RESEARCH PAPER

A Comprehensive Review(Phytochemical, Pharmacological Activities, Traditional Uses & Therapeutic Potential) On Acacia Arabica (Syn. Acacia Nilotica) Gum

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ABSTRACT- *Acacia arabica* gum (Babool gum) is a natural substance obtained from the bark of the tree, either naturally or by making incisions on the trunk or branches. It is a water-soluble hydrocolloid. Chemically, it contains various bioactive compounds such as polysaccharides, proteins, and minerals. Due to the presence of these components, it exhibits several physiological, nutritional, and medicinal properties. Because of these beneficial characteristics, the gum has become an important natural product and is widely used in pharmaceuticals as well as in different industrial applications. This review article has been prepared through information collected from various sources like Ayurvedic textbooks, Nighantu, scientific sources and research articles with the help of previously published review studies on *Acacia arabica* gum.

The present review covers different aspects of *Acacia arabica* gum, including its taxonomical classification, Ayurvedic pharmacological actions, physicochemical properties, phytochemical constituents, mineral content, modern pharmacological activities, therapeutic uses, ethnomedicinal applications, and toxicity profile It also summarizes previously reported research emphasizing protective effects of this natural gum.

GA is widely used in traditional medicine and is gaining attention in modern pharmacological research. GA is composed of polysaccharides, essential minerals, minor amounts of proteins, tannins, flavonoids, and glycosides, etc. Due to these diverse phytochemicals profile GA exhibit multiple biological activities relevant to bone health and osteoporosis. Many studies show antioxidant, anti-inflammatory, antidiabetic, hypolipidemic, antiulcer, hepatoprotective, and nephroprotective activities. It also acts as a natural prebiotic fiber, improving gut health, enhancing nutrient and calcium absorption, mineral bioavailability, thereby supporting skeletal mineralization. In Ayurvedic classical textbooks, Nighantus, the therapeutic importance of Babula has been described at many places. As per Atreya Samhinta -A. Nilotica gum is described as having properties such as grahi (absorbent), vata pita shamaka (pacifies vata and pitta), and Bhagna sandhanak (helps in fracture healing) etc.

बबुरस्य तु निर्यासो ग्राही पित्तानिलापहः। रक्तातिसार पित्तास्रमेहप्रदरनाशनः॥ भग्नसन्धानकः शीतः शोणितास्रनिवारणः।(आ.सं.)॥।

Keywords:- *Acacia arabica*, Gum, Acacia nilotica, phytochemical, pharmacological uses, medicinal uses, Clinical triasl.

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Introduction:-

Acacia Arabica Willd (Babula) is a small tree with spines and yellow flowers. It is found in most parts of India. It is described for the first time by Sodhala Nighantu, where its gum is denoted as 'Gundra'. Rajnighantu mentioned it as 'Barbari' while Gadanigraha described Babbulasava and the usage of Babula leaves in diarrhea[2].

In traditional healthcare practices, Acacia nilotica is extensively used for the treatment of diverse ailments. Across many West African countries, different plant parts such as pods, bark, gum, roots, flowers, and leaves are highly valued for their medicinal properties. These

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components are widely used for managing gastrointestinal disorders, including diarrhea, dysentery, hemorrhoids, abdominal pain, toothache, and sore throat. It can also be utilized in the treatment of metabolic and respiratory conditions such as diabetes, asthma, and hypertension.[3][4]

GUM: The exudate obtained from the bark of Acacia nilotica, commonly known as Indian gum Arabic, is widely utilized in food, pharmaceutical, and industrial applications. Gum exudation generally occurs from injured bark, particularly during the warm months of March to May, and environmental factors such as temperature and humidity influence its production (Das et al., 2014)[5]

GA is formed in a process called "gummosis," which is a natural response of the tree to an injury to the bark, as a result of the transformation of cell contents into the gum in the form of nodules that are then collected as a raw product. Gum occurs in the form of irregular or broken tears.[6]

