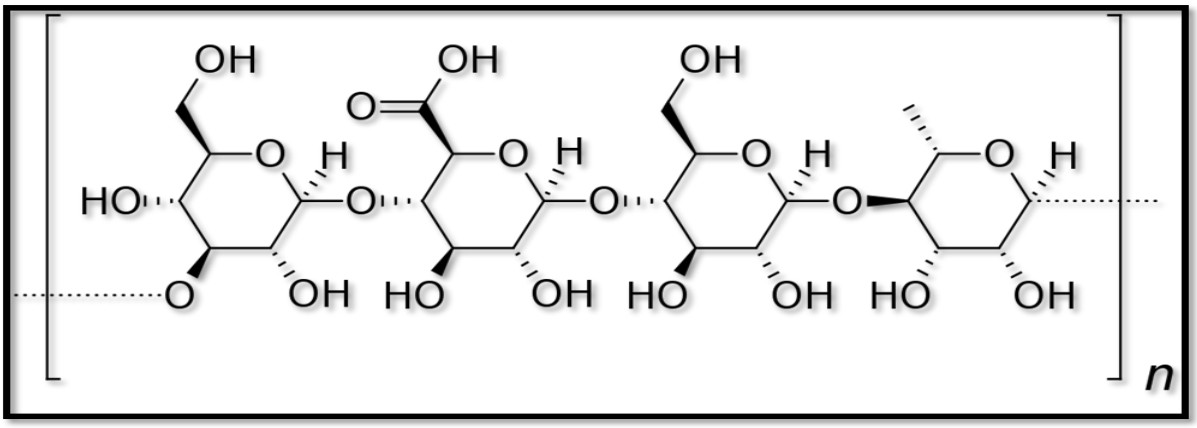


Fig.3: Gellan gum

ISSN- 2394-5125 VOL 06, ISSUE 06, 2019

GUAR GUM: Guar gum, also called guaran, is a galactomannan. It is primarily the ground endosperm of guar beans. Chemically, guar gum is a polysaccharide composed of the sugars galactose and mannose. The back bone is a linear chain of β- (1→4)-linked mannose residue to which galactose residues are (1→6)-linked at every second mannose, forming short side-branches. This gum, as awater-soluble fiber, acts as abulk-forming laxative, so is claimed to be effective in promoting regular bowel movements and relieving constipation and chronic related functional bowel aliments, such as diverticulosins, crohn's disease, colitis and irritable bowel syndrome. Guar gum has been considered of interest in regard to both weight loss and diabetic diets. It is a thermogenic substance [57]. Some studies have found guar gum to improve dietary glucose tolerance [58]. Research has revealed the water-soluble fiber in it may help people with diabetes by slowing the adsorption of sugars by the small intestine. In pharmaceutical industry – it is used as binder or as disintegrator in tablets; main ingredient in some bulk forming laxative. Folic acid conjugated guar gum nanoperticles are established recently which is used for targeting methotrexate to colon cancer [59].

