Pooler, Bob

From: bwolf@organicspecialists.com
Sent: Tuesday, September 04, 2007 3:11 PM
To: Pooler, Bob
Cc: cecilia@wizardscauldron.com%inter2; josiea@wizardscauldron.com%inter2
Subject: Tragacanth Petition for Listing on 205.606

Attachments: Tragacanth Petition & Attachments 8-31-072.pdf

Tragacant
ion & Attac

Bob,

Forwarded below and attached are the email correspondence and the Tragacanth petition from Wizard's Cauldron, as we discussed by phone this afternoon.

Sorry that it went to an incorrect email address on Friday.

Please let me know if you have any questions or if there is anything we can do to be of assistance.

Best regards,
Bill Wolf
Wolf, DiMatteo + Associates
Office: 540-864-5107
Cell: 540-798-1349
Email: bwolf@organicspecialists.com

>From: "Cecilia Redding" <cecilia@wizardscauldron.com>
>To: "'Bob Pooler'" <nosb.processing@usda.gov>
>Cc: <valerie.frances@usda.gov>, <mark.bradley@usda.gov>, <dcaroe@san.rr.com>,
> <andrea@protectedharvest.org>, <julie@flavorganics.com>
>Subject: Tragacanth Petition for Listing on 205.606
>Date: Fri, 31 Aug 2007 13:01:14 -0400
>
>Dear Mr. Pooler:
>
>Please accept the attached petition for tragacanth to be added to the
>list of gums that are listed on 7 CFR 205.606 as not currently
>available in an organic form.
>
>I request that review of the tragacanth petition be given priority and
>brought forward for decision at the November meeting.
>
>To help expedite this process, the attached document is a consolidated
>PDF Adobe File and contains:
>a. the full letter of transmission request (2 pages); b. the Wizard's
>Cauldron petition for tragacanth to be reviewed by the NOSB and
>considered for posting by the USDA to the 205.606 (5 pages); c. Seven
>Attachments as referred to in the petition (36 pages).
>
>If you need any additional information, please let me know.
>
>Thank you for your assistance in expediting this request.
>
>Sincerely,
>Cecilia Redding
>CEO
>Wizard's Cauldron, Inc

THE Wizard's CAULDRON
878 Firetower Road, Yanceyville, NC 27379 www.wizardscauldron.com

August 31, 2007

Robert Pooler, Agricultural Marketing Specialist
National Organic Standards Board (NOSB)
USDA-AMS-TMP-NOP
1400 Independence Avenue SW
Washington, DC 20250-0020

RE: Tragacanth Petition

Dear Mr. Pooler:

Please accept the attached petition for tragacanth to be added to the list of gums that are listed on 7 CFR 205.606 as not currently available in an organic form. I request that review of the tragacanth petition be given priority and brought forward for decision at the November meeting.

It is my understanding that tragacanth, prior to June 9, 2007, was allowed under section 205.606 of the National Organic Program (NOP) rule, as it is an agricultural product that is not available as a certified organic ingredient. Further to my understanding, that status has changed with the June 9, 2007 deadline, as tragacanth was not specifically listed as an allowed gum in the NOP rule - Federal Register dated May 15, 2007/Proposed Rule and June 27, 2007/Interim Final Rule, the exact listing (third column, item (j) "Gums – water extracted only (Arabic; Guar; Locust bean; and Carob bean).

I submit that tragacanth is a natural, exudate gum very much of the same class as gum Arabic (acacia gum) which is listed in the updated rule.

One of the attached abstracts is from Applied Microbiol Biotechnol (written in 2003), which clearly indicates that from growth, to harvesting, to processing, to functionality, the two gums (Arabic and Tragacanth) are almost the same. Tragacanth consists of two fractions: the first is tragacanthic acid, which is not water soluble, and tracanthin, which is water-soluble. These comments are intended for the latter fraction.

Growth of all exudate gums is in third world countries, and though they can be harvested, the normal collection method for all exudate gums is tapping from the various plants. The natural function of the gum is to seal off injuries to the plant. When the gum seeps out it hardens into a glass-like lump, which can easily be harvested.

All exudate gums are harvested and processed in virtually identical manner. In the dry season (October, November), the plants are stripped of bark, and the gums are allowed to exude. The gums are cleaned and graded, and then the gums are processed into kibbled (mechanical breaking into smaller chunks), and powdered form whereby the product is dissolved in water, filtered, and spray-dried into a powder. It is the latter form that is generally used in food production.

Both gum Arabic and tragacanth are used in the production of dressings and sauces as an emulsifier. Though they both perform admirably, each has its own application depending on the other ingredients used, processing methods, and use of heat. In many applications, tragacanth provides a superior emulsification without adding undesirable traits such as "stringiness." It is for this reason that I ask the NOSB to consider a review of the status of tragacanth to determine that it is a reasonable addition to the allowed gums provided in the NOP of water-extracted gums. The latter nomenclature may not be accurate since the gums are not truly extracted by water (as would caffeine from coffee), but are processed with water to be spray dried.

I wish to thank the NOP and the NOSB for all its work on behalf of the organic community. Thank you, especially, for your consideration of this request.

Sincerely,

Cecilia Redding

Cecilia Redding
CEO

cc: Mark Bradley, Associate Deputy Administrator, USDA-AMS-TMP-NOP
Valerie Francis, Executive Director, NOSB
Andrea Caroe, NOSB Chairperson
Julie Weisman, NOSB Vice Chairperson & Chair of NOSB Handling Committee

Petition to Add Gum Tragacanth to 7CFR205.606

Petitioner: **Wizards Cauldron, Inc**
Cecilia Redding
CEO
878 Firetower Road
Yanceyville, NC 27379
336-694-5665 ext 16 business
336-694-5284 fax
Cecilia@wizardscauldron.com

Item A

Petition for the Evaluation of **Gum Tragacanth** for Inclusion on the National List of Nonorganically Produced Agricultural Products Allowed as Ingredients in or on Processed Products Labeled as "Organic."

Item B

1) **Substance Name**: Gum tragacanth

2) **Manufacturer's Name**: Gumix International, Inc.
Address: 2160 North Central Road
Fort Lee, New Jersey 07024-7552
Telephone number: (201) 947-6300

3) **Current Use of the Substance**:

Gum tragacanth is an agricultural (nonorganic) ingredient used as an emulsifier and viscosifier. It provides body, texture, viscosity and emulsion stability for processed salad dressings and sauces. Gum tragacanth is used because, unlike other gums, it remains stable in perishable and shelf-stable products at low pH levels and across a wide range of temperatures.

4) **Mode of Action**:

Gum tragacanth is used in a powdered form to create a gel-like network within all types of salad dressings and sauces. Whether "hot" or "cold" processed, the gum is mixed with water in its powdered form or hydrated with oil prior to combining it with water. The water and gum mixture undergoes agitation until the gum is fully hydrated with water. This process creates viscosity, body and texture required for the final product. Gum tragacanth also acts as an emulsifier in products requiring non-miscible oil and water based ingredients. The distinct polar and non-polar regions of the gum allow oil and water based ingredients to remain in solution.

5) **Substance Source and Manufacturing Description**:

Gum tragacanth is harvested from plants grown in deserts and other arid areas of the Middle East including Iran, Turkey, Iraq, Syria and Lebanon. Harvesting occurs during the summer months of July through September from *Astragulus gummifer* Labill. and *A. microcephalus* Willd[1]. During this time, the plants become dormant and lose their leaves. The gum naturally exudes, during harvest season, from openings in the plant's bark as a means of protection. A collection process called tapping is used to encourage the secretion of the gum. The tapping process begins with a series of cuts on the exterior of the plant. The bark is then peeled away from these areas allowing the gum to exude. This dried exudate is then harvested, graded and usually exported for processing. Processing simply involves milling the exudate into several grades of fine powder[2]. Post harvest, the plant's exudate seals the tap wounds allowing the plant to naturally heal itself. The plants do not suffer any long term damage as a result of the tapping process.

6) **Reviews**:

A 1995 TAP review of gums found that they should be allowed as an ingredient in organic food. However, the TAP review only included guar gum, locust bean gum/carob gum and gum arabic (attachment #1). It is unknown why gum tragacanth was not included in this review but the attached documents on exudate gums (attachment #2), along with flow charts (attachment #3), explain how gum arabic and gum tragacanth are nearly identical gums in regards to plant production, harvest and manufacture. No other reviews of gum tragacanth are known.

7) **EPA, FDA and State Regulatory Agency Registrations**:

- Gum tragacanth is affirmed as GRAS by the FDA (attachment #4).
- The Select Committee on GRAS Substances (SCOGS) found that "there is no evidence in the available information on [substance] that demonstrates a hazard to the public when it is used at levels that are now current and in the manner now practiced. However, it is not possible to determine, without additional data, whether a significant increase in consumption would constitute a dietary hazard[3]."
- The EPA regulates gum tragacanth as a chemical in commerce (attachment #5).
- The Joint FAO/WHO Committee on Food Additives (JEFCA) lists specifications for gum tragacanth (attachment #6).

8) **CAS Number**: 9000-65-1

9) **Physical Properties and Chemical Mode of Action**:

Gum tragacanth is a polysaccharide composed of two distinct fractions. Tragacanthic acid is able to form gels while being insoluble in water and tragacanthin forms gels while being water-soluble. Both contain methoxyl groups and proteinaceous material responsible for the gum's solubility properties[4]. When mixed with water and agitated, the polysaccharide forms a network of cross-linked molecular chains that trap water, subsequently increasing viscosity[5]. These two polar and non-polar fractions also allow the gum to act as an emulsifier, keeping non-miscible ingredients combined in suspension.

a. **Chemical Interactions** – No interactions are known.
b. **Toxicity/Environmental Persistence** – Gum tragacanth is considered non-toxic and can be consumed by naturally occurring soil bacteria.
c. **Environmental Impact** – The manufacturing process for gum tragacanth is a natural process and does not use any chemicals. The harvested gum is simply ground into a powder. There is no environmental impact associated with its use.
d. **Human Health Effects** – Gum tragacanth is listed as GRAS by the FDA (attachment #4). The powdered gum is water soluble, and accordingly, will irritate the eyes and lungs. Health effects are associated with the handling process of the powder, not consumption (attachment #7).
e. **Effects on Soil/Organisms/Crops/Livestock** – There are no known negative effects.

