

The Medical Uses of Gum Acacia-Gum Arabic (GA) In Human

By: Prof: Sarah Saleh Obaid

College of Medicine - Arab Gulf University - United Arab Emirates

Email: sarahsaleh@outlook.com

Abstract:

The use of herbal medicine is widely distributed in the Middle East, Europe and the advanced countries. Many countries have accredited the traditional system of herbal treatment. Gum Acacia was widely distributed in the past in traditional medicine and folkloric uses. It was used for several purposes other than the usual uses, like infertility, impotence, diabetes, obesity, epilepsy, psychosomatic troubles, and many other diseases. Arabic Gum is a natural polysaccharides complexed exudate secreted from Acacia seyal and Acacia senegal trees. GA is approved as accepted food additive due to its emulsifying, stabilizing and thickening characters which enhance attractive flavors. GA has great intestinal tolerance and the least side effects comparing to other substrates used as prebiotic. The rapid interest in Gum Arabic treatment around the world come from its potency in treatment of many diseases and complications in addition to its safety and economical low-cost. GA exhibit an extensive range of biological activities, as stimulation of the immune system, antibacterial, antiviral, anti-hepatotoxic, antiulcer, anti-inflammatory, antioxidant, anti-mutagenic, and anti-cancer effects.

GA is not digested in the stomach or small intestine, but it is fermented in colon producing short-chain fatty acids (SCFA) which has wide beneficial effects on human health. It reduces glucose levels, increase stool mass (by augmenting the water content of stool), traps bile acids and therefor affecting on enhancing physiological body systems. GA also reduce serum urea in patients with chronic renal diseases, which affect positively on kidney functions. GA also has an anti-inflammatory effect due to its derivative butyrate. Butyrate is not synthesized by human body cells, but it is produced as the end-product of colonic bacterial aerobic fermentation of dietary fiber and starch, and it`s a potent anti-inflammatory substance. GA can decrease serum TNF α and ESR levels in rheumatoid arthritis patients through its slow fermentation in colon producing large quantities of butyrate. In this research we will determine the main uses of GA and the most approved medicinal uses.

Keywords: Medical Uses, Gum Arabic, Human.

Introduction:

Gum Acacia (GA) or Gum Arabic is considered as a soluble dietary fiber which is derived from acacia trees. Gum Acacia was widely used in the Arabian and African countries and still used as traditional medicine, in which GA has showed great medical effects as potential prebiotics, probiotics and synbiotics in the digestive system, especially in elderly people. GA also has many medical uses as anti-inflammatory, anti-ulcerative, anti-cancerous, immunostimulant, anti-obesity, anti-chronic renal failure, anti-diarrhea and anti-toxic effects. GA is found to have great effect on lipid and glucose metabolism and found to be resistant to digestion in the upper GIT (stomach) then go through the colon as it is to be interacted with the intestinal microflora. Also, it has dental re-mineralization properties, in addition to having positive effects on cardiovascular problems and hypo-cholesterolemic effect. The previous studies have proved that GA consumption didn`t induce negative gastrointestinal effects, but the consumer may have some digestive discomfort during the first days of intake till adaptation occur. Also, it`s shown that consuming more than 50g/day resulted in abdominal cramps and moderate diarrhea.[1][2][3]

GA is formed in a process called “gummosis” in which is a natural response of the tree to an injury to bark, so as a result the gum exudates in the form of nodules that is then

collected by farmers as a raw product (see figure 1). In general, there are two types of trees that are gum harvested from *Acacia senegal* and *Acacia seyal* trees. *Acacia* trees belong to the Leguminosae family. GA consists of branched chains of β -D-galactopyranosyl units. Both main and side chains contain α -L-arabinofuranosyl, α -L-rhamnopyranosyl, β -D-glucuronopyranosyl, and 4-Omethyl- β -D-glucuronopyranosyl units. [1]

The United States Food and Drug Administration (FDA) in 1973 has considered GA as generally safe material to be used in food in the form of food additive, and then accepted by the European Union (EU) as officially safe food additive material due to its number of benefits. GA is widely used nowadays in food industry as thickening agent, emulsifier and as a stabilizing agent in the pharmaceutical industry. The researchers found that GA composed of polysaccharides with high molecular weight (about 350-850kDa). The main components are galactose (45%), rhamnose (12.9%), glucuronic acid (14.8%) and arabinose residues (27.1%), and contains also many minerals as calcium, potassium and magnesium. In the same time, GA has very small amount of protein equal to approximately (3%) (see figure 2). More than 80% of the annual production of Gum Acacia are used in the food industry and pharmaceutical companies for various needs, as emulsification, encapsulation, coating, gum candies. [1][3]

