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A REVIEW OF RECENT TRENDS IN SELECTED MARKETS FOR WATER-SOLUBLE GUMS

S. R. J. ROBBINS

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NOTE

The following conventions are observed in all tables:

– nil or negligible

... not available

Any apparent minor errors in the totals or 'Other countries' categories are due to rounding.

In a number of cases it will be found that export figures and corresponding import figures do not equate. Such discrepancies may be due to time lags in recording or to differences in commodity definitions, or in methods of recording re-exports, where relevant, but they may also be due on occasion to deficiencies in the recording systems operating in some countries.

Summaries

SUMMARY

A review of recent trends in selected markets for water-soluble gums

1 Water-soluble gums, which are derived from plants, are hydrophilic carbohydrate polymers of high molecular weight, which dissolve or disperse in water to give solutions or colloidal suspensions of varying degrees of viscosity. Although there are several distinct categories of water-soluble gum, this report focuses on two categories: **exudate gums**, obtained from incisions on the surface of the plant, and **seed gums**, obtained by extraction from the endosperm of a bean. They are used variously as thickeners, emulsifiers, stabilisers, suspension agents, binding or coating agents, in both food and non-food applications. Many are produced in developing countries and some provide a source of income for very poor farmers or smallholders.

2 Many water-soluble gums have been periodically in short supply, their prices have varied to a degree unacceptable to many users, and in some cases doubts have arisen as to their inherent suitability for human consumption, both on account of alleged harmful characteristics *per se* and on account of the high bacterial loading of many consignments, which in turn necessitates forms of cleaning treatment which are themselves open to question on health grounds. For these reasons world demand for the water-soluble gums has in many cases decreased before the advance of synthetics which are either starch-based, cellulose-based or the product of fermentation technology. Nevertheless the water-soluble gums are in some cases still widely regarded as technically superior to their synthetic counterparts, although the gap is narrowing steadily.

3 There exist numerous trade associations which through programmes of research and concerted action seek to defend the long-term future of water-soluble gums by attention to various problems causing concern to buyers. In particular, the International Natural Gums Association for Research (INGAR) has vigorously championed the cause of water-soluble gums and provided valuable advice to the various participants in the trade.

4 **Gum arabic** is an exudate gum marketed in two main forms: 'hashab' or 'Kordofan' gum produced from the tree *Acacia senegal* (syn. *verek*) and certain other, closely-comparable but much less common, *Acacia* species; and 'talha' gum, produced mainly from the tree *Acacia seyal*. The former is used for higher-grade applications including food products, the latter only for the least demanding applications. The gum's principal property is its combination of high solubility in water and low viscosity even in high concentrations, this imparting to the gum its well-known stabilising and emulsifying action in combination with water-insoluble materials. It is widely used in so-called 'gum confectionery' and as a binder, stabiliser or coating in other types of confectionery and bakery preparations. It is also used in soft drinks as a suspension, stabilising or clouding agent. Other applications include prepared flavouring products, such as micro-encapsulated citrus flavours; pharmaceuticals, especially as tablet coatings or binders; health foods; and a range of mainly non-food uses, including lithography, adhesives, textiles, paper-making (especially carbonless copying papers), and a few others.

5 Most gum arabic is exported from the countries of production. Prior to a serious shortage in late 1984 and 1985, world production and consumption was in the range 35,000-40,000 tonnes per annum, but in the wake of the shortage demand fell to 30,000 tonnes or below, while production recovered substantially and now (early 1987) exceeds demand. The main producer is **Sudan**, which prior to the shortage regularly accounted for close to 90% of world supplies. The balance of world production takes place almost entirely in **West Africa**, notably Nigeria, Mali and Senegal, other countries in the region producing and exporting the gum in small quantities and generally intermittently. Very small quantities of low-grade gum are produced on the Indian sub-continent. The most widely-recognised grading system is operated by Sudan.

6 Western and Northern Europe account for approximately 40% of world consumption of gum arabic. In addition, large quantities are temporarily imported into, and then re-exported

from, European ports. Confectionery is the main area of usage. The United States accounts for a further 25% of the world market, the main area of usage in this case being the soft drinks industry. In both regions consumption has fallen as a result of the shortages and consequent high prices, although the Japanese market, which accounts for around 7-8% of the world total, appears to have held up well in spite of the difficulties.

7. Although the sole Sudanese exporter, the Gum Arabic Company of Khartoum, has on the whole a good reputation among buyers for its pricing and policies and its trading integrity, the suddenness of the shortage which occurred at the end of 1984 caused widespread loss of confidence and extensive switching to synthetics. The high price ruling at the beginning of 1987, namely around $5 per kg, appeared to have been forced on the Gum Arabic Company by internal pressure, both from the central Government and from local traders who were aware of the high price at which gum arabic had been changing hands outside the country; there had been a marked increase in illicit cross-border trade as traders sought to take advantage of the high world prices by any means. However, the price rise came about too late, insofar as production had already begun to recover and pressure of demand to fall. At the end of 1984, the price had been barely in excess of $2 per kg, and although a modest price fall is expected during 1987, it is unlikely to be adequate to restore former demand levels. It is likely that a long-term price level of below $3 per kg will be necessary to staunch the move into synthetics, and a lower price still, probably $2 per kg, would be necessary before there would be any prospect of recovery of lost markets. For the foreseeable future supply of the gum is likely to exceed demand and there are no prospects for new producers.

8 **Guar gum** is a seed gum of the galactomannan type obtained from the endosperm of the plant *Cyamopsis tetragonolobus*, which grows best in a hot and dry climate. The gum bears a strong resemblance to locust bean gum (q.v.) but dissolves readily in cold water, whereas locust bean gum requires the application of heat before it will dissolve completely; guar gum is also much cheaper than locust bean gum, although technically somewhat inferior in some applications. Unlike gum arabic, guar gum gives high viscosity at low concentrations. It is traded either as the unground endosperm (known in the trade as 'splits') or as a powder, and is graded mainly according to its measured viscosity. It is often modified before use, especially in its largest application, namely the petroleum oil extraction industry, in which it is mainly used in the semi-secondary process known as hydraulic fracturing. It is used as a flocculant, or settling agent, in certain mining industries. In the food industry it is widely used as a thickening agent in sauces, ketchups and similar products, and as a texture improver in ice-cream, frozen foods, baby foods, pet foods, a range of canned foods, soft cheeses, pie and pudding fillings, instant mixes and a range of bakery products including certain types of bread. Other applications include textile and carpet printing, paper-making, water treatment, explosives, pharmaceutical products such as medicinal suspensions and tablets, cosmetics, slimming and diabetic products and one or two others. As a rough estimate, technical non-food applications account for 65% of consumption of guar gum, food applications 30% and pharmaceuticals and cosmetics 5%. In the main countries of production guar is widely used as a cattle-feed.

9 World production of guar beans is of the order of 1 million tonnes per annum, but only around one-third of this total is processed into gum, world demand for which is in the region of 100,000 tonnes per annum. Production of the gum is dominated by **India** and **Pakistan**, in that order, these two countries accounting for over 90% of world supplies. There has for some years been regular, but now declining, production of guar gum in the southern **United States**, mainly for use in oil extraction in the States of Texas and Oklahoma. Among the minor producers, central African producers such as Malawi and Zaire have been prominent, although production has been highly irregular. In recent years there has been a marked tendency for the gum to be in short supply, mainly on account of low producer prices which are, however, likely to be raised to obviate the shortfalls, albeit at the cost of some increase in the long-term price level. Bacterial contamination of consignments is a regular problem, although the gum is recognised as an inherently safe food additive, and as such can be used without restriction.

10 In the early-to-mid 1980s the United States imported an average of 45,000-50,000 tonnes of guar gum annually, suggesting that local consumption is currently in the range 50,000-55,000 tonnes per annum when the United States' local production of the gum is taken into account. Up to two-thirds of consumption is attributable to the oil industry, although at the peak of the oil boom, when consumption was considerably higher, the industry accounted for 85-90% of the total. United States imports of guar are dominated by three large multinational companies which undertake extensive processing and modification of the gum for the United States oil industry. In some cases these firms have processing plants in the producing countries. Of the balance of consumption, rather over one-half is attributable to the food industry, notably in the production of ice cream and cream cheese. The balance is used in carpet and textile manufacture, explosives, pharmaceuticals and one or two other applications. Western Europe is the second largest consuming region, taking some 20,000 tonnes per annum although gross imports are higher owing to the re-export trade from the main European ports. The North Sea oil industry absorbs substantial quantities, but the food sector is of considerably greater proportionate importance than in the United States market, with large quantities used in ice-cream, sauces of various types, canned foods, pet foods and baby foods, while in the Federal Republic of Germany (West Germany) the gum is extensively used in the locally-popular rye bread. The recession in the oil industry has substantially reduced demand for guar, although demand from the food sector remains firm.

11 The supply-demand balance in relation to guar gum to a large extent depends on the fortunes of the oil industry. Low oil prices in recent times have reduced the profitability of all but primary extraction, in consequence of which demand for guar gum in this sector is depressed. Moreover, various synthetics based on starches, cellulose and fermentation technology (for example, xanthan gum) have, for technical reasons, displaced guar gum to a certain extent in oil extraction applications. However, the shortages at source, in India in particular, have more than compensated for this decline in demand, as a result of which prices have risen, the most widely-used grades being quoted at around $1.50/kg in early 1987. It is, however, likely that adjustments to producer price levels will restore the balance and the only possible imbalance beyond the short term is a minor shortage of splits, as a result of attempts by the Asian producers to maximise their exports of powder. The gum is held in generally high esteem, and although it is technically inferior to locust bean gum (q.v.) in many key food applications, the very high price of the latter gum could bring about increased prospects for guar gum, consumption of which in the food sector is already extremely stable. Even so, the potential resources of the existing Asian producers are very great, and although there is clearly room for improvements in the cleanliness of consignments marketed by them, the prospects for new producers in the long term cannot be described as good.

12. **Gum tragacanth** is an exudate gum obtained from small shrubs of the *Astragalus* species. It takes two basic forms, namely ribbons, which give the highest-quality gum, and flakes, which yield a rather lower-quality gum; these two forms are obtained from different sub-species of shrub. The preferred climate for production of the gum consists of abundant rainfall prior to the tapping season and dry conditions during the harvesting season. The gum dissolves in cold water to give a solution of very high viscosity which is additionally highly resistant to strongly acid conditions, and the gum is therefore used primarily as a stabiliser and thickener in acid preparations such as salad creams and dressings and certain pharmaceutical emulsioms. It also has minor uses elsewhere in the food industry and in certain non-food applications.

13 World production of gum tragacanth is currently (early 1987) no more than 500 tonnes per annum, which is a small proportion of earlier production levels, world demand having been heavily choked off by consistently high prices. **Iran** is the main producer, accounting for some 300-350 tonnes per annum, **Turkey** producing virtually all of the balance. Iran sets the standard both for gum quality and for grading procedures, Turkish gum being more variable in both respects. Grading is carried out on the basis of both viscosity and appearance.

14 Western Europe is the main consuming region, taking 200-250 tonnes per annum net of re-exports from European ports. Consumption in the United States averaged around 175 tonnes per annum in the 1980s, and on a downward trend. Consumption in Japan during the same period averaged around 30 tonnes.

15 The fortunes of gum tragacanth, which were declining for many years, worsened sharply in the wake of the political upheavals in Iran during the late 1970s, when State influence brought about a sharp rise in the price of the gum. The role of the State diminished by the end of 1986 and prices fell back appreciably, but much irretrievable damage had been done and in particular the much cheaper microbiologically-derived xanthan gum had made further substantial inroads into gum tragacanth's traditional applications. The gum as traded often requires cleaning to reduce the bacterial loading, yet the only truly effective cleaning methods are widely banned or severely restricted on account of problems with toxic residues; they can also seriously reduce the gum's all-important viscosity levels. The gum's future has been further clouded by the commissioning of various studies on its intrinsic suitability for human consumption. The results of these toxicological studies should be known by 1988 and the gum's legal status for the future finally established by the end of that year; until then, the gum remains temporarily cleared for human consumption. Even in the event of the gum being cleared as a food additive, however, it is unlikely that the long-term market decline can be reversed, and there is no foreseeable need for entry to the market by a new producer.

16. **Gum karaya** is an exudate gum obtained from the tapping of the tree *Sterculia urens* and other trees of the genera *Sterculia* (family Sterculiaceae) and *Cochlospermum* (family Bixaceae). In water it forms thick suspensions and is a good emulsifying agent. It is resistant to acid conditions, although less so than gum tragacanth, to which it is in some respects rather similar. It is used to a large extent in the medical field, principally in colostomy bag fixatives, dental fixatives and bulk laxatives. It also has uses in food products such as ice-creams and certain iced beverages. Its use in other areas has sharply declined and even in its existing applications some decline is evident.

17 World production of gum karaya is currently in the region of 5,500 tonnes per annum, and is overwhelmingly dominated by **India**. Conservation measures in India aimed at the prevention of over-tapping of the trees have restricted the supply base and caused prices to rise, although not as disastrously as in the case of gum tragacanth. The production and marketing system has generally been primitive, but there has been recent evidence that the local industry is to be placed on a more organised footing. Production is also known to take place in Pakistan and Sudan, but neither country is a regular exporter. There are five main grades which are registered with the Indian Agmark organisation, and which are based mainly on the gum's viscosity.

18 The United States consumes roughly one-half of internationally-traded gum karaya, and Western Europe around 30%. There is a significant re-export trade from European ports. Consumption in the United States is roughly stable, whereas in Europe there is evidence of some decline. In both regions the pattern of usage is broadly similar, as described above in paragraph 16, although in West Germany the use of the gum in food products is banned.

19 The future prospects for gum karaya are at present uncertain. Its use in colostomy bag fixatives and dental fixatives is in perceptible decline as a result of the development of new technologies, while in food products it faces two challenges: firstly, the need to reduce the bacterial loading of traded consignments, and secondly, the possible impact of current studies on the toxicological characteristics of the gum. The cleanliness problems are compounded by the widespread bans or restrictions on the use of the most effective cleaning methods, which tend to leave harmful residues in the gum. As with gum tragacanth, the results of these toxicological studies should be known by 1988 and the gum's legal status for the future finally established by the end of that year; until then, the gum remains temporarily cleared for human consumption as a food additive. To some extent the prospects for the gum are also dependent on the current reorganisation of production and marketing in India; in the event of these changes resulting in a consistent improvement in product quality and in a stabilising of the price at an acceptable level, trade confidence will be much improved; and, subject to the findings of the toxicological studies, whilst a recovery of lost markets is unlikely in any event, it should then be possible for the gum to enjoy a stable, if modest, level of world demand in view of the generally high regard in which its technical attributes are held. There are, however, no prospects for a new producer.

