

Review Article

A Review on Ethnobotanical, Pharmacological, and Conventional uses of Gum Arabic

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Abstract

Gum arabic also known as gum Acacia, *Acacia Senegal* and Arabic gum is a natural, edible, dietary fiber and polysaccharide consisting of an arabiono-galactan-protein complex. The term Arabic gum was proposed by European merchants. Two species of Acacia, *Acacia seyal* and *Acacia Senegal* are recommended to produce a gum. 80% gum is produced from *Acacia Senegal* which is widely distributed to Sudan, Africa, Japan, Nepal, and many other tropical and subtropic regions of the world. From ancient times, it has been used for many beneficial purposes. Anciently it was used to make mummies and in painting. Currently, it is widely used for food applications, clinical uses, and non-food applications. In food approaches, it is used as a flavoring agent, stabilizer, sweetener, and thickening agent. It is used for the formulation of ice creams, candies, jellies, soft drinks, beverages, desserts, and soup. In clinical uses, it is used due to its anti-inflammatory, anti-oxidant, anti-obesity, anti-diarrhea, immune-stimulant, analgesic, cardioprotective, hepatoprotective, renal protective, anti-cancerous, anti-ulcerative and for many other purposes due to diversity of potential. In non-food applications, it is used for the synthesis of syrups, tablets, lozenges, creams, lotions, paint, ink, glue, and ceramics. This review briefly covered the all area in which gum arabic is used widely due to its beneficial activities.

Key words

Gum arabic, Acacia Senegal, Clinical uses, Food application, Non-food application.

Introduction

Gum arabic is also known as Arabic gum, *gum acacia* and *Acacia Senegal* belongs to the *Fabaceae* family. The term “gum arabic” was proposed by European merchants. More than 1000 species of gum arabica are present but out of them two species *Acacia Senegal* (*Senegalia senegal*) and *Acacia seyal* are mostly recommended for useful purposes [1]. 80% of gum arabic is obtained from *Acacia senegal*. Acacia gum or gum Arabic is one of the oldest and most well-known among all gums. Gum Arabic is a gummy exudate, dietary solubility fiber obtained from the Acacia tree. It is a multifunctional hydrocolloid having a mildly acidic arabinose-galactan-protein complex consisting of calcium, potassium, and magnesium [2]. Acacia trees are native to Sudan, West Africa, Europe, the US, Japan, Nepal, and tropic to subtropic regions [3, 4, 5]. Gum arabic is produced in a process called “gummosis”. Heat, dryness, stress conditions, poor nutrition, tree sickness, and microbial infection are the conditions in which incisions are made on Acacia trees. Synthesis of gum occurred from those

incisions [8]. The color of gum depends upon the tannin concentration and ranges from dark brown to white. It has been used since ancient times by Egyptians to prepare mummies and paints [6].

In 1973, Food and Drug Administration considered gum arabic a safe material to be used in food and food industries. In food industries gum arabic is used as an emulsifier, binding agent, thickening agent, and stabilizing agent and used for the formulation of ice creams, candies, jellies, soft drinks, chewing gum, syrups, beverages, and flavoring agent. In cosmetics, it is used for the preparation of creams and lotions. In pharmaceuticals, it is used in tablet coating and lozenges. It is a key ingredient used in printing, lithography, and watercolor paintings due to its excellent binding property. It is also used in textile industries. It is divided into 2 categories non-digestible carbohydrates and water-soluble dietary fibers. Primarily it is indigestible for both human and animals because, in the small intestine, it is undegradable but fermented by microorganisms in the large intestine to propionic acid and fatty acids. Nowadays, it is widely used in pharmaceuticals, food, and many

other industries [7]. Gum arabic possesses several medical activities which are anti-inflammatory, anti-cancerous, anti-oxidant, anti-obesity, immunostimulant, anti-ulcerative, anti-renal failure, anti-toxic, and anti-diarrhea. It has a beneficial role in lipid and glucose metabolism. It also has dental-remineralization activity and is used for the treatment of arthritis.

