

## Industrial Applications of Natural Gums

S. K. S. Yadav

ICAR - Indian Institute of Natural Resins and Gums, Namkum, Ranchi – 834010 (Jharkhand)

Natural gums are a group of plant products, formed primarily due to the disintegration of plant cellulose. This process is known as gummosis. Gums are produced by members of a large number of families but commercial exploitation is restricted to a few tree species of Leguminosae, Sterculiaceae and Combretaceae families. The important gum yielding trees are *Acacia nilotica* (*babul*), *A. catechu* (*khair*), *Sterculia urens* (*kullu*), *Anogeissus latifolia* (*dhawra*), *Butea monosprma* (*palas*), *Bauhinia retusa* (*semal*), *Lannea coromandelica* (*lendia*), and *Azadirachta indica* (*neem*). Gum is also extracted from seeds of certain plants like *guar*, *tamarind*, *cassia tora* etc. Guar gum is the prominent seed based natural gum.

- The principal characteristics of gums are:
- They consist of polysaccharides or their derivatives
- They are soluble in water or at least become soft and swollen when mixed with water. However they are insoluble in alcohol and other organic solvents
- They decompose completely on heating without melting and tend to become charred

Most gums emanate from plants in a liquid form. They dry up into translucent, amorphous, tear-shaped bodies or flakes on contact with air.

The uses of natural gums in food, medicines and in various other fields go back to very early times. Certain natural gums are approved by the U.S. Food and Drug Administration for use in food and pharmaceuticals. There is no known allergy to any of the natural gums. The present day uses of natural gums are numerous and they are employed by a large number of manufacturing industries including food and pharmaceutical industries. Some of the gums of commercial importance are presented here.

### Industrial applications of guar gum

Guar gum is the gum derived from the seed of the guar plant (*Cyamopsis tetragonoloba*). The largest market for guar gum is in the food industry, where it is used as a thickener and binder of free water. Guar gum also finds extensive use in many industrial applications. The various applications of guar gum in different industries are given below:

Industry	Uses
<b>Food Industry</b>	
Bakery	Improves texture, Increases dough yield, Increases shelf life, Improves crumb structure
Processed Cheese	Improves texture and flavor, Stabiliser
Soups	Thickener, Stabiliser
Pastry Ices	Absorbs free water, Prevents excessive stickiness
Noodles	Improves texture and form, Improves moisture retention.
Meat Dressings and Sauces	Binder in sausages, Absorbs free water, Improves flow rate, Prevents separation and migration
Beverages	Thickener, Emulsion stabilizer, Improves flow properties
	Controls viscosity, Improves body and mouth feel, Improves shelf life
<b>Textiles</b>	For sizing and finishing
<b>Oil well drilling</b>	Fluid-loss controlling agent, Additives in fracturing fluids
<b>Mining</b>	Concentration of ores, Flocculation and better recovery
<b>Construction</b>	Waterproofing agent
<b>Explosives</b>	Water binding agent for aqueous slurry explosives

<b>Cosmetics and Pharmaceuticals</b>	Conditioner and viscosifier, Thickener in toothpastes and shampoos, Binder in tablets, To disintegrate compressed tablets, Mild laxative and soluble dietary fiber
<b>Paper</b>	For improved sheet formation, Increased bursting strength, Increased fold strength, Denser surface for printing, To get better finish

### Industrial applications of gum Arabic:

Gum arabic is the natural gum exuded by various species of *Acacia*. The main source of commercial gum arabic is *Acacia senegal* L. Willd. A brief summary of the industries that use gum arabic is given below.

#### Food Industry:

- Confectioneries: used to prevent crystallization of sugar
- Dairy products: Used as a stabilizer in frozen products
- Bakery products: Used for its viscosity and adhesive properties
- Beverages: Used as a foam stabilizer in beer, and as a clouding agent to give opacity
- Flavour emulsifier: used as an emulsifier and protective collide.
- Diabetic and dietetic products: Used because of its low level of metabolism.

#### Pharmaceutical Industry:

- Emulsions: Used as a stabilizer
- Tablets: Used as a binder
- Tablet coatings: Used as a mucilage
- Cough drops and syrups: Used as an emollient and demulcent

#### Cosmetic Industry:

- Lotions and protective creams: Used to give smooth feel
- Facial masks: Used as an adhesive
- Face powders: Used as an adhesive

#### Other Industries:

**Adhesives:** Used as a mucilage, as simple adhesive and glue for miscellaneous paper, glass and metal products.

**Ink:** Used as a protective collide and suspending agent.

**Lithography:** Used as a sensitizers for lithographic plates, elements in the light-sensitive composition, ingredients of the fountain solution used to moisten plates during pointing, and protectors during storage of plates.

**Paper:** as a coating for specialty papers and as a coacervate in carbonless paper.

**Paints:** Used as a protective collide, as a flocculant and emulsifier in vinyl resin emulsions

**Textiles:** used as sizing and finishing agents and in printing formulations for imparting designs and decorations to fabrics, also used to thicken the dye baths that are used in the printing and dyeing of fibers, fabrics and carpets.

### Applications of Gum Karaya

Gum Karaya, sometimes known as Sterculia gum, is the dried exudation of the Sterculia Urens tree and other species of Sterculia. Karaya is also known as Indian tragacanth as it resembles the gum tragacanth. Gum karaya is a complex, partially acetylated polysaccharide obtained as a calcium and magnesium.