20 **Locust bean gum** is not produced in developing countries and is included in this study only on account of its similarity to guar gum (q.v.). It is a galactomannan-type seed gum produced from the endosperm of the beans from the carob tree *Ceratonia siliqua*, which grows in abundance round the Mediterranean Sea. Like guar gum, locust bean gum gives high viscosity in solution at low concentrations, but unlike guar gum requires the application of heat for full solubility in water, although in certain uses this is an advantage. It is used mainly in the food industry, it being used as a texturiser in ice-cream, pet foods, canned pet foods and cream cheeses; as a thickener in instant soups; and to impart a range of desirable characteristics in various savoury, dessert and dairy products. Its non-food uses are of very minor importance.

21 Total world exports of locust bean gum are estimated to average a little over 12,000 tonnes per annum, of which over 80% is attributable to **Spain**, **Italy** and **Portugal** in that order, the balance being attributable to countries in **North-West Africa** and the **Eastern Mediterranean**. World production may be appreciably higher on account of consumption at source. The grading system is based on viscosity measurements. The main consuming countries or regions are Western Europe, the United States and Japan in that order, together accounting for around 75% of consumption of traded gum. A decline in the market for locust bean pods as a cattle feed in the producing countries, and consequently in income from the pods, combined with growing shortages of labour in this sector of the south-west European economies, has brought about heavy upward pressure on prices and a consequent reluctance on the part of users to use the gum in the same quantities, and in spite of its technical superiority over guar gum in certain applications, the cheaper gum has gained at its expense. At the time of writing (early 1987) there was no evidence of any easing in the locust bean gum market. While it can be said that there are no prospects for entry to this market by developing countries, in view of the very long time taken by carob trees to reach the required stage of maturity, it is possible that the guar gum producers could take further advantage of the market position.

22 With the notable exception of gum arabic, the export of which is dominated by the part-State-owned, part-privately-owned Gum Arabic Company of Khartoum, the water-soluble gums are marketed through the normal private commercial channels, and for most gums buyers have a fairly wide choice of exporters from which to choose. Some major end-users purchase direct from source, but many purchase their requirements from well-established gums traders, of which there are approximately 10-12 in Western Europe and North America. London, Hamburg, Paris and New York are the major centres; Rotterdam, Amsterdam and Antwerp are of relatively minor importance in the gums trade in comparison with other groups of commodities. The gums trade is highly competitive and in the mid-1980s there were far fewer active traders than existed in the early-to-mid-1970s, and a further contraction is possible in view of the increasing need for specialised cleaning and processing to customer order.

RÉSUMÉ

Etudes des tendances recentes sur certains marchés selectionnés pour les gommes solubles dans l'eau

1 Les gommes solubles dans l'eau, dont l'origine est végétale, sont des hydrates de carbone hydrophiles polymérisés de poids moléculaire élevé qui se dissolvent ou se dispersent dans l'eau pour donner des solutions ou des suspensions colloïdales de divers degrés de viscosité. Bien qu'il existe plusieurs catégories distinctes de gommes solubles dans l'eau, le présent rapport se concentre sur les deux catégories suivantes: gommes d'exsudats, obtenues à partir d'incisions pratiquées à la surface de la plante, et gommes de graines, obtenues par extraction de l'endosperme de la graine. Elles sont utilisées de diverses manières comme épaississants, émulsifiants, stabilisateurs, agents de suspension, agents adhésifs ou de recouvrement, dans des applications aussi bien alimentaires que non-alimentaires. Nombre d'entre elles sont produites dans des pays en voie de développement et certaines assurent une source de revenu aux agriculteurs ou petits exploitants très pauvres.

2 Beaucomp de gommes solubles dans l'eau ont connu des périodes de pénurie et leur prix ont augmenté dans des limites inacceptables pour de nombreux utilisateurs. Des doutes ont par ailleurs été exprimés quant à savoir si elles sont propres à la consommation humaine, tant en raison de leurs caractéristiques présumées nocives en soi, qu'en raison de la charge bactérienne élevée de nombreux envois, lesquels nécessitent à leur tour divers traitments de nettoyage eux-mêmes sujects à question pour des motifs sanitaires. Pour toutes ces raisons, la demande mondiale en gommes solubles dans l'eau a, dans de nombreux cas, reculé devant les progrès réalisés par des produits synthétiques qui sont soit à base d'amidon ou de cellulose, soit le produit d'une technologie de fermentation. Bien que l'écart avec ces derniers s'amenuise sans cesse, les gommes solubles dans l'eau sont encore, dans certain cas, largement considérees comme étant techniquement supérieures à leurs équivalents synthétiques.

3 Il existe à ce propos de nombreuses associations de commerce qui à l'aide de programmes de recherche et d'actions concertées, cherchent à défendre le futur à long terme des gommes solubles dans l'eau en prêtant une attention particulière aux divers problèmes qui préoccupent les acheteurs. C'est ainsi que l'Association internationale de recherche sur les gommes naturelles (International Natural Gums Association for research—INGAR) a défendu vigoureusement la cause des gommes solubles dans l'eau et a fourni des avis précieux aux diverses parties concernées par ce négoce.

4 *La gomme arabique* est une gomme d'exsudats commercialisée sous deux formes principales: la gomme 'Hashab' ou 'Kordofan', produite par l'*Acacia senegal* (syn. *verek*) et certaines autres espèces d'*Acacia* très similaires mais beaucoup moins communes; et la gomme 'talha', produite principalement par l'*Acacia seyal*. La première est destinée à des applications de grade supérieur, notamment dans des produits alimentaires, tandis que la seconde sert à des applications moins exigeantes. La principale propriété de cette gomme réside dans la combinaison d'une haute solubilité dans l'eau et d'une faible viscosité, même dans de fortes concentrations, ce qui lui confère son pouvoir reconnu de stabilisateur et d'émulsifiant en conjonction avec des matériaux insolubles dans l'eau. Elle est largement utilisée dans la préparation de ce qu'on appelle 'gommes de confiserie', ainsi que comme agent adhésif, stabilisateur et de recouvrement dans d'autres types de confiserie et de préparations pâtissières. Elle entre également dans la composition de boissons non-alcoolisées comme agent de suspension, stabilisateur ou de trouble. On l'utilise aussi pour la fabrication de produits aromatiques préparés, notamment aromes d'agrumes sous micro-capsules; produits chimiques, spécialement en tant que revêtement de pastille ou comme matière liante; produits diététiques. On l'utilise par ailleurs à de nombreuses fins non-alimentaires, entre autres en lithographie, pour la fabrication de colles, ainsi que dans l'industrie du textile et du papier (spécialement pour les papiers autocopiants).

5 La majeure partie de la gomme arabique est exportée des pays producteurs. Avant qu'une sérieuse pénurie ne sévisse à la fin de l'année 1984 et en 1985, la production et la consommation mondiale étaient de l'ordre de 35,000 à 40,000 tonnes par an, mais, suite à cette pénurie, la demande est tombée à 30,000 tonnes et moins, alors que la production reprenait de manière remarquable jusqu'à excéder la demande à l'heure actuelle. Principal pays producteur, le Soudan assurait de façon régulière près de 90% de l'approvisionnement mondial avant cette pénurie. L'équilibre de la production mondiale réside presque entièrement en Afrique occidentale, notamment au Nigeria, Mali et Sénégal, les autres pays de cette région ne produisant et n'exportant la gomme qu'en faible quantité et en général de façon intermittente. De très faibles quantités de gomme de médiocre qualité sont également produites sur le sous-continent indien. Le système de classement par grade le plus largement reconnu est appliqué par le Soudan.

6 L'Europe occidentale et l'Europe occidentale et l'Europe de Nord comptabilisent environ 40% de la consommation mondiale de gomme arabique. De larges quantités sont, en outre, temporairement importées vers des ports européens d'où elles sont ensuite ré-exportées. La pâtisserie est le principal secteur d'utilisation de gomme arabique. Les Etats-Unis comptabilisent

25% supplémentaires du marché mondial, le principal secteur d'utilisation étant cette fois l'industrie des boissons non-alcoolisées. Dans ces deux régions, la consommation a chuté en raison des pénuries et des hausses des prix qui en ont découlé. Toutefois, le marché japonais, qui représente 7 à 8% du total mondial, semble avoir bien tenu en dépit de ces difficultés.

7 Bien que l'exportateur exclusif du Soudan, la Société de gomme arabique de Khartoum, jouisse dans l'ensemble d'une bonne réputation auprès des acheteurs qui apprécient sa politique en matière de prix, ses lignes de conduite et son intégrité commerciale, la soudaineté de la pénurie qui a sévi à la fin de l'année 1984 a provoqué une perte de confiance généralisée et un vaste repli vers les produits synthétiques. Les cours élevés en vigueur au début de l'année 1987, environ 5 dollars par kg, semblant avoir été imposés à la Société de gomme arabique par contrainte interne, tant de la part du gouvernement central que des négociants indigènes qui étaient au courant du prix élevé auquel se revendait la gomme arabique à l'extérieur du pays; une augmentation sensible du commerce interlope avec l'extérieur avait été constaté lorsque les négociants cherchèrent à profiter par tous les moyens des cours mondiaux élevés. Toutefois, ce relèvement des prix est survenu trop tard dans la mesure où la production avait déjà commencé à reprendre et les contraintes de la demande à chuter. Au terme de l'année 1984, le cours en vigueur n'excédait guère 2 dollars par kg et, bien qu'une modeste baisse de prix soit prévue courant 1987, il est probable que celle-ci ne permettra pas de ramener la demande à ses niveaux antérieurs. Il se peut que le maintien à long terme d'un cours inférieur à 3 dollars par kg s'avère nécessaire si l'on veut endiguer le mouvement de repli vers les gommes synthétiques, et qu'il faille atteindre un cours encore plus bas, probablement 2 dollars par kg, pour avoir quelque chance de regagner certains des marchés perdus. Dans un avenir prévisible, l'offre en gomme risque fort d'excéder la demande et il n'y a donc aucune perspective favorable pour les nouveaux producteurs.

8 *La gomme guar* est une gomme de graines du type galactomannan obtenue à partir de l'endosperme de la plante *Cyamopsis tetragonolobus*, laquelle prospère surtout sous des climats chauds et secs. Cette gomme ressemble fortement à la gomme de la graine de caroube, mais se dissout telle quelle dans l'eau froide alors que la gomme de caroube exige d'être chauffée avant de se dissoudre totalement; la gomme guar est par ailleurs bien meilleur marché que la gomme de la graine de caroube, bien que, dans certaines applications, elle lui soit quelque peu inférieure d'un point de vue technique. Contrairement à la gomme arabique, la gomme guar procure une forte viscosité à de faibles concentrations. Elle est commercialisée soit sous la forme de l'endosperme non-broyé (connue dans le commerce sous le nom de 'splits'), soit en poudre, et est classée en fonction de son taux de viscosité mesuré. Elle subit souvent certaines modifications, surtout dans ses plus grandes applications, notamment pour le forage du pétrole où elle est principalement utilisée dans le procédé semi-secondaire de fracturation hydraulique. Elle sert également de floculant, ou d'agent de flottation, dans certaines industries minières. Dans l'industrie alimentaire, elle est largement utilisée comme épaississeur de sauces, ketchups et autres produits similaires, ainsi que comme améliorant de la texture des crèmes glacées, produits congelés, aliments pour nourrissons, aliments pour animaux domestiques, divers produits en conserves, fromages doux, tourtes et garnitures de dessert, mélanges instantanés et divers produits boulangers dont certains types de pains. On l'utilise par ailleurs dans l'industrie textile, pour l'impression de tapis, pour le traitement des eaux, dans la fabrication du papier, d'explosifs et de produits pharmaceutiques, tels que suspensions médicinales et comprimés, produits de beauté, d'amaigrissement, produits pour diabétiques, et quelques autres. Les applications techniques non-alimentaires représentent en gros 65% de la consommation de gomme guar, les applications alimentaires 30% et les applications pharmaceutiques et cosmétiques 5%. Dans les principaux pays producteurs de guar, celui-ci sert largement de nourriture pour le bétail.

9 La production mondiale de la graine de guar avoisine le million de tonnes par an, mais seulement un tiers de ce total est transformé en gomme, pour laquelle la demande mondiale est d'environ 100,000 tonnes par an. La production de cette gomme est dominée par l'Inde et le Pakistan, dans cet ordre, ces deux pays comptabilisant plus de 90% de l'approvisionnement mondial. La production de gomme guar, désormais en déclin, a été, pendant quelques années, régulière dans le sud des Etats-Unis, où la gomme servait avant tout à l'extraction du pétrole dans les états du Texas et de l'Oklahoma. Parmi les petits producteurs, les pays d'Afrique centrale, tels que le Malawi et le Zaïre, occupent une place prépondérante, bien que leur production ait été irrégulière. Au cours de ces dernières années, l'offre en gomme a accusé une nette tendance à la baisse, principalement en raison des faibles prix à la production, lesquels, toutefois, sont susceptibles d'augmenter pour parer au manque, et ceci risque de signifier une hausse du niveau des prix à long terme. La contamination bactérienne des envois pose un problème constant, bien que la gomme soit reconnue comme étant un additif alimentaire sans risque inhérent et pouvant donc s'utiliser sans restriction.

10 Entre le début et le milieu des années 80, les Etats-Unis ont importé en moyenne 45 à 50,000 tonnes de gomme guar par an, ce qui signifie que la consommation américaine tourne autour de 50 à 55,000 tonnes par an compte tenu de la production domestique. Deux tiers au plus de cette consommation sont imputables à l'industrie pétrolière, encore qu'au plus fort du boom pétrolier, lorsque la consommation était autrement plus élevée, cette industrie comptabilisait 85 à 90% du total. Les importations américaines de guar sont dominées par trois grandes sociétés multinationales qui font subir à la gomme un traitement poussé et la modifient

pour l'industrie pétrolière des Etats-Unis. Dans certains cas, ces firmes disposent d'installations de traitement dans les pays producteurs. Sur le tiers restant de gomme consommée, un peu plus de la moitié est imputable à l'industrie alimentaire, notamment pour la fabrication de crèmes glacées et de fromages blancs. Le reste est utilisé dans la fabrication des tapis et textiles, explosifs, produits pharmaceutiques et à une ou deux autres fins. L'Europe occidentale est la deuxième région consommatrice de gomme avec quelque 20,000 tonnes par an, bien que les importations brutes soient plus élevées en raison des ré-exportations qui se font à partir des principaux ports européens. L'industrie pétrolière de la mer du Nord en absorbe de grande quantités, mais le secteur alimentaire occupe une place proportionnellement beaucoup plus importante que dans le marché américain, de grande quantités de gomme entrant dans la composition de crèmes glacées, sauces de divers types, aliments en conserves, aliments pour nourrissons et animaux domestiques, alors qu'en Allemagne la gomme est largement utilisée dans la fabrication d'un pain de seigle apprécié localement. La récession que connaît l'industrie pétrolière a sensiblement réduit la demande en gomme guar, mais la demande dans le secteur alimentaire reste en revanche constante.

