# Re-Building Sudan
## AFTER THE WAR

# AGRICULTURE, ENVIRONMENT AND NATURAL RESOURCES

OPEN ACCESS

DOI: 10.47556/B.SUDAN2025.23

# CHAPTER 23

RESEARCH

# Novel Uses and Applications of Gum Arabic

**Dr Mohamed Elmustafa Osman Elsayed**
*University of Kordofan*
Email: mustafa2274@googlemail.com
ORCID: 0009-0009-8689-4431

**Dr Naglaa Abdelbasit Suliman**
*University of Kordofan*
Email: nglaasuliman353@gmail.com
ORCID: 0009-0004-9112-5657

## ABSTRACT

**PURPOSE:** This chapter reviews organic, prebiotic and dietary fibre (DF) properties of gum arabic (GA) and highlights its major applications.

**DESIGN/METHODOLOGY/APPROACH:** A conceptual literature review was conducted, examining scientific publications, food standards, pharmacopoeia references and Sudanese GA sector strategies.

**FINDINGS:** GA has prebiotic effects through fermentation by beneficial gut microbiota, classified as a soluble DF and considered as organic material.

**RESEARCH LIMITATIONS/IMPLICATIONS:** More research, laboratory, clinical and industrial trials are needed to optimise GA's uses and quantify health impacts.

**CITATION:** Elsayed, M. E. O. and Suliman, N. A. (2025): Novel Uses and Applications of Gum Arabic. In Ahmed, A. (Ed.): *Re-Building Sudan from War to Sustainable Development*, Vol 1, pp. 389-404.

**RECEIVED:** 9 September 2025 / **REVISED:** 10 September 2025 / **ACCEPTED:** 16 September 2025 / **PUBLISHED:** 1 December 2025

**COPYRIGHT:** © 2025 by all the authors of the chapter above. The chapter is published as an open access chapter by WASD under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/)

**PRACTICAL IMPLICATIONS:** Consistent with SDGs 1, 2, 3, 9, 17. These findings support the development of functional foods and pharmaceutical formulations incorporating GA as an organic, prebiotic and DF material.

**POLICY IMPLICATIONS:** Sudan's sector strategies should prioritise research and development (R&D) for health claims, organic certification systems, national nutrition integration, sustainable harvesting and investment in local value addition industries.

**KEYWORDS:** *Gum Arabic; Organic; Prebiotic; Dietary Fibre; Health Benefits; Sudan Policy*

## INTRODUCTION

Gum arabic (GA) is a dried exudate from *Acacia senegal* (L.) Willdenow and *Acacia seyal* Delile as defined by the FAO/WHO Joint Expert Committee for Food Additives (JECFA): Sudan is the leading producer and exporter of GA in the world. GA possesses a unique biochemical structure and properties that make its use in many applications a priority. It is biocompatible, biodegradable and its source is renewable. People worldwide are again seeing the necessity of using natural additives in products for human consumption due to severe adverse effects of synthetic additives. Such a shift in the human mindset has created additional demand for natural products such as GA (Prasad *et al.*, 2022). Recent advances highlight GA's organic, prebiotic and DF properties (Calame *et al.*, 2008; Phillips and Williams, 2000).

GA is a strategic export commodity for Sudan (Ali *et al.*, 2009). For centuries, GA has been traded as one of the most valuable non-timber forest products, with Sudan historically contributing between 50-80% of the world's supply.

Given its superior properties, natural origin and safety record, GA finds commercially valuable applications in many industries. In this context, GA could play a critical role in efforts to achieve the SDGs set forth in the 2030 Agenda for Sustainable Development (UNCTAD, 2018).

## PROBLEM STATEMENT

Despite its potentials, the utilisation of GA as a recognised organic, prebiotic and DF remains under-developed in both scientific and industrial frameworks. The literature is rich in studies on its physicochemical properties and industrial applications, but fewer works have systematically linked its chemical functionality to health outcomes, especially in human clinical settings.


© 2025 World Association for Sustainable Development (WASD)

## RESEARCH QUESTION

What are the organic, prebiotic and DF properties of GA, and how can these be leveraged for food and pharmaceutical applications alongside effective policy interventions to enhance Sudan's sector?

## METHODOLOGY

A conceptual literature review was conducted, analysing:

1. GA's chemical composition, functional, and physiological properties;
2. Sudan's sector strategies and policy frameworks.

## RESULTS AND DISCUSSION

### Chemical Composition and Functional Properties

The chemical composition of GA is a mix of complex polysaccharides, oligosaccharides, glycoproteins, arabinogalactans, and monosaccharides such as galactose (389g/kg), rhamnose (95g/kg), and arabinose (257g/kg), as well as an organic acid, mainly glucuronic acid (215g/kg) (Gashua *et al.*, 2015) (see Table 1). There are also the amino acids hydroxyproline, serine, threonine, proline, leucine and histidine (Babiker *et al.*, 2017a), traces of phytoconstituents, e.g., flavonoids, saponins, polyphenolic tannins, others and salts of Arabic acid with calcium (Ca), magnesium (Mg), and phosphorous (P) (Ashour *et al.*, 2022). GA is a valuable source of four antioxidant minerals, copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) (Farman *et al.*, 2020). GA is safe, odourless, tasteless, lowest in viscosity, and stable in acid solutions (Dashtdar and Kardi, 2018).

**Table 1: Chemical Composition of GA**

| *Component* | *A. senegal (%)* | *A. seyal (%)* |
|---|---|---|
| Total polysaccharides | 85-90 | 88-95 |
| Arabinogalactan-protein complex | 10-14 | 7-10 |
| Ash | 2-4 | 1.5-3 |
| Moisture | 10-12 | 12-15 |
| Protein | 2-3 | 1-2 |

*Source*: Randall *et al.*, 1988; Ali *et al.*, 2009; Phillips and Williams, 2000

### Organic and Halal Certification

GA is classified as an organic material when it is harvested sustainably, without synthetic chemicals or pesticides, and processed minimally. Its natural origin, biodegradability and chemical-free


© 2025 World Association for Sustainable Development (WASD)

extraction make it suitable for use in organic-certified food, a binder for seed coating, as a carrier for microbial inoculants, and cosmetic products (Ali *et al.*, 2009). Therefore, harvesting without synthetic chemicals qualifies GA for organic certification (USDA, 2020).