10) **Safety Information**:

a. **MSDS** – Attachment #7
b. **NIEHS** - No substance report

11) **Research Information**:

The Wizard's Cauldron processes perishable and shelf-stable dressings and sauces over a wide range of temperatures and pH levels. Gum tragacanth is the best viscosifier and emulsifier available under these conditions. Currently allowed alternatives to gum tragacanth include xanthan gum, locust bean gum, guar gum and gum arabic. Xanthan gum is most commonly used as an alternative to gum tragacanth because both work well in products over wide ranges of temperature and pH level. The downside to using xanthan gum is that it is a synthetic ingredient which may result in diminished consumer appeal for the intended product. Locust bean gum is not an alternative because it is only soluble at temperatures over 180° F (attachment #1). Guar gum is less stable than gum tragacanth at low pH levels, rendering it inferior for products with a long shelf life. Gum arabic is a good emulsifier, but provides little viscosity[5]. Sean Katiraei of Gumix International Inc. effectively describes the need for gum tragacanth in the following statement:

"For example, although gum arabic may be used for its emulsification properties and guar gum may be used for its thickening properties, none of these gums offer the wide range of properties gum tragacanth offers, particularly in very acidic products. In fact, one may have to use a compound of half a dozen natural and semi-natural gums to come close to properties gum tragacanth offers and still settle for less than the creamy mouth sensation that can differentiate salad dressings and sauces[6]."

12) **Petition Justification Statement**:

There is currently no available source of organic gum tragacanth, although it is capable of being produced using organic methods. Nearly all of the gum tragacanth produced in the world comes from Iran and neighboring countries. The United States currently has trade embargoes in place with Iran and other Middle Eastern countries, which limits the trade of gum tragacanth. Along with war, civil unrest and a volatile infrastructure, trade embargoes prevent gum suppliers in the United States from obtaining a reliable source of the gum. Tic Gums, the leading supplier of gums to the food industry, has chosen not to sell gum tragacanth. The past supplier of gum tragacanth to The Wizard's Cauldron, Gumix International Inc., currently sells nonorganic gum tragacanth and cannot obtain it in an organic form. The company is supplied by a source from Turkey. Presently, there is difficulty surrounding the acquisition of nonorganic gum tragacanth, let alone an organic form.

Although presently unavailable, The Wizard's Cauldron recognizes the need for an organic gum tragacanth. In cooperation with Gumix International Inc., we are actively seeking an organic gum tragacanth supply from Turkey. According to Akkaya et. al, the number of organic agriculture producers in Turkey rose from 313 in 1990 to 15,795 in 2001[7]. Additionally, the Ministry of Agriculture and Rural Affairs (MARA) reports the amount of land under organic management rose from 1,037 hectares in 1990 to 103,190 hectares in 2003[8]. This data shows Turkey's progression in organic agriculture, but more importantly, it shows that Turkey is capable of supplying an organic gum tragacanth.

Based on the data compiled for this petition, gum tragacanth is a safe, nonorganic agricultural food ingredient that is currently not available in an organic form and should be listed under 7CFR205.606 for consideration by accredited certifiers for allowance in organic foods. Just as the currently allowed food ingredient gum arabic, gum tragacanth is an exudate from the bark of a plant used to thicken foods products. Both are grown, harvested and processed by the same means. It is the opinion of this company that gum tragacanth was simply overlooked as a gum used by the organic food industry when the 1995 TAP review on gums was conducted. This petition serves as a means to rectify this action and have gum tragacanth added to the list of allowed non-organic gums in organic foods.

References

1) Gecgul AS, Yalabik Hs, Groves MJ (1975) A note on tragacanth of Turkish origin. Planta MED 27:284-286.
2) FAO (1995) Gums, resins and latexes of plant origin. (Non-wood forest products 6) FAO, Rome.
3) Select Committee on GRAS Substances (SCOGS) Database Overview. October 2006. <http://www.cfsan.fda.gov/~opascogs.html>.
4) Anderson DMW, Bridgeman MME (1985). The composition of the proteinaceous polysaccharides exuded by *Astragalus microcephalus*, *A. gummifer* and *A. kurdicus* – the sources of Turkish gum tragacanth. Phytochemistry 24:2301-2304.
5) Hegenbart, Scott, ed. "Bind for Glory." Food Product Design. Jan. 1993. <http://www.foodproductdesign.com/archive/1993/0193cs.html>.
6) Katiraei, Sean. Quotation from E-mail. Aug. 14, 2007.
7) Akkaya, F., H. Tokgoz, B. Sayin, B. Ozkan "Production and Marketing of Agricultural Products in Turkey." Paper presented at the 2. Organic Agriculture Symposium, Antalya 14-16 November 2001 (in Turkish).
8) Babadogan, Gulay, and Koc, D. "Organic Agriculture in Turkey 2004." Research Institute of Organic Agriculture. Nov. 17, 2005. <http://www.organic-europe.net/country_reports/turkey/default.asp>.

Attachments

1) 1995 Tap Review of Gums – 9 pages
2) Exudate gums: occurrence, production, and applications – 12 pages
3) Flow charts on manufacturing process of gum tragacanth and gum acacia – 2 pages
4) FDA GRAS affirmation – 2 pages
5) EPA Substance registration – 2 pages
6) JECFA specifications – 3 pages
7) MSDS sheet – 6 pages

NOSB NATIONAL LIST
FILE CHECKLIST

PROCESSING

MATERIAL NAME: **#12 Gums**

✓	**NOSB Database Form**
✓	**References**
___	**MSDS (or equivalent)**
___	**FASP (FDA)**
✓	**TAP Reviews from:** **Joe Montecalvo, Rich Theuer**

NOSB/NATIONAL LIST
COMMENT FORM
PROCESSING

Material Name: #12 Gums

Please use this page to write down comments, questions, and your anticipated vote(s).

COMMENTS/QUESTIONS:

---

1. In my opinion, this material is:
_____ Synthetic _____ Non-synthetic.

2. Should this material be allowed in an "organic food" (95% or higher organic ingredients)? _____ Yes _____ No
(IF NO, PROCEED TO QUESTION 3.)

3. Should this substance be allowed in a "food made with organic ingredients" (50% or higher organic ingredients)? _____ Yes _____ No

Locust bean gum (?)

TAP REVIEWER COMMENT FORM for USDA/NOSB

Use this page or an equivalent to write down comments and summarize your evaluation regarding the data presented in the file of this potential National List material. Complete both sides of page. Attach additional sheets if you wish.

This file is due back to us by: Sept 8, 1995

Name of Material: Gums

Reviewer Name: R Theuer

Is this substance Synthetic or non-synthetic? Explain (if appropriate) NON-SYNTHETIC

If synthetic, how is the material made? (please answer here if our database form is blank)

This material should be added to the National List as:

___ Synthetic Allowed ___ Prohibited Natural

or, ✓ Non-synthetic (Allowed as an ingredient in organic food)

✓ Non-synthetic (Allowed as a processing aid for organic food)

or, ___ this material should not be on the National List

Are there any use restrictions or limitations that should be placed on this material on the National List?

CURRENT USES LIMITED BY GOOD MANUFACTURING PRACTICES. GUMS ARE EXPENSIVE. TOO MUCH MEANS PRODUCT IS TOO THICK

Please comment on the accuracy of the information in the file: OK

Any additional comments? (attachments welcomed)

—

Do you have a commercial interest in this material? ___ Yes; ✓ No

Signature [signature] **Date** 8/28/95

Please address the 7 criteria in the Organic Foods Production Act:
(comment in those areas you feel are applicable)

(1) the potential of such substances for detrimental chemical interactions with other materials used in organic farming systems;

NONE

(2) the toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment;

NONE

(3) the probability of environmental contamination during manufacture, use, misuse or disposal of such substance;

SOME, BUT WASTE STREAM CAN BE USED AS ANIMAL FEED, MULCH, ETC.

(4) the effect of the substance on human health;

OK SAFE (GRAS)

(5) the effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock;

NONE

(6) the alternatives to using the substance in terms of practices or other available materials; and

VARIOUS GUM AND HYDROCOLLOIDS EXIST ~~USE~~ CHOICE IS GOVERNED BY COST, APPLICATION, ETC.

(7) its compatibility with a system of sustainable agriculture.

EXCELLENT

TAP REVIEWER COMMENT FORM for USDA/NOSB

Use this page or an equivalent to write down comments and summarize your evaluation regarding the data presented in the file of this potential National List material. Complete both sides of page. Attach additional sheets if you wish.

This file is due back to us by: Sept 8, 1995

Name of Material: Gums

Reviewer Name: Dr. Joe Montecalvo

Is this substance Synthetic or non-synthetic? Explain (if appropriate)

Synthetic for Guar and Locust Bean Gum and Carob — Non Synthetic for Gum Arabic

If synthetic, how is the material made? (please answer here if our database form is blank) See Attached sheet for further information

This material should be added to the National List as:

✓ **Synthetic Allowed** For Guar, Locust and Carob ____ **Prohibited Natural**

or, ✓ **Non-synthetic (Allowed as an ingredient in organic food)** For Gum Arabic

____ **Non-synthetic (Allowed as a processing aid for organic food)**

or, ____ **this material should not be on the National List**

Are there any use restrictions or limitations that should be placed on this material on the National List? none.

Please comment on the accuracy of the information in the file: not clear - need more detailed information on extraction and purification of these gums. I will have more info available at a later date - please contact me.

Any additional comments? (attachments welcomed)

See Attached Sheet.

Do you have a commercial interest in this material? ____ Yes; ✓ No

Signature [signature] **Date** 8/22/95

Please address the 7 criteria in the Organic Foods Production Act:
(comment in those areas you feel are applicable)

(1) **the potential of such substances for detrimental chemical interactions with other materials used in organic farming systems;**

None

(2) **the toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment;**

None

(3) **the probability of environmental contamination during manufacture, use, misuse or disposal of such substance;**

None

(4) **the effect of the substance on human health;**

No data

(5) **the effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock;**

None

(6) **the alternatives to using the substance in terms of practices or other available materials; and** None

(7) **its compatibility with a system of sustainable agriculture.**

O.K.

NOSB Materials Database

Identification

Common Name **Gums, Acacia, Guar etc.** **Chemical Name**

Other Names Gum Arabic, Locust Bean Gum, Guar Gum, Carob Bean gum

Code #: CAS 9000-30-0 (Guar); 9000-40-2 (Locust) **Code #: Other**

N. L. Category Non-agricultural **MSDS** ○ yes ● no

Chemistry

Family

Composition polysaccharides. Guar (*Cyamopsis tetragonolobus*) and locust bean (*Ceratonia siliqua*) consist of galactan and mannan units. Gum arabic is an exudate from the stem of the acacia tree.

Properties Guar is cold water soluble so can be used in cold processes. Also stable at boiling temperatures over a wide pH range. Locust bean is not fully soluble until 180 degrees F, so it used for hot processes. Both are slightly cloudy and very viscous in solution.

How Made Guar: seeds are dehusked and seed germs removed (sometimes the hull is loosened with 55% sulfuric acid). The endosperm portion, called splits, are swollen in water, dried, and milled by differential grinding to separate the endosperm from the germ. Locust bean gum is the same except not swollen in water. It can sometimes be pre-treated with a dilute alkali. An alternate procedure involves further purification by dispersing in boiling water, filtering, and recovering the gum by evaporation. Gum arabic is collected from the acacia tree which grows in Africa, India and the southern U.S.