11 L'équilibre entre l'offre et la demande en gomme guar dépend en grande partie des diverses fortunes de l'industrie pétrolière. Les faibles prix du pétrole affichés ces derniers temps ont eu des incidences sur la rentabilité de tous les secteurs, en particulier sur celui de l'extraction, et la demande en gomme guar s'en trouve d'autant affectée. De plus, divers produits synthétiques à base d'amidon, de cellulose ou provenant de technologie de fermentation (par example, gomme xanthan) ont, pour des raisons techniques et dans une certaine mesure, supplanté la gomme guar dans ses applications pour le forage du pétrole. Les pénuries à la source, plus particulièrement en Inde, ont toutefois largement compensé le déclin de la demande et entraîné une hausse des prix; c'est ainsi que les grades les plus utilisés se cotaient à environ $1.50/kg au début de l'année 1987. Il est cependant probable que des ajustements au niveau des prix de production ramèneront l'équilibre; le seul déséquilibre éventuel au-delà du court terme est alors dû à une pénurie mineure des 'splits' comme suite aux tentatives des producteurs asiatiques de maximiser leurs exportations de poudre. Cette gomme a généralement la faveur des usagers et, bien qu'elle soit techniquement inférieure à la gomme de la graine de caroube dans de nombreuses applications alimentaires fondamentales, le prix treѕ élevé de cette dernière pourrait accroître les perspectives de la gomme guar dont la consommation dans le secteur alimentaire est déjà très stable. Quoi qu'il en soit, les ressources potentielles des producteurs asiatiques sont très grandes, et même s'il leur reste encore beaucoup à faire pour améliorer la propreté de leurs envois, les perspectives à long terme pour d'éventuels nouveaux producteurs ne peuvent être qualifiées de bonnes.

12 *La gomme adragante* est une gomme d'exsudats obtenue à partir de petits arbustes de la famille des *Astragalus*. Elle se présente essentiellement sous deux formes, à savoir en 'rubans', qui donnet une gomme de haute qualité, et en 'flocons', qui produisent une gomme de qualité quelque peu inférieure; ces deux formes proviennent de différentes sous-espèces d'arbustes. Le climat favori pour la production de cette gomme consiste en d'abondantes pluies avant la saison de la saignée, et en une période sèche durant la récolte. Cette gomme se dissout dans l'eau froide pour donner une solution à viscosité très élevée qui est de plus hautement résitante à des conditions fortement acides; elle sert donc avant tout de stabilisateur et d'épaississant dans des préparations acides telles que sauces et assaisonnements de salades, ainsi que dans certaines émulsions pharmaceutiques. Elle a également d'autres utilisations mineures dans l'industrie alimentaire et quelques applications non-alimentaires.

13 La production mondiale de gomme adragante ne dépasse pas actuellement les 500 tonnes par an, ce qui représente une faible proportion des taux de production antérieurs, mais la demande mondiale a été rebutée par le niveau constamment élevé des prix. L'Iran est le principal producteur avec quelque 300 à 350 tonnes par an, la Turquie se chargeant, quant à elle, de produire pour ainsi dire toute la différence. L'Iran définit à la fois les normes de qualité et les procédures de classement par grades, car la gomme turque est plus variable à ces égards. Le classement par grades s'effectue en fonction de la viscosité et de l'apparence de la gomme.

14 L'Europe occidentale en est le principal consommateur à raison de 200 à 250 tonnes par an, net de toute ré-exportation à partir des ports européens. La consommation aux Etats-Unis accuse une tendance à la baisse en tournant autour de 175 tonnes par an dans les années 80. Au cours de cette même période, la consommation japonaise a été de l'ordre de 30 tonnes par an.

15 En déclin depuis de nombreuses années, la gomme adragante a connu un sérieux revers de fortune à l'aube des bouleversements politiques qui ont secoué l'Iran vers la fin des années 70, l'influence de l'Etat provoquant alors une escalade des prix de la gomme. Cette influence s'est estompée avant le terme de l'année 1986 et les prix ont chuté de manière appréciable. Il n'empêche, toutefois, qu'un préjudice irréparable a été causé du fait, entre autres, que la gomme xanthan, dérivé microbiologique bien meilleur marché, avait déjà sérieusement empiété sur les applications traditionnelles jusque là réservées à la gomme adragante. Telle qu'elle est commercialisée, cette gomme demande à être nettoyée afin de réduire sa charge en bactéries; toutefois, les seules méthods de nettoyage véritablement efficaces font l'objet d'interdictions ou de restrictions répandues en raison des problèmes touchant aux résidus toxiques; ces nettoyages peuvent également avoir des incidences fâcheuses sur le taux de viscosité dont l'importance

est capitale. L'avenir de la gomme a été de surcroît ombragé par la mise en train de diverses études mettant en cause sa nature intrinsèque propre à la consommation humaine. Les résultats de ces études toxicologiques devraient être connus d'ici à 1988 et le statut légal de la gomme finalement défini pour l'avenir avant la fin de cette même année; jusque là, la gomme reste temporairement autorisée comme additif alimentaire. Il est toutefois peu probable que le déclin à long terme du marché puisse être renversé et il n'y a donc aucun besoin en perspective justifiant l'entrée sur le marché de nouveaux producteurs.

16 *La gomme karaya* est une gomme d'exsudats obtenues en pratiquant la saignée du *Sterculia urens* et d'autres arbres du genre *Sterculia* (famille Sterculiaceae) et du genre *Cochlospermum* (famille Bixaceae). Dans l'eau, elle forme des suspensions épaisses et est un bon agent émulsifiant. Elle résiste aux conditions acides, pas autant, toutefois, que la gomme adragante, à laquelle elle ressemble par certains aspects. Elle est utilisée en grande partie dans le domaine médical, surtout dans les fixatifs de sacs pour colostomie, fixatifs dentaires et fixatifs de remplissage. Elle entre également dans la composition de produits alimentairs, tels crèmes glacées et certaines boissons glacées. Son utilisation dans d'autres seceurs a sérieusement déclinée, de même que ses applications actuelles accusent aussi un recul manifeste.

17 La production mondiale est actuellement de l'ordre de 5,500 tonnes par an et es très largement dominée par l'Inde. Des mesures conservationnistes indiennes visant à prévenir tout abus dans la saignée des arbres, ont entraîné une réduction de l'offre à la base et provoqué une augmentation des prix qui, toutefois, n'a pas été aussi désastreuse que dans le cas de la gomme adragante. Le système de production et de commercialisation est dans son ensemble assez rudimentaire, mais certaines indications récentes laissent penser que l'industrie locale va se voir conférer une assise mieux organisée. Le Pakistan et le Soudan figurent parmi les producteurs de gomme mais aucun de ces pays n'exporte de façon régulière. Il existe cinq grades principaux de classification adoptés par l'organisation indienne Agmark et basés essentiellement sur le degré de viscosité de la gomme.

18 Les Etats-Unis consomment environ la moitié de la gomme karaya commercialisée à l'échelle internationale, et l'Europe occidentale environ 30%. Le commerce de ré-exportation à partir de ports européens est significatif. La consommation des Etats-Unis est relativement stable alors qu'en Europe les signes d'un recul sont manifestes. Dans ces deux régions consommatrices, la gomme est dans l'ensemble utilisée à des fins identiques, telles que décrites au paragraphe 16 supra; il n'y a qu'en Allemagne de l'Ouest que l'utilisation de la gomme est interdite dans la fabrication de produits alimentaires.

19 Les perspectives futures de la gomme karaya sont à présent incertaines. Son utilisation dans les fixatifs de sac pour colostomie et dans les fixatifs dentaires est en déclin sensible par suite du développement de nouvelles technologies, alors que dans les produits alimentaires, deux obstacles restent à surmonter: d'une part, le besoin de réduire la charge bactérienne des envois commercialisés, d'autre part, l'incidence éventuelle des présentes études sur les caractéristiques toxicologiques de la gomme. Les problèmes touchant à la propreté se trouvent aggravés du fait des interdictions ou des restrictions largement répandues sur les méthodes de nettoyage les plus efficaces, lesquelles tendent à laisser des résidus nocifs dans la gomme. Comme pour la gomme adragante, les résultats de ces études toxicologiques devraient être publiés d'ici à 1988 et le statut légal de la gomme pour l'avenir finalement établi avant le terme de cette même année; jusque là, la gomme reste temporairement autorisée à la consommation humaine en tant qu'additif alimentaire. Dans une certaine mesure, les perspectives pour la gomme dépendent également de la réorganisation actuelle de la production et de la commercialisation en Inde; dans l'éventualité où ces changements résulteraient en une amélioration consistante de la qualité du produit et en une stabilisation des prix à un niveau acceptable, la confiance commerciale s'en trouverait de beaucoup renforcée. Ainsi, en fonction de l'aboutissement de ces études toxicologiques, et même si une quelconque reconquête des marchés perdus reste de toute façon improbable, la gomme devrait toutefois pouvoir jouir d'une demande mondiale qui, si modeste, sera du moins stable étant donné ses qualités techniques généralement très estimées. Les perspectives s'offrant à un nouveau producteur sont cependant nulles.

20 *La gomme de la graine de caroube* n'est pas produite dans les pays en voie de développement et ne figure dans cette étude qu'en raison de ses similitudes avec la gomme guar. Il s'agit d'une gomme de graines de type galactomannan provenant de l'endosperme des graines du caroubier *Ceratonia siliqua*, lequel prolifère autour de la Méditérrannée. A l'instar de la gomme guar, la gomme de la graine de caroube donne une viscosité élevée dans des solutions à faibles concentrations, mais, contrairement à cette même gomme, elle a besoin d'être chauffée pour devenir pleinement soluble dans l'eau (caractéristique qui, il faut le préciser, peut quelquefois s'avérer un avantage). Elle s'utilise principalement dans l'industrie alimentaire, en tant qu'agent de texture dans les crèmes glacées, aliments pour animaux, conserves pour animaux et fromages blancs; comme épaississeur dans les soupes instantanées; et pour conférer une gamme de caractéristiques appréciables à divers mets non sucrés, desserts et produits laitiers. Ses applications autres qu'alimentaires sont négligeables.

21 Le total des exportations mondiales de gomme de caroube est estimé à environ un peu plus de 12,000 tonnes per an, sur lequel plus de 80% sont imputables à l'Espagne, l'Italie et le Portugal (dans cet ordre); les quelque 20% restants reviennent à certains pays d'Afrique du Nord et de l'Est de la Méditérrannée. Il se peut que la production mondiale soit sensiblement

plus élevée compte tenu de la consommation domestique de ces pays. Le système de classement par grades est basé sur la mesure de la viscosité. Les principaux pays ou régions consommateurs sont, dans l'ordre, l'Europe occidentale, les Etats-Unis et le Japon, lesquels se partagent environ 75% de la gomme commercialisée. Un déclin du marché des gousses de caroube en tant qu'aliment pour le bétail, et, par voie de conséquence du revenu qui en provient, allié au fait que ce secteur des économies du sud-ouest de l'Europe connaît une pénurie de main-d'oeuvre croissante, fait qu'une pression grandissante s'exerce sur les prix et que les utilisateurs hésitent aujourd'hui à utiliser cette gomme dans les mêmes proportions qu'auparavant; c'est ainsi qu'en dépit de sa supériorité technique sur la gomme guar dans certaines applications, cette dernière l'a supplantée en raison de son prix plus avantageux. Au moment de la rédaction du présent texte, aucun signe manifeste de détente n'est à dénoter dans le marché de la gomme de caroube. Si l'on peut dire que les perspectives sont nulles pour les pays en voie de développement désireux d'entrer sur ce marché, il convient toutefois de noter qu'étant donné la longue période de temps requise par le caroubier pour atteindre le stade de maturité voulu, les productures de gomme guar pourraient ancrer davantage leurs positions sur le marché.

22 A l'exception notable de la gomme arabique, dont l'exportation est dominée par la Société de gomme arabique de Khartoum mi-privée mi-nationalisée, le commerce des gommes solubles dans l'eau suit les voies privées normales et, en ce qui concerne la plupart des gommes, les acheteurs ont le choix entre un assez grand nombre d'exportateurs. Certains gross consommateurs finaux s'approvisionment directement à la source, mais la plupart d'entre eux passent par des négociants en gomme bien établis dont le nombre est d'environ 10–12 en Europe occidentale et en Amérique du Nord. Londres, Hambourg, Paris et New York sont les principaux centres; Rotterdam, Amsterdam et Anvers occupent une place d'importance relativement moindre en ce qui concerne le commerce des gommes comparé aux autres groupes de denrées. Le commerce des gommes connaît une concurrence très sévère et il se comptait beaucoup moins nombre diminue encore compte tenu des exigences grandissentes de la clientèle en matière de nettoyage et de traitement spécialisés de la gomme.

RESUMEN

Reseña en torno a las tendencias existentes actualmente en los mercados selectos de las gomas hidrosolubles

1 Las gomas hidrosolubles, derivadas de las plantas, son polímeros de hidratos de carbono hidrófilos de peso molecular elevado, los cuales se disuelven o dispersan en agua para proporcionar soluciones o suspensiones coloidales de diversos grados de viscosidad. Aunque existen varias categorías distintas de gomas hidrosolubles, este informe se concentra en dos categorías, a saber: las gomas rezumadas, obtenidas mediante incisiones hechas en la superficie de la planta, y las gomas contenidas en semillas, las cuales se obtienen mediante su extracción de la endoesperma de un grano dado. Estas se usan variadamente como agentes de espesamiento, diluyentes, emulsores, estabilizadores, agentes de suspensión, agentes aglutinantes o de revestimiento, en productos tanto alimenticios como no alimenticios. Muchas de estas gomas son producidas en países menos desarrollados, representando algunas de ellas una fuente de ingresos para labradores o pequeños granjeros sumamente pobres.