**Food applications:** The use of gum karaya in foods has to be in accordance with the FDA Code of federal regulations. 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. Gum levels of 0.6–1.0% are used to obtain the desired texture, color, and suspension, but during processing care must be taken regarding the heat- and shear-sensitivity of the gum. In French dressings, gum karaya functions as a stabilizer, increasing the viscosity of the aqueous phase of the oil-in-water emulsion. 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. 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. In frozen desserts, such as sorbet, sherbet, and ice lollies, gum karaya is used in concentrations typically varying between 0.2% and 0.4%. It controls the formation of ice crystals, preventing them from growing too large, prevents the migration of free water, and reduces the suck-out of color and flavor during consumption. It is also found in ice cream, together with locust bean gum. In sausages, gum karaya is used in concentrations ranging from 0.75% to 3% and performs several functions. It acts as an adhesive between meat particles and as a water-binder during preparation and storage. During smoking and cooking, the gum seals the pores of the casings, reducing the loss of volatile flavoring components. It also provides the appropriate sensorial characteristics to the product, such as a smooth texture, mouthfeel, body, and appearance. In bakery products, gum karaya is mainly used to reduce the effect of variations in water addition and mixing time. Due to its water-binding capacity, it also slows down aging, extending the shelf-life of baked goods.

**Non-food applications:** Most gum karaya is consumed in the pharmaceutical industry, where it is used in diverse applications. It functions as an adhesive in leak proof sealing rings for post-surgical drainage pouches or ostomy bags. Coarse gum particles are very effective as bulk laxative as they absorb water and swell to 60–100 times their original volume. They are neither digested nor absorbed in the human ingestion channel. Powdered gum karaya is widely applied on dental plates as an adhesive. 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. Deacetylated gum karaya is used as a binding agent in the production of long-fiber, lightweight papers. 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 dir

### **Industrial applications of gum ghatti**

Powdered gum ghatti is used in ammonium nitrate semi gelatin mixtures, and powdered explosives to improve their resistance to water damage. This allows the explosive cartridge to be submerged in water. The gum absorbs any water seeping in the cartridge and forms a surface protection for the interior explosive so that its detonation sensitivity is not impaired. Ghatti is used in varnishes and emulsifying oils, such as 40% kerosene oil. It acts as a stabilizer in auto polishes and wallpaper gum sizings. Ghatti has been used with polyacrylamide to aid in the polymerization and formation of uniform and discrete pills of cross-linked polystyrene. Gum Ghatti prevents fluid loss in oil well drilling muds when used at low concentrations in neutral mixtures, and in high salt concentration. It also prevents fluid loss at elevated temperature. It is used in the acidizing of oil wells in combination with a water-insoluble non-aqueous liquid that is inert to both the gum and acid. It also finds application in emulsification of petroleum and non-petroleum waxes to form liquid and wax paste emulsions.

**Table: Applications with functions of Gum Ghatti**

<b>Applications</b>	<b>Functions</b>
Emulsifier for Carbonated drinks	Stabilizes water and oil Emulsion
Beverages (Powdered)	Encapsulation of Flavor
Flavors (Powdered)	Encapsulation of Oil Entrapment
Chewing Gum	Flavor and Water Retention Softening
Gum Drops	Prevents Sugar Crystallization
Fruit Jellies	Independent Jelling of Sugar
Sweets	Source of Fiber
Coated Sweets	Coating Film Forming & Glazing
Caramels	Improves Chew Ability
Printing	Film Forming
Hair Fixers	Binding Agent
Wine	Colloidal Stabilization & Tannin
Pharmaceuticals	Suspension

#### **Utilization of locust bean gum**

Locust bean gum is the preferred texturizer for variety of food applications due to its natural image, the neutral taste and the very creamy texture it provides. It has a positive impact on the protein stability and not interacts with other ingredients in the food due to its neutral behavior.

- Used in the manufacture of food stuffs especially confectionary.
- It is a major thickening and gelling agent.
- Also used in food technology
- Used in pet foods
- Mining products
- Paper making
- To thicken textiles
- Increase the cigarette flavor
- Used in cosmetics
- Gum powder is used as an additive in shoe polish and insecticide

#### **Applications of tamarind Gum**

Tamarind Gum is derived from tamarind kernel seeds grown on tamarind tree. Tamarind gum powder has various applications in the following industries.

##### ***Food Processing Industry***

In the food industry, tamarind gum powder is used in the manufacturing of ketchups, sauces, baked food, meat product, instant noodles and ice cream. It is also used on pet food as an additive. One of the souring agents in Indian curries is tamarind pulp. Due to its sugar and acid content tamarind pulp is utilized in kitchens for curries syrup and variety of other food beverages.

##### ***Pharmaceutical Industry***

Tamarind gum is used as binder for making bioadhesive tablets. Tamarind seed polysaccharide is used for production of thickened ophthalmic solutions having a pseudo plastic

rheological behaviour and mucoadhesive properties. It is used as potential polysaccharide having high drug holding capacity for sustained release.

***Textile Industry***

In the textile industry, tamarind gum powder is used in textile sizing and textile thickeners. The good thickening property of tamarind gum powder makes it an excellent thickening agent for textile industries. Tamarind kernel powder is also used for textile sizing purposes.

***Mining Industry***

Due to its brilliant property of a soil stabilizer, tamarind gum powder is widely used in mining. The specific areas of its application in mining are the oil drilling and gas industries.

***Pet Food***

Tamarind kernel powder has better ability to control viscosities when added in solutions and hence makes up for a great viscosifier for addition in pet foods. It is an excellent thickening agent used in manufacture of canned pet foods processed for cats and dogs. Moreover the powder is also nutritious and contains fibres which can aid for improved digestion in the pets.