Gum Ghatti: A Comprehensive Review on its Physicochemical Dynamics, Pharmaceutical Applications, and Future Horizons.

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***Abstract*— The gum produced in India using natural tree exudate is described in this chapter. The exudate gum has a glassy appearance and can be transparent white or dark red in color, depending on whether it is a nodule or a spiro. The chapter then discusses the botanical origin of gum ghatti as well as recent discoveries concerning its structure. It is directly compared to gum arabic in terms of its solubility, sugar composition, protein content, molecular weight, viscosity, and emulsification efficiency. The present regulatory status of gum ghatti is described, along with a number of culinary and other uses.**

***Index Terms*— Gum Ghatti, Natural polysaccharide, Hydrocolloid, Emulsifying agent, Physicochemical properties, Hydrogel, Wastewater treatment, Nanotechnology.**

I. INTRODUCTION

Indian gum is another name for gum ghatti, a non-starch polysaccharide native to India. Anogeissus latifolia, that is. This ancient plant exudate's name is derived from the word "Ghat," which describes a mountain route. The gum may have been given name because of its ancient mountain trails. Non-carbohydrate impurities can occasionally color gum and make it leak on its own. After drying, the product is filtered and treated according to conventional protocols. It was not traditionally acknowledged as an important tree gum in culinary items due to the uncertainties around its amount and quality. [1,2,3]

II. PHYSICOCHEMICAL PROPERTIES

Like gum arabic, the location, surroundings, and kind of exudate (yellow, white, or spiro) can all affect the quality of gum ghatti. Along with 2.2% ash, 4.2% protein, and 7.7% moisture, polysaccharides make up around 86% of gum ghatti. About 90% of the total sugar content is made up of galactose and arabinose. The amount of sugar in gum ghatti is influenced by the plant's maturation stage, the season, and the grades.

III. CHEMICAL PROPERTIES AND SOLUBILITY

Gum ghatti is a large molecular weight, complex polysaccharide. It is a naturally occurring mixture of potassium, sodium, magnesium, and calcium salt. Complete hydrolysis reveals less than 1% of 6-deoxyhexose, along with L-arabinose, D-galactose, D-mannose, D-xylose, and D-glucoronic acid in a molar ratio of 10:6:2:1: Two. Gum Ghatti is a water-soluble gum that forms a colloidal solution when it dissolves in hot or cold water. Water dissolves 80–90% of it. Ghatti dispersions are mostly unaffected by traces of acid or alkali because the gum acts as a buffer and recovers to its normal pH of 4.8. Ghatti is also a strong emulsifier.[4]

IV. HARVESTING, PROCESSING, AND STORAGE

- Harvesting

1. After exudation, GG absorbs color from bark and turns darker when it comes into contact with it, which is less advantageous for gum producers.
2. GG that develops on trees as a result of either natural or artificial damage is removed as tears as it has dried. Gum that touches the bark dries and adheres to the surface as well. It is not ideal for GG to collect tears while sticking firmly to the bark due to its exceptional adhesive properties.
3. Gum from Karaya is going through a similar situation. The Kovel Foundation in

Visakhapatnam, India, developed a new method for gathering karaya gum on polythene sheets (Prasad et al., 2022). and gathering and harvesting GG may benefit from it.

4. Gum tapping and harvesting from A. latifolia trees is commonly done in the summer, from March to June, due to the high temperatures and low relative humidity that are suitable for gum production. Gum pickers collect the gum tears produced on the tree by hand.
5. Gum pickers may use a locally made pruning knife to remove GG rips from trees. When immediately gathering gum by hand, it was discovered that relatively few gum manufacturers used gloves. In order to avoid bacterial or fungal diseases, gloves must be used. [5]

- Processing

1. Gum karaya is prepared in a manner like to that of GG. GG produced from trees may include 20% moisture on a dry basis (d.b.). Furthermore, it often contains foreign things like as leaves, bark, sand, and dirt.
2. GG turns tinted as it comes into touch with newly extruded bark. Darker-colored GG containing foreign products is perceived as being of poorer quality and generates less revenue for the maker.
3. Furthermore, GG with more than 10% moisture (d.b.) is vulnerable to bacterial and fungal infections. Therefore, the grower's harvested GG must be dried to lower the moisture content to less than 10% and cleaned to eliminate any superfluous material (d.b.). Almost no processing occurs at the level of the gum pickers.
4. The processing centers oversee the grading and cleaning processes. After that, gum is manually divided into a number of categories based on its color and amount of foreign material.
5. Ghatti tears are crushed into a fine powder in certain processing plants and then graded into powders with varying particle sizes based on the customer's requirements. During this process, contaminants are eliminated from the gum powder using a variety of techniques, including aspiration, shifting, and density-based separation.
6. The liquid portion of gum is converted into spray-dried GG powder in some industries using spray dryers (Giri et al., 2008). GG producers must be trained in primary processing and informed of its benefits, and small, useful equipment for GG primary processing (cleaning and grading) must be built at the village level.[6]