2 Muchas gomas hidrosolubles han escaseado de manera periódica, sus precios han variado hasta un nivel inaceptable para numerosos usuarios, y en algunos casos han surgido dudas en torno a su inherente apropiabilidad para el consumo humano, tanto en lo que refiere a sus presuntas características nocivas 'per se', como en lo que refiere a la alta carga bacteriana existente en muchas consignaciones, lo cual a su vez precisa formas de tratamientos purificadores que de por sí se hallan en tela de juicio en lo que respecta al tema de la salud. Debido a estas razones, la demanda mundial de las gomas hidrosolubles se ha reducido en numerosos casos antes del avance de los materiales sintéticos, los cuales se basan en almidones. en celulosas, o bien son un producto de la tecnología de la fermentación. No obstante, las gomas hidrosolubles son ampliamente consideradas en ciertos casos como técnicamente superiores a sus versiones sintéticas, si bien esta diferencia se está reduciendo paulatinamente.

3 Existen numerosas asociaciones comerciales, las cuales, a través de programas de investigación y de una acción coordinada, tratan de defender a largo plazo el futuro de las gomas hidrosolubles al concentrarse en los diversos problemas que preocupan a los compradores. En particular, la International Natural Gums Association for Research (INGAR) ha defendido enérgicamente la causa de las gomas hidrosolubles, habiendo proporcionado un valioso asesoramiento a los diversos participantes del gremio.

4 La goma arábiga es una goma rezumada comercializada en dos formas principales: la goma 'Hashab' o 'Kordofan', producida con el árbol Acacia senegal (syn. verek), y ciertas otras especies de Acacia, muy comparables pero mucho menos comunes; y la goma 'talha', producida principalmente con el árbol Acacia seyal. La primera se usa en aplicaciones de grado elevado, incluyendo productos alimenticios, mientras que la segunda se usa solamente en aplicaciones menos exigentes. La principal propiedad de la goma es su elevada solubilidad en agua combinada con su baja viscosidad, incluso a altas concentraciones, lo cual imparte a la goma su bien conocido efecto estabilizante y emulsionante en combinación con materiales insolubles en agua. Se usa extensamente en la llamada 'confitería de la goma', y como agente aglutinante, estabilizador o recubridor en otros tipos de preparados de confitería y panadería. Se usa también en bebidas no alcohólicas como agente de suspensión, estabilizador o nublador. Entre otras aplicaciones se cuentan productos aromatizantes preparados, incluyendo sabores cítricos micro-encapsulados, productos farmacéuticos, especialmente en la forma de revestimiento o aglutinado de tabletas; productos alimenticios saludables; y una gama de usos no relacionados principalmente con alimentos, incluyendo la litografía, los adhesivos, los textiles, la fabricación de papel (especialmente papeles de copia sin carbón), y algunos otros.

5 La mayoría de la goma arábiga es exportada directamente de los países que la producen. Antes de la gran escasez ocurrida a finales de 1984 y 1985, la producción y consumo mundial se hallaba entre 35.000 y 40.000 toneladas por año, pero como consecuencia de la escasez, la demanda se ha reducido a 30.000 toneladas o menos, mientras que la producción se ha recuperado considerablemente y en la actualidad excede a la demanda. El principal país productor es Sudán, el cual antes de la escasez producía regularmente muy cerca del 90% del suministro mundial. El balance de la producción mundial se lleva a cabo casi exclusivamente en Africa Occidental, especialmente en Nigeria, Mali y Senegal, mientras que otros países de la región producen y exportan la goma en pequeñas cantidades y en general de manera esporádica. En el subcontinente indio se producen cantidades muy pequeñas de goma de bajo grado. Sudán utiliza el sistema de clasificación por grados más extensamente reconocido.

6 La Europa del Oeste y del Norte importa aproximadamente un 40% del total mundial del consumo de goma arábiga. Además, grandes cantidades son importadas temporalmente por puertos europeos, para ser luego reexportadas desde los mismos. El sector principal de utilización lo constituye la industria de la confitería. Los EE.UU. representan un 25% más del mercado mundial, siendo el principal sector de utilización en este caso la industria de las bebidas no alcohólicas. En ambas regiones, el consumo ha disminuido como consecuencia de las escaseces y los consiguientes altos precios, aunque el mercado japonés, con un 7-8% del total mundial, parece haberse mantenido estable a pesar de las dificultades.

7 Si bien la unica firma exportadora sudanesa, la Gum Arabic Company of Khartoum, goza en general de una buena reputación entre sus compradores por sus precios, sus métodos y su integridad comercial, la repentina escasez ocurrida a finales de 1984 causó una amplia pérdida de confianza y una extensa conmutación hacia los sintéticos. El elevado precio vigente a comienzos de 1987, a saber unos 5 dólares ($) por kg., pareció haber sido forzado sobre la Gum Arabic Company mediante presión interior, tanto desde el Gobierno central como por parte de los comerciantes locales, los cuales conocían el alto precio que se estaba pagando por la goma arábiga fuera del país. Se había registrado un notable aumento en el comercio ilegal entre fronteras, a medida que los comerciantes trataron por cualquier medio de aprovecharse de los altos precios mundiales. No obstante, la subida del precio se produjo demasiado tarde puesto que la producción ya había comenzado a recuperarse y la presión de la demanda había comenzado a descender. A finales de 1984, el precio había apenas rebasado los 2 dólares ($) por kg., y si bien se espera una modesta reducción del precio durante 1987, no es probable que sea adecuada para restaurar los anteriores niveles de la demanda, Es probable que sea necesario a largo plazo un nivel de precios por debajo de los 3 dólares ($) por kg. para detener la tendencia hacia los sintéticos, y un precio todavía más bajo – probablemente de 2 dólares ($) por kg. – antes de que se produjera alguna perspectiva de recuperar los mercados perdidos. Hasta donde se pueda ver, el suministro de goma es probable que exceda la demanda, y no existen perspectivas para nuevos productores.

8 La Guar Gum (goma de guar) es una goma de semilla del tipo galactomannan, obtenida del endosperma de la planta Cyamopsis tetragonolobus, la cual se cultiva mejor en un clima caluroso y seco. La goma se parece mucho a la goma de semillas de algarrobo (q.v.), pero se disuelve fácilmente en agua fría, mientras que la de algarrobo requiere la aplicación de calor antes de pueda ser disuelta por completo. La goma guar es también mucho más barata que la de semilla de algarrobo, si bien técnicamente algo inferior en algunas aplicaciones. A diferencia de la goma arábiga, la goma de guar produce alta viscosidad en bajas concentraciones. Se vende ya sea como endosperma sin moler (conocida en el gremio como 'splits'), o bien en la forma de polvo, siendo clasificada principalmente con arreglo a su viscosidad medida. Es con frecuencia modificada antes de su uso, especialmente en su mayor aplicación, a saber en la industria de la extracción petrolífera, en la cual se usa principalmente en el proceso semisecundario llamado fracturación hidráulica. Se usa como floculante o agente sedimentador en ciertas industrias mineras. En la industria de los productos de alimentación, se usa extensamente como agente espesador en salsas, 'ketchups' y productos similares, y como mejorador de textura en helados, alimentos congelados, alimentos para bebés, alimentos para animales domésticos, en una gama de alimentos enlatados, quesos cremosos, rellenos de empanadas y pudíns, mezclas instantáneas y en un surtido de productos de panadería, incluyendo ciertos tipos de pan. Otras

aplicaciones se usan en la impresión de textiles y alfombras, fabricación de papel, tratamiento de aguas, explosivos, en productos farmacéuticos tales como suspensiones medicinales y tabletas, cosméticos, productos para adelgazar y para diabéticos, y uno o dos más. Como cálculo aproximado, las aplicaciones en productos no alimenticios técnicos representan el 65% del consumo de la goma guar, las aplicaciones alimenticias el 30% y los farmacéuticos y cosméticos el 5%. En los principales países de producción, la goma de guar se usa extensamente como pienso para el ganado.

9 La producción mundial de semillas de guar es de aproximadamente 1 millón de toneladas anuales, pero solamente un tercio de este total es elaborado en goma, cuya demanda mundial se halla en la región de las 100.000 toneladas al año. La producción de la goma está dominada por la India y el Paquistán respectivamente, proporcionando estos dos países más del 90% del suministro mundial.

Durante algunos años se ha venido produciendo de manera regular, pero ahora en disminución, goma de guar en el sur de los EE.UU. principalmente para su uso en la extracción petrolífera en los Estados de Texas y Oklahoma. Entre los productores de menor cuantía, han sido prominentes los países africanos tales como Malawi y Zaire, aunque la producción ha sido sumamente irregular. En años recientes se ha reflejado una marcada tendencia hacia la escasez de la goma, principalmente debido a precios bajos del productor. No obstante, es probable que éstos sean incrementados para evitar los déficits, aunque al costo de cierto incremento en el nivel de precios a largo plazo. La contaminación bacteriana de consignaciones es un problema regular, si bien la goma está reconocida como un aditivo de alimentación inherentemente seguro, y como tal puede ser usado sin limitaciones.

10 De principios a mediados de los años 1980, los EE.UU. importaron un promedio de 45.000-50.000 toneladas de goma de guar por año, lo cual sugiere que el consumo local actual se halla entre las 50.000 y 55.000 toneladas por año, cuando se tiene en cuenta la producción local de la goma en los EE.UU. Hasta dos tercios del consumo es atribuible a la industria del petróleo, aunque durante el apogeo de demanda del petróleo, cuando el consumo era considerablemente más alto, la industria consumía el 85-90% del total. Las importaciones de goma de guar en los Estados Unidos están dominadas por tres grandes multinacionales, las cuales llevan a cabo una extensa elaboración y modificación de la goma para la industria del petróleo estadounidense. En algunos casos, estas firmas poseen plantas de elaboración en los países productores. Del resto del consumo, algo más de la mitad es atribuible a la industria de los productos alimenticios, particularmente en la producción de helados y de quesos cremosos. El balance se usa en la fabricación de textiles y alfombras, explosivos, productos farmacéuticos, y en una o dos otras aplicaciones. La Europa Occidental es la segunda mayor región de consumo, recibiendo unas 20.000 toneladas por año, si bien las importaciones brutas son mayores debido al comercio de reexportación desde los principales puertos europeos. La industria del petróleo del Mar del Norte absorbe importantes cantidades, pero el sector de alimentación reviste una importancia considerablemente mayor en proporción con la del mercado de los EE.UU., usándose grandes cantidades en helados, salsas de varios tipos, alimentos enlatados, alimentos para animales domésticos y alimentos para bebés, mientras que en Alemania, la goma se usa extensamente en el pan de centeno muy popular a nivel local. La recesión en la industria del petróleo ha reducido considerablemente la demanda de goma de guar, si bien la demanda procedente del sector de la alimentación permanece firme.

11 El equilibrio entre el suministro y la demanda en el caso de la goma de guar, depende en gran parte de los altos y bajos ocurridos en la industria del petróleo. Los bajos precios del petróleo en años recientes han reducido el nivel de la remunerabilidad en toda la extracción que no sea la primaria y por consiguiente la demanda de goma de guar en este sector está desanimada. Además, varios productos sintéticos a base de almidones, celulosas y a la tecnología de la fermentación (e.g. la goma de xanteno), han desplazado hasta cierto punto, y por motivos técnicos, a la goma de guar en las aplicaciones de la extracción petrolífera. No obstante, las escaseces ocurridas en los puntos de origen, particularmente en la India, han compensado con creces esta disminución en la demanda, y como resultado los precios an subido, siendo los grados más ampliamente usados cotizados a unos 1,50 dólares ($) por kg. a principios de 1987. Es, sin embargo, probable que los ajustes en los niveles de precios del productor restauren el equilibrio, y el único posible desequilibrio que podría producirse más allá del plazo corto sería una pequeña escasez de 'splits', como consecuencia de los esfuerzos llevados a cabo por los productores asiáticos para aumentar al máximo sus exportaciones de polvo. La goma se estima generalmente a un alto nivel y, aunque es técnicamente inferior a la goma de semilla de algarrobo (q.v.) en muchas aplicaciones alimenticias principales, el sumamente elevado precio de esta última goma podría crear perspectivas para la goma de guar, cuyo consumo en el sector de la alimentación es ya sumamente estable. Aun con esto, los recursos potenciales de los productores asiáticos existentes son sumamente grandes y, si bien existen posibilidades de mejora en la limpieza de las consignaciones por ellos comercializadas, las perspectivas para los nuevos productores a largo plazo no pueden definirse como buenas.

12 La Gum Tragacanth (goma tragacanto) es una goma rezumada obtenida de unos pequeños arbustos de la especie Astragalus. Adopta dos formas básicas, a saber la de cintas, las cuales ofrecen la goma de mejor calidad, y la de hojuelas, las cuales producen una goma de calidad inferior. Estas dos formas se obtienen de diferentes subespecies del arbusto. El clima preferido

para la producción de goma consiste en una abundante lluvia antes de la estación de la incisión, seguido de condiciones secas durante la temporada de recogida. La goma se disuelve en agua fría para proporcionar una solución de viscosidad sumamente alta, la cual resulta adicionalmente muy resistente a los ácidos fuertes. Así pues, la goma se usa principalmente como agente estabilizador y espesador en preparaciones ácidas tales como cremas y aderezos para ensaladas, así como en ciertas emulsiones farmacéuticas. También se usa minoritariamente en otros sectores de la industria de la alimentación, y en ciertas aplicaciones no alimenticias.

13 La producción mundial de goma tragacanto no asciende en la actualidad a más de 500 toneladas por año, lo cual representa una pequeña proporción de los niveles de producción anteriores, habiendo sido la demanda mundial ahogada a causa de sus altos precios. Irán es el principal país productor, suministrando unas 300-350 toneladas por año, y produciendo Turquía prácticamente el resto del balance. Irán establece la norma tanto en lo que refiere a la calidad de la goma como en los procedimientos de clasificación de la misma, siendo la goma turca más variable en ambos aspectos. La clasificación se lleva a cabo con arreglo a la viscosidad y el aspecto.

14 Europa Occidental es la principal región consumidora, recibiendo 200-250 toneladas por año, sin contar las reexportaciones efectuadas desde los puertos europeos. En los EE.UU. el consumo ha promediado unas 175 toneladas anuales en la década de los 1980, siguiendo una tendencia descendente. El consumo en el Japón, durante el mismo período, registró un promedio de unas 30 toneladas.