Use/Action

Type of Use Processing

Specific Use(s) Guar and Locust bean: Used in dairy (especially ice cream), baked goods, condiments and sauces, cake mixes, puddings and fillings, beverages. Gum arabic is an emulsifier, surfactant, stabilizer, texturizer and binder used in candies, jellies, and baked goods.

Action functions as a viscosifier, water binder, texturizer, and to improve freeze-thaw stability of the finished product. Synergistic with xanthan gum and carrageenan to improve binding properties.

Combinations

Status

OFPA

N. L. Restriction

EPA, FDA, etc FDA-GRAS

Directions

Safety Guidelines

State Differences

Historical status

Internationl status

	Composition	Prop[illegible]ies	Manufact.	S[illegible]ses
Locust Bean Gum	From Carob Flour, endosperm consisting protein + CHO's	Yellow-green color, odorless and tasteless	Extracted from ground kernel endo-sperm of tree pods Ceratonia	① Use as coffee, chocolate and cocoa substitute and extender ② Stabilizer, thickener and binder in foods and cosmetics
Guar Gum	composed of linear chains of (1→4) β-D mannopyranosyl units with α-D-galactopyranosyl attached by a (1→6) linkage. Ratio of D-galactose to D mannose is 1:2.	Soluble in cold and hot H_2O, solutions are tasteless, odorless, nontoxic. Heat stable	Extracted from the ground endosperm of Cyamopsis tetragonolobus by water extraction	Used as a stabilizer and thickener for cheese, salad dressings, ice cream and soups. Has 5 to 8X the thickening power of starch
Gum Arabic	Polysaccharide composed of arabinose, galactose, rhamnose and glycuronic acid	Soluble in water, thickener, emulsifier	Extracted from the dried gummy exudation from the stems and branches of the Acacia senegal	Emulsifier, thickener, in candy and confectionary products – in manufacturing spray dried stable flavor compounds – i.e for packaged dry goods, puddings, deserts, cake mixes

Prep. Joe Montecalvo 8/22/95

OFPA Criteria

2119(m)1: chemical interactions **Not Applicable**

2119(m)2: toxicity & persistence **Not Applicable**

2119(m)3: manufacture & disposal consequences

biodegradeable.

2119(m)4: effect on human health

2119(m)5: agroecosystem biology **Not Applicable**

2119(m)6: alternatives to substance

xanthan gum, carrageenan; many gums substitute for each other.

2119(m)7: is it compatible?

References

Mar B. Nieto, Ph. D. 1995. written communication.

Boyd Foster, Arrowhead Mills, 1994. written communication.

Glicksman, M., Food Hydrocolloids. Vol. III; CRC Press, Inc., Boca Raton, FL

Furia, T.E. (ed.). CRC Handbook of Food Additives. 2nd ed. Cleveland: the Chemical Rubber Co., 1972.

Appl Microbiol Biotechnol (2003) 63:10–21
DOI 10.1007/s00253-003-1354-z

MINI-REVIEW

D. Verbeken · S. Dierckx · K. Dewettinck

Exudate gums: occurrence, production, and applications

Received: 9 April 2003 / Revised: 23 April 2003 / Accepted: 25 April 2003 / Published online: 12 June 2003
© Springer-Verlag 2003

Abstract This paper presents a review of the industrially most relevant exudate gums: gum arabic, gum karya, and gum tragacanth. Exudate gums are obtained as the natural exudates of different tree species and exhibit unique properties in a wide variety of applications. This review covers the chemical structure, occurrence and production of the different gums. It also deals with the size and relative importance of the various players on the world market. Furthermore, it gives an overview of the main application fields of the different gums, both food and non-food.

Introduction

Exudate gums are amongst the oldest natural gums: about 5,000 years ago they were already being used as thickening and stabilizing agents. The three major exudate gums—gum arabic, gum tragacanth, and gum karaya—possess a unique range of functionalities (Phillips and Williams 2001). They have been important items of international trade in the food, pharmaceutical, adhesive, paper, textile, and other industries for centuries.

Gum arabic is the oldest and best known of all natural gums. Its use can be traced back to the third millennium B.C., the time of the ancient Egyptians. Early Egyptian fleets shipped gum arabic as an article of commerce. It was used as a pigment binder and adhesive in paints for making hieroglyphs, and ancient inscriptions refer to it as *kami*. Furthermore, it was used as a binder in cosmetics and inks and as an adhering agent to make flaxen wrappings for embalming mummies. Introduced in Europe through various Arabian ports, it was called gum arabic after its place of origin. During the Middle Ages, gum arabic trade was controlled by the Turkish Empire, giving rise to the name turkey gum. Gum arabic is defined by the FAO/WHO Joint Expert Committee for Food Additives (JECFA) as: "a dried exudate obtained from the stems and branches of *Acacia senegal* (L.) Willdenow or *Acacia seyal* (Fam. Leguminosae)" (FAO 1999). In a wider sense, the name gum arabic is also used to denominate gums produced by other *Acacia* species, like for example *A. karroo*, and is sometimes referred to as gum acacia (FAO 1995).

Gum tragacanth, like gum arabic, has an ancient history. It was described by Theophrastus in the third century B.C. (Whistler 1993). Its name is derived from the two Greek words *tragos* (goat) and *akantha* (horn) and probably refers to the curved shape of the ribbons, the best grade of commercial gum. Gum tragacanth is defined by JECFA as: "a dried exudation obtained from the stems and branches of *Astragalus gummifer* Labillardière and other Asiatic species of *Astragalus* (Fam. Leguminosae)" (FAO 1992b).

Gum karaya has a more recent history and has only been used commercially for about 100 years. In the early 1900s, it was introduced on the market as an adulterant or alternative for gum tragacanth, due to the great similarity between both gums (Dziezak 1991). Gum karaya is defined by JECFA as: "a dried exudation from the stems and branches of *Sterculia urens* Roxburgh and other species of *Sterculia* (Fam. Sterculiaceae) or from *Cochlospermum gossypium* A.P. De Candolle or other species of *Cochlospermum* (Fam. Bixaceae)" (FAO 1992a).

Many other higher plants exude gums, such as *Anacardium* (Menestrina et al. 1998), *Pithecellobium* (De Pinto et al. 2001), *Spondias* (De Pinto et al. 2000), *Albizia* (De Paula et al. 2001), *Prosopis* (Goycoolea et al. 1997), *Enterolobium* (De Pinto et al. 1994), *Hakea* (Eagles et al. 1993), and *Combretum* (Anderson and Weiping 1990).

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Chemical structures

The chemical composition of the three gums is complex and varies to some extent depending on the source and its age. Therefore, it is not possible to provide defined structural formulas of these biopolymers.

Gum arabic

Gum arabic is a branched, neutral or slightly acidic, complex polysaccharide obtained as a mixed calcium, magnesium, and potassium salt. The backbone consists of 1,3-linked β-D-galactopyranosyl units. The side chains are composed of two to five 1,3-linked β-D-galactopyranosyl units, joined to the main chain by 1,6-linkages. Both the main and the side chains contain units of α-L-arabinofuranosyl, α-L-rhamnopyranosyl, β-D-glucuronopyranosyl, and 4-*O*-methyl-β-D-glucuronopyranosyl, the latter two mostly as end-units (Anderson and Stoddart 1966). Table 1 gives an overview of some chemical characteristics of the gum from *Acacia senegal*, as obtained by Idris et al. (1998). The characteristics may vary significantly, depending on the geographical origin and age of the trees, climatic conditions, soil environment, and even on the place of exudation on the tree (Idris et al. 1998; Islam et al. 1997; Karamalla et al. 1998). Studies are undertaken to obtain identifiable methods and parameters allowing the characterization of commercial gum arabic and the detection of adulterants (Biswas et al. 2000; Mocak et al. 1998).

Because of its heterogeneous nature, gum arabic was described by Anderson and Stoddart (1966) as heteropolymolecular, on the one hand having a variation in monomer composition and/or in the linking and branching of the monomer units and on the other hand having a molecular mass distribution. The heterogeneous nature of the gum has been studied extensively using different techniques (Islam et al. 1997): hydrophobic affinity chromatography (Fauconnier et al. 2000; Osman et al. 1993a, 1993b; Randall et al. 1989; Ray et al. 1995), anion-exchange chromatography (Osman et al. 1995), gel permeation chromatography (Idris et al. 1998; Osman et al. 1993a, 1993b), high-performance size-exclusion chromatography (Ray et al. 1995), flow-field flow fractionation (Picton et al. 2000), enzymatic degradation (Connolly et al. 1988), and sequential Smith degradation (Anderson and McDougall 1987a, 1987b, 1987c).

Table 1 Analytical data for the gum obtained from *Acacia senegal* (Idris et al. 1998)

Parameter	Range
Moisture content (%)	12.5–16.0
Specific rotation	From −32.7 ° to −27.0 °
Nitrogen (%)	0.22–0.39
Protein (%)	1.5–2.6
Galactose (%)	39–42
Arabinose (%)	24–27
Rhamnose (%)	12–16
Glucuronic acid (%)	15–16
Equivalent mass (Da)	1,118–1,238

Using hydrophobic affinity chromatography, gum arabic was separated into three fractions (Randall et al. 1989; Ray et al. 1995). Most of the gum had a very low protein content (0.35%) and was referred to as an arabinogalactan (AG). It represented 88.4% of the total gum and was found to have a molecular mass of 3.8×10^5 Da. The second fraction represented 10.4% of the total gum and was referred to as an AG–protein complex (AGP) with a molecular mass of 1.45×10^6 Da. The protein content of the AGP was 11.8%. The smallest fraction (1.2% of total gum) was referred to as a low-molecular-weight glycoprotein (GP) with a molecular mass of 2.5×10^5 Da and a protein content of 47.3%. Fincher et al. (1983) proposed the wattle blosom model for describing the structure of AGP. They suggested that the high-molecular-weight fraction of the gum consists of large carbohydrate blocks with a molecular mass of approximately 2.5×10^5 Da attached individually to a polypeptide chain. An alternative model was proposed by Qi et al. (1991), who described the AGP as a twisted hairy rope. Using chromatographic techniques and electron microscopy, they concluded that the molecules had a polypeptide backbone of some 400 amino acid residues with numerous small carbohydrate substituents (molecular mass ~6,000 Da) linked through hydroxyproline. Over the years, numerous studies were conducted, suggesting that AGP molecules have a globular structure and thus supporting the wattle blosom model (Connolly et al. 1988; Idris et al. 1998; Picton et al. 2000; Vandevelde and Fenyo 1985). The polypeptide backbone of the gum arabic GP is composed of repeating sequences of 19 amino acids (Goodrum et al. 2000).