Gum arabic is a natural, safe, and less toxic compound having no or fewer side effects used for oral ingestion. According to leaves contain psychoactive 0.003% N-N-dimethyltryptamine in extract. The side effects which occur due to this are minor allergic symptoms and hypersensitivity. This review demonstrates the beneficial effects of gum arabic, its uses for different purposes, and its clinical effects.

Composition of gum arabic

Chemically, acacia gum is a mixture of macromolecules which are carbohydrates, protein, and sugar including galactose, arabinose, rhamnose, and glucuronic acid. The amino acids which are present in gum arabic are alanine, arginine, glycine, aspartic acid, histidine, glutamic acid, lysine, leucine, isoleucine, proline, phenylalanine, serine, hydroxyproline, valine, tyrosine, and threonine. Other secondary elements present in gum Arabic are sodium, potassium, calcium, phosphorus, copper, nickel, zinc, cadmium, magnesium, and lead [8].

Food applications of gum arabic

Almost 80% of gum Arabic arabic used in food industries where it is used to form various products. It is widely used to make wine gum because it halts sucrose crystallization. The acacia gum inhibits melting in the mouth, provide flavor and make wine long-lasting. It provides such texture to candies where they deform in the mouth easily but do not adhere to gum, teeth, and mouth [9]. It is used as a sweetener agent for the preparation of candies to replace sugar. For the preparation of chewing gum, it is used as a pigment stabilizer and

coating agent. Being an excellent emulsifier, it is used for the preparation of caramel and toffee to maintain the uniformity of products. It provides a fruit-like structure to form jellies [10]. In the preparation of soft drinks, gum acacia is used as an emulsifier. To produce citrus and cola flavor gum arabic is used due to its acidic characteristics and high solubility. Gum arabic of the best quality is used to prevent the coalescence and flocculation of oil droplets [11]. For the coating of liquid, gaseous and solid substances in microencapsulation, a protective layer is needed to prevent the loss of volatile compounds. Gum Arabic is the best encapsulated agent used in this process in which liquid food is converted to powder for dry use to form other products. Due to high solubility in water, best emulsification activity, and low viscosity, gum arabic is used widely for desert and soup formation [12]. Gum arabic can form stable clouds on drinks and is used in the preparation of drinks and juices. Due to the presence of anti-diabetic constituents, gum Arabic is applied for the formation of drinks to can easily be taken by a diabetic patient. Due to its low-caloric potential it is also used in dietic beverages.

Non-food applications of gum arabic

Gum arabic is a excellent emulsifier, stabilizing agent, binding agent, and adhesive properties and is used in the pharmaceutical industries for the preparation of demulcent syrups and tablets. It is also used for the synthesis of lozenges and in the coating of pills. In lithography, it is used for the synthesis of plating solutions. In cosmetics, it is used in the formulation of creams and lotion where it provides a protective layer, stability, and smooth texture and feelings. For paint synthesis, gum Arabic is used as a dispersant. In textile industries, it is used as a thickening agent. The other non-food applications of gum arabic are insecticidal, larvicidal, used in ink, printing media, glue, ceramic, and polishes manufacturing.

Clinical or medicinal uses of gum arabic

Anti-hyperlipidemic activity

In medical terms, hyperlipidemia is defined as an abnormal lipid profile in which LDL level increases in the body and the level of HDL decreases. Raised lipid profile or hyperlipidemia is considered a major risk factor for cardiac problems. Gum arabic is a solubility fiber and can lower abnormal lipid levels in the body. Anti-hypercholesteremic effect of gum arabic attributed to bind with bile acids and reduce the absorption of bile acid in the terminal ileum. Acidic pH is produced from the fermentation of gum Arabic which contributes to the insolubility of bile acid and causes them to excrete in stools. Further formation of bile acid needed cholesterol but the ingestion of gum arabic decreases cholesterol levels and plays its antihyperlipidemic activity [13, 14].