On 1 April 2024, the Islamic Food and Nutrition Council of America (IFANCA) certified that GA is in compliance with the halal requirements under Islamic laws (Document #: 1341.17070. II240031; Halal ID: D25370; Product certificate: HC-23INSB62) (IFANCA, 2024). As a plant derived ingredient, GA is generally recognised as halal. We will still audit another two key points to make sure that our GA is 100% halal: are there any pig products used in the manufacturing process of this ingredient? Does the ingredient contain alcohol (impure) or other haram ingredients? The manufacturing process of GA is pig-free; the raw materials (or culture medium) are Acacia senegal and no other haram ingredients will be used in the manufacturing process of GA. As a top food ingredients supplier, Foodchem has been supplying halal certified GA to customers all over the world for many years (Foodchem, 2025).

## PREBIOTIC EFFECTS

GA, traditionally a food ingredient, exhibits potential as a health-promoting prebiotic in the human gut. Prebiotics, distinct from probiotics, are DFs selectively fermented by beneficial gut bacteria, enhancing their growth and activity (Vu *et al.*, 2023). As a result, short-chain fatty acids (SCFAs) are produced in the large intestine instead of being digested in the small intestine. A combination of these SCFAs improves gut barrier function, reduces inflammation, and improves immune response (Li *et al.*, 2023). Beneficial gut bacteria such as Bifidobacterium and Lactobacillus are encouraged, and harmful bacteria such as clostridium are inhibited (Calame *et al.*, 2008). As a prebiotic, GA has potential applications and challenges in various sectors, including food, beverage, pharmaceuticals, and nutraceuticals, as well as solutions to these challenges (Talib *et al.*, 2018). Since GA does not break down in the large intestine, it is a non-digestible carbohydrate or fibre (Bejeshk, 2022). It ferments slowly into SCFAs, particularly propionic acid, by intestinal bacteria. GA, a DF with a bifidogenic effect, increases the proportion of lactic acid bacteria and bifidobacteria in healthy subjects (Yousefi *et al.*, 2023). Acacia gum has shown prebiotic potential at a 10g/day dose (Cherbut *et al.*, 2003). Studies have investigated the fermentability of Acacia senegal, identifying Prevotella ruminicola as a predominant bacterium in the fermentation process (Phillips and Phillips, 2011). By providing energy for intestinal bacteria to uptake ammonia as a nitrogen source, this bacterium, an ordinary member of the human intestinal microbiota, suggests that GA can reduce luminal ammonia concentrations in large intestine. This may benefit patients with renal and hepatic diseases (Abd Aziz, 2020).

GA is used as a natural prebiotic, due to its resistance to digestion. GA is fermented by the anaerobic microbiota to short-chain fatty acids (SCFs) that have an important role in maintaining homeostasis, structure, and function in the gastrointestinal tract (GIT). They also control the whole

 © 2025 World Association for Sustainable Development (WASD) 

luminal microbial ecology and inhibition of pathogenic where cecum harbour the most microbiota in the GIT; the fermentation is mainly done at this part. GA is a natural supplement that plays an important role in intestinal and liver metabolism and has other potential health benefits.

GA holds excellent promise as a natural prebiotic, potentially offering numerous health benefits. Further research is required to comprehensively understand its prebiotic mechanisms and optimise its applications across various industries. GA could be essential in promoting gut health and preventing disease as we continue to learn more about the human gut microbiome (Elnour *et al.*, 2023).

## DIETARY FIBRE ASPECTS

The term "dietary fibre" was first introduced in the 1950s, referring to plant cell wall materials; it was later used to describe a class of plant-originated polysaccharides that cannot be digested and absorbed in the gastrointestinal tract (van der Kamp *et al.*, 2004) (see Table 2). Dietary fibre is the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine, with complete or partial fermentation in the large intestine (AACC, 2001).

**Table 2: Conventional Classification of Dietary Fibre**

| | *Chemical constituents from plant cell walls* | *Major physiological effects and mechanisms* |
|---|---|---|
| **Soluble fibre** | Non-cellulosic polysaccharides, oligosaccharides, pectins, β-glucans, gums | Delay gastric emptying, regulate blood glucose levels, lower serum cholesterol levels, due mainly to its effects of increasing viscosity of gut content and colonic fermentation |
| **Insoluble fibre** | Cellulose, hemicellulose, lignin | Shorten bowel transit time, improve laxation due to its bulking capacity; support growth of intestinal microflora (esp. probiotic species) due to its fermentation in large intestine |

*Source*: Cho and Dreher, 2001; Chawla and Patil, 2010; Dai and Chau, 2016

GA is classified as soluble DF for its indigestibility and physiological benefits (CAC, 2009). It has been considered as a safe additive since the 1970s, approved by the US Food and Drug Administration (FDA) and the Joint FAO/WHO Expert Committee on Food Additives (JECFA) (Cox *et al.*, 2021). GA is a natural DF, considered as the best of all soluble fibres and a direct additive to liquid foods (Satti *et al.*, 2020). The soluble DF content is 85-90% (Dashtdar and Kardi, 2018).

DFs can be categorised into three groups: insoluble DF, soluble DF and resistant starch. Soluble DF has been widely used as thickener, emulsifier, stabiliser, fat replacer, suspending and gelling agents, etc., in food and the pharmaceutical industry. DFs are becoming one of the most important food ingredients for their irreplaceable roles of techno-functional as well as biofunctional purposes in food products (Delcour and Poutanen, 2013). Acacia fibre is a non-viscous, fermentable DF that


© 2025 World Association for Sustainable Development (WASD)

is obtained from the branches of Acacia senegal and Acacia seyal trees as a water-soluble exudate (Al-Jubori *et al.*, 2023). Acacia fibre is non-digestible in the human body but fermentable by the large intestine's microbiota, consequently modulating resident taxa, specifically bifidobacteria and lactobacilli and producing short-chain fatty acids (SCFAs) (Calame *et al.*, 2008) (see Figure 1). Acacia fibre is among the oldest and most well-known natural gums, with its usage dating back 5,000 years (Patel and Goyal, 2015).