Gum karaya

Gum karaya is a complex, partially acetylated polysaccharide obtained as a calcium and magnesium salt. It has a branched structure and a high molecular mass of approximately 16×10^6 Da (Le Cerf et al. 1990). The backbone of the gum consists of α-D-galacturonic acid and α-L-rhamnose residues. Side chains are attached by 1,2-linkage of β-D-galactose or by 1,3-linkage of β-D-glucuronic acid to the galacturonic acid of the main chain. Furthermore, half of the rhamnose residues of the main chain are 1,4-linked to β-D-galactose units (Weiping 2000). The chemical composition of gum samples obtained from different *Sterculia* species and from different places of origin was found to be quite similar (Anderson et al. 1982; Whistler 1993). Commercial gum karaya contains about 13–26% galactose and 15–30% rhamnose, which is considerably higher than the rhamnose content of other commercial exudate gums. However, the protein content of about 1% is lower than that of other exudate gums. Gum karaya contains approximately 40% uronic acid residues and 8% of acetyl groups, from which free acetic acid is released on aging. Due to the presence of these acetyl groups, native gum karaya is insoluble and only swells in water (Imeson 1992). Le Cerf et al. (1990) distinguished three fractions in gum karaya, based on their solubility in water. Only 10% of the native gum was solubilized in cold water, increasing to 30% in hot water. After deacetylation with dilute ammonia, 90% of the native gum dissolved in water. The equivalent weight of the deacetylated-soluble fraction was higher than that of the cold-water-soluble fraction. This indicates that only lower-molecular-weight molecules are able to dissolve in cold water, while deacetylation leads to the solubilization of material of higher molecular weight (Le Cerf et al. 1990).

Gum tragacanth

Gum tragacanth is a complex, highly branched, heterogeneous polysaccharide, naturally occurring as a slightly acidic calcium, magnesium, and potassium salt. It has a molecular mass of about 8.4×10^5 Da and an elongated shape of 4,500×19 Å. The composition of the gum obtained from different *Astragalus* species shows considerable variation. This variability is not surprising, since the genus *Astragalus* is the largest within the Leguminosae family. It occurs worldwide in tropical regions and contains around 2,000 species, grouped into more than 100 sub-divisions (Anderson and Grant 1988). Also, commercial samples obtained from one particular species show larger differences in chemical composition than those expected due to seasonal and geographical variations. Hence, commercial gum tragacanth is a highly variable product. In Table 2, the composition of Turkish samples of gum from the two commercially most important species (*A. microcephalus*, *A. gummifer*) are compared. Important differences are found in sugar composition, methoxyl content, and relative proportion of soluble and insoluble components.

Gum tragacanth consists of two fractions. Tragacanthic acid or bassorin is insoluble in water, but has the capacity to swell and form a gel. The other fraction is called tragacanthin and is water-soluble. Both fractions contain small amounts of proteinaceous material and methoxyl groups, the latter present in higher amounts in the water-soluble fraction (Anderson and Bridgeman 1985). As shown in Table 2 for the gums from *A. microcephalus* and *A. gummifer*, the ratio of the two fractions strongly varies between species. The water-swellable tragacanthic acid fraction has a high molecular weight and a rodlike molecular shape (Stephen and Churms 1995). The main chain is formed by 1,4-linked D-galactose residues with side chains of D-xylose units attached to the main chain by 1,3 linkages. The water-soluble tragacanthin is a neutral, highly branched arabinogalactan with a spherical molecular shape. Its structure probably consists of a core composed of 1,6- and 1,3-linked D-galactose with attached chains of 1,2-, 1,3- and 1,5-linked L-arabinose.

Table 2 Analytical data for the exudates from Turkish *Astragalus* species (Anderson and Bridgeman 1985). The sugar composition was assessed after hydrolysis

Parameter	*A. microcephalus*	*A. gummifer*
Loss on drying (%)	12.7	9.9
Total ash (%)	3.2	2.9
Nitrogen (%)	0.58	0.46
Total protein (%)	3.65	2.84
Methoxyl (%)	3.3	0.9
Ratio of soluble:insoluble components	65:35	40:60
Galacturonic acid (%)	11	3
Galactose (%)	14	23
Arabinose (%)	37	63
Xylose (%)	22	5
Fucose (%)	12	2
Rhamnose (%)	4	4

Occurrence

None of the three gums is produced in industrialized countries. They must be imported from third-world countries.

Gum arabic

The genus *Acacia* is the second largest within the Leguminosae family and contains at least 900 species. With their extensive root system, *Acacia* trees can be found in semi-arid areas in Australia, India, and America, but mainly in the Sahelian region of Africa. They are multipurpose trees, not only producing gum, but also preventing desert encroachment, restoring soil fertility, and providing fuel and fodder. Almost all commercial gum comes from the so-called gum belt of Africa, a vast area which extends over Mauritania, Senegal, Mali, Burkina Faso, Benin, Niger, Nigeria, Chad, Sudan, Eritrea, Ethiopia, Somalia, Uganda, and Kenya (FAO 1995). Sudan is the world's largest producer of gum arabic, followed by Nigeria, Chad, Mali, and Senegal. Gum from the Sudanese Kordofan region is known as the best quality gum and is used as the standard to judge gums obtained from other areas.

Commercial gum arabic is collected from a number of *Acacia* species, of which *A. senegal*, *A. seyal*, and *A polyacantha* are the most widespread in the gum belt. *A. laeta*, *A. karoo*, and *A. gourmaensis* are some other gum-yielding species with a more limited distribution (Islam et al. 1997). In Sudan, the gums from *A. senegal* and *A. seyal* are referred to as hashab and talha respectively, the former considered of higher quality (Baldwin et al. 1999). Most of these species grow scattered in the wild and gum from these untended trees is collected by semi-nomadic people. Cultivation is only practiced for *A. senegal*. Particularly in Sudan, wild stands of *Acacia* trees are replaced by monocultures of *A. senegal* in order to facilitate collection and obtain a more consistent quality.

Gum arabic from other African countries may be variable in quality, because it may contain gums obtained from different species which occur jointly in the collection area. *A. senegal* is a thorny tree that reaches a height of 4.5–6.0 m. It is very drought-resistant and grows on sites with annual rainfall of 100–950 mm and dry periods of 5–11 months. It also tolerates high daily temperatures of up to 45 °C or more, dry winds, and sandstorms. After 5 years, trees reach maturity and are tapped. Although gum can be tapped from the trees after 3 years, the quality and yield are consistent only after 5 years, suggesting that gum biosynthesis and tree growth are in competition with each other (Joseleau and Ullmann 1990).

Gum karaya

Most commercial gum karaya is obtained from *Sterculia urens*, a large, bushy deciduous tree that can grow up to 15 m high. It is found on the dry, rocky hills and plateaus of central and northern India. Other sources are the related species *S. villosa* that occurs in India and Pakistan and *S. setigera* that grows in some north African countries, such as Sudan, Senegal, and Mali.

Gum tragacanth

Most commercial gum tragacanth is obtained from *Astragalus gummifer* Labill. and *A. microcephalus* Willd., but the contribution of other species such as *A. adscencens* Boiss., *A. echidnaeformis* Sirjaev, *A. gossypinus* Fisch., and *A. kurdicus* Boiss. is also significant. These small shrubs, varying in height from hardly 10 cm (*A. microcephalus*) up to 1 m (*A. gummifer*), grow in the highlands and deserts of Turkey, Iran, Iraq, Syria, Lebanon, Afghanistan, Pakistan, and Russia (Geçgil et al. 1975). Iran dominates the gum tragacanth market and supplies the highest quality gum. Turkey is the second largest producer, but Turkish gum is considered of inferior quality. Much smaller amounts of gum are exported by Afghanistan and Syria.

Functions

Exudate gums are produced by many trees and shrubs as a natural defense mechanism, particularly in semiarid regions. When the plant's bark is injured, an aqueous gum solution is exuded to seal the wound, preventing infection and dehydration of the plant. The solution dries in contact with air and sunlight, to form hard, glass-like lumps which can easily be collected.

Joseleau and Ullmann (1990) provided evidence for the formation of gum arabic in the cambium of gum-producing branches of *Acacia senegal*. The water-soluble polysaccharide extracted from the cambial zone was found to be identical to gum arabic, while the gum was absent in the other tissues of gum-producing branches and in non-productive branches.

Collection and processing

Although natural exudates are sometimes harvested, virtually all exudate gum is tapped from the trees. When *Acacia* trees lose their leaves and become dormant at the beginning of the dry season, usually by the end of October or beginning of November, superficial incisions are made in the branches and bands of bark are stripped off. After 5 weeks, gum is manually collected as partially dried tears. This collection is repeated at 15-day intervals for up to five or six collections in total, depending on the weather conditions and the health of the tree (Imeson 1992). After collection, the gum is cleaned and graded. This is traditionally done by women, who manually sort the gum according to the size of the lumps and remove foreign matter (FAO 1995). Since the 1990s, cleaning has also been performed mechanically using conveyor belts and sieving machines. In Sudan, the gum from *A. senegal* (hashab) is presented in various grades, listed in Table 3. Since 1995, the gum from *A. seyal* (talha) has been divided into three grades: super, standard clean, and siftings. Nigerian gum arabic is also sorted into three grades (FAO 1995). Grade 1 is gum obtained from *A. senegal* and comparable to cleaned hashab. Grade 2 is produced by other *Acacia* species, such as *A. seyal* and *A. sieberana*. Grade 3 may contain gum from species other than *Acacia*, like *Combretum* and *Albizia*. After collec-

Table 3 Commercial grades of *Acacia senegal* gum from Sudan (Islam et al. 1997)

Grade	Description
Hand-picked selected	The cleanest and largest pieces with the lightest color. The most expensive grade
Cleaned and sifted	The material which remains after hand-picked selected and siftings are removed. This grade comprises whole and broken lumps with a pale to dark amber color
Cleaned	The standard grade with a light to dark amber color. It contains siftings but the dust is removed
Siftings	The residue formed by sorting the above, more choice grades. This grade contains a proportion of sand, dirt, and bark
Dust	This grade is collected after the cleaning process and comprises very fine particles of gum, sand, and dirt
Red	Dark red gum particles removed from other lumps

tion, the gum can be further processed into kibbled and powdered forms. Kibbling is a mechanical process which breaks up large lumps into smaller granules with a more uniform size distribution and facilitates the dissolution of the gum in water. Even better solubility characteristics are obtained with powdered gum, which is usually produced by dissolving the gum in water, removing impurities by filtration or centrifugation and spray-drying.