15 La suerte de la goma tragacanto, que había estado decayendo durante muchos años, se empeoró dramáticamente al comenzar los disturbios políticos del Irán durante finales de los años 1970, cuando la influencia del Estado provocó una acusada subida del precio de la goma. La participación del Estado disminuyó a finales de 1986 y los precios bajaron de manera apreciable, pero se había producido un gran daño irremediable, particularmente porque la mucho más barata goma de xanteno, derivada microbiológicamente, había avanzado considerablemente en las aplicaciones tradicionales de la goma tragacanto. La goma en venta normalmente ha de ser limpiada para reducir el contenido bacteriano, pero los únicos métodos verdaderamente eficaces están prohibidos extensamente o severamente limitados a causa de los problemas que plantean los residuos tóxicos. También pueden reducir seriamente los importantes niveles de viscosidad de la goma. El futuro de la goma se ha nublado también ulteriormente mediante el encargo de varios estudios en torno a su apropiabilidad intrínseca para el consumo humano. Los resultados de estos estudios toxicológicos deberán darse a conocer para 1988, y el estado legal de la goma para el futuro será finalmente establecido para finales del mismo año; hasta entonces, la goma permanece aprobada provisionalmente para el consumo humano. No obstante, aún en el caso de que la goma sea aprobada como aditivo de alimentos, es improbable que pueda ser invertida la tendencia a su declinación en el mercado, y por consiguiente no existe una necesidad previsible para la entrada al mercado de un nuevo productor.

16 La Gum Karaya (goma karaya) es una goma rezumada obtenida mediante la incisión del árbol Sterculia urens y de otros árboles del género Sterculia (familia Sterculiaceae) y Cochlospermum (familia Bixaceae). En el agua, se forma en suspensiones espesas y es un buen agente emulsionante. Es resistente a las condiciones ácidas, si bien lo es menos que la goma tragacanto, a la cual se parece bastante en algunos aspectos. Se usa extensamente en el sector médico, principalmente en los fijativos de bolsa en colostomía, en los fijativos dentales y en los laxativos a granel. También se usa en productos alimenticios tales como helados y en ciertas bebidas heladas. Su uso en otros sectores ha disminuido intensamente e incluso en sus aplicaciones existentes se ha manifestado cierta medida de disminución.

17 La producción mundial asciende en la actualidad a unas 5.500 toneladas por año, y está completamente dominada por la India. Las medidas de conservación en la India, diseñadas para prevenir una incisión excesiva de los árboles, han limitado la base de suministro haciendo subir los precios, si bien no de manera tan desastrosa como lo han hecho los de la goma tragacanto. El sistema de producción y comercialización ha sido generalmente primitivo, pero se ha comprobado recientemente que la industria local va a ser situada sobre una plataforma más organizada. Se sabe también que su producción se lleva a cabo en Paquistán y Sudán, pero ninguno de estos países es exportador regular. Existen cinco grados principales registrados con la organización india Agmark los cuales se basan mayormente en la viscosidad de la goma.

18 Los EE.UU. consumen aproximadamente la mitad de la goma karaya comercializada a nivel internacional, y la Europa Occidental alrededor del 30%. Existe un considerable mercado de reexportación desde los puertos europeos. El consumo en los EE.UU. es aproximadamente estable mientras que en Europa existen pruebas de alguna disminución. En ambas regiones, el patrón de uso es aproximadamente similar, según se describe en el párrafo 16, si bien en Alemania Occidental está prohibido el uso de la goma en productos alimenticios.

19 Las perspectivas futuras para la goma karaya son de momento inciertas. Su uso en fijativos de bolsa de colostomía y en fijativos dentales se halla en disminución perceptible, como resultado del desarrollo de nuevas tecnologías, mientras que en los productos alimenticios se enfrenta con dos desafíos: en primer lugar, la necesidad de reducir el contenido bacteriano de las consignaciones vendidas, y en segundo lugar, el posible impacto de los estudios actuales sobre las características toxicológicas de la goma. Los problemas de limpieza son incrementados

mediante las amplias prohibiciones o restricciones sobre el uso de los métodos de limpieza más efectivos, los cuales tienden a dejar residuos dañinos en la goma. Como ocurre con la goma tragacanto, los resultados de dichos estudios toxicológicos deberán conocerse para 1988, y el estado legal de la goma en el futuro será establecido para el final del mismo año. Hasta entonces, la goma permanece aprobada provisionalmente para el consumo humano como aditivo en alimentos. Hasta cierto punto, las perspectivas para la goma dependen también de la reorganización actual de la producción y comercialización en la India. En el caso de que estos cambios resulten en una mejora continuada de la calidad del producto, y en la estabilización de su precio en un nivel aceptable, se mejorará en gran parte la confianza en el mercado. Además, y sujeto a los resultados de los estudios toxicológicos, si bien en cualquier caso es poco probable una recuperación de los mercados perdidos, deberá ser posible entonces que la goma adquiera una demanda mundial a nivel modesto, en vista del alto nivel en que son considerados sus atributos técnicos. Sin embargo, no existen perspectivas para un nuevo productor.

20 La Locust Bean Gum (goma de semilla de algarrobo) no es producida en países menos desarrollados, y se incluye en este estudio solamente debido a su similitud con la goma de guar (q.v.). Se trata de una goma de semilla tipo galactomannan producida de la endoesperma de las semillas del algarrobo Ceratonia siliqua, el cual crece en abundancia alrededor del Mar Mediterráneo. Al igual que la goma de guar, la goma de semilla de algarrobo produce alta viscosidad en solución a bajas concentraciones, pero a diferencia de la goma guar requiere la aplicación de calor para obtener una solubilidad completa en agua, si bien en ciertos usos esto resulta ventajoso. Se usa principalmente en la industria de la alimentación, siendo utilizada como agente texturizador en helados, alimentos para animales domésticos, alimentos para animales domésticos enlatados y quesos cremosos; como agente espesador en sopas de cocción instantánea, y para impartir una serie de características deseables en diversos productos salados, dulces y lácteos. Su aplicación en productos no alimenticios es de importancia insignificante.

21 La exportación total mundial de la goma de semilla de algarrobo se calcula en un promedio de algo más de 12.000 toneladas por año, de las cuales más del 80% son atribuibles a España, Italia y Portugal respectivamente, siendo el resto atribuible a países situados en el noroeste de Africa y en la región oriental del Mediterráneo. La producción mundial puede ser apreciablemente más elevada dado su consumo en los países de origen. El sistema de clasificación está basado en mediciones de viscosidad. Los principales países o regiones consumidores son la Europa Occidental, los EE.UU. y el Japón en este orden, representando en conjunto alrededor del 75% del consumo de la goma comercializada. Una disminución en la demanda de vainas de algarrobo como pienso para el ganado en los países productores, y subsiguientemente en los ingresos obtenidos de las vainas, combinada con la creciente escasez de mano de obra en este sector de las economías de la Europa del Suroeste, ha originado una presión ascendente en los precios y una desgana consecuente por parte de los usuarios a usar la goma en las mismas cantidades y, a pesar de su superioridad técnica sobre la goma de guar en ciertas aplicaciones, la goma más barata ha ganado popularidad a costa suya. En el momento de redactar el informe, no existían pruebas de aflojamiento en el mercado de la goma de semilla de algarrobo. Aunque se puede decir que no existen perspectivas para la entrada a este mercado por países menos desarrollados, en vista del largo tiempo que tardan los algarrobos en alcanzar la etapa requerida de madurez, es posible que los productores de la goma guar podrían sacar mayor ventaja de la posición del mercado.

22 Con la notable excepción de la goma arábiga, cuya exportación está dominada por la Gum Arabic Company of Khartoum (perteneciente en parte al Estado y en parte al sector privado), las gomas hidrosolubles son comercializadas a través de los canales comerciales privados normales, y para la mayoría de las gomas, los compradores tienen a su disposición una amplia selección de exportadores para escoger. Algunos importantes usuarios finales compran directamente en el país de origen, pero muchos de ellos compran sus necesidades a través de comerciantes en gomas bien establecidos, de los cuales existen aproximadamente 10-12 en la Europa Occidental y en Norteamérica. Los principales centros son Londres, Hamburgo, París y Nueva York; Rotterdam, Amsterdam y Amberes son puertos de importancia relativamente pequeña en el mercado de las gomas, en comparación con otros grupos de mercaderías. El comercio de las gomas es sumamente competitivo y a mediados de los años 1980, existían mucho menos comerciantes activos de los que existían de principios a mediados de los años 1970. Además, es posible una mayor concentración, en vista de la creciente necesidad de efectuar una limpieza especializada y una elaboración a pedido del cliente.

Section 1

Introduction

PURPOSE OF BULLETIN

The object of this short bulletin is to provide, mainly for the benefit of existing or potential suppliers, a broad general overview of recent and current trends in the world market for the five main edible water-soluble gums: **gum arabic, guar gum, gum tragacanth, gum karaya and locust bean gum** (carob bean gum). The approximate value of world trade in these five products (that is, excluding consumption at source) is shown below, the ranges reflecting recent price fluctuations:

Gum arabic	$70m—$140m
Guar gum	$170m—$210m
Gum tragacanth	$7m—$10m
Gum karaya	$10m—$13m
Locust bean gum	$40m—$50m

These gums can be scientifically described as hydrophilic carbohydrate polymers of high molecular weight, which can be made to dissolve or disperse in water to give solutions or colloidal suspensions of varying degrees of viscosity. All are of plant origin, and are obtained either as exudates from deliberate or accidental incisions on the exterior of the plant, or through the processing of a vitreous layer within the seed. Gums arabic, tragacanth and karaya fall into the former category and are often termed **exudate gums**; guar gum and locust bean gum are members of the latter category and are commonly referred to as **seed gums**. Although guar gum has many non-food uses, edible gums as a group have traditionally found wide application in the food industry, where they are used as thickeners, emulsion stabilisers, binders and suspension agents, as well as for imparting a desired texture known as 'mouthfeel' to certain types of food product. The common properties of the various gums render them interchangeable to some degree, but each possesses certain unique properties which renders it suitable for applications in which the use of the other gums would be inappropriate.

The Overseas Development Natural Resources Institute has for many years received regular enquiries on the market prospects for these products, yet for various reasons the future of several gums, notably gums arabic, tragacanth and karaya, has been called increasingly into question. The growing doubts on the part of users have in part arisen from supply problems. For this reason even those gums, such as guar gum, which have been relatively little affected by shortages and which on technical grounds are widely considered to have a good future, have to some extent been adversely affected by the unfavourable publicity attracted to those products which have been genuine sources of concern.

THE CHALLENGE FROM SYNTHETICS

Nowadays there is severe competition for natural gums from synthetics. **Modified starches** and dextrins are readily available and, at prices typically in the $1-2 per kg range, are generally very competitive. **Cellulose-based products** such as sodium carboxymethylcellulose (widely known as **CMC**) and

hydroxypropylmethylcellulose are rather more expensive at between $3 and $4.50 per kg but are highly effective, of very even quality and in regular supply. More recently, developments in fermentation technology have made available **xanthan gum**, a microbiologically-derived product manufactured by the fermentation of *Xanthomonas campestris*, which has presented a further formidable challenge to certain natural gums. This product is more expensive than the synthetics referred to above, costing some $3.50-4.00 per kg to produce and available to users at some $7-8 per kg once producer margins are taken into account, but in certain key applications, such as the oil-drilling industry, smaller quantities of xanthan gum are needed to achieve a required technical effect than of the equivalent exudate or seed gum. A number of early production difficulties, which forced one major processor to close down its xanthan gum operations, have largely been solved and world production capacity, which is now in the hands of three companies and by the mid-1980s stood at around 16,000 tonnes per annum, is now steadily rising to match demand, so in the long run the gum's price may fall in real terms. In the very nature of this product it is not bacteriologically sterile and a grading system exists which distinguishes between food-grade and technical-grade gum (with a price differential of around 15%); however, the bacterial load is easily controlled, and the United States plate-count limit of 10,000 colonies per gram is easily attainable, while in the European Community food-grade xanthan gum carries the official additive code E 415. The various starch-based and cellulose-based alternatives to natural gums have also been allocated 'E' numbers.

The availability of these synthetics has in a number of cases tilted the balance of user favour sharply away from the natural products. Sudden shortages of essential raw materials can cause severe embarrassment to end-product manufacturers, especially if the result is an inability to fulfil agreed orders for their products on time in a highly competitive market. The problem has to some extent been exacerbated by misguided attempts on the part of some producers to add value to their product by means of a degree of further processing, instead of concentrating on the production and marketing of a basic raw material of consistently even quality. While it is undoubtedly true that natural gums which can be chemically modified before use can often compete better with synthetics on technical grounds than those that cannot, the fact remains that most of the required processing is carried out in the importing countries by companies which tailor the products to buyers' known requirements, and it is the preference of most users that this should be so. Faced with recurrent supply and quality problems, the obvious and natural reaction of the affected users is to invest in such research as may be needed to reformulate their products so as to render the relevant ingredient redundant. Research of this nature may be time-consuming and consequently very expensive; for example, it may take between five and ten years to obtain the approval of the United States Food and Drug Administration for a new ingredient, and longer still for the entire research, development and clearance chain to be completed. Moreover, modern legislation requires that end-product labels be changed on every occasion when the formulation is in any way altered. It is therefore not surprising that, once the required reformulation has been achieved, reversion to the use of the original, natural ingredient is unlikely to take place in the absence of very clear evidence that price and supply stability has returned to stay. However, it is here worth noting that very many present and former users of natural gums consider that they continue to possess technical advantages over many of their lower-priced synthetic rivals, and therefore believe there to be some justification for a rather higher price level for natural gums *vis-à-vis* their competitors. This is to some extent true, but in some instances prices have either fluctuated excessively or have settled at too high a level for the satisfaction of users, with the inevitable consequences.

While supply problems have played their part in the recent vicissitudes of the fortunes of the natural gums, the growing pressure from increasingly-stringent national food and drug laws should not be underestimated. For

example, the European Inventory of Chemical Substances (EINECS) lists all substances used in industry and commerce, and any new product has to be examined and certified safe for use before it can be cleared for sale. These tests are often very expensive. Problems of excessive bacterial contamination can, of course, affect many natural products and the gums are no exception; but in addition to the attention they have received in this regard, serious doubts have been raised regarding the intrinsic suitability of certain gums, notably gum tragacanth and gum karaya, for use in foodstuffs. The close official scrutiny to which the affected products have been subjected as a result of the questions raised has culminated, in some countries, in outright bans on their use in a wide range of food products, particularly in the case of gum karaya. The problem for the natural gums has been exacerbated by the widespread ban on the use of ethylene oxide (ETO), especially in the United States and parts of Europe, as a cleaning and sterilising agent, on account of its toxic residues. Technically ETO is highly effective, appreciably more so than propylene oxide (PPO), the use of which is still permitted as long as its residues in the product treated do not exceed 300 parts per million (ppm), but which too frequently fails to reduce the bacterial loading of gum consignments to acceptable levels. Similarly, heat treatment also provides only a limited degree of 'kill'. Moreover, while irradiation of contaminated raw material consignments with gamma rays is known to be very effective and is steadily gaining consumer acceptability, particularly in Europe, doubts exist regarding its effects on the basic characteristics and quality of the gums, and unless these doubts can be allayed it is unlikely that the technology will be commercially applied. It is, of course, also possible that the steady expansion of national safety legislation throughout the world will eventually culminate in the setting of strict limits on the various forms of contamination in gum consignments prior to their shipment, which would clearly benefit the natural products.