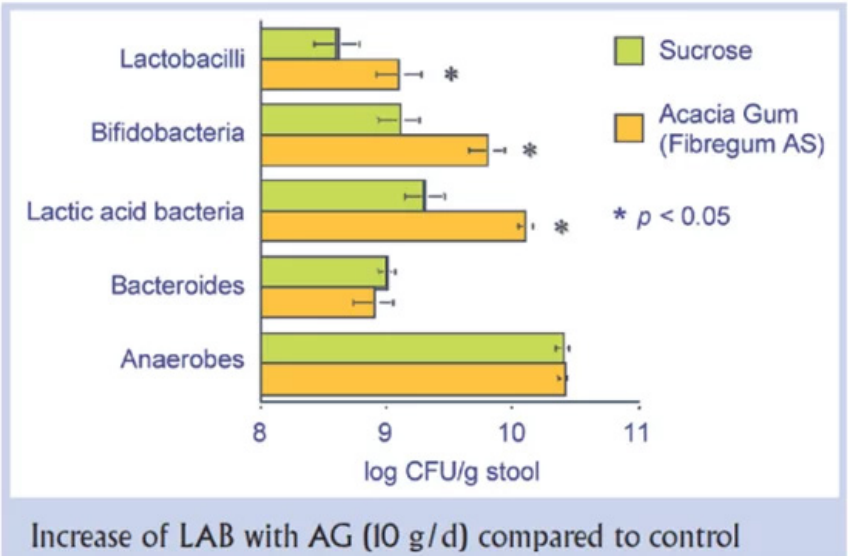


**Figure 1: Sucrose and GA as Feed for Bacteria**

*Source*: https://www.nexira.com/wp-content/uploads/2020/12/increase-of-lab-with-ag.png

Sperber *et al.* (2021) found that across 33 countries on 6 continents, more than 40% of persons worldwide suffer with Functional Gastrointestinal Disorders (FGIDs), such as Irritable Bowel Syndrome (IBS); these dramatically affect their quality of life and healthcare use. Across Europe, consumer spending on over-the-counter medicines (OTC) and supplements is considerable. Diets and supplements have crucial roles in managing these disorders and brands can play a part.

Acacia fibre is commonly found in powder form, with prebiotic efficacy demonstrated at 10g/day (Calame *et al.*, 2008; Cherbut *et al.*, 2003). Most published studies report a daily dose of acacia fibre between 5g and 30g used for up to 3 months with no safety or tolerability concerns (Al-Jubori *et al.*, 2023; Cherbut *et al.*, 2003; Larson *et al.*, 2021). With thousands of years of traditional use and over 15 years of research into its prebiotic potential, acacia fibre has demonstrated various health benefits (Table 3 and Figure 2).


© 2025 World Association for Sustainable Development (WASD)

**Table 3: Health Benefits and Mechanisms of GA as a Prebiotic DF**

| *Health Benefit* | *Mechanism of Action* | *Source* |
|---|---|---|
| Gut microbiota modulation | Fermentation by *Bifidobacteria* and *Lactobacilli* producing SCFAs that improve gut health | Calame *et al.* (2008) |
| Improved bowel function | Increases stool bulk and moisture due to its soluble fibre nature, aiding regularity | CAC (2009) |
| Cholesterol reduction | Binds bile acids in intestine, increasing excretion and reducing serum cholesterol levels | Ali *et al.* (2009) |
| Glycaemic control | Slows gastric emptying and reduces postprandial glucose absorption | Babiker *et al.* (2017b) |
| Enhanced mineral absorption | SCFAs production enhances solubility and absorption of Ca, Mg, and Zn | Phillips and Williams (2000) |
| Anti-inflammatory properties | SCFAs and bioactive components reduce gut and systemic inflammation | Calame *et al.* (2008); Ali *et al.* (2009) |
| Potential weight management | Increases satiety and reduces calorie intake due to fibre's bulking effect | Calame *et al.* (2011) |
| Heart health | Improving cardiovascular and metabolic syndrome risk factors, including high blood pressure, high blood glucose and dyslipidemia | Mohamed *et al.* (2015); Jarrar *et al.* (2021); Larson *et al.* (2021); Al-Jubori *et al.* (2023) |
| Malnutrition control | Managing malnutrition in children aged 6-59 months | Omer and Hilali (2016) |
| Dental health | Improving plaque and gingivitis | Gafar *et al.* (2022) |
| Treatment of sickle cell anaemia | Exhibiting anti-inflammatory effects in sickle cell anaemia | Kaddam and Kaddam (2020); Al-Jubori *et al.* (2023) |
| Protective effect and enzyme reduction | Conferring hepatic and renal protective effects, including uric acid and liver enzyme reduction | Hasheim *et al.* (2021); Kamal *et al.* (2021); Al-Jubori *et al.* (2023) |

*Source*: Given in table

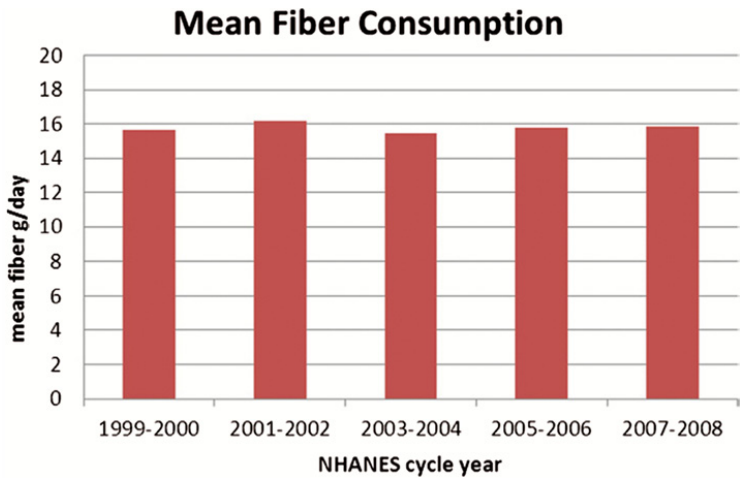


**Figure 2: Mean Fibre Consumption in the US (1999-2008)**

*Source*: King *et al.*, 2012


© 2025 World Association for Sustainable Development (WASD)