Gum karaya exudation begins immediately after wounding the *Sterculia* tree and is particularly extensive during the first days. The exudate is allowed to solidify on the tree and is then removed as large, irregular tears. The yield of gum from a mature tree is 1–5 kg per season. In India, the world's biggest producer of gum karaya, the best quality gum is collected from April to June, before the monsoon season, as the temperature increases. Collection may be repeated in September, although in this period gum may be less viscous and darker, due to the presence of higher amounts of foreign matter. In Senegal, the biggest African producer of gum karaya, harvesting is done from September to January and from March to July. After collection, the gum is manually or mechanically cleaned and sorted. Commercial Indian gum karaya is available in five different grades: hand-picked selected, superior no. 1 and no. 2, fair average quality, and siftings (FAO 1995). The higher grades contain less foreign matter and have a lighter color. Senegalese gum is sorted in two grades, hand-picked and standard, and is generally inferior to Indian gum.

Gum tragacanth exudes from wounds in *Astragalus* trees and hardens as curled ribbons or flakes, which can be collected after a few weeks. The primary source of the gum are the rather large tap roots of the bush, inside of which gum is contained in a central gum cylinder. Incisions are also made in the bark of the branches, although this usually yields gum of an inferior quality. The plants require a plenitude of rainfall prior to tapping, but dry conditions during harvesting. Rain and wind during the gum exudation may wash some gum off and lead to a decrease in quality. Tapping and collecting is carried out in the dry summer months from July to September. After collection, the gum is sorted manually into various grades of ribbon and flake. Iranian tragacanth ribbons are sorted into five grades, while flakes are sold in seven different grades (FAO 1995). After arrival in the importing country, the gum is usually ground into powder, with particle size varying according to the desired viscosity.

World market

Production and provision of gums varied considerably during the past decades, due to climatic and political constraints. These uncertainties of supply promoted the replacement of exudate gums by other biopolymers, which are for example of microbial origin and can therefore be constantly supplied.

Table 4 Gum arabic production in Sudan (5-year annual averages) between 1960 and 1994 (FAO 1995)

Period	Annual average (t)
1960–1964	46,550
1965–1969	50,576
1970–1974	35,073
1975–1979	37,408
1980–1984	31,079
1985–1989	23,721
1990–1994	18,358

Gum arabic

In modern times, Sudan has dominated the production and trade of gum arabic, accounting for 80–90% of the world market (Chikamai et al. 1996). Sudanese production and export data are therefore representative for the whole market. Table 4 gives an overview of the production of gum arabic in Sudan for the period 1960–1994. In the late 1960s, Sudanese gum arabic production was in excess of 60,000 t/year, but in the 1970s and 1980s the gum market was disturbed by climatic and political events. In 1973–1974, a severe drought occurred in the Sahelian gum belt, resulting in the collapse of gum production to 20,000 t/year. Together with the dramatically increased prices and the fact that the decrease in supply was not announced, the limited availability caused a major loss of confidence by manufacturers, many of whom switched to alternative materials, such as modified starches and dextrins (Imeson 1992). The Sudanese gum production recovered to around 40,000 t at the end of the 1970s, but a new drought in 1982–1984, together with political and civil unrest, brought production down to below 20,000 t at the end of the 1980s. In the early 1990s, gum supply further decreased due to cold weather, rainfall fluctuations, foliage attack by locusts, and changes in export duties. Over recent years, production strongly recovered to an estimated 40,000–50,000 t/year (Williams and Phillips 2000; Williams et al. 1990). These important supply variations led to strongly fluctuating prices. After the first drought, the gum price increased dramatically from about US$ 1,500/t to US$ 5,000/t and even up to US$ 8,000/t. Nowadays, prices are back at the same level as 30 years ago.

Europe is by far the biggest importer of gum arabic. Between 1988 and 1993, an annual average of 30,000 t of gum arabic was imported, about a third of which was directly imported from Sudan. About 5,000 t was imported from Nigeria, the world's second largest producer and exporter of gum arabic, followed by Chad with an annual European import average of 2,000 t. France and the United Kingdom are the biggest markets, although the majority of their imported gum is later re-exported. Other important European markets are Italy and Germany. Outside Europe, the United States is the largest market for gum arabic, with an annual import of about 10,000 t. The most important exporters to the United States are Sudan and France, the latter mainly exporting

Table 5 Producers and/or suppliers of exudate gums. This list is not exclusive and does not in any way reflect the preferences of the authors

Company	Products
Gum Arabic Co., Sudan	Gum arabic
Victoria Agro Exports Ltd. Nigeria	Gum arabic
Importers Service Corp., USA	Gum arabic, karaya, tragacanth
TIC Gums, USA	Gum arabic
Colloides Naturels International, France	Gum arabic
Alok International, India	Gum arabic, karaya, tragacanth
Natural Colloids, Singapore	Gum arabic, tragacanth
AEP Colloids, USA	Gum arabic, karaya, tragacanth
Agriproducts, USA	Gum arabic
KIC Chemicals, USA	Gum arabic

processed gum. The Japanese market represents about 2,000 t/year, most of which is imported from Sudan. Table 5 lists a number of companies from which gum arabic and possibly other exudate gums can be obtained.

Gum karaya

Traditionally, India is the largest producer and exporter of gum karaya. From the end of the 1960s until the mid-1980s, the annual export averaged 4,000–6,000 t (FAO 1995). Total gum production was about three times that amount, since most Indian gum was and probably still is consumed domestically. At the end of the 1980s, gum supply collapsed, reaching an all-time low of 570 t in 1991–1992. The reason for this dramatic decrease was the switch to a government-controlled market. Initially, the local industry was organized through private merchants, but in the 1980s the entire gum market from collection to export came under government control (Imeson 1992). Initially, the government introduced a conservation policy: they restricted tapping and initiated replanting to secure the gum's future. Recently, government controls were relaxed and export has increased again, but is still much below the level of the mid-1980s. It is far from sure that India can regain its original dominance in the gum karaya market, since increasing amounts are exported by African countries. Senegal is the biggest African producer and exports annually around 1,000 t. Sudan exports only small amounts of gum karaya, although it has numerous *Sterculia* trees. Sudan therefore has the potential to become an important supplier in the future, if the same efforts are applied for gum karaya as for gum arabic.

Europe is the largest importer of gum karaya. The most important European importers are France and the United Kingdom, with an annual average of respectively 400 t and 210 t. Others are Germany, Italy, Belgium, and the Netherlands, with a joint total of around 130 t/year. Each year, 360 t of gum are imported into the United States and 110 t into Japan (FAO 1995). The price of Indian gum karaya varies between US$ 2,250/t and US$ 6,000/t, depending on the grade.

Gum tragacanth

Commercial gum tragacanth supplies are dominated by Iran, which is by far the world's largest producer. Fifty years ago, Iran exported annually more than 4,000 t, but in the 1970s and 1980s this amount greatly decreased, due to a number of reasons (Anderson and Grant 1988). There were serious doubts about the toxicological safety of the gum, which led to concerns about its use in the food industry. The war between Iran and Iraq resulted in gum scarcity and uncertainty of supply which, together with high prices, led to a loss of confidence on the market. Finally, the approval of cheaper xanthan gum for food use resulted in an importantly diminished market for gum tragacanth. Xanthan gum can replace gum tragacanth in many applications and has the advantages of constant quality, virtual sterility, and lower more stable prices (Weiping 2000). At present, the world market for gum tragacanth is estimated to be no more than 500 t/year, about 300 t of which is exported by Iran (FAO 1995). The price of ribbons is US$ 3,000–4,000/t for the lowest grade and up to US$ 22,000/t for the highest grade.

Properties and applications

Exudate gums are used in an overwhelming number of applications, mainly situated in the food area. However, there are also considerable non-food applications.

Gum arabic

Gum arabic readily dissolves in cold and hot water in concentrations up to 50%. Because of the compact, branched structure and therefore small hydrodynamic volume, gum arabic solutions are characterized by a low viscosity, allowing the use of high gum concentrations in various applications (Dziezak 1991). Solutions exhibit Newtonian behavior at concentrations up to 40% and become pseudoplastic at higher concentrations. The pH of the solutions is normally around 4.5–5.5, but maximal viscosity is found at pH 6.0.

Gum arabic has excellent emulsifying properties, particularly thanks to its AGP fraction. The hydrophobic polypeptide backbone strongly adsorbs at the oil–water interface, while the attached carbohydrate units stabilize the emulsion by steric and electrostatic repulsion. Fractionation studies show that, although emulsifying properties generally improve with increasing molecular weight and protein content, the best results are obtained with mixtures of different fractions (Ray et al. 1995). Seemingly, the heterogeneous nature of the gum makes it an excellent emulsifier. Buffo et al. (2001) found that stability of beverage emulsions is influenced by a number of processing factors, such as pasteurization and demineralization, and by the pH of the emulsion.

Table 6 Maximum usage levels (%) of gum arabic permitted in accordance with the FDA Code of federal regulations (title 21)

Food (as served)	Percentage	Function
Beverages and beverage bases	2.0	Emulsifier and emulsifier salt, flavoring agent/adjuvant, formulation aid, stabilizer/thickener
Chewing gum	5.6	Flavoring agent/adjuvant, humectant, surface-finishing agent
Confections and frostings	12.4	Formulation aid, stabilizer/thickener, surface-finishing agent
Dairy products analogues	1.3	Formulation aid, stabilizer/thickener
Fats and oils	1.5	Formulation aid, stabilizer/thickener
Gelatins, puddings, and fillings	2.5	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Hard candy and cough drops	46.5	Flavoring agent/adjuvant, formulation aid
Nuts and nut products	8.3	Formulation aid, surface-finishing agent
Quiescently frozen confectionery	6.0	Formulation aid, stabilizer/thickener
Snack foods	4.0	Emulsifier, emulsifier salt, formulation aid
Soft candy	85.0	Emulsifier, emulsifier salt, firming agent, flavoring agent/adjuvant, formulation aid, humectant, stabilizer/thickener, surface-finishing agent
Other food categories	1.0	Emulsifier, emulsifier salt, flavoring agent/adjuvant, formulation aid, stabilizer/thickener, surface-finishing agent, texturizer

Food applications

The use of gum arabic in foods has to be in accordance with the FDA Code of federal regulations (title 21, section 184.1330; Table 6). Gum arabic is mainly used in the confectionery industry, where it is incorporated in a wide range of products. It has a long tradition of use in wine gums, where it produces a clarity that is higher than can be obtained with other hydrocolloids (Williams and Phillips 2000). Furthermore, it prevents sucrose crystallization, provides a controlled flavor release, and slows down melting in the mouth, making the wine gum long-lasting (Imeson 1992). It also provides the appropriate texture to these candies, which are easily deformed in the mouth but do not adhere to the teeth. In lower-calorie candy, gum arabic is used to compensate for the loss of texture, mouthfeel, and body, resulting from the replacement of sugars by artificial sweeteners (Brucker et al. 1974). It is also used in chewing gum as a coating agent and as a pigment stabilizer (Cherukuri et al. 1983; Huzinec and Graff 1987). In aerated confectionery products, such as marshmallows, nougats, and meringues, gum arabic acts as a whipping and stabilizing agent. It is also used in toffees and caramels as an emulsifier, to maintain a uniform distribution of the fat across the product. In jelly products, it is used to provide a fibrous, fruit-like texture (Shigeo et al. 1989). Gum arabic glazes are used as coatings for nuts, dragees, and others.