GA is taken by mouth in order to treat high cholesterol, diabetes, irritable bowel syndrome (IBS), obesity and as bifidogenic substance. GA is applied to the skin inside the mouth for plaque and gum inflammation (gingivitis) and applied to the skin (topically) decrease skin inflammation (redness). GA may have cross interaction with Amoxicillin, in which *Acacia* may prevent the body from absorption of antibiotic Amoxicillin. In order to prevent the interaction you can take GA 4 hours earlier than taking Amoxicillin. Another interaction is with diabetes medications due to its effect on decreasing blood sugar levels, so the diabetic patient must adjust or modulate its diabetes drug dosage with the physician. [8]

In rheumatoid arthritis, GA decreases the pro-inflammatory cytokine expression through increased butyrate production. Butyrate inhibits TNF α -induced expression of vascular cell adhesion molecule-1 (VCAM-1) and intracellular cell adhesion molecule-1 (ICAM-1), and decrease the stimulated release of IL-5, IL-12, and IL-13. GA was found to increase anti-inflammatory cytokine IL10 and decrease TNF α and CRP. [5]

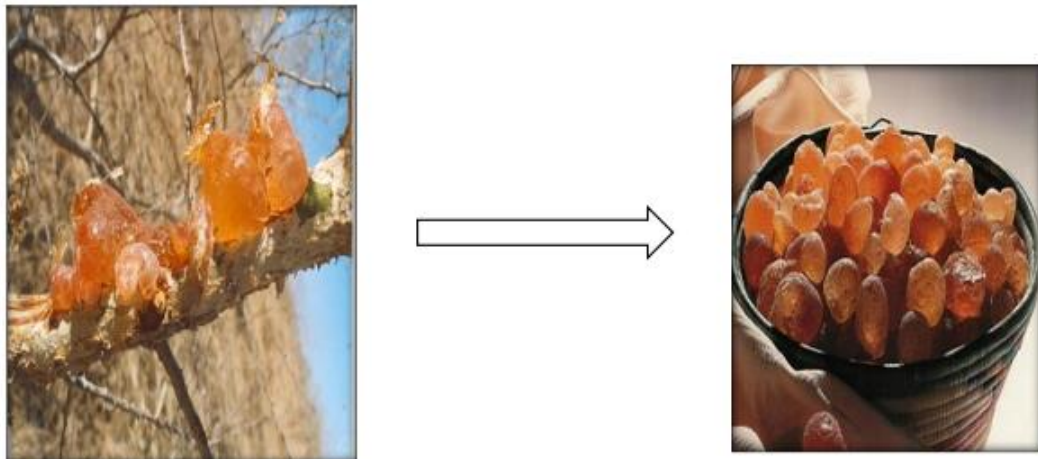


Figure (1): shapes of GA as raw material (pre-harvest) and commercial material (post-harvest). [1]

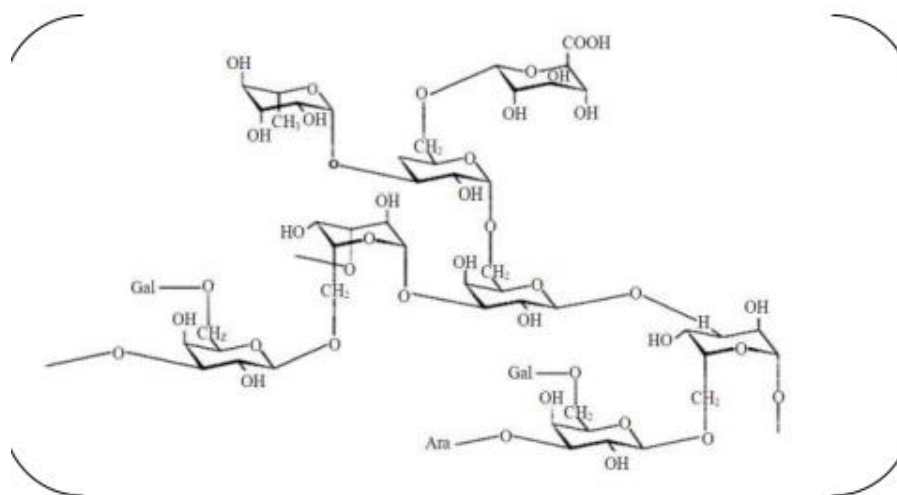


Figure (2): chemical composition of GA. [1]

Statement of the problem

This research is concerned with discussing the medical uses and benefits of Gum Acacia or Gum Arabic on the different body systems. Consumption of Arabic Gum is distributed all over the world due to its great benefits as anti-cancerous, anti-inflammatory, antioxidant, anti-toxic and anti-ulcerative properties.