In some cases the evaluation procedures are still under way and the long-term future of the products under study continues to hang in the balance. At this point it is appropriate to draw attention to the various trade associations which exist in the natural gums industry, primarily the International Natural Gums Association for Research Ltd. (INGAR), which has taken a vigorous lead in support of natural gums and has played a prominent role in the widespread negotiations concerning the current toxicological studies. Corresponding national organisations such as the British Association for Natural Gums and Resins (BANGAR), the United States-based Water-Soluble Gums Association (WSGA) and similar organisations in Japan, India and elsewhere, most of which have close links with INGAR, are also active in defence of the natural products. Of the major trading countries, only France is not represented on INGAR.

CONCLUDING OBSERVATIONS

In spite of the problems which have beset the gums market in recent years, the fact remains that in many cases the gums provide a valuable source of income for many poor smallholders or itinerant labourers, either in very poor countries or in the poorest regions of rather more developed countries. As such they are important commodities and the present study was considered justified largely on that account. However, it was found during the course of the research – which was undertaken between 1984 and 1986 – that the number of traders handling gums in the importing countries had declined very substantially over the previous 10-15 years, and that unusually intense competition exists between the comparatively few firms, located mainly in London, Hamburg, Paris and New York, that now remain in this generally declining market. As a result, many of the traders approached were understandably secretive and the information obtained was patchy, generally 'broad-brush' in nature and often given in confidence. For this reason it has not been possible to give the subject the detailed treatment normally accorded by the

Institute to the commodity market studies it regularly undertakes. However, brief and general in nature though the subsequent treatment of the subject-matter inevitably has to be, it was possible to arrive at clear conclusions which are likely to hold good for the foreseeable future. It should be noted that this study does not contain proposals aimed at increasing the marketability of water-soluble gums, but it is clear that there is a major lack of research effort in this direction on the part of the producing countries, and considerable scope for further work in this respect. Finally, it should be noted that the inclusion of locust bean gum, which is mostly produced, and will almost certainly continue to be produced, outside the developing countries, has been justified mainly by the fact that its uses overlap in a number of areas with those of guar gum, of which the bulk of production takes place in developing countries. However, in view of the negligible prospects for an appreciable level of production of locust bean gum in the poorer developing countries, the product is only briefly discussed.

Section 2

Gum arabic

INTRODUCTION AND DESCRIPTION

As mentioned in the Introduction, gum arabic, arguably the best-known of the water-soluble gums, was the subject of a major market study four years prior to the issue of the current study. The report, entitled *'The Gum Arabic Market and the Development of Production'*, was prepared jointly by the UNCTAD/GATT International Trade Centre (hereafter referred to as ITC), Geneva and the United Nations Sudano-Sahelian Office (UNSO) and was completed and released in 1983. To avoid unnecessary duplication, this section consists mainly of an updating of that report's findings, and readers requiring more comprehensive background should therefore apply to the ITC at the following address: UNCTAD/GATT International Trade Centre, 54-56 rue de Montbrillant, CH-1202 GENEVA, Switzerland. However, as a general guide to very recent developments, this section stands on its own.

Gum arabic – more correctly, although nowadays seldom, known as gum acacia – is an exudate obtained from a number of tree species of the *Acacia* genus. In practice, however, only two species are of commercial importance, namely *A. senegal* (syn. *verek*), and *A. seyal*, the use of the latter being restricted to non-food applications only. It is widely laid down in national food regulations that only the gum obtained from *A. senegal (L.) Willd.*, which includes *A. senegal* (syn. *verek*) and a few other very uncommon *Acacia* species, may be used in applications for human consumption. The best foodstuff grades of gum arabic are mostly produced in Sudan and account for the bulk of world trade. Gum arabic from *A. senegal* is often known as 'hashab' gum or alternatively 'Kordofan' gum after the name of the province from which the product mainly originates, while the exudate of *A. seyal* is often referred to as 'talha' or 'tahl' gum (and will hereafter be referred to simply as talha gum). *Acacia* trees occur widely across the Sudano-Sahelian region and, quite apart from their gum-bearing properties, possess various environmentally beneficial properties in that they enrich the soil, assist in dune stabilisation, nitrogen fixation and pasture renewal, and generally thrive in poor soils with the minimum of rainfall. As such, they are regarded as an essential weapon in the fight against further encroachment by the Sahara Desert. Although the *Acacia* species are not confined to the continent of Africa and small quantities of gum arabic appear to have been produced outside Africa from time to time, the great bulk of commercial production of the gum nonetheless originates in Sudan and in a number of West African countries either wholly or partly situated in the Sahelian region, such as Nigeria, Chad, Niger, Mali, Mauritania and Senegal. The trees must be at least six years old before they can be tapped without risk of damage, and harvesting mostly takes place between the months of October and May. In general, the higher the average temperature, the higher the yield of gum.

Gum arabic is odourless, tasteless, often colourless in use, imparts no undesirable properties to materials in contact with it, and has been toxicologically approved for all foodstuffs usage. Its principal property is its combination of high solubility in water and low viscosity. Whereas the high viscosities of most other gums preclude their being dissolved in water at concentrations greater than around 5%, gum arabic forms mildly acidic solutions of around

50% concentration. It is this characteristic that imparts the gum's renowned stabilising and emulsifying properties when in combination with water-insoluble materials. It also possesses good film-forming and gelling properties and lowers the surface tension of aqueous solutions.

USES

Perhaps the best-known traditional use of gum arabic is in certain types of confectionery, especially those products which are commonly referred to as 'gums', for example fruit gums and wine gums. The gum is also used in pastilles, mainly by virtue of its viscosity characteristics, and in protective coatings or glazes for certain candies, chocolate preparations and several other types of sugar-coated confectionery. It is noteworthy that gum arabic is a relatively low-calorie product and, although it has been supplanted by modified starches or fluidised starches in many applications, these starches have higher calorie counts than gum arabic; with the modern popularity of 'health foods' and low-calorie sugarless confectionery, gum arabic's properties in this respect can be turned to its advantage in product advertising, especially as the gum possesses much of the bulk and texture characteristics of sugar. The use of gum arabic in confectionery is particularly dominant in Western and Northern Europe. Even in Europe, however, there has been encroachment by modified starches into gum arabic's traditional applications. On the other hand xanthan gum, which has made large inroads into applications which were formerly the preserve of certain natural gums such as gum tragacanth, has made very little impact on gum arabic, mainly because the physical characteristics of the two products differ too much, especially in terms of viscosity.

Another major area of usage is the flavouring of soft and alcoholic beverages, particularly in North America. In many types of bottled beverage, both still and carbonated, gum arabic continues to enjoy technical advantages over modified starches as an emulsifying, stabilising, suspension or clouding agent, as a protective colloid and as a source of 'eye effect', although the starches tend to dominate in flavoured syrups for use in dispenser-distributed beverages. The gum is also used to a rather smaller extent in flavouring products, again for its emulsifying, stabilising or suspension-forming properties. These uses include powdered flavourings, in which citrus essential oils are encapsulated in gum to preserve their flavouring properties; such products are widely used in beverages and bakery preparations such as cake mixes. Other food applications include wine processing and the brewing industry, mainly for the gum's qualities as a stabiliser.

Non-food uses for gum arabic are, taken as a group, far less important than are the food-related uses. The non-food uses include offset lithography in the printing industry, where the gum is used variously as a base for photo-sensitive chemicals, as a component of the solutions used to impart ink-repellency to metal plates, and as a coating to prevent the plates from oxidation; talha gum is often used in these applications. Gum arabic was also traditionally used as the basis for adhesives, for example in the bottled adhesive gum so familiar in offices, or in remoistenable adhesives as used on postage stamps, gummed labels and so forth; however, its use on stamps has almost entirely yielded to synthetics, while its use in adhesives is nowadays mainly restricted to children's glues and perhaps a few office glues. It was once widely used in paints and inks but has to a great extent been supplanted by synthetics in these applications. In the same way, gum arabic's traditional uses as a sizing and finishing material in the textiles industry have also mostly given way to modern substitutes. However, small quantities continue to be used in paper-making, including the manufacture of carbonless copying papers. The gum is also used to a limited extent in polishes, in contact insecticides and pesticides, in photographic emulsions, and in technical ceramics for use in the modern electronics industry. There is also limited usage in pharmaceuticals, where the gum is used as a compression, granulation, tablet-forming or coating agent, although synthetics have largely displaced the natural product in this area.

As may be inferred from a previous paragraph, talha gum from *A. seyal* is used almost exclusively in undemanding non-food applications, although it should be noted that low-grade gum arabic rather than true talha gum is preferred in the manufacture of certain products such as polishes and, although not in every case, textiles.

PRODUCTION AND EXPORTS

Virtually all gum arabic produced in the Sahelian zone is exported, either immediately or after a period of storage or stockpiling. During the period 1975-1977 gum arabic exports averaged slightly over 30,000 tonnes per annum and steadily recovered from the low point of just over 21,000 tonnes in 1975. Exports from 1978 are shown in Appendix A, Table 1.

Sudan

Prior to the mid-1970s **Sudan**'s share of the gum arabic market was typically between two-thirds and three-quarters, almost all of the balance being accounted for by the Sahelian zone countries of West Africa. However, the severe drought of the early 1970s brought about a massive reduction in the natural stands of *Acacia* trees in the latter region, as a result of which Sudan's dominance in the trade substantially increased. During the period 1977-1984 Sudan accounted on average for 90% of world gum arabic exports. At the end of 1984, the effects of a combination of renewed climatic irregularities and prolonged civil conflict in Sudan brought about a severe shortage of Sudanese gum arabic, its effect on overseas markets being the more pronounced for there having been no clear warning from the sole Sudanese exporter (The Gum Arabic Company of Khartoum) that stocks were close to exhaustion. By the end of 1986 the situation had improved markedly and the prospects for a steady flow of supplies were much improved.

West Africa

Nigeria is the most important producer after Sudan, having overtaken Mali during the 1980s. However, in spite of a regular following among some overseas customers, mainly in the English-speaking world, Nigerian gum arabic does not enjoy the consistently high reputation of the Sudanese product. The reasons include a somewhat unstructured and therefore unpredictable internal marketing system; failure of some consignments to match corresponding samples, although this problem has not been experienced with the best-known traders; and variable quality, particularly in relation to colour, which is often purplish rather than the preferred amber. **Mali** has become, since the early 1980s, a less important producer than it was previously, although it continues to be a regular exporter with reputable traders. It has a generally better market structure than Nigeria's, and offers a range of grades, the best of which rival the Kordofan grades although available only in very small quantities, the lowest comparing unfavourably with even the cheapest Sudanese grades. **Senegal** and **Mauritania** possess extensive stands of *Acacia* trees but, although gum quality is often high, production and exports have been irregular in volume and generally falling; in the case of Mauritania this was partly a result of a degree of State involvement which was not welcomed by the traders and which has caused periodic smuggling of gum from Mauritania to the Senegalese port of Dakar. In both countries attempts are being made, with West European assistance in Senegal and UN assistance in Mauritania, to reverse the production trend. Production in **Niger** and **Burkina Faso** has been virtually negligible for some years, although the possibility of regenerating Burkina Faso's industry has been the subject of recent study. Similarly **Chad**, a country with large resources of *Acacia*, has exported the gum very infrequently in recent years, mainly on account of the local civil conflict, although prior to the war it was a regular supplier with an excellent reputation. The status of the **Côte d'Ivoire** as a producer and exporter is unclear; while it is entirely

possible that production may take place in the arid north of the country, there is also a strong possibility that the Côte d'Ivoire's trade may consist merely of re-exports of gum arabic of other origins, for example Burkina Faso or Mali.

Tanzania and **Kenya** are known to have produced and exported gum arabic from time to time but their role in the trade is a very minor one. Exports from **Cameroon** have been recorded but it is generally accepted that this was a re-export trade, the origin of the consignments being mainly Chad. It is known that some gum collection takes place in **Ethiopia**, and although some export consignments from that source may from time to time have included parcels of Sudanese gum smuggled over the border, Ethiopian gum is known to a few European buyers and it is possible that Ethiopian production, which is at present negligible, could increase in the event of an easing of the current local political and economic difficulties.

Other

Outside Africa, production of generally low-quality gum similar to talha gum takes place under primitive conditions in **India**, mainly in Gujurat and the sub-Himalayan regions, but in very small quantities only; exports are recorded with fair regularity, but at least a proportion of these consignments are either re-exports of African gum or else may consist of local **gum ghatti**, incorrectly recorded as gum arabic.

Until the recent shortages, the rough balance of annual world production was as follows: Sudan 40,000 tonnes, Nigeria 3,000 tonnes, other producers 2,000 tonnes in total, most of these minor producers rarely accounting for more than a few hundred tonnes annually, even tens of tonnes in a few cases. At the end of 1986, the worst of the shortage was over but a few 1984 trading contracts were reputed to be still in the process of being fulfilled, while the Sudanese production potential was not considered likely to exceed 30,000 tonnes per annum in the short term and 35,000 tonnes in the longer term. However, the temporary system of rationing supplies between the various buyers is expected to end during 1987. Reductions in production of a similar order also apply in West Africa. In Sudan, the combined effects of drought, civil conflict and low farm-gate prices have forced many collectors to move away from the traditional producing areas, while the former cleaners and sorters, who were often Mecca pilgrims, are also far fewer in number. However, there are no grounds for ruling out a further recovery in Sudan's production potential in the long term, and there remains a considerable body of respect for the Gum Arabic Company. In spite of the period of shortage, Sudan's dominance in the market appears not to have been reduced significantly, given the West African producers' parallel difficulties during the same period. A particular problem for the West African producers over a number of years has been the fact that they have been obliged to hold their prices broadly in line with those set by the Sudanese exporter, which often meant that the real value of their revenue has fallen. In view of all the circumstances, it is surprising that there were so few attempts on the part of the West African producers to take advantage of Sudan's recent difficulties, although it is clear that one or two influential traders took advantage of the situation. There is evidence that some consideration has been given to the possibility of co-operation between producing countries with a view to improved plantation management, preparation and packaging. Natural regeneration of the *Acacia* trees has been seriously retarded by over-population, over-grazing and natural disasters such as prolonged drought; managed plantations are therefore widely recognised as essential to the gum arabic trade if the natural *Acacia* stands, in which yields are low and working conditions increasingly difficult, are to be adequately protected. There would therefore clearly be advantages to all producers in co-operation across national boundaries, particularly if wasteful duplication of research is to be avoided. Nevertheless, it is highly probable that Sudan will continue to dominate the market, especially since few West

African producers can match the quality of the best Sudanese gum in a market in which user quality requirements are becoming ever more critical.