Gum arabic is widely used as an emulsifier in the manufacture of soft drinks. Due to its stability in acid conditions and its high solubility, gum arabic is well suited for use in citrus and cola flavor oil emulsions (Sunkist Growers. 1958). High levels of gum are used to ensure a complete coverage of the interface and to prevent flocculation and coalescence of oil droplets. Normally, a weighting agent is added to increase the oil-phase density, inhibiting destabilization due to creaming. Gum arabic can also form a stable cloud in the drink, imitating the effect of added fruit pulps and juices (Eng and Mackenzie 1984). In beer, it is used as a foaming agent and to assist lacing (Tiss et al. 2001). Gum arabic is used increasingly as a source of soluble fiber in low-calorie and dietetic beverages (Phillips 1998). In powdered beverage mixes, gum arabic is added to produce the same opacity, appearance, mouthfeel, and palatability as natural fruit juices (Common and Manor 1962). In microencapsulation, liquid, solid or gaseous substances are coated with a protective layer to prevent chemical deterioration and the loss of volatile compounds. It is a useful technique to convert liquid food flavors to flowable powders that can be used in dry food products (McNamee et al. 1998). Gum arabic is an effective encapsulation agent because of its high water solubility, low viscosity, and emulsification properties and is used in soups and dessert mixes. Gum arabic is also used to prevent gelation in canned gravy-based pet foods, as it inhibits the extraction of proteins from the meat into the gravy (Glicksman and Farkas 1975).

Non-food applications

Gum arabic was once extensively used in the pharmaceutical industry, but is now replaced by celluloses and modified starches in many applications. It is still used as a suspending agent, emulsifier, adhesive, and binder in tabletting and in demulcent syrups (Ferdinand and Krüger 1986; Millard and Balmert 1961; Tame-Said 1997). In cosmetics, gum arabic functions as a stabilizer in lotions and protective creams, where it increases viscosity, imparts spreading properties, and provides a protective coating and a smooth feel. It is used as an adhesive agent in blusher and as a foam stabilizer in liquid soaps (Whistler 1993).

Gum arabic is also used in the preparation of etching and plating solutions in the lithography industry (FAO 1995). It is used as a dispersant in paints and insecticidal/acaricidal emulsions, respectively keeping the pigments and active components uniformly distributed throughout the product (Fuyama and Tsuji 1981; Gamble and Grady 1938; Henson and Westveer 1956). In the textile industry, it is used as a thickening agent in printing pastes for the coloration of knitted cellulose fabrics (Kraus and Jeths 1966). Other applications are ink and pigment manufacture, ceramics, and polishes.

Gum karaya

Gum karaya is one of the least soluble of the exudate gums. When dispersed in water, the gum particles do not dissolve but adsorb water and swell extensively to more than 60 times the original volume, producing a viscous colloidal sol. The swelling behavior of gum karaya is caused by the presence of acetyl groups in its structure (Le Cerf et al. 1990). Chemical deacetylation through an alkali treatment results in a water-soluble gum. Coarse gum particles give a grainy dispersion, whereas finely powdered gum hydrates more rapidly and gives a homogeneous dispersion.

The viscosity of gum karaya dispersions depends on the grade but normally ranges from 0.12–0.40 Pa s for 0.5% dispersions to 10 Pa s for 3% dispersions (Weiping 2000). Storage of dry gum results in a loss of viscosity, which is more pronounced for powdered than crude gum. Viscosities are higher when the gum is dispersed in cold water than in hot water (Dziezak 1991). Boiling of the dispersion results in a permanently reduced viscosity, but heating increases the solubility and allows the preparation of dispersions up to 18%, compared to 4–5% in cold water. A decrease in viscosity is also observed following the addition of strong electrolytes and acid or alkali, but this decrease is smaller when the gum is hydrated prior to pH adjustment (Whistler 1993). Indian gum karaya gives a lower pH when dispersed in water than African gum, respectively pH 4.4–4.7 and pH 4.7–5.2, as a result of its higher acid content (Imeson 1992). Above pH 8, deacetylation occurs, resulting in an increase in viscosity and degree of ropiness. Because of the high uronic acid content, gum karaya resists hydrolysis in 10% hydrochloric acid solution at room temperature for at least 8 h.

Food applications

The use of gum karaya in foods has to be in accordance with the FDA Code of federal regulations (title 21, section 184.1349; Table 7). Due to its acid stability, high viscosity, and suspension properties, gum karaya is well suited for stabilizing low pH emulsions, such as sauces and dressings (Partyka 1963). Gum levels of 0.6–1.0% are used to obtain the desired texture, color, and suspension, but during processing care must be taken regarding the heat- and shear-sensitivity of the gum. In French dressings, gum karaya functions as a stabilizer, increasing the viscosity of the aqueous phase of the oil-in-water emulsion (Dziezak 1991). In cheese spreads, gum karaya is used as a binder to provide texture and spreadability and to prevent water separation. In salads, the gum acts as a stabilizer and prevents the weeping of the water from the oil-in-water emulsion (Beach 1969). It is also incorporated in aerated dairy desserts and whipped cream, where it acts as a foam stabilizer. Gum karaya significantly reduces the bioavailability of calcium in milk-based foods, as demonstrated by Kelly and Potter (1990). In frozen desserts, such as sorbet, sherbet, and ice lollies, gum karaya is used in concentrations typically varying between 0.2% and 0.4% (Weiping 2000). It controls the formation of ice crystals, preventing them from growing too large, prevents the migration of free water, and reduces the suck-out of color and flavor during consumption. It is also found in ice cream, together with locust bean gum.

In sausages, gum karaya is used in concentrations ranging from 0.75% to 3% and performs several functions (Allen and McCaleb 1938). It acts as an adhesive between meat particles and as a water-binder during preparation and storage. During smoking and cooking, the gum seals the pores of the casings, reducing the loss of volatile flavoring components. It also provides the appropriate sensorial characteristics to the product, such as a smooth texture, mouthfeel, body, and appearance. In bakery products, gum karaya is mainly used to reduce the effect of variations in water addition and mixing time. Due to its water-binding capacity, it also slows down aging, extending the shelf-life of baked goods.

Non-food applications

Most gum karaya is consumed in the pharmaceutical industry, where it is used in diverse applications. It functions as an adhesive in leakproof sealing rings for post-surgical drainage pouches or ostomy bags (Carpenter 1979; Marsan 1967; Sanderson 1996). Coarse gum particles are very effective as bulk laxative as they absorb water and swell to 60–100 times their original volume. They are neither digested nor absorbed in the human ingestion channel. Powdered gum karaya is widely applied on dental plates as an adhesive (Steinhardt and Goldwater 1962). When brought in contact with the moist surfaces of the mouth, the gum does not dissolve but swells and provides a more comfortable and tighter fit of the plate. Furthermore, it is very resistant to bacterial and

Table 7 Maximum usage levels (%) of gum karaya permitted in accordance with the FDA Code of federal regulations (title 21)

Food (as served)	Percentage	Function
Frozen dairy desserts and mixes	0.3	Formulation aid, stabilizer/thickener
Milk products	0.02	Stabilizer/thickener
Soft candy	0.9	Emulsifier, emulsifier salt, stabilizer/thickener
Other food categories	0.002	Formulation aid, stabilizer/thickener

enzymatic degradation. In tampons, gum coatings form a gelatinous medium in contact with body fluids, preventing irritation of the mucous membranes and facilitating removal after use (Boiteau and Blondeel 1981). Deacetylated gum karaya is used as a binding agent in the production of long-fiber, lightweight papers (Whistler 1993). It effectively prevents the fibers from forming flocks and keeps them homogeneously distributed, resulting in a lightweight sheet of improved formation and strength. The gum is deacetylated in order to expose more active carboxyl and hydroxyl groups and improve the association with the cellulose fibers. For textile applications, the solubility of gum karaya is increased by cooking an aqueous dispersion under pressure. It is then used as a thickening agent for the dye in direct color-printing on cotton fabrics.

Gum tragacanth

When solubilized in water, gum tragacanth forms viscous solutions, even at low concentrations. Depending on the grade, the viscosity of 1% solutions may range from 0.1 Pa s up to 3.5 Pa s (Weiping 2000). Higher viscosities are obtained with ribbon types than with flake types. When shear is increased, the viscosity of the solution decreases, indicating pseudoplastic behavior. This decrease is reversible and the viscosity regains its original level as shear is reduced. Gum tragacanth is one of the most acid-resistant gums. The pH of a 1% solution varies between 5 and 6, but the viscosity remains quite stable over a broad range (pH 2–10). Because of this high acid stability, which is more pronounced for flake types, the gum is widely used in acidic conditions. Gum tragacanth is also an excellent emulsifying agent for oil-in-water emulsions (Gentry et al. 1990). It is very effective in lowering the interfacial tension, even at low concentrations, and simultaneously acts as a thickener of the continuous phase of the emulsion, preventing flocculation and coalescence of the dispersed oil droplets.

Food applications

The use of gum tragacanth in foods has to be in accordance with the FDA Code of federal regulations (title 21, section 184.1351; Table 8). Gum tragacanth is used in the preparation of low-viscosity, pourable dressings and sauces. Because of its high acid stability, the gum is well suited for use in these low pH products. It lowers the interfacial tension due to its surface active properties and acts as a thickener in the continuous water phase, thus stabilizing the emulsion and providing long shelf-life. Typical usage levels are at 0.4–0.8%, depending on the oil content (Imeson 1992). In low-calorie, oil-free dressings, gum tragacanth is used to imitate the creamy mouthfeel and body of dispersed oil droplets. In fish and citrus oil emulsions with a long shelf-life, gum tragacanth is used in combination with gum arabic. The interaction between the two gums reduces viscosity, allowing the production of thin, pourable, smooth emulsions. Gum tragacanth is used in ice cream to provide texture to the product (Weiping 2000). It also prevents texture changes during storage due to the formation of ice crystals. In water ices, sorbets, and ice pops, the gum prevents the migration of flavor and color components during storage and consumption. It is also used in milkshakes as a viscosity control agent, providing texture and stabilizing incorporated air (Smith 1968).