### *Health effects of dietary fibre*

Health benefits of DF have been well documented in literature over the past two decades. Diets, deficient in DF, lead to a number of diseases, i.e., constipation, hiatus hernia, appendicitis, diabetes, obesity, coronary heart diseases, gallstones, etc. (Sudha *et al.*, 2012). Consumption of adequate amounts of DF reduces risk of the above-mentioned diseases (Dahl and Stewart, 2015); specifically, studies have shown that individuals with an adequate intake of DF appear to be at lower risk for developing stroke (Zhang *et al.*, 2013), colorectal cancer (WCRF/AICR, 2011), cardiovascular diseases (Threapleton *et al.*, 2013), and type-2 diabetes (Yao *et al.*, 2014). Increased intake of DF is also associated with lower blood pressure and lower serum cholesterol levels (Brown *et al.*, 1999). In addition, an adequate intake of fibre is suggested to aid in weight loss or prevent weight gain, mainly through satiety or fullness regulation (Li *et al.*, 2014), and appears to improve immune function through gut health and fibre-microbiota interactions (Dong *et al.*, 2016). In children, increased fibre intake has been found to be associated with lower risk of being overweight or obese (Quick *et al.*, 2013). Fermentation by gut microbiota produces SCFAs beneficial to gut health (Calame *et al.*, 2008).

### *FDA Grants Citizen Petition on Acacia (GA) as a DF*

In the 1970s, the US Food and Drug Administration (FDA) labelled acacia fibre as Generally Recognised as Safe (GRAS) and more recently as DF (FDA, 2021). The FDA later reported that:

> "based on our consideration of scientific evidence and other information submitted with the petition, and other pertinent scientific evidence and information; we conclude that strength of the evidence shows that gum acacia has a physiological effect that is beneficial to human health. Therefore, in accordance with 21 CFR § 10.30(e) (3), we are granting your request and will propose to amend the list of non-digestible carbohydrates that meet the definition of DF to include "acacia (GA)." We intend to exercise enforcement discretion for declaring "acacia (GA)" in the amount of DF declared on Nutrition and Supplement Facts labels until we can complete a rulemaking to amend 21 CFR § 01.9(c)(6)(i) to include additional DFs in the list of non-digestible carbohydrates that meet our definition of DF" (FDA, 2021).

## EFSA OPINION ON ACACIA FIBRE

The European Food Safety Authority (EFSA) released an opinion letter on acacia fibre's safe use as a feed and food additive for animals and humans, respectively, including its use in food for infants below 16 weeks of age (Younes *et al.*, 2019; Bampidis *et al.*, 2022).


© 2025 World Association for Sustainable Development (WASD)

## GLOBAL FIBRE MARKET

The global acacia fibre market was recorded at a compound annual growth rate (CAGR) of 5.9% from 2016-2021, reaching almost US$900 million in 2022; it is expected to grow at a rate of 7.2% CAGR within 2022-2023 to reach US$1.797 billion (Future Market Insights, 2022).

## APPLICATIONS IN FOOD AND PHARMACEUTICALS

GA is a natural polysaccharide extensively employed as a food additive (Le Van *et al.*, 2023). GA applications are wide and versatile, spanning the food, pharmaceutical, cosmetics, paint, textile and printing industries (Patel and Goyal, 2015). In the food industry, GA is used as a carrier, stabiliser, texturiser, emulsifier and binder, demulcent and thickener in various food formulations, including ice creams, jellies, candies, soft drinks, beverages, syrups, and chewing gums to increase their fibre content (Patel and Goyal, 2015; Larson *et al.*, 2021).

In baked goods, GA is used to regulate the moisture content for its water regulation properties, helping with the preservation of these products and extending their shelf-life (Ashour *et al.*, 2022). In the pharmaceutical and cosmetic industries, it is used to coat pills and lozenges and formulate creams and lotions, respectively. Due to its binding properties, it is used in lithography, printing, and watercolour paints (Patel and Goyal, 2015). Lastly, acacia fibre is showing promise in nanotechnology and nanoformulation-based drug delivery (Al-Jubori *et al.*, 2023).

### Types and Grades of GA

As shown in Table 4, conventionally, the raw GA is graded into different size. Moreover, it is processed mechanically into kibbled gum (small particles) or mechanical powder (by milling) and spray-dried into microbiologically stable, food-grade powder. These specifications are shown in Table 5.

**Table 4: General Specifications of GA Grades**

| **Hashab** *(Acacia senegal)* | | **Talha** *(Acacia seyal)* | |
|---|---|---|---|
| *Grade* | *Size (mm)* | *Grade* | *Size (mm)* |
| Hand Picked Selected | 16 and above | - | - |
| Cleaned and Sifted | 5-16 | Cleaned | 4 and above |
| Granules | 0.5-5 | Sifting | 0.5-4 |
| Dust | 0.5 | Dust | 0-0.5 |

*Source*: https://bayrony.com/product-enquiry/products/gum-arabic/


© 2025 World Association for Sustainable Development (WASD)