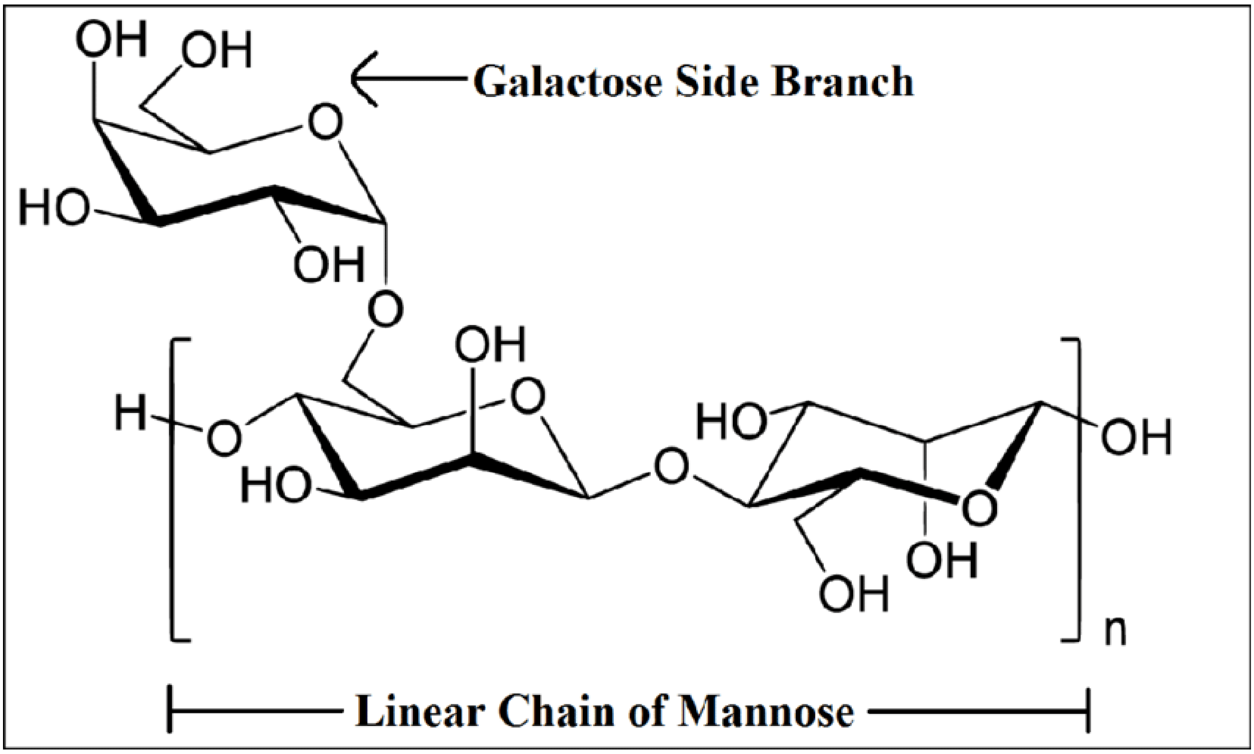


Fig.3: Gaur gum

CONCLUSIONS:

This paper presented a review of the industrially most relevant exudates gums: gum Arabic, gum Karya, and gum Tragacanth. This review covers the chemical structure, occurrence and production of the different gums. It also deals with the size and relative importance of the various players on the world market. Furthermore, it gives an overview of the main application fields of the different gums, both food and non-food. Recently, many of scientists and researchers are interested of these different gum polysaccharides because of their good stabilizing properties. Gum karya used as a biotemplate using green synthesis of copper oxide nanoperticles which is shown as antibacterial properties [60]. Again, gum of *Cochlospermum gossypium* used also a template for the green synthesis of silver nanoperticles and also shown antibacterial application [61]. Some of gums are used as magnetic nano-absorbent [62]. Gum Xanthan / Fe_3O_4 based nanocomoposite hydrogel are used as adsorption of methyl violet from aqueous solution [63]. Gum Xanthan / Silica hybrid nanocomoposite are used as absorbent for removal of congo red dye from aqueous solution [64]. Ultimately, the pharmaceutical industry as also as food and non-food industry may provide new markets for chemically modified these gum polysaccharides and help develop new generations of polysaccharides with more beneficial biological activities.

REFERENCES:

1. Phillips, G.O.; Williams, P.A. Tree exudate gums: natural and versatile food additives and ingredients. *Food Ingred Anal Int*. **2001,** 23,26, 28.
2. *Acacia nilotica* "Gum Arabic tree. Invasive species compendium. *Centre for Agriculture and Biosciences International*. Retrieved 24 January **2016**.
3. http://www.kew.org/science-conservation/plants-fungi/acacia-senegal-gum-arabic.
4. http://www.pfaf.org/user/Plant.aspx.
5. Germplasm Resources Information Network (GRIN). Retrived 24th December, **2010**.
6. Dziezak, J.D. A focus on gums. *Food Technol*. **1991,** 45:116–132.
7. FAO, Karaya gum, (Food and nutrition paper 52) FAO, Rome. **1992.**
8. *Wealth of India*; CSIR: New Delhi, **1962**; Vol. 2, p. 261.
9. Prajapati, N.; Purohit, S.; Sharma, A.; Kumar, T. *A hand book of Medicinal plant*; Agrobios: Jodhpur, **2003**.
10. Kirtikar, K. R.; Basu, B. D. In *Indian Medicinal Plants Cochlospermaceae;* Blatter, E., Caius, J.F., Mhaskar, K. S., Eds.; Bishen Sing Mahendra Pal Singh: Dehradun, India, **1998**; Vol. I, pp 214- 215.
11. Izydorczyk, M; Cui, S. W.; Wang, Q. In Food Carbohydrate; Polysacharide Gums Struutures Functional Properties and Applications; Cui, S. W., Ed.; Taylor and Francis: New York, **2005**; pp 281-282.
12. Idris, O. H. M.; Williams, P. A.; Phillips, G. O. *Food Hydrocolloid* **1998**, *12*, 379-388.
13. Islam, A.M.; Philips, G.O.; Sljivo, M. J.; Willams, P.A. A review of recent development on the regulatory, structural and functional of gum Arabic. *Food Hydrocolloids* **1997,** *11*, 493-505.
14. Karamalla, K,A;, Siddig, N.E.; Osman, M.E. Analytical data for *Acacia senegal* var. *senegal* gum samples collected between 1993 and 1995 from Sudan. *Food Hydrocolloids* **1998,** *12*, 373–3.
15. Anderson, D.M.W.; Stoddart, J.F. Studies on uronic acid materials. *Carbohydr Res* **1966**, *2*,104–114.
16. Anderson. D.M.W.; Bridgeman, M.M.E. *Phytochem*. **1985,** *24*, 2301-2304.
17. Le Cerf, D.; Irinei, F.; Muller, G. Solution properties of gum exudates from *Sterculia urens* (karaya gum). *Carbohydr Polym.* **1990,** *13*, 375–386.
18. Weiping, W. Tragacanth and karaya In. Ed.; Philips, G.O.; Williams, P.A. Handbook of hydrocolloids. Woodhead, Cambridge, 2000 pp 155–168.
19. Anderson, D.M.W.; McNab, C.G.A.; Anderson, C.G.; Braown, P.M.; Pringuer, M.A. Gum exudates from the genus *Sterculia* (gum karaya). *Int Tree Crops J.* **1982,** *2*, 147–154.

20. Whistler, R.L. Exudate gums. In: Ed.; Whistler, R.L.; Bemiller, J.N. Industrial gums: polysaccharides and their derivatives. Academic Press, San Diego, 1993, pp 318–337.
21. Imeson, A. Exudate gums. In: Ed.; Imeson, A. Thickening and gelling agents for food. Chapman and Hall, London. 1992, pp 66–97.
22. Hirst, E. L; Dustan, S. *J. Chem. Soc.* **1953**, 2332-37.
23. Aspinall, G.O.; Hirst, E.L; Johnston, J.M. *J.Chem.Soc*, **1962,** 2785- 2789.
24. Ojha, A.K.; Maiti, D.; Chandra, K.; Mondal, S.; Das, D.; Roy, S.K.; Ghosh, K.; Islam, S.S. *Carbohydrate Research*, **2008,** *343*, 1071-1078.
25. Ray, A.K.; Bird, P.B.; Iacobucci, G.A.; Clark, B.C. Jr Functionality of gum arabic. Fractionation, characterization and evaluation of gum fractions in citrus oil emulsions and model beverages. *Food Hydrocolloids*. **1995**, *9*, 123-131.
26. Buffo, R.A.; Reineccius, G.A.; Oehlert, G.W. Factors affecting the emulsifying and rheological properties of gum acacia in beverage emulsions. *Food Hydrocolloids* **2001**, *15*, 53–66.
27. Williams, P.A.; Phillips, G.O.; Gum arabic. In: Ed.; Phillips, G.O.; Williams, P.A. Handbook of hydrocolloids. Woodhead, Cambridge, 2000, pp 155–168.
28. Brucker, C.E.; Uhlarik, K.S.; Lampe, J.W.; Bush, J.W. Lower calorie candy. US patent application. **1974,** *3*, 800-45.
29. Cherukuri, S.R.; Friello, D.R.; Parker, E.; Hopkins, W.; Mackay, D.A.M. Stable liquid red beet color and chewing gum containing same. US patent application. **1983,** *4*, 371,549.
30. Huzinec, R.J.; Graff, A.H. Coatings for chewing gums containing gum arabic and a soluble calcium salt. US patent application **1987**, *4*, 681,766.
31. Shigeo, O.; Hiroya, Y.; Sumio, T.; Keiji, M. A method of manufacturing jelly products having fibrous texture. European patent application. **1989**, *10*, 334,466.
32. Sunkist, G. Flavour preservation of essential oils. GB patent application. **1958**, 802,538.
33. Ferdinand, G.; Krüger, W. Vitamin E effervescent tablets. German patent application. **1986,** *3*, 517,916.
34. Millard, R.; Balmert, C.A. Effervescent compositions. US patent application. **1961,** *2*, 985,562.
35. Tame-Said, J.I. Toothpaste and mouthwash in tablets. Patent application WO. **1997**, *9*, 719,668.
36. Fuyama, H.; Tsuji, K.) Oil-in-water insecticidal and acaricidal emulsion. US patent application. **1981**, *4*, 283,415.
37. Gamble, D.L.; Grady, L.D. Paint and process for producing the same. US patent application. **1938**, *2*, 135,936.
38. Henson, W.A.; Westveer, W.M. The preservation of water-emulsion paints with haloacetamides. US patent application. **1956**, *2*, 758,103.
39. Kraus, F.; Jeths, J. New colouration process. GB patent application. **1966**, *1*, 024, 224.
40. Smith, W.B. Sterilized milkshake and the process for making same. US patent application. **1968**, *3*, 385,714.