Objectives

This research aims to determine the following points:

- 1- Define Gum Acacia and its natural sources.
- 2- Discuss its active ingredients.
- 3- Discuss mechanism of action of GA as bifidogenic.
- 4- Determine its medicinal uses and other actions as anti-cancerous, anti-inflammatory, antioxidant, anti-toxic and anti-ulcerative agent.
- 5- Discuss effect of GA in chronic renal failure patients

Research Questions

The researcher concerned to have answers to the following questions:

- 1- What are the different sources of Gum Acacia?
- 2- How it is formed and collected?
- 3- What are the different medicinal uses of Arabic Gum?
- 4- What are the active ingredients of Gum Acacia?
- 5- What is the mechanism of action of Gum Arabic as prebiotic and probiotic, anti-cancerous, anti-inflammatory, antioxidant, anti-toxic and anti-ulcerative properties?
- 6- How could GA help patients of chronic renal failure?
- 7- What are the complications of GA consumption?

Discussion

1- Effect of GA as bifidogenic substance in the digestive system and anti-inflammatory agent:

GA is having many potential health benefits as prebiotic and probiotic specially in elderly people,

which are having negative changes in their gut microbiota (beneficial anaerobic bacteria) and their immune system due to their age. The most common human anaerobic bacterial genera are Bacteroides, Eubacterium, Bifidobacterium, Clostridium, Peptococcus, Peptostreptococcus and Ruminococcus. So, consumption of GA has showed relevant increase in Bifidobacterium spp. (which inhibit growth of pathogenic bacteria, modulate the immune system, and produce SCFAs), and increase the cytokines production with PBMC cells and increase the levels of IL-10 as a result. The combination between probiotic and prebiotics is called synbiotic which has potential effect on increasing lactobacilli and inhibiting clostridium histolyticum spp. formerly, we must define prebiotics and probiotics and the role of each one. [1]

Probiotics: is termed to be live microorganisms which is in administration with adequate amounts it makes health benefits on the host. The most of probiotics belongs to genera lactobacilli or bifidobacterial. Probiotics found to have health promoting action as decreasing diarrhea, reducing constipation, immunostimulant and reducing hypercholesterolemia. Probiotics can make lower colonic pH which result in making the environment less favorable for pathogenic bacteria which will influence the immune system in the aspects of promoting gut barrier function and increasing the inflammatory response. [1]

Prebiotics: is defined as selectively fermented materials which result in certain changes especially in the composition of the GIT microbiota that reflects on the host health. The perfect prebiotic must have the following characters: to be resistant to stomach acidity and enzyme hydrolysis, and to be fermented by the intestinal microflora. The most common prebiotics used are inulin, fructo-oligosaccharides (FOS) and galacto-oligosaccharides (GOS). The effect of GA is found to similar to the effect of FOS 1% as prebiotic. Gum acacia is mostly made up of arabinogalactan which have many health promoting actions and differ from the other prebiotics in which GA has proteolytic fermentation in the distal colon in adverse to the commercial prebiotics that make its fermentation in the proximal colon. The selective ability of GA belongs to the main content of polysaccharides of arabinogalactan. The secreted enzymes from Bifidobacterium and Lactobacilli (which are β -galactosidase and α -arabino-furanosidase) make breakdown of the arabinogalactan content of GA, so having its prebiotic potential. [1]

In elderly people, there are digestive system impairment due to physiological changes and altered colonic microbiota. So, there are announced decrease in the number of beneficial bacteria of colon specially Bifidobacterium spp. which directly affect on the immune function. Immune-suppression in elderly people include increased pro-inflammatory cytokines levels, as interleukin 6 (IL-6), IL-1 β , and tumor necrosis factor α (TNF- α). Butyrate production is found to be increased after regular consumption of GA. Butyrate production has very important role in stimulating mucins production which is important in maintaining mucous layers and epithelial protection. Also, butyrate is a key colonocyte energy source and involved in regulation and growth differentiation of cells. Then, using of Gum Acacia in modulating gut microbiota is associated with regulating cytokine production and enhancing the immune system function (see figure 3). [1]