**Table 5: Specifications of Raw, Powder and Spray Dried Acacia Gum**

| *Property* | *Raw* | *Powder* | *Spray dried* |
|---|---|---|---|
| **Appearance** | Off-white to yellowish granular or powder | White to off-white powder | White to off-white powder |
| **Odour** | Own inherent smell, no odor | | |
| **Viscosity** | 60-100 | 60-100 | 60-100 |
| **pH** | 3.5-6.5 | 3.5-6.5 | 3.5-6.5 |
| **Moisture** | 15% Max | ≤10% | ≤10% |
| **Total ash** | 4% Max | ≤4% | ≤4% |
| **Acid insoluble ash** | 0.5% Max | ≤0.5% | ≤0.5% |
| **Acid insoluble matter** | - | ≤1% | ≤1% |
| **Solubility** | Soluble in water, insoluble in ethanol | | |
| **Nitrogen** | 0.24-0.41% | 0.24-0.41% | 0.24-0.41% |
| **Starch or dextrin** | Negative | | |
| **Tannin** | Negative | | |
| **Arsenic (As)** | 3 ppm Max | ≤2 mg/kg | ≤2 mg/kg |
| **Lead (Pb)** | 10 ppm Max | ≤3 mg/kg | ≤3 mg/kg |
| **Mercury (Hg)** | - | ≤1 mg/kg | - |
| **Cadmium (Cd)** | - | ≤1 mg/kg | - |
| **Heavy Metals** | 40 ppm Max | ≤20 mg/kg | ≤20 mg/kg |
| **E. coli/5g** | Negative | | |
| **Salmonella/10g** | Negative | | |
| **Total Plate Count** | 1000 cfu/g Max | ≤5000 cfu/g | ≤5000 cfu/g |

*Source*: https://www.foodchemadditives.com/halal/1554#sthash.Fb7g3MR1.dpuf

## Policy Strategies, Targets and Responsible Institutions for GA Sector

As shown in Table 6, the chapter suggests some policy strategies, targets and responsible institutions for Sudan's GA sector. This may lead to the improvement and development of all actors and stakeholders of the GA sectors, especially the producers.

**Table 6: Policy Strategies, Targets and Responsible Institutions for GA Sector**

| *Strategy* | *Specific Target* | *Responsible Institution(s)* |
|---|---|---|
| **Research and Development (R&D)** | Validate health claims and develop functional products | ARC; Universities |
| **Organic certification facilitation** | Increase certified GA exports by 30% within 5 years | Ministry of Trade; SSMO |
| **Nutrition policy integration** | Include GA as recognised DF in national guidelines | Ministry of Health; National Nutrition Programme |


© 2025 World Association for Sustainable Development (WASD)

| *Strategy* | *Specific Target* | *Responsible Institution(s)* |
|---|---|---|
| **Sustainable harvesting and reforestation** | Increase gum belt area under managed production by 20% within 10 years | FNC; Ministry of Agriculture |
| **Value addition and industrial investment** | Establish at least 3 new gum-based processing industries | Ministry of Industry; SMEDA; Private Sector |
| **Market development and branding** | Develop Sudanese GA international branding strategy | GA Board; Ministry of Trade |
| **Capacity building for producers** | Train 10,000 producers on sustainable tapping and handling | FNC; Universities; NGOs; Producer Associations |

*Source*: Constructed by authors

## RECOMMENDATIONS

1. Conduct interdisciplinary research on health, market, and environmental impacts.
2. Establish GA research and innovation centres.
3. Facilitate international collaborations for certification and product development.
4. Promote national DF and prebiotic awareness campaigns.
5. Incentivise private sector investments in value addition and sustainable forestry.

## CONCLUSIONS

GA's scientifically validated prebiotic and DF properties make it a strategic health-promoting and economic resource. Integrated research, innovation and enabling policies are essential to maximise its benefits sustainably.

## CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

## ACKNOWLEDGEMENTS

The authors gratefully acknowledge Dr Idris Musa Adam, Agricultural Research Corporation Sudan, Elobeid Research Station for his significant contributions, critical review and dedicated efforts that enriched the quality of this work.

 © 2025 World Association for Sustainable Development (WASD) 

## REFERENCES

Abd Aziz, N., Salleh, N.H., Anuar, A., Samat, A.F., Lian, O.L., Hassan, S.A. and Hassan, A.F.A. (2020): Growth optimisation of Bacillus subtilis in medium supplemented with prebiotic gum Arabic. In *IOP Conference Series: Materials Science and Engineering* (Vol. 932, No. 1, p.012014). IOP Publishing.

Ali, B.H., Ziada, A. and Blunden, G. (2009): Biological effects of gum arabic: A review of some recent research. *Food and Chemical Toxicology*, Vol. 47, No. 1, pp.1-8. Available at: https://doi.org/10.1016/j.fct.2008.07.001

Al-Jubori, Y., Ahmed, N.T.B., Albusaidi, R., Madden, J., Das, S. and Sirasanagandla, S.R. (2023): The Efficacy of Gum Arabic in Managing Diseases: A Systematic Review of Evidence-Based Clinical Trials. *Biomolecules*, Vol. 13, No. 1, p.138. Available at: https://doi.org/10.3390/biom13010138

American Association of Cereal Chemists (AACC) (2001): *The Definition of Dietary Fiber*. Report of the Dietary Fiber Definition Committee to the Board of Directors of the American Association of Cereal Chemists. Submitted January 10, 2001. Publication No. W-2001-0222-01O. March 2001, Vol. 46, No. 3, pp.112-126. Available at: https://www.cerealsgrains.org/resources/definitions/Documents/DietaryFiber/DFDef.pdf

Ashour, M.A., Fatima, W., Imran, M., Ghoneim, M.M., Alshehri, S. and Shakeel, F. (2022): A Review on the Main Phytoconstituents, Traditional Uses, Inventions, and Patent Literature of Gum Arabic Emphasizing Acacia seyal. *Molecules* (Basel, Switzerland), Vol. 27, No. 4, p.1171. Available at: https://doi.org/10.3390/molecules27041171

Babiker, M., Abbas, T. and Mohammed, M. (2017a): Effect of Gum Arabic on Liver Function and Antioxidant Enzymes of Sprague-Dawley Rats. *IOSR Journal of Pharmacy and Biological Sciences*, Vol. 12, No. 2, pp.29-33. Available at: https://doi.org/10.9790/3008-1202032933

Babiker, R., Elmusharaf, K., Keogh, M.B., Banaga, A.S.I. and Saeed, A.M. (2017b): Metabolic effect of Gum Arabic (Acacia Senegal) in patients with Type 2 Diabetes Mellitus (T2DM): Randomized, placebo controlled double blind trial. *Functional Foods in Health and Disease (FFHD)*. Vol. 7, No. 3, pp.222.234. Available at: https://www.ffhdj.com/index.php/ffhd/article/view/325?utm_source=chatgpt.com