Gum tragacanth is used in bakery fruit-based toppings and fillings to give a shiny, clear appearance and a creamy texture (Dziezak 1991). In chewy sweets, such as lozenges, it acts as a thickener and provides texture. The gum is used in fruit tablets, gum drops, and pastilles as a binding agent during compression. It also provides body and mouthfeel and ensures good flavor-release during consumption. In icings, gum tragacanth is used as a water-binder, maintaining pliability and preventing cracks and breaks. It also provides consistency, smooth texture, and creamy taste to the product.

Non-food applications

Gum tragacanth is widely used in the pharmaceutical industry. It is an effective suspending agent and prevents insoluble materials, which are usually the active ingredients, from settling-out in aqueous mixtures. Oil-soluble active components are solubilized in the dispersed oil phase of oil-in-water emulsions. By stabilizing the emulsion and keeping the oil droplets uniformly distributed throughout the product, the gum facilitates the absorption of the water-insoluble components, thus improving the action of the pharmaceutical (Whistler 1993). Gum tragacanth is used as a stabilizer in dermatological creams and lotions, also contributing a protec-

Table 8 Maximum usage levels (%) of gum tragacanth permitted in accordance with the FDA Code of federal regulations (title 21)

Food (as served)	Percentage	Function
Baked goods and baking mixes	0.2	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Condiments and relishes	0.7	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Fats and oils	1.3	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Gravies and sauces	0.8	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Meat products	0.2	Formulation aid, stabilizer/thickener
Processed fruits and fruit juices	0.2	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener
Other food categories	0.1	Emulsifier, emulsifier salt, formulation aid, stabilizer/thickener

Table 9 A selection of patents dealing with the application of exudate gums

Application domain	Product	Patent number	Year
Food	Emulsions	US 2,021,027	1935
		GB 802,538	1959
	Dry beverage mixes	US 3,023,106	1962
		US 3,395,021	1968
		US 5,609,897	1997
	Ready-to-drink beverages	US 4,479,971	1984
	Milkshakes	US 3,385,714	1968
	Salads	US 3,454,405	1969
	Dressings	GB 936,531	1963
	Cream cheese spreads	GB 1,088,195	1967
	Candy	US 3,800,045	1974
	Chewing gum	US 4,371,549	1983
		US 4,681,766	1987
	Jellies	EP 334,466	1989
	Sausages	GB 483,925	1938
Pet food	Canned meat-containing pet foods	US 3,881,031	1975
Biocides	Insecticidal and acaricidal emulsions	US 4,283,415	1981
Pharmaceuticals	Effervescent tablets	US 2,985,562	1961
		DE 3517916-A1	1986
	Denture adhesive	US 3,029,187	1962
	Colostomy seal	US 3,302,647	1967
		GB 2,017,501	1979
		US 4,252,120	1981
	Catamenial appliances	GB 471,388	1937
		GB 722,629	1955
		GB 2,075,846	1981
Cosmetics	Toothpaste	GB 746,550	1949
		WO 9,719,668	1997
	Lotions	GB 901,554	1962
		GB 1,049,063	1966
	Hair paint	FR 2,773,472-A1	1998
Paints	Thixotropic paint	US 2,135,936	1938
	Water-emulsion paints	US 2,758,103	1956
Ceramics	Glaze mixes	GB 977,838	1964
Textiles	Coloration process	GB 1,024,224	1966

tive coating and smooth handfeel (Leupold et al. 1962; Smith and Wands 1966). Combined with glycerin, it acts as a binding agent in the production of tablets (Weiping 2000). It is used as a basis for jelly lubricants and as a suspending agent in jellies and toothpastes, providing spreadability and a shiny, creamy appearance (Grossmith 1956; Nebergall 1956). In the glazing process of ceramic materials, the gum is used to produce glazes of increased hardness and resistance to handling (Lloyd and Read 1964). Furthermore, gum tragacanth is used as a dispersing agent in paint, as a stabilizer in insecticides and polishes, and in textile printing paste (Gamble and Grady 1938; Kraus and Jeths 1966).

Patents

Exudate gums appear in a large number of patents, covering a wide range of applications in food, pharmaceutical, cosmetic, paper, textile, and other industries. Gum arabic is by far the most cited gum, which corresponds with its much larger market, compared with gum karaya and gum tragacanth. It is also remarkable that the amount of published patents strongly decreased in the early 1970s, coinciding with the collapse of the gum arabic market, and recovered in the 1990s. A limited selection of relevant patents is listed in Table 9.

Outlook and perspectives

Security of supply and stable prices are major concerns of the end-users of exudate gums. Since the 1970s, the market has been characterized by important fluctuations in both supply and price, causing a major loss of confidence. Manufacturers who switched to alternatives during periods of shortage did not necessarily switch back to exudate gums when production was increased and supply problems eased. Over the years, substitutes have been developed which are more cost-effective and offer security of supply, such as modified starches and synthetic polysaccharides derived from fermentation or by direct enzyme action. However, many alternatives have proved to be poor substitutes in a variety of applications, for example gum arabic in soft drinks (Menzies et al. 1996). Exudate gums possess a unique combination of functionalities which is so far not found in any alternative and which makes their complete substitution impossible. Furthermore, the increasing demand for natural ingredients by health-conscious consumers and for higher-quality products offers the exudate gums a considerable advantage in the competition with starches and other gums. Product development can offer new opportunities, such as the increasing use of gum arabic as a source of soluble fiber in low-calorie and dietetic beverages (Phillips 1998).

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Flow Chart of Manufacturing Process of Gum Tragacanth

Tapping of the stem elements of species of **Astragalus** with special blades in regions of Asia Minor

↓

Hand picking of the dried gum exudate and transporting the gum to sorting center

↓

Sorting and grading of the gum at the sorting center

↓

Shipment of the sorted gum to manufacturing facility in Europe

↓

Sampling and quality evaluation of the material to ensure compliance with specifications

↓

Milling and sieving of the material in the processing plant

↓

Sampling and quality evaluation of the processed material to ensure compliance with specifications

↓

Shipment of the material to the U.S. for storage and shipment to customers

↓

Shipment to customers

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Flow Chart of Manufacturing Process of Gum Arabic (Acacia)

1. Tapping of the barks and branches of Acacia Senegal or of related species in Africa to accelerate exudation of gum Acacia
2. Hand picking of the dried gum exudate and transporting the gum to sorting center
3. Sorting and grading of the gum at the sorting center
4. Shipment of the sorted gum to manufacturing facility in Europe
5. Sampling and quality evaluation of the material to ensure compliance with specifications
6. Milling and sieving of the material in the processing plant
7. Sampling and quality evaluation of the processed material to assure compliance with specifications
8. Shipment of the material to the U.S. for storage and shipment to customers
9. Shipment to customers

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[Code of Federal Regulations]
[Title 21, Volume 3]
[Revised as of April 1, 2005]
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[Page 527-528]

TITLE 21--FOOD AND DRUGS

CHAPTER I--FOOD AND DRUG ADMINISTRATION, DEPARTMENT OF HEALTH AND HUMAN SERVICES (CONTINUED)

PART 184_DIRECT FOOD SUBSTANCES AFFIRMED AS GENERALLY RECOGNIZED AS SAFE--Table of Contents

Subpart B_Listing of Specific Substances Affirmed as GRAS

Sec. 184.1351 Gum tragacanth.

(a) Gum tragacanth is the exudate from one of several species of Astragalus gummifier Labillardiere, a shrub that grows wild in mountainous regions of the Middle East.

(b) The ingredient meets the specifications of the ``Food Chemicals Codex,'' 3d Ed. (1981), p. 337, which is incorporated by reference. Copies may be obtained from the National Academy Press, 2101 Constitution Ave. NW., Washington, DC 20418, or may be examined at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: http://www.archives.gov/federal--register/code--of--federal--regulations/ibr--locations.html.

(c) The ingredient is used in food under the following conditions:

Maximum Usage Levels Permitted

Food (as served)	Percent	Function
Baked goods and baking mixes, Sec. 170.3(n)(1) of this chapter.	0.2	Emulsifier and emulsifier salt, Sec. 170.3(o)(8) of this chapter; formulation aid, Sec. 170.3(o)(14) of this chapter; stabilizer and thickener, Sec. 170.3(o)(28) of this chapter.
Condiments and relishes, Sec. 170.3(n)(8) of this chapter.	.7	Do.
Fats and oils, Sec. 170.3(n)(12) of this chapter.	1.3	Do.
Gravies and sauces, Sec. 170.3(n)(24) of this chapter.	.8	Do.
Meat products, Sec. 170.3(n)(29) of this chapter.	.2	Formulation aid, Sec. 170.3(o)(14) of this chapter; stabilizer and

		thickener, Sec. 170.3(o)(28) of this chapter.
Processed fruits and fruit juices, Sec. 170.3(n)(35) of this chapter.	.2	Emulsifier and emulsifier salt, Sec. 170.3(o)(8) of this chapter; formulation aid, Sec. 170.3(o)(14) of this chapter; stabilizer and thickener, Sec. 170.3(o)(28) of this chapter.

All other food categories....	.1	Do.

(d) [Reserved]

(e) Prior sanctions for this ingredient different from the uses established in this section do not exist or have been waived.

[42 FR 14653, Mar. 15, 1977, as amended at 42 FR 55205, Oct. 14, 1977; 49 FR 5612, Feb. 14, 1984]

U.S. Environmental Protection Agency
Substance Registry System

Gum tragacanth

EPA Source Name: ChemIDStd
Systematic Name: Gum tragacanth
Systematic Source Name: CAS-9CI
CAS Number: 9000-65-1
Classification: Chemical
Molecular Formula: Unspecified

Other Numbers

This section provides other identifiers associated with this substance, including former CAS numbers, incorrectly used CAS numbers, and retired EPA Identifiers.

37319-02-1 (CAS Registry **Former CAS Number**) 88026-05-5 (CAS Registry **Former CAS Number**)

SMILES Notation

None

Synonyms

Name
Gum tragacanth

Regulatory Resources

This section provides a list of regulations applicable to this chemical and other regulatory information such as chemical name listed in the regulation, name status, comments, regulation acronym, the regulation identifier, reason for the regulation, effective date, and withdrawn date.

Acronym Name Status Alternate ID Reason for Regulation Effective Date End Date Comment
TSCA Inv Gum tragacanth Chemical in Commerce Exempt from reporting under the Inventory Update Rule.
FIFRA-Inerts Gum tragacanth List 3

Other Sources

This section provides a list of other sources of synonyms that contain data about this chemical substance, including literature references and databases.

Acronym Name Status Alternate ID Comment
CAS-9CI Gum tragacanth Systematic
ChemIDStd Gum tragacanth EPA Registry

Group/Component

None

Related Links

The following list includes links related to the selected metadata item. A link may lead to resources within the SRS, to another site within EPA, or go to a site outside EPA. A link may be another Web site or a document. For additional information on links to external Web sites, see SoR Disclaimer. Additional information about the source of the Related Links can be found by clicking on the acronym or by selecting Help from the left-hand menu.