41. Partyka, A. Salad dressing. GB patent application. **1963,** 936,531.
42. Dziezak, J.D. A focus on gums. *Food Technol* .**1991**, *45*, 116–132.
43. Beach, P.L. Preparation of a proteinaceous food salad. US patent application. **1969**, *3*, 454,405.
44. Kelly, B.J.; Potter, N.N. Dialyzable calcium from milk processed with soluble fiber-containing gums, thickeners, and cocoa. *J Food Sci.* **1990,** *55*, 1004–1007.
45. Carpenters. Seals for colostomy or like bags. GB patent application. **1979**, *2*, 017,501.
46. Marsan, A.E. Sealing pad for a post-surgical drainage pouch. US patent application. **1967**, *3*, 302,647.
47. Sanderson, G.R. Gums and their use in food systems. *Food Technol.* **1996**, *50*, 81–84.
48. Steinhardt, A.; Goldwater, F.A. Gelatin adhesive pharmaceutical preparations. US patent application.**1962**, *3*,029,187.
49. Boiteau, C.; Blondeel, G. Tampon having a surface covering. GB patent application. **1981**, *2*, 075,846.
50. Maity, S.; Sen, I.K.; Islam, S.S. *J. Physica E.* **2012**, *45*, 130-134.
51. Sharma, V.K.; Mazumdar, B. J. Indcorp. **2013**, *50*, 776-786.
52. Barrêre, G.C.; Barber, C.E.; Daniels, M.J. *Int. J. Biological Macromolecules*. **1986**, *8(6),* 372-374.
53. Davidson, Robert, L.; Handbook of water-soluble gums and resins. McGraw Hill. **1980,** ISBN: 0-07-015471-6.
54. Garcia-ochoa, F.; Santos, V.E.; Casas, J.A.; Gômez, E. J. Biotechnology Advance. **2000**, *18(7),* 549-579.
55. Kang, K.S.; Veeder, G.T.; Mirrasoul, P.J.; Kaneko, T.; Cottrell, I.W. *J. Applied & Environmental Microbiology*. **1982**, *43,* 1086-1091.
56. Shungh, D.; Valiant, M.; Tutlane, V.; Weinberg, E.; Weissberger, B.; Koupal, L.; Gadebusch, H.; Stapley, E. *J. Applied & Environmental Microbiology*. **1983**, *46(4),* 840-845.
57. Brown, J.C.; Livesey, G. *Am. J. Clin. Nutr.* **1994,** *60(6),* 956-964.
58. Daumeric, C.; Henquin, J.C. *nih. gov.* **1982,** *8,* 1-5.
59. Sharma, M.; Malik, R.; Verma, A.; Dwivedi, P.; Baoth, G.S.; Pandey, N.; Sarkar,J.; Mishra, P.R.; Dwivedi, A.K. *Journal of Biomedical Nanotechnology*. **2013,** *9(1),* 96-106.
60. Padil, V.V.T.; Cernik, M. *Int. J. Nanomedicine*. **2013,** *8,* 889-898.
61. Kora, A.J.; Sashidhar, R.B.; Arunachalam, J. *Carbohydrate polymer*. **2010,** *82(3),* 670-679.
62. Banerjee, S.S.; Chen, D.H. *J. of Hazardous Materials.* **2007**, *147(3),* 792-799.
63. Mittal, H.; Saruchi, V.K.; Ray, S.S. *Int. J. of Biological Macromolecules*. **2016,** *89,* 1-11.
64. Ghorai, S.; Sarkar, A.K.; Panda, A.B.; Pal. S. *J. Bioresource Technology.* **2013,** *144,* 485-491.