Chemically, the gum consists mainly of high-molecular-weight polysaccharides along with mineral salts of calcium, magnesium, and potassium (Williams and Phillips, 2000) [12]. Hydrolysis of *Acacia Arabica* gum gives arabinogalactan, arabinogalactan-protein complex, and some glycoproteins, but arabinogalactan is more abundant. It contains sugar compounds like arabinose, galactose, shamnose and glucuronic acid. (Kapoor et al., 1991)[7].Some Ayurvedic textbooks mention its use as an astringent, demulcent, and nutritive tonic for various ailments. (Chopra et al., 2002[8]; Kirtikar and Basu, 2003[9]; Nadkarni, 2005)[10].It increases fecal nitrogen excretion and absorption of water and electrolytes in the intestine, making it beneficial in diarrhea. (Codipilly and Wapnir,2004).[11].It increases fecal nitrogen excretion and protects the kidneys by reducing serum urea level (Bliss et al., 1996) [13]. Due to all these activities, it is considered as an important medicine and nutritive substance. (Raj and Chandrawanshi, 2015)[14].

TAXONOMIC CLASSIFICATION (AC. CAROLUS LINNAEUS)[16]

Botanical name: *Acacia arabica* Willd., Syn. *Acacia nilotica* Delile ssp. Indica (Benth.) Brenan.[15]

Kingdom:- Plantae
Subkingdom:- Tracheobionta
Super division: - Spermatophyta
Division: - Magnoliophyta
Class: - Magnoliopsida
Subclass:- Rosidae
Order: - Fabales
Family:- Fabaceae
Genus: - Acacia
Species: - nilotica

CLASSICAL NAMES[15]:

Babbula, Kinkirat, Abha. Shatpadmodini, Yugmakantak, Sukshamapatra, Dridharuha,
Sapitaka, Malaphala

AYURVEDIC PHARMACOLOGICAL PROPERTIES OF *A. ARABICA* GUM[15]

Rasa: Madhur, Kashaya
Guna: Snigdha
Veerya: Sheeta
Vipaka: Madhura
Doshaghanata: Vatapitta shamaka
Rogaghanata: Sheeghrapatana nasak, Shukradaurbalyata hara, Koshathagata raukshyata nasak, Mootrakrichchhra hara, Daurbalyanasak.
KARMA: Mootrala, Balya, Vrishya, Sangrahi, Snehana.
Dose (Matra)[17]
The dose of Babool Gum 2 to 4 masha.

Vernacular names[15]

S.No.	LANGUAGE	VERNACULAR NAME
1.	Sanskrit	Dridhabeeja, Panktibeeja,deerghakantaka
2.	Hindi	Babul, Kikar, Babur
3.	English	Indian Gum Arabic, Black Babool
4.	Beng.	Babulgachh, Babla, Babul
5.	Gujrati	Kalobaval, Babul, Babariya, Baval
6.	Punj.	Kikkar
7.	Arabi	Ummughilan
8.	Tam.	Karuvael
9.	Tel.	Nallatumma, Tumma
10.	Marathi	Babhul, Vedibabul
11.	Malyalum	Karuvelum

MATERIAL AND METHODS-

The review aimed to summarize experimental findings related to bioactive constituents, clinical findings, and therapeutic potential, etc., as reported in previous studies.

Literature Search Strategy

A systematic and extensive literature search was conducted using multiple international scientific databases, including PubMed, Scopus, Web of Science, ScienceDirect, Google Scholar, and SpringerLink. Additional literature sources, such as AYURVEDIC CLASSICAL books, thesis, dissertations, conference proceedings, and institutional repositories, were also consulted to obtain supplementary information.

Exclusion criteria:
Studies focusing on unrelated plant species. Articles lacking experimental evidence or unclear scientific methodology. Duplicate records or non-peer-reviewed sources with insufficient scientific credibility

PHYSICAL CHARACTERISTIC

Acacia nilotica gum occurs in the form of irregular or broken tears, of various sizes, agglutinated or stalactiform masses, and angular fragments or pieces with pale yellow or deep reddish brown colour. Thick pieces opaque, thin ones transparent; each tear about 1" to 1.5" in diameter; it is brittle, breaks with a glassy iridescent fracture; bland and mucilaginous, without odour, and off-white to orange-brown nodules, entirely insoluble in alcohol and, are water-soluble at 30°C forming viscous hydrophilic colloidal solutions, insoluble in organic solvents and oils but capable of forming emulsions in aqueous systems. (Yusuf, 2011; Remington, 2000)[18][19].