There are two respects in which Sudanese gum arabic trading has failed to attract the confidence of users. The first relates to the alleged maintenance of a buffer stock by the Gum Arabic Company. In reality, it would appear that the Gum Arabic Company first accumulated large stocks in the wake of the crisis of the early 1970s, at a time when many users switched away from gum arabic to alternatives, leaving the Gum Arabic Company with little alternative but to hold stocks of unsold gum. Although a degree of stocking has occurred since then, it does not appear to have been done on a consistent basis and it is possible that an appreciable proportion of the stock has often consisted of talha gum, which is less easy to sell than true gum arabic. It is unlikely that a buffer stock in the usually-accepted sense of the term has ever been consistently maintained in Sudan, and it is possible that, by the time when the late 1984 shortage came to light, local stocks had been close to zero for many months. The second area of failure concerns recent attempts to market a spray-dried gum of Sudanese origin. A local factory was established during the early 1980s, using modified Soviet-made equipment originally designed for the spray-drying of milk. Virtually all importers and users contacted during the course of the study considered that the quality of the locally-made product was poor, and that the products of European and United States spray-drying firms were so superior that their increased cost over the Sudanese product was more than justified. While some users expect Sudan to make further attempts to penetrate the market for processed gum arabic, it may well be some time before such attempts bring about any appreciable change in trading patterns.

GRADING, QUALITY, TOXICOLOGY AND PACKAGING

Only Sudan has a well-established grading system for gum arabic, the main Kordofan grades being as follows (alternative terms, used mainly in the United States where some re-grading and re-processing may take place, are shown in brackets):

Hand-Picked-Selected or HPS (Selected Sorts)
Cleaned and Sifted (Clean Sifted Sorts)
Cleaned (Cleaned Amber Sorts)
Siftings
Red
Dust

Occasionally consignments of a low-grade gum, with a relatively high sand and bark content, are marketed. This is not the same as talha gum, which has already been mentioned. Because of gradual loss of buyer interest in the lower grades, there has in recent years been an increasing tendency for the Gum Arabic Company to insist that buyers place orders only for consignments of a range of grades, rather than of a single grade, in order to be sure of disposing of its stocks of lower-grade gum. A customer might, for example, be obliged to accept a few bags of siftings or dust within an order mainly for the 'Cleaned' or 'HPS' grades. This practice has tended to bring the grading system into disrepute with some Western buyers, many of whom are obliged to use only gum arabic meeting the specifications of the European Pharmacopoeia, British Pharmacopoeia or other national standards such as those laid down by the United States Food and Drug Administration or the West German DAB. Some of these buyers, dissatisfied both with the grading system and with the apparent lack of adequate local cleaning facilities, have responded by installing sophisticated cleaning equipment which can substantially upgrade the quality of even low-grade gum arabic, albeit at fairly high cost. A consequence of this development is that for these users the grading system is now of only limited significance, and there is a growing unwillingness to support local

changes in grading procedures if higher f.o.b. prices are likely to be a consequence.

West African producers in general have far less comprehensive grading systems than has Sudan; even where they exist, buyers are reluctant to rely on them owing to wide quality variations within the grades, preferring instead to buy on sample, although it has been known for consignments not to match corresponding samples. Although good-quality West African gum is available, the quantities are not great.

Gum quality depends not only on the species exploited but also on other factors such as the soil characteristics of the geographical source, recent climatic conditions and precise time of harvesting. Even within the better-quality Sudanese grades, there can be variations in gum character arising from the above influences, some consignments yielding a smooth consistency in solution, others a more stringy consistency, a difference which may matter in applications such as lithography. Gum arabic from some sources, for example Kenya or Tanzania, tends to be dark red in colour rather than amber, which may preclude its use in certain applications such as beverages, where 'eye-appeal' is an important factor. Similarly, gums from some regions are more brittle than others and differences of this type are of importance for the main types of confectionery made. Less defensible quality variations relate to excessive bacterial loads and contamination with sand, bark and other foreign matter. The United States Food and Drug Administration's regulations in relation to such contamination are stringent and rigorously enforced. Although contaminated consignments may not be rejected outright, on-the-spot treatment at the port of entry is obligatory.

High-grade gum arabic for food-additive use is required to meet the various specifications published in the various consuming countries, precise requirements varying from country to country. Food-grade gum is recognised as GRAS (Generally Recognised As Safe) in the United States, although the United States' Food and Drug Administration's usual labelling procedures still have to be followed. Moreover, the results of toxicity tests carried out between 1978 and 1982 led to food-grade gum being rated 'Acceptable Daily Intake (ADI) Non-Specified' in the European Community, indicating that it may be used without restriction as a food additive up to a maximum of 2% of the final product. Food-grade gum also carries the official additive number E 414 in the European Community. It should be noted that the specifications laid down in the longer-standing Pharmacopoeias differ somewhat from those applicable to food-grade gum. It should also be noted that the talha grade and the majority of West African grades with positive optical rotation fail to meet any of the foregoing specifications.

At one time gunny bags of net weight 100 kg were used for the transport of gum arabic. Nowadays, although gunny bags continue to be used, the net weight is usually 50 kg.

IMPORTS AND MARKETS

World consumption of gum arabic, which at the beginning of the 1980s was in the region of 40,000 tonnes per annum, has declined as a result of the recent shortages and high prices, and in 1987 is not expected to exceed 30,000 tonnes.

Western and Northern Europe

The combined markets of the European Community (of 12 nations), Switzerland and Scandinavia account for around 40% of world purchases of gum arabic, that is to say 15,000-16,000 tonnes per annum prior to the recent shortages. Gross imports, indeed, are considerably greater than this, in the region of 30,000 tonnes, but France and to a lesser extent West Germany and the United Kingdom are important entrepôts and large quantities of gum arabic

are re-exported outside the region, while there is also an appreciable amount of cross-border trade within the region. In Europe gum arabic is used in confectionery products such as gums, pastilles and sugar-coated candies; in powdered flavours; to a smaller extent in beverages and sodas and in the processing of wine; in some health and slimming products; and in a few non-food uses such as offset printing, paints, inks, adhesives and one or two others. The applications of gum arabic in confectionery products, powdered flavours and health products, in which the gum may account for a major proportion of the formulation, are highly price-sensitive.

France has in the past been both the largest entrepôt for gum arabic and also the largest consuming country in the region. However, at the beginning of 1987 there were signs that this may cease to be the case in future. The recent French trade in gum arabic is shown in detail in Appendix A, Table 2 and summarised below.

Table A

Imports of gum arabic into France

Year	Gross imports (m.t.)	Exports (m.t.)	Apparent consumption (m.t.)
1979	13,622	8,252	5,370
1980	11,939	8,330	3,609
1981	12,051	8,287	3,764
1982	12,382	8,108	4,274
1983	15,064	9,654	5,410
1984	10,564	7,654	2,910
1985	9,559	5,558	4,001

Note: m.t. = metric tonnes

Annual consumption has therefore averaged around 4,000 tonnes per annum, with an additional 8,000 tonnes re-exported. The French trade has been dominated by a Paris-based firm which has controlled 75-80% of all gum arabic passing through France, but whereas this firm handled in the region of 90% of France's re-export trade, it accounted for no more than 35-40% of the gum arabic consumed within France. Unlike most other French importers, this firm purchased gum in sufficiently large consignments for it to be eligible for discounts from the Sudan Gum Arabic Company, thereby placing it at a further advantage in world markets. It is also noteworthy that this firm overwhelmingly dominates world trade in gum arabic from the francophone West African producers. Nonetheless, because of Sudan's dominance of the export trade, the greater part of the gum arabic consumed within France is of Sudanese origin, while West African sources include Nigeria as well as the francophone countries; however, some French traders considered that the proportion of French consumption attributable to the francophone suppliers is likely to increase. The main grades imported are Kordofan, HPS and cleaned; imports of low grades and talha gum are rather less common, although it was reported that low-grade gum from Mali is sometimes blended with better grades. Little or no spray-dried gum arabic is imported from Sudan. Some users undertake their own grinding but one or two of the importer-dealers, of which there are five or six in all, offer a full cleaning and grinding service. Imports typically pass from the importer to a processor and then to the final user. Overall consumption in France is at best stable, maybe even falling slightly. Confectionery and food flavourings are quite important outlets but pharmaceuticals and the perfumery and cosmetics industry are also important. One importer noted that the growing preference of many Western consumers for products containing ingredients of natural origin appeared not to be in evidence in France where gum arabic is concerned. No change in current consumption trends in France is expected.

The **United Kingdom** is the second most important European consumer of gum arabic. The United Kingdom trade is shown in Appendix A, Table 3 and is summarised below.

Table B

Imports of gum arabic into the United Kingdom

Year	Gross imports (m.t.)	Exports (m.t.)	Apparent consumption (m.t.)
1979	5,162	544	4,618
1980	3,917	649	3,268
1981	4,889	584	4,305
1982	4,532	877	3,655
1983	10,089	3,814	6,275
1984	8,851	6,901	1,950
1985	6,653	5,463	1,190

Annual net imports during the period 1981-85 averaged around 3,500 tonnes, although with considerable year-to-year variation, the volume of both gross imports and exports having increased dramatically from 1983 onwards. There are four main importers, of which one is dominant and closely linked to the Gum Arabic Company. A fifth firm handles gum arabic in small quantities, and with decreasing frequency. In contrast, around fifteen firms were actively importing the gum at the beginning of the 1970s, severe competition having taken a heavy toll. All of the importing firms undertake a degree of further processing of the gum before resale to users. Probably 75% of United Kingdom consumption of gum arabic is attributable to the confectionery industry, although there have been recent suggestions that this proportion may decline appreciably. A major United Kingdom confectionery manufacturer, which imports both direct and through dealers, uses Nigerian gum arabic in large quantities as well as the Sudanese product; the Nigerian product is actually preferred in certain types of product on account of its special consistency. Other important applications include pharmaceutical pastilles and tablet-coatings, flavourings for a range of food and beverage products, and carbonless copying paper. There have been reports of a major recent reduction in the gum arabic content of some major lines of so-called gum confectionery, mainly as a result of the high price prevailing at the end of 1986. The overall trend in consumption is not encouraging, the synthetic substitutes such as modified starches and carboxymethyl cellulose (CMC) having made substantial inroads. Although gum arabic has been regarded as technically superior to all challengers in many forms of confectionery, the cellulose-based synthetics have improved steadily to a point at which gum arabic no longer has the advantage, and the best prospect for future consumption of gum arabic in the United Kingdom is one of broad stability at around current levels, and it must be stressed that this conclusion presupposes an early price reduction; prolonged maintenance of a price of close to $5 per kg could bring about a severe collapse of the United Kingdom market, and even the promised reduction to $4 per kg is unlikely to make an appreciable difference.

Italy has become a major European consumer of gum arabic in recent years, average annual imports being in excess of 3,000 tonnes. Details of Italy's trade are given in Appendix A, Table 4 and summarised below.

Table C

Imports of gum arabic into Italy

Year	Gross imports (m.t.)	Exports (m.t.)	Apparent consumption (m.t.)
1979	3,089	29	3,060
1980	2,698	22	2,676
1981	3,810	11	3,799
1982	2,693	18	2,675
1983	3,529	25	3,504
1984	3,780	23	3,757
1985	3,073	107	2,967

The gum is imported mainly by dealers who mostly sell to a few large manufacturers of gum confectionery, much of which is exported. There is also a substantial amount of brokerage trade on a commission basis (1% *ad valorem* being a typical charge) but many of the consignments involved, being destined mainly for other countries, do not enter Italy at all. Usage of gum arabic in applications other than confectionery in Italy is small. There is some usage of modified starches in confectionery but they are regarded as second-best to gum arabic, which will therefore continue to be used in better-quality products as long as shortages such as occurred in 1985-86 do not recur and its price rapidly moves into a more appropriate relationship with those of the starches. In comparison with France and the United Kingdom, the prospects for market growth in Italy seem comparatively good.

The **Federal Republic of Germany** (West Germany) is a comparatively small user of gum arabic, especially in relation to its size. Around two-thirds of gross imports are re-exported from the port of Hamburg, to Scandinavia, Eastern Europe and other Western European countries. The recent trade pattern is summarised overleaf, full details being given in Appendix A, Table 5.

The import trade is dominated by five or six dealers and brokers, and by one in particular. Internal consumption now averages no more than 1,200 tonnes per annum, and is not increasing. Very little is used in confectionery, in which modified starches are firmly established, although slimming products still incorporate gum arabic since starches contain too many calories. The main West German applications include food flavourings, pharmaceuticals, textiles, lithography and a few uses in which the gum's emulsion-forming and film-forming properties are critical. Mainly the higher grades are used; in spite of the fact that in some years several hundred tonnes of talha gum are imported, it would appear that most is re-exported. Sudanese gum is generally favoured, although limited imports from West African sources, for example Mali, are regularly recorded. There is little prospect of any expansion in West German gum arabic consumption in the foreseeable future, and indeed unless the price of the Kordofan grades falls substantially from present levels in the very near future, there could be a further contraction of the market.

Table D

Imports of gum arabic into the Federal Republic of Germany

Year	Gross imports (m.t.)	Exports (m.t.)	Apparent consumption (m.t.)
1979	3,276	1,890	1,386
1980	3,714	2,299	1,415
1981	3,861	2,180	1,681
1982	2,843	2,081	762
1983	3,608	2,095	1,513
1984	4,547	3,106	1,441
1985	4,628	3,664	964

The **Netherlands**, **Belgium** and **Luxembourg** are minor consumers of gum arabic, notwithstanding an appreciable re-export trade from Belgium. Details of the trade of each country are given in Appendix A, Tables 6 and 7 and are summarised in Table E below. Total apparent internal consumption for the three countries combined averaged just over 1,100 tonnes per annum during the period 1981-85. In the Netherlands and Belgium, one or two importing firms, equipped with cleaning and re-processing equipment, dominate the import trade, although some users do their own reprocessing. Although consumption in the Netherlands during the 1970s ran to thousands of tonnes, it is now well down into the hundreds, modified starches and other synthetics having made severe inroads, particularly in the confectionery and lithography applications. Only premium grade confectionery now incorporates the natural gum. One-third of Netherlands imports is destined for spray-dried flavour products, although Sudan's spray-dried product is emphatically disliked; apart

from confectionery and lithography, the balance is used mainly in pharmaceuticals and a few adhesives. The balance of Belgian consumption is similar. Little gum arabic is imported from sources other than Sudan. The current trading pattern is unlikely to change, and consumption levels are not expected to increase, even in the event of a substantial downturn in the price.