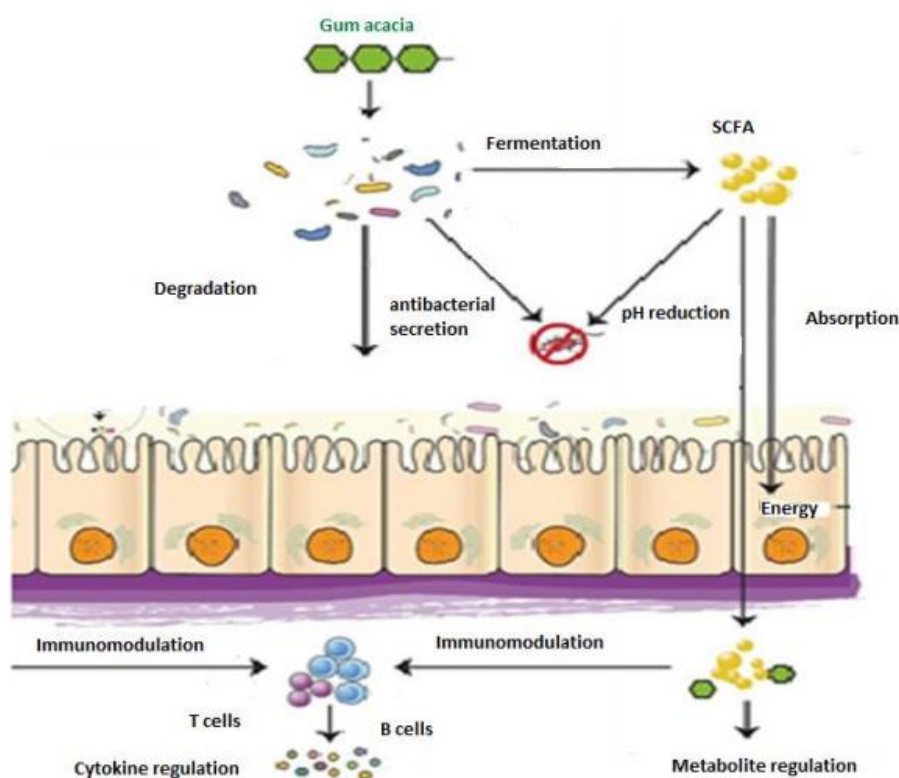


Figure (3): mechanism of action of GA as prebiotic and its effect on immune system. [1]

2- Effect of GA as anti-toxicity agent:

Toxic exposure may be environmental chemicals or drugs. Toxicity is defined as a stressful status which leads to disturbance in the balance between pro-oxidants and antioxidants causing biochemical and physiological changes and may be called oxidative stress. Toxic exposure induces excessive free radical production which leads to changes in the levels of oxidative stress bio-makers. Arabic Gum Arabic is now mentioned as natural antioxidant due to its effective protective and curative properties in many intoxicated cases. It is found that GA has the ability to prevent the toxic symptoms of some drugs as analgesics and chemotherapy. It was proved that GA can prevent the systemic toxicity of indomethacin overdose on the different body organs and systems. Where it was found that the regular use of GA in case of indomethacin toxicity can reduce renal and hepatic toxicity and modify the morphological changes of retina, then improving the complete blood picture (CBP) and the coagulation profile. [2]

GA also has effective role in preventing the intoxication effects of acetaminophen toxicity. Thus, protecting the liver by reducing oxidative stress, nitric acid scavenging and blockage of liver macrophage function. In addition, the combination between GA and aspirin may prevent the intestinal mucosa from the ulcerative effect of aspirin, maintain the balance of the pancreatic and intestinal enzymes, and maintain the intestinal content of iron and zinc. GA play an important role in preventing the side effects of chemotherapy intoxication, where it can limit the urinary bladder cytotoxicity through neutralizing the reactive oxygen metabolites of cyclophosphamide. In addition, GA reduce the nephrotoxic effect of chemotherapy and radiotherapy (γ -radiation) as agents used in cancer treatment. Finally, GA is proved as potent antioxidant and reno-protective material helping physicians to overcome the side effects of chemotherapy. GA has preventive role against nephrotoxic effect of aminoglycosides antibiotics which has one of the most serious drugs toxicity signs. [2]

In the aspect of chemicals toxicity, GA is proved to eliminate the lung toxicity induced by paraquat intoxication, which is one of the most toxic herbicidal agents. GA also has a protective effect on preventing the hazards of Mercury toxicity and its different forms. Mercury is considered as an environmental and industrial toxicant which causes severe systemic changes all over the body,