Bampidis, V., Azimonti, G., de Lourdes Bastos, M., Christensen, H., Dusemund, B., Durjava, M.F., Kouba, M., Lopez-Alonso, M., Lopez Puente, S., Marcon, F., Mayo, B., Pechova, A., Petkova, M., Ramos, F., Sanz, Y., Villa, R.E., Woutersen, R., Brantom, P., Svensson, K. and Innocenti, M. (2022): Safety and efficacy of a feed additive consisting of acacia gum (gum Arabic) for all animal species (A.I.P.G. Association for International Promotion of Gums). *EFSA Journal* Vol. 20, No. 4, p.e07252. Available at: https://doi.org/10.2903/j.efsa.2022.7252

Bejeshk, M.A., Aminizadeh, A.H., Rajizadeh, M.A., Khaksari, M., Lashkarizadeh, M., Shahrokhi, N., Zahedi, M.J. and Azimi, M. (2022): The effect of combining basil seeds and gum Arabic on the healing process of experimental acetic acid-induced ulcerative colitis in rats. *Journal of Traditional Complementary Medicine*, Vol. 12, No. 6, pp.599-607.

Brown, L., Rosner, B., Willett, W.W. and Sacks, F.M. (1999): Cholesterol lowering effects of dietary fiber: a meta-analysis. *American Society of Clinical Nutrition*, Vol. 69, No. 1, pp.30-42.

 © 2025 World Association for Sustainable Development (WASD) 

Calame, W., Thomassen, F., Hull, S., Viebke, C. and Siemensma, A.D. (2011): Evaluation of satiety enhancement, including compensation, by blends of gum arabic. A methodological approach. *Appetite*, Vol. 57, No. 2, pp.358-364. Available at: https://doi.oprg/10.1016/j.appet.2011.06.005

Calame, W., Weseler, A.R., Viebke, C., Flynn, C. and Siemensma, A.D. (2008): Gum Arabic establishes prebiotic functionality in healthy human volunteers in a dose-dependent manner. *British Journal of Nutrition*, Vol. 100, No. 6, pp.1269-1275.

Chawla, R. and Patil, G.R. (2010): Soluble dietary fiber. *Comprehensive Reviews in Food Science and Food Safety*, Vol. 9, No. 2, pp.178-196.

Cherbut, C., Michel, C., Raison, V., Kravtchenko, T. and Severine, M. (2003): Acacia gum is a bifidogenic dietary fiber with high digestive tolerance in healthy humans. *Microbial Ecology in Health and Disease*, Vol. 15, No. 1, pp.43-50.

Cho, S.S. and Dreher, M.L. (Eds) (2001): *Handbook of Dietary Fiber*. Marcel Dekker, Inc, New York, NY. CRC Press.

Codex Alimentarius Commission (CAC) (2009): *Guidelines on nutrition labelling* (CAC/GL 2-1985). FAO/WHO.

Cox, S., Sandall, A., Smith, L., Rossi, M. and Whelan, K. (2021): Food additive emulsifiers: a review of their role in foods, legislation and classifications, presence in food supply, dietary exposure, and safety assessment. *Nutrition Reviews*, Vol. 79, No. 6, pp.726-741. Available at: https://doi.org/10.1093/nutrit/nuaa038

Dahl, W.J. and Stewart, M.L. (2015): Position of the academy of nutrition and dietetics: health implications of dietary fiber. *Journal of the Academy of Nutrition and Dietetics*, Vol. 115, No. 11, pp.1861-1870.

Dai, F.J., and Chau, C.F. (2017): Classification and regulatory perspectives of dietary fiber. *Journal of Food and Drug Analysis*. Vol. 25, No. 1, pp.37-42.

Dashtdar, M., and Kardi, K. (2018): Benefits of gum arabic, for a solitary kidney under adverse conditions: A case study. *Chinese Medicine and Culture*, Vol. 1, No. 2, pp.88-96, Available at: https://doi.org/10.4103/CMAC.CMAC_22_18

Delcour, J.A. and Poutanen, K. (2013): *Fiber-Rich and Wholegrain Foods, Improving Quality, The range of dietary fiber ingredients and a comparison of their technical functionality*. Copyright © 2013 Woodhead Publishing Limited. ISBN: 978-0-85709-038-6. Available at: https://shop.elsevier.com/books/fibre-rich-and-wholegrain-foods/delcour/978-0-85709-038-6

Dong, H., Sargent, L.J., Chatzidiakou, Y., Saunders, C., Harkness, L., Bordenave, N., Rowland, I., Spencer, J.P. and Lovegrove, J.A. (2016): Orange pomace fiber increases a composite scoring of subjective ratings of hunger and fullness in healthy adults. *Appetite*, Vol. 107, pp.478-485.

Elnour, A.A., Abdurahman, N.H., Musa, K.H. and Rasheed, Z. (2023): Prebiotic potential of gum Arabic for gut health. *International Journal of Health Sciences*, Vol. 17, No. 6, p.4. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC10624802/

 © 2025 World Association for Sustainable Development (WASD) 

Farman, M.S., Salman, M.I. and Hamad, H.S. (2020): Effect of gum Arabic administration on some physiological and biochemical parameters in chronic renal failure patients. *Systematic Reviews in Pharmacy*, Vol. 11, No. 6, pp.697-701.

Foodchem (2025): *Halal Certified Gum Arabic/Acacia Gum*. E No: E414, CAS No. 9000-01-5, HS Code: 130120. Available at: https://www.foodchemadditives.com/halal/1554

Future Market Insights (2022): *Gum Arabic Market Snapshot (2022-2032)* [Online]. Available at: https://www.futuremarketinsights.com/reports/gum-arabic-market

Gafar, A.M., Ramadan, A.M., ElSaid, N.A. and Nurelhuda, N.M. (2022): Effect of Gum Arabic on plaque-induced gingivitis: A randomised controlled trial. *The Saudi Dental Journal*, Vol. 34, No. 6, pp.494-502. Available at: https://doi.org/10.1016/j.sdentj.2022.06.002

Gashua, I.B., Williams, P.A., Yadav, M.P. and Baldwin, T.C. (2015): Characterisation and molecular association of Nigerian and Sudanese *Acacia* gum exudates. *Food Hydrocolloids*, Vol. 51, pp.405-413.