None

TRAGACANTH GUM

Prepared at the 29th JECFA (1985), published in FNP 34 (1986) and in FNP 52 (1992). Metals and arsenic specifications revised at the 57th JECFA (2001). An ADI 'not specified' was established at the 29th JECFA (1985)

SYNONYMS INS No. 413

DEFINITION A dried exudation obtained from the stems and branches of *Astragalus gummifer* Labillardiere and other Asiatic species of *Astragalus* (Fam. *Leguminosae*); consists mainly of high molecular-weight polysaccharides (galactoarabans and acidic polysaccharides) which, on hydrolysis, yield galacturonic acid, galactose, arabinose, xylose and fucose; small amounts of rhamnose and of glucose (derived from traces of starch and/or cellulose) may also be present.

C.A.S. number 9000-65-1

DESCRIPTION The unground gum occurs as flattened, lamellated, straight or curved fragments or as spirally twisted pieces 0.5 - 2.5 mm thick and up to 3 cm in length; white to pale yellow, but some pieces may have a red tinge; the pieces are horny in texture, with a short fracture; odourless. The powdered gum is white to pale yellow or pinkish brown (pale tan).
Items of commerce may contain extraneous materials such as pieces of bark which must be removed before use in food.
Unground samples should be powdered to pass a No. 45 sieve (355 M) and mixed well before performing any one of the following tests.

FUNCTIONAL USES Emulsifier, stabilizer, thickening agent

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4) 1 g of the sample in 50 ml of water swells to form a smooth, stiff, opalescent mucilage; insoluble in ethanol and does not swell in 60% (w/v) aqueous ethanol.

Microscopy Examine microscopically a suspension of the sample in water. Numerous angular fragments with circular or irregular lamellae, starch grains up to 15 µm in diameter, and stratified cellular membranes, which turn violet in colour on the addition of iodinated zinc chloride solution, are visible.

Precipitate formation The samples gives a precipitation reaction with a saturated aqueous solution of copper (II) acetate.

Gum constituents Identify arabinose, xylose, fucose, galactose and galacturonic acid as follows: Proceed as directed under *Gum Constituents Identification* using the following reference standards: arabinose, mannose, galactose, xylose, fucose, galacturonic acid and glucuronic acid. Arabinose, xylose, fucose, galactose and galacturonic acid should be present; mannose and glucuronic acid should be absent.

PURITY

Loss on drying (Vol. 4) Not more than 16% (105°, 5 h)

Sulfated ash (Vol. 4) Not more than 4%

Acid insoluble ash Not more than 0.5%
Boil the ash obtained as directed under Sulfated ash above, with 25 ml of 3 M hydrochloric acid for 5 min., collect the insoluble matter on a tared crucible or ashless filter paper, wash with hot water, ignite, and weigh. Calculate the percentage of Acid-insoluble ash from the weight of the sample.

Acid insoluble matter Not more than 2%
In a 250 ml round-bottomed flask, place 2.0 g of tragacanth and add 95 ml of methanol. Moisten the powder by swirling and add 80 ml of hydrochloric acid. Add a few glass beads of about 4 mm in diameter and heat under reflux in a water-bath for 3 h. shaking occasionally. Eliminate the glass beads and filter by suction the suspension while hot through a previously tared sintered-glass filter. Rinse the flask with a small quantity of water and pass the rinsings through the filter. Wash the residue on the filter with about 40 ml of methanol and dry at 110° to constant weight. Allow to cool in a desiccator and weigh. Calculate as percentage.

Acacia and other soluble gums To 20 ml of a 0.25% (w/v) suspension of the sample in freshly boiled and cooled water add 10 ml of lead (II) acetate solution. A flocculent precipitate is produced. Filter, and to the filtrate add 10 ml of lead sub-acetate solution. The solution may become slightly cloudy but no precipitate is formed.

Agar To 4 ml of a dispersion [0.5% w/v] of the sample in water, add 0.5 ml of hydrochloric acid and heat on a boiling water bath for 30 min. Add a few drops of barium chloride solution [3.65%, w/v]. No precipitate is formed.

Dextrin Mount the sample in aqueous glycerol and examine under the microscope. The addition of 1% aqueous iodine solution does not reveal yellow-brown or purplish-red particles.

Karaya gum (a) Boil 1 g of the sample with 20 ml of water until a mucilage is formed. Add 5 ml of hydrochloric acid and again boil for 5 min. No permanent pink or red colour develops.

(b) Shake 0.2 g with 10 ml of ethanol (60%) in a 10 ml stoppered cylinder, graduated in 0.1 ml intervals. Any gel formed occupies not more than 1.5 ml.

(c) Shake 1.0 g with 99 ml of water. Titrate the mucilage so formed with 0.01 M sodium hydroxide, using methyl red solution as indicator. Not more than 5.0 ml of 0.01 M sodium hydroxide is required to change the colour of the solution.

Microbiological criteria *Salmonella* spp.: Negative in 1 g

(Vol. 4)	*E. coli*: Negative in 1 g
Lead (Vol. 4)	Not more than 2 mg/kg Determine using an atomic absorption technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the method described in Volume 4, "Instrumental Methods."

Material Safety Data Sheet
Tragacanth gum

ACC# 96792

Section 1 - Chemical Product and Company Identification

MSDS Name: Tragacanth gum
Catalog Numbers: AC421380000, AC421385000
Synonyms:
Company Identification:
Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
9000-65-1	Tragacanth gum	100	232-552-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: white to yellow crystalline powder.
Caution! Causes eye and skin irritation. May cause respiratory and digestive tract irritation. Ingestion may result in an allergic reaction.
Target Organs: None.

Potential Health Effects
Eye: Causes eye irritation.
Skin: Causes skin irritation.
Ingestion: Ingestion of large amounts may cause gastrointestinal irritation. May cause allergic reaction.
Inhalation: May cause respiratory tract irritation.
Chronic: Not available.

Section 4 - First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid if irritation or symptoms occur.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid if cough or other symptoms appear.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use agent most appropriate to extinguish fire. Use water spray, dry chemical, carbon dioxide, or appropriate foam.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: ; Flammability: ; Instability:

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up or absorb material, then place into a suitable clean, dry, closed container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Avoid contact with eyes, skin, and clothing. Avoid ingestion and inhalation.

Storage: Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances.•

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Tragacanth gum	none listed	none listed	none listed

OSHA Vacated PELs: Tragacanth gum: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Crystalline powder
Appearance: white to yellow
Odor: odorless
pH: Not available.
Vapor Pressure: Negligible.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point: Not available.
Decomposition Temperature: Not available.
Solubility: Not available.
Specific Gravity/Density: Not available.
Molecular Formula: Not available.
Molecular Weight: Not available.

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, strong oxidants.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, oxides of nitrogen, irritating and toxic fumes and gases, carbon dioxide.
Hazardous Polymerization: Will not occur.

Section 11 - Toxicological Information

RTECS#:
CAS# 9000-65-1: XW7750000
LD50/LC50:
CAS# 9000-65-1:
- Draize test, rabbit, eye: 610 ug Mild;
- Draize test, rabbit, skin: 3050 ug/24H Mild;
- Oral, mouse: LD50 = 10 gm/kg;
- Oral, rabbit: LD50 = 7200 mg/kg;
- Oral, rat: LD50 = 10200 mg/kg;

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Carcinogenicity:
CAS# 9000-65-1: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No data available.
Teratogenicity: No data available.
Reproductive Effects: No data available.
Mutagenicity: No data available.
Neurotoxicity: No data available.
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 9000-65-1 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
None of the chemicals in this material have an RQ.
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
Section 313 No chemicals are reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE

CAS# 9000-65-1 can be found on the following state right to know lists: New Jersey.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

Not available.

Risk Phrases:

Safety Phrases:

S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)

CAS# 9000-65-1: No information available.

Canada - DSL/NDSL

CAS# 9000-65-1 is listed on Canada's DSL List.

Canada - WHMIS

not available.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 9000-65-1 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 6/02/1998
Revision #5 Date: 3/16/2007

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Pooler, Bob

From: Frances, Valerie
Sent: Thursday, October 11, 2007 8:39 AM
To: Pooler, Bob
Subject: Tragacanth gum Petition / 606
Attachments: ATTACHMENT.TXT; letter from TIC.doc; Letter from Gumix.pdf

This came in via this email address

Valerie

From: cecilia@wizardscauldron.com [mailto:cecilia@wizardscauldron.com]
Sent: Thursday, September 20, 2007 12:08 PM
To: NOSB Processing
Subject: Tragacanth Petition

Dear Mr. Pooler:

I apologize that letters from our vendors stating that tragacanth is not commercially available in organic form were not submitted with the petition we sent to you on August 31st.

Please attach these 2 letters to our petition for tragacanth.

Thank you for your assistance with this,

Cecilia Redding
Wizard's Cauldron Inc.
878 Firetower Road
Yanceyville, NC 27379
336-694-5665 ext 16 office
919-522-2285 mobile
cecilia@wizardscauldron.com

TIC GUMS
We're your Gum Guru
4609 Richlynn Drive, Belcamp, MD 21017 USA
(800) 899-3953 • (410) 273-7300
Fax (410) 273-6469 • www.ticgums.com

September 11, 2007

The Wizard's Cauldron
878 Firetower Road
Yanceyville, NC 27379

Attention: Sean Kearney

Thank you for your request that we supply The Wizard's Cauldron with a certified organic form of gum Tragacanth to be used in the production of organic table condiment products.

At this time TIC Gums, Inc. does not produce or supply Tragacanth organically and does not know of any sources of this ingredient in an organic form.

Thank you for your continued interest in TIC Gums, Inc. products.

Sincerely,

Janet Jacoby
Chief Compliance Officer

Gumix International, Inc.
2160 North Central Road
Fort Lee, New Jersey 07024-7552 USA

Phone: (201) 947-6300
Fax: (201) 947-9265

August 31, 2007

The Wizard's Cauldron
878 Firetower Road
Yanceyville, NC 27379

Attention: Sean Kearney

Thank you for your request that we supply The Wizard's Cauldron with a certified organic form of gum Tragacanth to be used in the production of organic table condiment products.

At this time Gumix International does not produce or supply Tragacanth organically and does not know of any sources of this ingredient in an organic form.

01 We can supply The Wizard's Cauldron with gum Tragacanth in a non-organic form.

02 We do confirm and guarantee that the gum Tragacanth that Gumix International would provide to The Wizard's Cauldron is not a product or by-product of genetic engineering, has not been produced with the use of sewage sludge, and has not been irradiated.

Thank you for your continued interest in Gumix International's product.

Sincerely,

Susan Day
Sales Vice President