Anti-obesity potential

Obesity is a nutritional disorder more prevalent in adults of both developed and developing countries. Increased BMI due to ingestion of a high caloric diet comes in terms of obesity. Obesity is also considered a major risk of cardiac diseases. Gum arabic is considered a safe and effective component of ingestion as a diet for the prevention and treatment of obesity. Gum arabic is a dietary fiber and has an equal effect on both glucose and fat metabolism [15]. It inhibits the deposition of fat in the body by down-regulation of tumor necrosis factor-alpha through stimulation of β 3-adrenergic adipocytes.

Anti-inflammatory activity

Inflammation is considered a major causative agent of various diseases such as cancer, arthritis, diabetes, neurological problems, and cardiovascular diseases. TNF- α is a pro-inflammatory mediator of rheumatoid arthritis which is an autoimmune disease mostly occurring in females and recognized by chronic synovial inflammation [16, 17]. The results of numerous experimental studies on the effect of gum arabic on rheumatoid arthritis revealed that gum arabic by reducing tumor necrosis factor-

alpha and erythrocyte sedimentation improves the symptoms of rheumatoid arthritis [18]. Anti-ulcerative effects of gum Arabic have been observed through the experimental studies conducted on Wistar rats. The results of the study demonstrated that gum arabic has strong anti-ulcerative and gastroprotective potential and has been used for the preparation of anti-ulcer medications. Cancer is defined as the abnormal and uncontrolled growth of cells which spread to healthy and normal tissues. Gum arabic by possessing cytotoxic potential prevents the growth and proliferation of cancerous cells.

Anti-diabetic activity

Diabetes mellitus is disease characterized by high glucose or sugar in the blood due to the deficiency or resistance of insulin. The insulin hormone present in the pancreas controls the amount of glucose in the blood and regulates the metabolism of carbohydrates, proteins, and fats. This chronic illness has spread globally and increasing in frequency steadily. Mortality or morbidity is common due to the macro and microvasculature complications of diabetes. Gum arabic has been reported as a potential anti-diabetic affecting both humans and animals. Food supplements containing gum arabic has shown a significant reduction in fasting blood glucose levels in prediabetic and diabetic subjects [19]. Gum arabic is rich in amino acids and the amino acids having anti-oxidant potential by reducing the free radicals play a major contribution in the treatment of type 2 diabetes mellitus. Due to its anti-oxidant potential, it also prevents the damage of islet cells from damage from free radicals. By activating the beta cell islet present in the pancreas gum Arabic stimulates the production of insulin [20, 21].

Anti-bacterial activity

Gum arabic possesses strong anti-bacterial activity against the gram-positive bacteria *Klebsiella pneumonia*, *Staphylococcus aureus*, and *E. coli*. It also has significant inhibition potential on gram-negative bacteria *Proteus*

mirabilis, *Salmonella typhi*, *Acinetobacter*, *Enterobacter species*, and *Serratia species*. Due to its anti-microbial activity, it inhibits the growth of *Candida albicans* and *Cryptococcus neoformans* which is a fungus. [22, 23]. The result of studies conducted via in vivo and in vitro experimentation stated that it has inhibitory effects on malaria.

Anti-coagulation activity

Gum arabic is known as a natural anti-coagulant. Suppressing the coagulation cascades, considerably prevents blood clots [24, 25].

Anti-toxic activity

Toxicity is defined as the quality of being unpleasant, very harmful, and poisonous. Toxicity is a stressful status which attributes to the disturbance in the balance of chemical, physiological, anti-oxidant, and pro-oxidant processes and known as oxidative stress. Oxidative stress leads to fatigue, memory loss, joint pain, muscle stiffness, headache, increase susceptibility to infection, decrease eyesight, grey hairs, and wrinkles due to the production of free radicals. Gum arabic is known as a natural anti-oxidant and is used in the treatment and prevention of problem occurring due to the production of free radicles. Gum arabic also used in chemotherapy. Gum Arabic prevents the hepatic toxicity from acetaminophen by reducing free radicals, blocking the macrophage function of the liver, and scavenging free radicals. It also prevents renal toxicity from the effects of chemotherapy and radiotherapy. It also has preventive effects on mercury toxicity and toxicity caused by hazardous substances from textile industries. Catalase, superoxide dismutase and glutathione peroxidase enzymes play a significant role as defense tools against free radicals and oxygen reactive species. Gum arabic by activating these enzymes prevents oxidative stress and is used in the treatment of numerous diseases and the preparation of several medications.