Hasheim, A.S., Awad, M.H. and Soleiman, M.A. (2021): Physicochemical Studies on *Acacia Senegal* Gum, and Their Effect on Uric Acid Levels in Gout Patients. *IOSR Journal of Humanities and Social Science (IOSR-JHSS)*, Vol. 26, No. 5, pp.01-08.

IFANCA (2024): *The Islamic Food and Nutrition Council of America (IFANCA) Halal Product Certificate*, Ingredion Incorporated 5 Westbrook Corporate Center Westchester, Illinois 60154 USA. Available at: https://www.ingredion.com/content/dam/ingredion/technical-documents/es-mx/Halal%20Certificate%20Belcamp%20Maryland%20(BMOC).pdf

Jarrar, A.H., Stojanovska, L., Apostolopoulos, V., Feehan, J., Bataineh, M.F., Ismail, L.C. and Al Dhaheri, A.S. (2021): The Effect of Gum Arabic (*Acacia senegal*) on Cardiovascular Risk Factors and Gastrointestinal Symptoms in Adults at Risk of Metabolic Syndrome: A Randomized Clinical Trial. *Nutrients*, Vol. 13, No. 1, p.194. Available at: https://doi.org/10.3390/nu13010194

Kaddam, L.A. and Kaddam, A.S. (2020): Effect of Gum Arabic (*Acacia senegal*) on C-reactive protein level among sickle cell anemia patients. *BMC Research Notes*, Vol. 13, No. 1, p.162. Available at: https://doi.org/10.1186/s13104-020-05016-2

Kamal, E., Kaddam, L.A., Alagib, A. and Saeed, A. (2021): Dietary Fibers (Gum Arabic) Supplementation Modulates Hepatic and Renal Profile Among Rheumatoid Arthritis Patients, Phase II Trial. *Frontiers in Nutrition*, Vol. 8, p.552049. Available at: https://doi.org/10.3389/fnut.2021.552049.

King, D.E., Mainous III, A.G. and Lambourne, C.A. (2012): Trends in dietary fiber intake in the United States, 1999–2008. *Journal of the Academy of Nutrition and Dietetics*, vol. 112, No. 5, pp.642–648.

Larson, R., Nelson, C., Korczak, R., Willis, H., Erickson, J., Wang, Q. and Slavin, J. (2021): Acacia Gum Is Well Tolerated While Increasing Satiety and Lowering Peak Blood Glucose Response in Healthy Human Subjects. *Nutrients*, Vol. 13, No. 2, p.618. Available at: https://doi.org/10.3390/nu13020618.

Le Van Vu, K., Tran, N.T.T., Nguyen, D.N., Nguyen, L.T.T. and Phan, T.D. (2023): Application of electron beam irradiation for selenium nanoparticles production using gum Arabic as stabilizer. *Radiation Physics and Chemistry*, Vol. 211, p.111061.

 © 2025 World Association for Sustainable Development (WASD) 

Li, S.S., Kendall, C.W., de Souza, R.J., Jayalath, V.H., Cozma, A.I., Ha, V., Mirrahimi, A., Chiavaroli, L., Augustin, L.S., Blanco Mejia, S. and Leiter, L.A. (2014): Dietary pulses, satiety and food intake: a systematic review and meta-analysis of acute feeding trials. *Obesity*, Vol. 22, No. 8, pp.1773-1780.

Li, X., Gui, R., Wang, X., Ning, E., Zhang, L., Fan, Y., Chen, L., Yu, L., Zhu, J., Li, Z. and Wei, L. (2023): Oligosaccharides isolated from *Rehmannia glutinosa* protect LPS-induced intestinal inflammation and barrier injury in mice. *Frontiers in Nutrition*, Vol. 10, p.1139006.

Mohamed, R.E., Gadour, M.O. and Adam, I. (2015): The lowering effect of Gum Arabic on hyperlipidemia in Sudanese patients. *Frontiers in Physiology*, Vol. 6, p.160. Available at: https://doi.org/10.3389/fphys.2015.00160

Omer, D.A.M. and Hilali, F.M.A. (2016): Effect of Gum Arabic in Management of Malnourished Children Aged 6-59 Months. *Journal of Biology, Agriculture and Healthcare*, Vol. 6, No. 24, pp.7-14.

Patel, S. and Goyal, A. (2015): Applications of Natural Polymer Gum Arabic: A Review. *International Journal of Food Properties*, Vol. 18, No. 5, pp.986-998. Available at: https://doi.org/10.1080/10942912.2013.809541

Phillips, A.O. and Phillips, G.O. (2011): Biofunctional behaviour and health benefits of a specific gum Arabic. *Food Hydrocolloids*, Vol. 25, No. 2, pp.165-169.

Phillips, G.O. and Williams, P.A. (2000): *Handbook of Hydrocolloids*. CRC Press.

Prasad, N., Thombare, N., Sharma, S.C. and Kumar, S. (2022): Gum arabic - A versatile natural gum: A review on production, processing, properties and applications. *Industrial Crops and Products*, Vol. 187, p.115304.

Quick, V., Wall, M., Larson, N., Haines, J. and Neumark-Sztainer, D. (2013): Personal, behavioral and socio-environmental predictors of overweight incidence in young adults: 10-yr longitudinal findings. *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 10, No. 1, p.37.

Randall, R.C., Phillips, G.O. and Williams, P.A. (1988): The role of the proteinaceous component on the emulsifying properties of gum Arabic. *Food Hydrocolloids*, Vol. 2, No. 2, pp.131-140.

Satti, N.M.E., Ahmed, F.A.M., Bawadekji, A. and Eltahir, S.E.H. (2020): Gum Arabic (Acacia Gum): A review. *Journal of the North for Basic and Applied Sciences*, Vol. 347, No. 7856, pp.1-14.