- Drying:

1. GG has between thirty and thirty-five percent moisture when trees discharge (d.b.). After GG exudation, the tree dries up naturally till it is harvested.
2. GG has a moisture content of around 20% when taken from trees (d.b.). Although gum dries more quickly at first, the Kovel Foundation in Visakhapatnam advised sun drying gum karaya on an elevated platform made of wooden poles, a bamboo mat, and a polythene sheet to avoid contamination by dogs and children during the drying process (Prasad et al., 2022).
3. GG drying may also be accomplished using this technique. To swiftly dry gum and stop foreign materials from combining, ICAR-IINRG in Ranchi, India, developed a small-scale drier (Annual Report, ICAR-IINRG, 2013). For GG drying, this drier could be recommended as well. [8]
4. The drying process gets quite sluggish when hardening takes place. The GG producer allows collected GG to dry in the sun for five to ten days until the moisture content falls below 10% (d.b.), depending on the weather.
5. To dry GG in the sun, gum makers frequently place gum rips on a cloth, plastic sheet, or mat (made of bamboo, palm tree, or date tree leaves) on the ground.[9]

- Storage and transportation

50 kg burlap bags are used for the storage and transportation of GG; drums, cardboard boxes, or multi-layered craft paper bags coated with polythene are used for the transportation of semi-processed and processed GG, which is usually in kibbled, granule, and powdered form. It is recommended to keep GG in cold, dry warehouses to prolong its shelf life because it is utilized in many culinary and medicinal purposes.

V. TRADITIONAL USES OF GHATTI GUM

- The wood is used by the villagers to make posts, houses, and agricultural tools, among other things.
- Its lops and tips make fine firewood, and its green

leaves is highly valued as feed.
- Charcoal made from thicker branches works well.
- The leather industry uses the leaves and bark, which have a high tannin content, to color skins.
- This wood's springy quality increases its usefulness. It is both difficult and simple to deal with. Its goods have a beautiful grain pattern when given a thorough polish and a varnish coat. As a result, the species can be used as decorative wood. It is utilized for high-quality furniture, cart axels, etc. and is seasoned in kilns with scientific designs. The term "axle-wood tree" comes from this.
- In reference books pertaining to various Indian medical systems, ghatti is regarded as a therapeutic plant. Ghatti, according to Ayurveda, is stomachic, promotes biliousness, cools, enhances taste and hunger, and is helpful in treating erysipelas, discharges, anemia, and skin issues. Its leaves can help with problems relating to the ears. The Unani (Greek) medical system claims that its bark is bitter, astringent to the intestines, and helpful in treating eye sores, chronic diarrhea, and liver problems. [11,12]

VI. APPLICATIONS

- Stability

Plant exudate gum, or gum ghatti, has distinctive qualities that are useful for a variety of commercial uses, particularly in the food sector. Its chemical makeup, the environment, and interactions with other chemicals all affect its long-term stability and endurance. Gum ghatti's hydrophobic proteins and amino acids improve its emulsifying and stability qualities. Plant exudate gum, or gum ghatti, has distinctive qualities that are useful for a variety of commercial uses, particularly in the food sector. Its chemical makeup, the environment, and interactions with other chemicals all affect its long-term stability and endurance. Gum ghatti's stability and emulsifying qualities are improved by the hydrophobic proteins and amino acids. Its stability can be further increased by modifications such as heat, radiation, enzymatic, and cross-linking treatments. Maintaining its efficacy and increasing its shelf life also depend on controlling moisture, temperature, and pH in addition to using preservatives to ensure microbiological stability. [13,14]

- Emulsification Property

Since this gum can emulsify, they can all be used in the pharmaceutical and edible coatings industries. This suggests that the hydrophobic amino acid distributions of gum ghatti and β-casein are comparable. These chemicals are highly effective in binding oil at the oil-water interface due to their hydrophobic amino acid sequences. Gum ghatti's ability to stabilize and emulsify oil-in-water solutions is improved by this feature, which makes it especially useful in situations where strong emulsification abilities are needed.[15]

- Hydrogels

Cross-linked polymer grids that can stretch and hold massive volumes of water without breaking down make up hydrogels. Hydrogels are used in many scientific fields, including biotechnology, biomedicine, agriculture, water purification, sanitation, and biosensing. Superabsorbent hydrogels have also primarily been used for drug delivery. Gum ghatti and other natural gums are suitable raw materials for hydrogel. The efficiency of a hydrogel made of acrylamide and gum ghatti was assessed using a microwave-assisted embedding approach as an adsorbent. [16]