NOTE: Its color varies from pale yellowish brown to dark reddish-brown, depending on the amount of tannin it contains[14].

PHYSICOCHEMICAL PROPERTIES[20]

The physicochemical properties comprises of 13% moisture, 38% solubility, 300-320ºC melting temperature, 3.54% ash, 0.4% nitrogen, 2.71% protein, 78.15% total soluble fibre, 0.70g/100g Ca, 0.30g/100g Mg, 0.004g/100gFe,0.016g/100g Na, and 0.78g/100g K.
NOTE: The gum of Acacia nilotica has a higher molecular weight (Mw, 2.3 x 106) than Acacia senegal (Mw, 600,000).
Moisture content –15.60 %, Ash content – 3.54 %, Volatile matter –65.50 %, Tannin content – 0.0024mg/g, Protein content – 16.94mg/g, pH(25%sol.)-4.50, Ferrous (Fe) content-1278ppm, Zinc (Zn) content-96.916ppm, Manganese (Mn) -104.6ppm, Copper (Cu) - 65.251ppm.[22]
The physicochemical properties of Acacia nilotica gum are minimally influenced by multiple factors, including plant genetics, environmental conditions, harvesting method, chemical composition, and post-harvest handling. These factors collectively determine the quality and industrial or pharmaceutical applications of the gum[23].

MACRONUTRIENT CONTENTS OF *Acacia Nilotica* GUM[23]

Sr.No.	Nutrients	Quantity(per 100gm)
1	Moisture	14.5gm
2	Energy Value	351.37Kcal
3	Carbohydrate	87.05gm
4	Protein	0.50gm
5	Fat	0.13gm
6	Crude Fiber	0.15gm

VITAMIN CONTENT OF THE GUM[23]

Sr.No.	Vitamin	Unit	Quantity
1	Beta Carotene	Micro gm/100gm	114.675
2	Vitamin C	Mg/100gm	13.18663
3	Vitamin B_1	Mg/kg	BDL(DL:10)
4	Vitamin B_2	Mg/kg	BDL(DL:10)
5	Vitamin B_3	Mg/kg	BDL(DL:10)

BDL: Below Detection Limit;**DL:**Detection Limit

MINERALS IN THE GUM[24]

Sr.No.	Name of the Minerals	Unit	Quantity
1	Ash	Gm/100gm	2.98
2	Ca	Mg/100gm	366.37
3	Fe	Mg/100gm	25.41
4	Na	Mg/100gm	11.91
5	K	Mg/100gm	124.87
6	Cr	Mg/kg	0.67
7	Se	Mg/kg	0.54
8	Cu	Mg/kg	0.66
9	Co	Mg/kg	<0.1
10	Mg	Mg/kg	22.61

11	Mn	Mg/kg	5.73
12	Pb	Mg/kg	0.26
13	Zn	Mg/kg	10.28
14	Mo	Mg/kg	BDL(DL:1.0)
15	P	Mg/100gm	2.96

BDL: Below Detection Limit; **DL:** Detection Limit

PROTEIN AND CONSTITUENT SUGAR ANALYSIS OF DIFF. SAMPLE OF ACACIA NILOTICA GUM[7]

Sample from	Protin%	Constituent sugar %			
		Rhamne	Arabinose	Galactose	Uronicacid
Maharashtra	1.8	2.0	53.5	36.6	7.9
Andhrapradesh	2.1	2.4	45.9	30.6	14.1
Madhyapradesh	2.5	3.4	49.4	33.7	12.4
U.P. (Banthra Research Station)	2.2	Trace	65.7	24.2	8.2
U.P.(Kukrail forest during winter)	1.6	Trace	62.6	23.1	13.2
U.P.(Kukrail forest during summer)	1.3	Trace	53.6	32.7	11.9