Effect of gum arabic on fertility

Infertility is a condition that prevents pregnancy in women. The prevalence of fertility is increasing in obese ladies. The prominent signs metabolic syndrome is abdominal obesity and central obesity. Metabolic syndrome is a major cause of infertility. Researchers demonstrated that gum arabic by elevating the anti-oxidant enzymes and reducing lipid oxidation improve the sign and symptoms of obesity which ultimately improve the symptoms of infertility. Consumption of gum Arabic improves degenerative testicular tissue and enhances semen quality used in the management of reproductive dysfunctioning [26, 27, 28].

Effect of gum arabic on hypertension

The effect of gum arabic on hypertension has been proved from numerous experimental studies. Experimental studies demonstrated that 10gm/day intake of gum arabic on regular basis for 10 days significantly decreases hypertension. Gum arabic taken in a dose of 25 gm/day decrease systolic blood pressure effectively and improves the symptoms of hypertension [29].

Effect of gum arabic on oral hygiene

It is considered that gum Arabic can improve the mineralization of teeth due to the presence of calcium contents. Gum arabic as a protective layer prevents the teeth from the harshness of acid present in drinks. Suppressing the growth of *Prevotella intermedia* and *Porphyromonas gingivalis* gum arabic prevents plaque formation in teeth. Cyanogenic glycosides present in gum arabic play anti-microbial activity and inhibit tooth decaying [30, 31].

Effect of gum arabic on sickle cell anemia

Sickle cell anemia is defined as an inherited autosomal recessive disorder of red blood cells that occur due to the mutation of a beta-globin chain of hemoglobin at position-6 [34]. The main region of sickle cell mutation is Africa [35, 36]. According to pathology sickle cell anemia is characterized by oxidative stress and inflammatory conditions [37]. At diagnostic

finding level of C-reactive protein, cell count, cytokines, monocytes, platelets and neutrophils were found elevated. The US Food and Drug Administration recognized gum arabic as dietary fiber used for the treatment of various ailments. Results of the studies show that administration of gum arabic significantly reduces the elevated C-reactive protein level and down-regulates the inflammation.

Effect of gum arabic on renal failure

Gum arabic decreases uremia and due to its life-improving quality, it is prescribed in many countries for renal dysfunctioning. It has proved from experimental studies that ingestion of gum arabic along with pomegranate juice improves nutritional status and renal functioning [32, 33]. Gum Arabic causes significant reduction in c-reactive protein, creatinine, uremia, and acidosis and approached in the treatment of renal dysfunctioning as renal protective.

Other uses of gum arabic

The other beneficial uses of gum arabic are

- Drug delivery agent
- Used in Sensor and tumor imaging
- Applications in nanotechnology

Conclusion

Gum Arabic was obtained from two species of *Acacia Senegal* and *Acacia seyal* out of the 1000 species of *Acacia*. Gum arabic due to its beneficial properties used for various purposes. Recently it used due to its anti-hyperlipidemic, anti-obesity, anti-inflammatory, antioxidant, anti-cancerous, anti-microbial, immunostimulant, hepatoprotective, Renoprotective, cardioprotective, for sickle cell anemia, oral hygiene and diabetes mellitus. The other beneficial properties are that it has been used for the preparation of syrups, lozenges, coating pills, creams, lotions, ice creams, deserts, jellies, candies, soft drinks, beverages, wine, paint, ink, glue, ceramics, and many others.

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