- Food and Beverage Industries

Gum ghatti is frequently used in the food business as a unique gourmet ingredient in a range of pricey goods. It acts as an emulsifier, stabilizer, and thickening agent while altering the behavior of water in food products. Gum ghatti is better than other gums in various ways, such its resistance to salt and acid and its capacity to mix with oil. Gum ghatti may bond with oil at lower concentrations and is more resistant to salt and acid than gum arabic.[17]

VII. GUM GHATTI USED IN PHARMACEUTICAL FORMULATION

- Gum ghatti polymeric carrier for entreic sustained delivery of diaclofinac sodium

The costly enteric coatings used in current Diclofenac Sodium (DS) tablets frequently "dose dump," releasing the full medication at once and irritating the stomach. Gellan gum–Chitosan (GG-CH) beads, which provide a better regulated method, are used in your study to replace this:

- Matrix vs. Coating: The medication is implanted in a thick, "crystal-like" polymer network rather than a thin shell.
- pH-Targeted Release: In stomach acid (pH 1.2), the beads stay intact, but in the intestine (pH 6.8), they expand to offer a prolonged release.

Although Gellan gum–Chitosan (GG-CH) complexes have promise, preliminary experiments revealed that under acidic stomach conditions (pH 1.2), simple beads enable more than 10% of the medication (DS) to escape after 120 minutes.Your study is headed toward a triple-polymer approach to address this "leakage" and fortify the matrix:

- The Mechanism: Coulombic attraction, or charge-based bonding, and secondary forces like hydrogen bonds and van der Waals interactions are how beads are formed.
- The Change: Gum Ghatti or Gum Karaya are two more anionic gums that you are adding while maintaining a steady concentration of Gellan gum.
- The Objective: By combining these polysaccharides, you hope to produce a stronger, denser polyelectrolyte complex (PEC) that effectively reduces acid-phase release while preserving a prolonged release in the intestinal environment (pH 6.8). [20,21,22]

VIII. CHALLENGES AND FUTURE PROSPECT

The inability of gum ghatti to completely dissolve in water and produce dispersions is one of its primary problems in the food, beverage, and pastry industries. As a result, in some formulations, achieving homogeneity and continuous dispersion is difficult. Using gum ghatti and other biopolymers as reducing and capping agents, it is difficult to create silver nanoparticles in situ and combine them into bio-nanocomposites appropriate for food packaging. The potential antibacterial activity of these nanoparticles in polymer blends may lead to the development of enhanced food packaging materials in the future that enhance food safety and shelf life. [23,24]

IX. CONCLUSION

Gum ghatti is a promising natural polymer with excellent emulsifying, stabilizing, and biodegradable properties. Its many uses in food, medicine, and emerging fields like nanotechnology demonstrate its industrial worth. With further research and improved processing, it has enormous promise for innovative and sustainable uses.

Table 1- Anogeissus latifolia Classification

kingdom	Plantae
subkingdom	Tracheobionta (vascular plant)
super division	Spermatophyta (seed plant)
division	Magnoliophyta (flowering plants)
class	Magnoliopsida (dicotyledons)
subclass	Rosidae
order	Myrtales
family	Combretaceae (white mangrove family)
genus	Anogeissus
species	Anogeissus latifolia

Table 2- Characters in food and beverages industry [18]

Food Application	Characters
Emulsifier for carbonated drinks	Stabilizers water and oil emulsions
Beverages	Encapsulation of flavor
wine	Colloidal stabilization and tannin suspensions
Fruit jelly	Independent gelling of sugar
sweets	Source of fiber
Coated sweet	Coating film forming and glazing
Gum drops	Prevent sugar crystallization
caramels	Improves chewability
Flavours(powder)	Encapsulation of oil entrapment

Figures

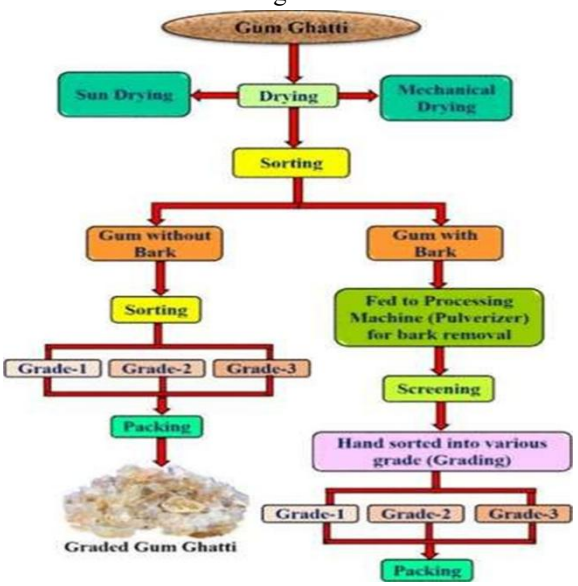

Fig 1- Outline flow of the cleaning and grading of gum ghatti.[7]

fig 2- applications of gum ghatti in nanotechnology [19]

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