PHYTOCHEMICALS

The gum contains high molecular weight polysaccharides and their calcium, magnesium, and potassium salts. Hydrolysis of gum yields three fractions named arabinogalactan (88%), arabinogalactan protein (~ 10%), and glycoprotein (< 2%). Arabinose, galactose, rhamnose, and glucuronic acids are the principal sugars present in the gum. Sugars like D-galactose, L-arabinose, and L-rhamnose are majorly present in the *A. arabica* gum along with four aldobiouronic acids, namely 6-O-(β-D-glucopyranosyluronicacid)-D-galactose,6-O-(4-O-methyl-β-Dglucopyranosyluronicacid)-D-galactose, 4-O-(α-D–glucopyranosyluronicacid)-D-galactose, and 4-O-(4-Omethyl-α-D-glu- copyranosyluronic acid)-D-galactose[25].The gum contains a high percentage of phenolic constituents, including m-digallic acid, gallic acid, methyl and ethyl esters, protocatechuic acid, ellagic acids, leucocyanidin, m digallicdimer 3,4,5,7-tetrahydroxy flavan-3-ol, oligomer 3,4,7-trihydroxyflavan 3,4-diol, and 3,4,5,7-tetrahydroxyflavan-3-ol and (-) epicatecho[27]. Other constituents of gum include tannic acid, cresol (an antiseptic), and methylsalicylate. ProsapoganiniA, Quercetin, Alpha Amyrin, Alpha 1-Sitosterol, Lupeol, Arabinose-2-O-Beta-L-arabinofuranosyl-L-arabinose, along with known 3-O-Beta-L-arabinopyranosyl-L-arabinose[26]

PHARMACOLOGICAL ACTION

Acacia nilotica exhibits diverse pharmacological activities, including analgesic, anti-inflammatory, antipyretic, aphrodisiac, astringent, emollient, and expectorant effects. Traditionally, it is used to manage asthma, diabetes mellitus, diarrhea, dysentery, gastrointestinal disorders, hematuria, hemorrhage, liver diseases, urinary tract infections, leucorrhea, and vaginal discharge. It is also employed in conditions such as eye diseases, furunculosis, oral and laryngeal disorders, pharyngitis, low back pain, and insect bites. Moreover, it acts as a general tonic and provides a cooling effect on the body[25].

1.Antioxidant activity -*A. arabica* gum, has been reported to possess significant antioxidant potential. It also shows protective effects against drug-induced toxicity caused by agents such as indomethacin, aspirin, gentamicin, and certain chemotherapeutic drugs (Elshama, 2018) [54]. *A. arabica* gum exhibits antioxydent properties by reducing oxidative stress and tissue damage(Ali & Moundhri, 2006; Hinson et al., 2004) [56][60].In these in vitro studies, it was observed that *A. arabica* gum exhibits antioxidant properties that help reduce lipid peroxidation [57][58][61][59].

These experimental findings indicate that the aqueous extract of the gum helps maintain the activity of antioxidant enzymes within the body and reduces reactive oxygen species (ROS), thereby mitigating the toxic effects on the kidneys(Gado & Aldahmash, 2013) [53].

2. Anti-cancer, chemoprotective, and antimutagenic antioxidant, anti-inflammatory activity -This experiment suggests that *A. arabica* gum demonstrates these types of activities due to the presence of compounds such as gallic acid, ellagic acid, catechin, kaempferol, and tannins. These compounds exhibit antioxidant and anti-inflammatory activities and may inhibit tumor growth by inducing apoptosis and cell-cycle arrest (Imran et al., 2019) [64]. Experimental studies have reported cytotoxic activity of Vachellia nilotica (Acacia nilotica)extracts against various cancer cell lines, including leukemia, breast, lung, prostate, and colon cancers (Diab et al., 2022) [63]. Additionally, plant extracts have shown chemo-preventive effects in experimental models, including inhibition of DMBA-induced skin tumors (Kaur et al., 2002). These findings suggest that Vachellia nilotica (Acacia nilotica)may have potential applications in integrative cancer therapy.