Beginning with acute renal failure that is caused by reduction of glutathione levels and increased reactive oxygen levels as hydrogen peroxide (H₂O₂), then modulating the nephrotoxic effect of mercuric chloride. [2]

3- Effect of GA as anti-cancerous agent:

Arabic Gum is recently used in advanced countries as anti-cancer herbal treatment due to its bioactive compounds which have relatively low or non-toxic effect, anti-tumor property and minimum level of adverse effects on patients, beside its low cost and wide availability. The researchers have found the major effectiveness of herbal treatment as an alternate to the common available drugs used to cure cancer, as drugs of synthetic or semisynthetic origin, chemotherapy or radiotherapy. GA showed potential cytotoxic activities on cancer cells of hepatocellular carcinoma (HepG2), breast adenocarcinoma (MCF-7), lung carcinoma (A549) and colorectal carcinoma (HCT-116). Regular consumption of GA in cancer patients lead to preventing the development of cancer. Its potential in preventing cancer progression come from its immunomodulatory effect. So, using GA even in its crude form extract is still having considerable effects due to conversion to nanoparticles or nano-emulsions which enhance its bioavailability and targeted therapy in the affected areas of cancer. [7]

4- Effect of GA in modulating chronic renal failure (CRF):

It is found that Ga has potential effect on reducing serum urea level due to high excretion of bacterial nitrogen in feces in patients with chronic renal failure. Another evidence has proved that consumption of 50g/day of Gum Arabic in patients undergoing regular hemodialysis will affect positively on their biochemical and blood pressure profiles. Another study showed that regular intake of GA has decreased levels of serum urea and creatinine concentrations, also it decreased the need for dialysis from 3 to 2 times/week. In addition, it lowers the uremic toxins in uremic children and adults. GA showed reduction in the raised CRF induced blood pressure. [4][6]

Conclusion

Gum acacia (GA) is a non-starch complex polysaccharide (95%), dietary soluble fiber. GA has bifidogenic potential in healthy humans. It also has immune-stimulant effect, anti-inflammatory effect and decreasing pro-inflammatory cytokines. The daily over consumption of GA may have health adverse effects as mild diarrhea and bloating. The recommended daily intake of GA is determined by FDA as to be 25-40g. GA fermentation has enhanced the modulation of the colonic microbiota, with increased levels of acetate, propionate, and butyrate. The slow fermentation of GA in the distal colon produces many degradation products including SCFA which has an anti-inflammatory effect. Gum Arabic is approved from WHO and FDA as a potent anti-inflammatory, prebiotic and probiotic, anti-ulcerative, antioxidant and anti-toxic agent.

References

- [1] Sehad Nassr M. Alarifi. In Vitro Studies on Gum Acacia and its Potential as a Prebiotic in an Elderly Population. University of Reading [Internet]. 2016 [cited Dec 2016]
- [2] Said Said Elshama. The preventive role of Arabic gum in the treatment of Toxicity. Bio Core [Internet]. 2018 [cited Dec 2018]
- [3] Christine Cherbut, Catherine Michel, Virginie Raison et al. Acacia Gum is a Bifidogenic Dietary Fibre with High Digestive Tolerance in Healthy Humans. Microbial Ecology in Health and Disease [Internet]. 2009 [cited 11 Jul 2009].
- [4] Sami A. Khalida, Abdelrahman M. Musac, Amal M. Saeed et al. Manipulating dietary fibre: Gum Arabic making friends of the colon and the kidney. Science Direct [Internet]. 2014 [cited 31 Jan 2014].
- [5] Ebtihal Kamal, Lamis AbdelGadir Kaddam, Maha Dahawi, et al. Gum Arabic Fibers Decreased Inflammatory Markers and Disease Severity Score among Rheumatoid Arthritis Patients, Phase II Trial. International Journal of Rheumatology [Internet]. 2018 [cited 3 Jul 2018].

[6] Badreldin Hamid Ali. Effects of Gum Arabic in treating chronic renal failure. Oman Daily Observer [Internet]. 2014 [cited 15 Jun 2014].

[7] Rizwan Ahmad, Niyaz Ahmad, Atta Abbas Naqvi, Adeeb Shehzad, Mastour SaferAl-Ghamdi. Role of traditional Islamic and Arabic plants in cancer therapy. Journal of Traditional and Complementary Medicine [Internet]. 2017 [cited Apr 2017].

[8] Acacia. WebMD. 2018.

Copyright © 2020 Dr. Sarah Saleh Obaid, AJRSP. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY NC).