Sperber, A.D., Bangdiwala, S.I., Drossman, D.A., Ghoshal, U.C., Simren, M., Tack, J., Whitehead, W.E., Dumitrascu, D.L., Fang, X., Fukudo, S. and Kellow, J. (2021): Worldwide Prevalence and Burden of Functional Gastrointestinal Disorders, Results of Rome Foundation Global Study. *Gastroenterology*, Vol. 160, No. 1, pp.99-114. Available at: https://doi.org/10.1053/j.gastro.2020.04.014.

Sudha, M.L., Rajeswari, G. and Venkateswara Rao, O. (2012): Effect of wheat and oat brans on the dough rheological and quality characteristics of instant vermicelli. *Journal of Texture Studies*, Vol. 43, No. 3, pp.195-202.

Talib, M.A., Rayis, O.A., Konozy, E.H. and Salih, M.A. (2018): Effect of gum Arabic (prebiotic) on physicochemical and organoleptic properties of yogurt (probiotic). In: Mariod, A.A. (Ed.): *Gum Arabic: Structure, Properties, Application and Economics* (pp.167-171). Amsterdam: Elsevier.

 © 2025 World Association for Sustainable Development (WASD) 

Threapleton, D.E., Greenwood, D.C., Evans, C.E., Cleghorn, C.L., Nykjaer, C., Woodhead, C., Cade, J.E., Gale, C.P. and Burley, V.J. (2013): Dietary fibre intake and risk of cardiovascular disease: systematic review and meta-analysis. *BMJ British Medical Journal*, Vol. 347, p.f6879.

United Nations Conference on Trade and Development (UNCTAD) (2018): *Commodities at a Glance, Special issue on gum Arabic.* No. 8, New York and Geneva, UNCTAD/SUC/2017/4, eISBN 978-92-1-363264-2, ISSN 2522-7866. Available at: https://unctad.org/system/files/official-document/suc2017d4_en.pdf. 83pp.

US Department of Agriculture (USDA) (2020): *Organic Certification and Accreditation*. United States Department of Agriculture. Available at: https://www.ams.usda.gov/services/organic-certification

US Food & Drugs Administration (FDA) (2021): *FDA Grants Citizen Petition on Acacia (Gum Arabic) as a Dietary Fiber*. US Food & Drugs Administration, Centre for Food Safety & Applied Nutrition. Available at: https://www.hoganlovells.com/en/publications/fda-to-propose-acacia-gum-arabic-as-a-dietary-fiber

van der Kamp, J.W., Asp, N.G., Jones, J.M. and Schaafsma, G. (Eds) (2004): *Dietary Fiber: Bio-active Carbohydrates for Food and Feed*. Wageningen Academic Publishers, Wageningen, The Netherlands.

Vu, V., Kim, Y.M. and Cho, M. (2023): Effects of SCFAs and TMAO on non-alcoholic fatty liver disease indicating the therapeutic benefits of plant-based diet, and supplemental prebiotics, probiotics and synbiotics. *Applied Biological Chemistry*, Vol. 66, No. 1, p.11.

World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) (2011): *Continuous update project report: food, nutrition, and physical activity and the prevention of colorectal cancer*. American Institute for Cancer, Arlington, VA.

Yao, B., Fang, H., Xu, W., Yan, Y., Xu, H., Liu, Y., Mo, M., Zhang, H. and Zhao, Y. (2014): Dietary fiber intake and risk of type 2 diabetes: a dose response analysis of prospective studies. *European Journal of Epidemiology*, Vol. 29, No. 2, pp.79-88.

Younes, M., Aquilina, G., Castle, L., Engel, K.-H., Fowler, P., Frutos Fernandez, M.J., Fürst, P., Gürtler, R., Gundert-Remy, U., Husøy, T., Mennes, W., Moldeus, P., Oskarsson, A., Shah, R., Waalkens-Berendsen, I. and Wölfle, D. (2019): Opinion on the re-evaluation of acacia gum (E 414) as a food additive in foods for infants below 16 weeks of age and the follow-up of its re-evaluation as a food additive for uses in foods for all population groups. *EFSA Journal*, Vol. 17, No. 12, p.305922. Available at: https://www.efsa.europa.eu/en/efsajournal/pub/5922

Yousefi, M., Farsani, M.N., Ghafarifarsani, H. and Raeeszadeh, M. (2023): Dietary *Lactobacillus helveticus* and gum Arabic improves growth indices, digestive enzyme activities, intestinal microbiota, innate immunological parameters, antioxidant capacity, and disease resistance in common carp. *Fish & Shellfish Immunology*, Vol. 135, p.108652.

Zhang, A., Xu, G., Liu, D., Zhu, W., Fan, X. and Liu, X. (2013): Dietary fiber consumption and risk of stroke. *European Journal of Epidemiology*, Vol. 28, No. 2, pp.119-130.

 © 2025 World Association for Sustainable Development (WASD) 

## BIOGRAPHY

**Dr Mohamed Elmustafa Osman Elsayed** is an associate professor at the Department of Food Science and Technology, Faculty of Natural Resources and Environmental Studies, Kordofan University in Sudan. In 2008, he obtained his PhD in Chemistry of Plant Products from Georg-August University of Gottingen in Germany, and he holds both an MSc and a BSc from the Department of Biochemistry of Food Science, Faculty of Agriculture, University of Khartoum (1991 and 1994). Since 1994, he has taught, conducted research and consulted for various institutions in food science, biochemistry and nutrition. He worked as Deputy Director and then Director of the Institute of Gum Arabic Research & Desertification Studies (IGARDS) (2008-2014), and, since 2014, is Principal of the College of Developmental and Technological Studies.

**Dr Naglaa Abdelbasit Suliman** graduated from the Faculty of Pharmacy University of Khartoum. Dr Suliman obtained her MSc and PhD in Medical Biochemistry, Faculty of Medicine, Department of Medical Biochemistry and Molecular Biology, University of Khartoum. She is currently assistant professor at the Department of Medical Biochemistry, Faculty of Medicine, University of Kordofan. She has participated in teaching, research activities and community services.


© 2025 World Association for Sustainable Development (WASD)