A study evaluated the chemopreventive potential of aqueous extracts of Acacia nilotica gum, flowers, and leaves against DMBA-induced skin papilloma formation in male Swiss albino mice. The animals were divided into control and treatment groups. The control group received DMBA and croton oil without any extract, while the treatment groups were administered 800 mg/kg body weight of gum, flower, or leaf extract during

the peri- and post-initiation phases. Results showed a marked decrease in tumor incidence, tumor burden, and total papilloma count in treated mice compared to controls. Among the extracts, the leaf extract exhibited the strongest chemopreventive and antimutagenic effect, followed by the flower extract and gum (Meena et al., 2006) [66].

3. Antiosteoporosis activity- In an experimental study on induced osteoporotic albino rats, administration of an aqueous solution of *A. arabica* gum (10% w/v) at a dose of 1 ml per body weight per day resulted in a significant improvement in mean serum calcium, phosphorus, magnesium levels, and bone mineral density (BMD). The results of this investigation indicate that *A. arabica* gum protects osteoporotic rats receiving therapy. The dietary intervention with Arabic gum aids in maintaining calcium, phosphorus, and magnesium levels. [67]

4. Cellular Adhesion and Proliferation-*A. arabica* gum (GA) has demonstrated the ability to enhance cellular adhesion and proliferation, making it a promising biomaterial in tissue engineering and regenerative medicine[68][69]. (Miller et al., 2022; Wilson & Johnson, 2023).

5. Wound Healing-These studiesindicate that The gum possesses anti-inflammatory properties and facilitates tissue repair by enhancing cell migration and growth, thereby accelerating wound healing[70][72][71].

6. Cartilage and bone Regeneration: Experiments have revealed that *A. arabica* gum provides an environment resembling the natural extracellular matrix (ECM). It supports the attachment and growth of chondrocyte cells, thereby facilitating cartilage formation[73] [(Martin et al., 2022; Zhao et al., 2023).It promotes bone repair and regeneration by enhancing osteoblast cell activity and the formation of a mineralized bone matrix[74][75] (Taylor & Nguyen, 2021; Santos et al., 2022).

7. Antipyretic and antidiabetic-Antipyretic and Anti-diabetic Activity: Experimental studies on A. arabica gum have revealed that, due to its expectorant and antipyretic properties, it is considered beneficial in managing lung diseases and controlling diabetes[76][8].

8. As a galactogogue- Galactagogue Activity: An animal experimental study was conducted at the University of Khartoum, in which a total of nine cows were divided into three groups and administered A. arabica gum at concentrations of 0%, 5%, and 10% for a period of four weeks. The results revealed that milk production increased by 7.7% to 19%. Furthermore, improvements were observed in milk quality, specifically an increase in the levels of calcium (Ca), phosphorus (P), moisture, protein, fat, and lactose. No toxic effects were detected(Idris et al., 2007) [77].

9. Effect on Renal Function: Effect on Renal Function: Experimental research conducted on mice revealed that administering *A. arabica* gum to healthy mice resulted in an increase in 24 hours creatinine clearance indicating that *A. arabica* gum improves kidney filtration capacity(Nasir, 2007) [79]. It has also been reported that GA consumption can increase serum butyrate levels, which may contribute to improved creatinine clearance and glomerular filtration rate (GFR) (Matsumoto et al., 2006) [78]

10. *A. arabica* gum as a Prebiotic-*A. arabica* gum acts as a fermentable soluble fiber with prebiotic effects. It helps to improve digestive health by delaying gastric emptying, increasing stool bulk and bowel movement frequency, and regulating colonic transit time. Additionally, it can slow glucose absorption in the small intestine and contribute to the reduction of postprandial blood glucose, total cholesterol, and LDL levels (Luca et al., 2009) [65].

11. Hypocholesterolemic effects, when acacia gum was combined with other soluble fibers such as psyllium, pectin, guar gum, and locust bean gum, the mixture produced a reduction of about 10% in total serum cholesterol and around 14% in LDL-cholesterol (Haskell et al., 1992; Jensen et al., 1993) [80][81]. Similarly, a crossover study in 27 men using a fiber mixture of apple fiber and acacia gum (10 g/day) also demonstrated significant decreases in total cholesterol (≈10%) and LDL-cholesterol (≈14%) compared with the non-fiber control group (Mee & Gee, 1997) [82].

MEDICINAL USES:

Strength-promoting (Balavardhana): When Babool gum is fried in ghee and prepared as a confection (pak) and consumed, it helps increase semen (virility) in men. When given to women during the post-partum period, it helps improve their strength and recovery. [27]

Diarrhea (Atisara): Drinking water mixed with Babool gum helps relieve diarrhea and dysentery (including bloody diarrhea). Taking 1½ masha of powdered Babool gum as a dry dose (phakki) continuously for 10 days helps in relieving diarrhea. [27]

The gum obtained from Acacia nilotica possesses several important therapeutic properties. Traditionally, the powdered gum is administered along with quinine in cases of fever that are associated with gastrointestinal complications such as diarrhoea and dysentery. This combination is believed to help reduce the severity of these symptoms and support recovery[10].

Gastric pain: Administration of Babool gum water helps relieve pain in the stomach and intestines.

Gonorrhea / urinary inflammation (Sujak): When Babool gum is dissolved in water and administered locally as a douche or irrigation, it helps reduce inflammation of the urinary bladder, burning sensation, and discharge (pus) associated with gonorrhea [27]

Diabetes (Madhumeha): Consumption of the gum obtained from Acacia nilotica is believed to help reduce or control diabetes (Madhumeha) [27]

In addition, the gum exhibits astringent and haemostatic properties, which make it useful in controlling bleeding as well as abnormal urinary and vaginal discharges. It has also been reported to be beneficial in the management of diabetes in traditional medicine[26].

Excessive Menstrual Bleeding:4½ masha of roasted Babool gum mixed with 4½ masha of geru (red ochre) and powdered together. When this powder is taken as a morning dose (phakki), it helps control excessive menstrual bleeding [27].

Burns and scalds-For external application, the powdered gum is commonly mixed with egg white and applied over burns and scalds. This preparation forms a protective layer over the affected area and may help in soothing the skin and promoting healing [27].

The substance is not converted into sugar during digestion by Jatharagni (the digestive fire); therefore, it can be safely used in conditions such as Somaroga and Madhumeha (diabetes mellitus). It is also beneficial in disorders arising due to the stimulation of Shleshmadhara Kala, which is associated with Kapha-related pathological conditions. Such conditions include cough, throat lesions (Galakshata), intestinal disorders involving excess Kapha, Raktatisara (bloody diarrhea or dysentery), Shweta Pradara (leucorrhoea), Mutraghata (urinary retention), and Mutrakrichhra (dysuria or painful urination). [28]

Traditional medicinal texts describe the gum as an astringent, demulcent, and nutritive agent, commonly employed in gastrointestinal and respiratory disorders (Chopra et al., 2002; Kirtikar and Basu, 2003; Nadkarni, 2005) [8][9][10].

A. arabica gum is used in the treatment of eye, ear and testicular tumors[29].Dental cavity feeling and oral hygiene maintenance[30]. *A. arabica* gum is used in skin irritation and reduce mucus membrane swelling [31].

A. arabica gum is also used in the food industry as a natural binding agent and food additive due to its viscosity, surface tension, emulsifying capacity and encapsulation properties[32][33].

Owing to these functional properties, the gum is widely applied in the development of industrial food products such as dairy preparations, confectionery items, soft beverages, edible coatings, and encapsulated flavoring compounds[34][35][36].

Babool gum fried with ghee and made into halwa, this is beneficial in vaginal secretion and leucorrhoea. Roasted babool gum, along with an equal quantity of geru, taken in 7 gms of mixed powder daily in the morning, will help in reducing menorrhagia. [39]

Babool gum dissolved in water is used in the form of douching of genital organs, which helps in burning micturition[39]. Take leaves, bark, flowers, and gum in equal quantities in powder form orally to treat leucorrhoea and premature ejaculation. [37][38][40][41]

The gum obtained from Acacia nilotica is traditionally fried in ghee and used in the preparation of various sweetmeats[46]. The extract of the gum is reported to possess astringent, styptic, and tonic properties[43][44][45][48][49]. It has also been used therapeutically for dry cough, amoebic dysentery, asthma, and painful lesions of the oral cavity, and is considered to exhibit analgesic and tonic effects[45].

Furthermore, the gum acts as a demulcent, providing a soothing effect on inflamed tissues of the respiratory, digestive, and urinary systems[42]. Traditional sources describe the gum as having cooling, expectorant, constipating, hepatotonic, aphrodisiac, haemostatic, antipyretic, and general tonic properties. It is therefore used in the management of cough, asthma, diarrhoea, dysentery, seminal weakness, and haemorrhagic conditions[48].

When fried in ghee, the gum acts as a nutritive tonic and is traditionally advised for sexual debility. Powdered gum mixed with quinine has been used for fever associated with diarrhoea or dysentery. A paste made from gum powder and egg white is applied externally to treat burns and scalds. The powdered gum is used to control haemorrhage. Gum mucilage is taken internally for managing diarrhoea, dysentery, and diabetes mellitus[13].

Fermentation of *A. arabica* gum by intestinal microbiota leads to the production of short-chain fatty acids (SCFAs), which enhance mineral solubility and improve intestinal absorption of calcium and other minerals [52]

These SCFAs can also help reduce parathyroid hormone (PTH) levels, thereby supporting calcium homeostasis and bone health [52]. Therefore, *A. arabica* gum may contribute to bone health through both its calcium content and its beneficial effects on gut microbial metabolism.

NOTE: *A. arabica* gum obtained from Acacia senegal contains a relatively high concentration of calcium ions (Ca^{2+}), which play an important role in bone mineralization and skeletal metabolism. Calcium shows significant chemical and functional similarity to the mineral components of bone tissue, contributing to structural integrity and bone regeneration [50]. The high calcium content of *A. arabica* gum has been reported to support remineralization processes and may aid in the prevention and management of Osteoporosis [51].

The gum is expectorant, antipyretic, and antiasthmatic and is also useful to cure lung troubles[9]. The hypoglycemic effect of gum is useful in the treatment of diabetes mellitus, as it can significantly reduce the blood glucose level 25. It is also used in diarrhea, amoebic dysentery, irritations, and ulcers of the stomach and intestine. It is potentially used in the treatment of hemoptysis, bleeding piles, menorrhagia, leucorrhoea, spermatorrhoea, dry cough, and oral cavity lesions[9]

Fried in ghee is useful as a nutritive tonic and aphrodisiac in case of sexual disability[10].

PREVIOUSCLINICAL STUDY ON *ACACIA NILOTICA GUM-*

S.n	disease name	Sample size	T/t duration	Dosed Dose	Main findings	Reff
1.	Type-II diabetes	40	16week	10gm	Reduce blood glucose level and HbA1C, decreased also urea, nitrogen, and creatinine, and kidney function improves.	[85]
2.	Type 2 diabetes	48	6week	0gm,20gm,40gm	**20 gm dose-** after 30 min, the glucose level is down. **40 g dose-**abdominal fullness, no significant effect on glucose level.	[86]
3.	Hyperlipidemia	62	12week	15gm	No significant effect on cholesterol level	[80]
4.	hyperlipidemia	110	4week	30mg	Total cholesterol, triglyceride, and LDL level down.	[7]
5.	Obesity	120	6week	30gm	Bodyweight, skinfold thickness, and 2.18%body fat were reduced.	[54]
6.	Sickle Cell Anemia	47	12week	30gm	Increase antioxidant effect.	[88]
7.	Drug efficacy	24	Single dose	-	Reduce the peak blood concentration of amoxicillin as compared to the control group	[96]
8.	Kidney Disease	36	3month	50gm	Reduce levels of Urea, Creatinine, Uric acid, and Phosphorus while serum calcium is increased.	[97]
9.	kidney disease	36	4week	10gm,20gm,40gm	Reduced CRP that indicates improved antioxidant property, while creatinine level, urine volume, and indoxyl sulfate remained unchanged.	[98]
10.	Chronic Renal Failure	20	-	50gm/day	Increase Nitrogen and bacterial mass in feces, and a significant reduction in serum Urea, Nitrogen.	[108]
11.	Fecal Incontinence	189	32 days	16gm	Incontinence episodes were similar to those of the placebo group.	[100]
12.	Prebiotic	54	4week	5gm,10gm,20gm,40gm	Significant increase in beneficial gut bacteria such as Lactobacilli, particularly at the 10 gm dose.	[10 [101]
13.	Acute non-bloody diarrhea	180	Daily until recovery	*A. arabica* guma solution	Diarrhea stops within 24 hours, and minimal electrolyte imbalance.	[102]
14.	Gastroparesis	10	-	10gm/day	Blood glucose level control, but intestinal transit time changes were not significant.	[103]
15.	Dental Caries	63	1year	1ml distilied water+62.5gm *A. arabica* guma	Significantly reduced Streptococcus mutans and Lactobacillus acidophilus.	[89]
16.	Plaque Formation	20	1week	Chewing for 10 min	Reduce plaque formation and shows better improvement.	[90]

17.	Plaque-induced Gingivitis	30	2month	150mg	Decreased plaque and gingivitis with significant improvement in plaque index, gingival index, and inflammatory marker(IL-13) level.	[91]
18.	18. Chronic Periodontitis	59	90days	-	Reduce periodontal pocket depth, improve clinical attachment levels, and lower plaque and gingival index scores.	[105]
19.	Chronic periodontitis	80(age 18-70)	Twice/day	Gagel after brushing	Reduce periodontal pocket depth.	[105]
20.	Uterine proleps	30	daily	Powder orally and pessary form	Significant improvement in quality of life compared to the control group.	[104]
21.	Xerostomia	26	10min	10gm(chewing)	Significantly increase salivary flow rate.	[93]
22.	Rheumatoid arthritis	40	12week	30gm	Improved albumin levels and reduced liver enzymes(ALT, AST) and urea with minimal effects on kidney function.	[94]
23.	Rheumatoid arthritis	40	12week	30gm/day	Significantly lowered inflammatory markers, including TNF-a, ESR, and disease severityerity scores with little change in blood parameters.	[95]

TOXICOLOGICAL SAFETY OF *A. ARABICA*

..- Toxicological studies indicate that *A. arabica* gum has a wide margin of safety. Acute toxicity experiments have reported high oral LD_{50} values in animals, including approximately 16 g/kg/day in mice, 18 g/kg/day in rats, 16 g/kg/day in hamsters, and 8 g/kg/day in rabbits, suggesting very low acute toxicity (WHO, 1982; JECFA, 1982) [106]. Long-term carcinogenicity studies conducted by the National Toxicology Program in F344 rats and B6C3F1 mice fed diets containing up to 5% *A. arabica* gum for 103 weeks showed no significant differences in survival and no treatment-related tumor formation. Although a slight reduction in body weight gain was observed in female rats, no histopathological abnormalities were detected, indicating that *A. arabica* gum is non-carcinogenic under experimental conditions (Melnick et al., 1983) [107]. Furthermore, the U.S. Food and Drug Administration (FDA) has approved *A. arabica* gum as a food additive and classified it as "Generally Recognized as Safe" (GRAS) (CFR, 1974) [109].

CONCLUSION-

Through this review article, it can be concluded that *Acacia arabica* gum is a very important natural substance. It contains various types of compounds that contribute to its nutritional, medicinal, and biological activities. Traditionally, it has been used in the management of many diseases. It contains compounds such as high molecular weight polysaccharides, minerals, etc.These various compounds exhibit several pharmacological actions, such as antioxidant, antimutagenic, anti-inflammatory, anti-osteoporotic effects, wound healing, cartilage and bone regeneration, and also act as a prebiotic.Traditionally, it has been used for the treatment of different conditions, including strength enhancement, diarrhea, gastric pain, swelling, diabetes, menstrual bleeding, burns and scalds, etc.Many clinical trials have also been conducted on conditions such as obesity, diabetes, hyperlipidemia, sickle cell anemia, dental caries, gingivitis, chronic periodontitis, kidney disease, rheumatoid arthritis (RA), and drug efficacy.Based on toxicological studies, this gum has been found to be safe.From this review, it is also observed that there are no available results of LCMS and GCMS analysis for Acacia arabica gum. Although clinical trials have been conducted for various conditions, no clinical trial has yet been reported for its anti-osteoporotic potential.

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