Of the **other EC markets**, such as Denmark, the Irish Republic, Greece, Spain and Portugal, only Denmark is of more than minor importance, and none possesses any special features setting them apart from the rest of Europe. Denmark's consumption is attributable mainly to manufacturers of Scandinavian confectionery. Outside the EC, **Switzerland** is of moderate importance insofar as there are seven or eight Swiss blenders who import, grind and blend water-soluble gums, in considerable measure for the export market. The Swiss market is less heavily dominated by confectionery manufacturers than some other markets, although the opposite is likely to be true of gum arabic usage on the Iberian peninsula. No great increase in gum arabic consumption is likely in Switzerland, and although there is a rather greater likelihood of market growth in the Iberian countries, this is likely to be offset by losses elsewhere in Europe.

Table E below summarises gum arabic consumption in those EC countries not covered by the previous summary tables.

TABLE E

Apparent consumption of gum arabic in the Netherlands, Belgium/Luxembourg, Denmark, Irish Republic, Greece, Spain and Portugal

(tonnes)

	Netherlands	Belgium/ Luxembourg	Denmark	Irish Republic	Greece	Spain	Portugal
1979	382	293	1,425	469	405	n.a.	n.a.
1980	391	703	1,293	267	335	n.a.	n.a.
1981	425	700	1,507	532	272	n.a.	n.a.
1982	353	760	1,354	234	163	488	28
1983	414	711	1,296	349	154	571	57
1984	577	751	1,687	326	175	522	35
1985	307	483	1,397	590	88	n.a.	n.a.

Source: Trade returns n.a. not available

Northern Europe, that is to say **Scandinavia** excluding Denmark (already discussed in the paragraphs on the EC countries) has traditionally been an important market for gum arabic, especially on a *per capita* basis. Most imports into Sweden, Norway and Finland are routed either through Hamburg or through a United Kingdom port. Until the recent shortage, consumption in these countries averaged in the region of 2,500 tonnes per annum, the dominant application being sugarless gum confectionery, other uses accounting for no more than 10-15% of total consumption. Since many Scandinavian products are designed specifically as low-calorie products, replacement of gum arabic with modified starches is not possible. Nonetheless, concern at the recent shortages and current high price has been considerable, and it has been reliably reported that at least one major Scandinavian confectionery manufacturer has dropped gum arabic from most of its products, representing a loss of maybe 25% of the total Scandinavian market, although it remains to be seen whether this loss is permanent. In the absence of the recent crisis in the gum arabic market, it might have been possible to predict a modest growth in Scandinavian gum arabic consumption, especially in view of the aggressively export-oriented policy of certain key manufacturers in the region. However, unless stability is rapidly restored to the market, it is difficult to foresee other than a flat, stable market, and maybe even a decline if other manufacturers of gum confectionery drop gum arabic from their formulations.

Details of imports of gum arabic into Sweden, Norway and Finland are given in Appendix A, Table 8.

United States

The United States is the largest single market for gum arabic, annual consumption currently being in the region of 8,000-9,000 tonnes. The recent import trend is summarised below, full details being given in Appendix A, Table 9.

Table F

Imports of gum arabic into the United States

tonnes

1979	9,882
1980	9,922
1981	8,645
1982	6,658
1983	8,647
1984	11,574
1985	7,205

Although there is a re-export trade, it is proportionately far smaller than that of France, West Germany or the United Kingdom. Gum arabic is imported both by intermediaries such as dealers or agents based mainly in the New York area, some of whom reprocess it before resale, and by the largest users direct. Well over 90% of the United States's supplies are of Sudanese origin, West African gum too frequently failing to meet the quality requirements of United States users. In particular, Nigerian samples have been regularly rejected in recent years, and although Nigerian gum was used in its own right when Sudanese gum was scarce and continues to be imported in small quantities, it generally has to be blended with better qualities of Sudanese gum before it can be used. One importer reported having modest stocks of Mali gum, but in general imports of gum from francophone producing countries are uncommon; a common comment on gum of non-Sudanese origin is that it tends to be too viscous, and originates in species other than *Acacia* which are not recognised as yielding foodstuff grades. Although many United States users specify a need for spray-dried gum, the Sudanese spray-dried product was never accepted and all spray-dried gum for the United States market is either manufactured in the United States or imported from Europe or Japan. Returning to unprocessed gum, the main grade imported is locally described as 'Clean Amber Sorts', which is synonymous with the 'Cleaned' grade; other grades used in much smaller quantities include 'Selected Sorts', which is identical to 'Hand Picked Selected', and 'Clean Sifted Sorts', elsewhere known as 'Cleaned and Sifted'. Normally, little tahla gum is imported, probably no more than 200 tonnes annually, and although imports of this type increased temporarily when the best grades were scarce, it was found unsatisfactory for many purposes, and it is used exclusively for non-food applications. In contrast with the European market, the main applications in the United States are for the emulsification of beverage flavours and, to a much smaller and decreasing extent, food products. This sector accounts for 45% of the United States market, 35% in beverages and 10% in food. Lithography accounts for around for 20%, confectionery for 10-15%, pharmaceuticals (mainly tablets) and cosmetics for up to 10%, prepared foods such as salted peanuts and other sweet or savoury products requiring a protective film coating for 6%, with the balance of 5-10% mostly attributable to non-food applications, mainly in the photographic, pesticides and electronics industries. Health foods and wine stabilisation are among the gum's residual uses. These applications are described in rather greater detail in the section on Uses.

Although no completely consistent picture has emerged, it is clear that the effects of the post-1984 shortage, and in particular the end-1986 price levels of around $5/kg, have brought about a large reduction in United States usage of gum arabic. In the dominant soft drinks sector, one major manufacturer has severely cut back gum arabic consumption in its South-American-based operations, mainly in products destined for consumption within the country of production, since shelf-life is less critical than for export items. Even within the United States the firm has reformulated certain of its lines in such a way as to reduce the need for gum arabic. Had this firm, and many other United States firms, not had substantial stocks of gum arabic at the time of the shortage, the embarrassment caused might have brought about an even larger move away from the natural product. In spite of gum arabic's technical superiority and the frequent claim that modified starches have inferior 'mouthfeel', and are less effective as clouding and emulsifying agents, protective colloids or foam stabilisers, the unremitting research effort on the development of good-quality substitutes appears to be bearing fruit. Moreover, one or two informed United States observers expressed the view that, in the event of a major switch by the major soft-drinks multinational firms away from gum arabic, very many smaller firms would follow suit. The above general observations on the soft drinks industry also broadly apply to coatings for chocolate and candies. In the pharmaceutical industry, where gum arabic has been used extensively in tablet colourings and coatings, usage is in any case nowadays much reduced, and further reductions can be expected, although one major multinational company still uses the natural gum for the interior binding of tablets. The 'Selected Sorts' grade is generally required for tablet manufacture, to avoid speckiness in the final product. Among non-food uses, lithography is one of the more demanding and, although gum arabic is very serviceable, some consignments have a stringy consistency which renders the gum less convenient in use, and here as elsewhere there has been steady development of alternatives. Similar conclusions apply to carbonless papers.

Competition within the gum-arabic-using sectors of the United States industry is fierce and, while the natural product continues to be admired, it was stressed that users would not hesitate to discard it in favour of those synthetics for which supplies are more dependable and prices more stable, in the event either of continuation of current price levels much beyond the early months of 1987 or of further dislocation of supplies. It is likely that the price would need to fall to below $3 per kg, and probably below $2.50 per kg, for the 'Clean Amber Sorts' grade before there would be any likelihood of recapture of lost outlets, but even on the most favourable assumptions there is unlikely to be any appreciable growth in the United States market.

Japan

Japan is an important outlet for gum arabic, taking some 2,500-3,000 tonnes annually. Details of recent Japanese imports are given in Appendix A, Table 10. The balance of usage is broadly similar to that in the United States, the main areas being the flavouring of beverages and foodstuffs, with perhaps rather greater emphasis on the latter. Other areas of usage include confectionery and the photographic and electronics industries. There appears to be a greater tendency in Japan than elsewhere to regard gum arabic as a premium-grade product, especially in certain areas of food flavouring and in confectionery, and some users are therefore less concerned about high prices, believing their clients to be more quality-sensitive than price-sensitive. For this reason there was a belief in some quarters that Japanese buyers might be prepared to accept the end-1986 price level over a longer period than might European and United States buyers, and thereby contribute to a further fall in United States and European consumption by helping to maintain the $5/kg level for longer than would otherwise be the case. However, gum arabic is doubtless used in many Japanese products for which demand is very price-sensitive, and it is likely that the Japanese market as a whole would favour at least some reduction in

the price, while a substantial reduction below the $2.50/kg level might bring about some increase in Japanese consumption. At the same time, it is worth noting that there has not been an increase in gum arabic consumption since the mid-1970s, and there is no reason to believe that price-elasticity of demand is as great as appears sometimes to have been assumed.

Other markets

Markets other than those discussed above consume the equivalent of about 3,000-5,000 tonnes of gum arabic annually. However, many do not import the crude gum direct from source, but rather import gum that has been subjected to further processing, such as spray-drying, from Western processors. Often these processed gums do not enter into the trade statistics as such, and the above figure is therefore only an order of magnitude. There are, of course, exceptions to the above rule, one being India, which imports fairly large quantities direct from source, as well as possibly producing small quantities domestically, as discussed in a previous section. In many of these minor markets, however, tastes are relatively unsophisticated, and price is accordingly a more important consideration than quality. For this reason, even though rising consumer incomes in these markets will undoubtedly create a growing market for confectionery, soft drinks and so forth, it is likely that synthetics, rather than natural gum, will benefit from the general market growth, even if the price of gum arabic does fall substantially during 1987.

PRICES

The recent trend in the price of Sudanese gum arabic is shown in the table below (for comparison, London prices are given in Appendix A, Table 11):

Table G

Gum arabic – prices, f.o.b. Port Sudan

United States $/tonne

Season	Cleaned	Hand-Picked-Selected
1977/78	1,200	1,300
1978/79	1,280	1,380
1979/80	1,410	1,510
1980/81	1,500	1,650
1981/82	1,500	1,750
1982/83	1,500	1,750
1983/84	1,500	1,750
1984/85	1,600	1,800
1985/86	1,900	2,250
end-1986	5,000	6,000

Sources: The Gum Arabic Company up to 1982/83, importers for subsequent years

The price of the 'Cleaned and Sifted' grade is usually mid-way between those of the 'HPS' and 'Cleaned' grades. At the time when the f.o.b. price of the 'Cleaned' grade was $1,600 per tonne, the 'Siftings' grade was being marketed at about $1,300 per tonne and 'Dust' at $1,000 per tonne. Non-Kordofan grades, whether from Sudan or elsewhere, are priced at between 20% and 50% of the price of the 'Cleaned' grade, the precise level being subject to negotiation between buyer and seller. To these f.o.b. prices should be added $120-200 per tonne to give corresponding c.i.f. prices for Hamburg, New York or London.

The Gum Arabic Company (GAC) in the past used its discretion in the granting of small discounts on large-volume purchases of gum arabic. This aspect of the GAC's trading policy was not universally popular, effectively discriminating against the small trader, whose margins may in any case be

tighter than those of larger-volume traders. It appears that, at the time of the 1984/85 shortage, no discounts were offered.

On the whole, the GAC's fixed-price policy has been welcomed by buyers, providing a welcome degree of stability to the market. However, the strength of the United States dollar during the early 1980s caused the price to non-dollar economies to be high in relation to synthetics produced outside the United States, and reinforced the steady advance of the latter until the downturn in the value of the dollar. At the onset of the 1984/85 shortage, the GAC initially refrained from taking advantage of the situation by raising the price unduly. Subsequently, however, at the height of a panic among overseas buyers which enabled some intermediate traders to make windfall gains by temporarily charging up to $19 per kg, increasing pressure was brought to bear on the GAC from within Sudan by local traders who observed that the high international prices were not filtering down to the local Sudanese trade. The obvious tactic of the local traders was either to refuse to release their stocks to the GAC or else to attempt, often successfully and under inducement from certain importers, to smuggle their gum out through more remunerative routes, for example via Chad and Cameroun. In the end, under additional pressure from another source, namely the Ministry of Commerce, and in spite of the fact that the worst of the pressure of demand had eased, the GAC was forced to concede a substantial price rise which brought about the end-1986 level of $5/kg. Shortly before the end of 1986, a group of key overseas buyers met the Sudanese Minister of Commerce in Rome and attempted to negotiate a reduction in the price; further meetings were subsequently held in Brussels, Khartoum and London, but by the year's end there was still no indication of an early substantial price cut, although a nominal reduction to $4.95 per kg occurred in early 1987 and the GAC undertook to reduce the price to $4 in the autumn of the same year. It would appear that at the beginning of 1987 the GAC had lost, at any rate temporarily, some of its independent freedom of action in respect of price fixing; it would also appear that certain vested interests in Sudan argued that the international price-elasticity of demand for gum arabic is such that greater revenue would accrue from selling a smaller quantity at a high price than by re-establishing and maintaining the earlier price levels. There may be some truth in this view, but if it were to prevail, the significance of gum arabic as a source of employment in Sudan and elsewhere would be much reduced and, while overall income levels might not be reduced, the distribution of the overall income would certainly be affected adversely. In any case, there is almost certainly still scope for increasing local farm-gate prices while reducing the overall level of local taxes on the gum trade, without any need to raise the long-term f.o.b. price level.

The cost of freighting gum arabic from origin to destination is typically in the range $120-200 per tonne including insurance, the lower end of the range relating mainly to European destinations, the higher end to more distant destinations such as the United States and Japan.

TRADING STRUCTURES AND PROCEDURES

The observations made at the conclusion of the preceding section were made in the context of the very large number of Sudanese directly or indirectly involved in the production of gum arabic, notwithstanding the extensive involvement of itinerant foreigners, often Mecca pilgrims. Between the producers and the GAC is a network of cleaners and graders and local auction floors, use of the latter involving the payment of royalty fees charged mainly by local authorities, although a proportion of the royalties is destined for Central Government. The GAC, which is approximately one-third State-owned and two-thirds privately-owned, has a statutory monopoly in the export of gum, although – as has been mentioned earlier – illicit cross-border trade readily takes place whenever local traders judge that the advantages outweigh the risks. The capacity of the GAC's warehouse is 60,000 tonnes and therefore

far exceeds recent annual sales of gum arabic, even allowing for a buffer stock of up to 20,000 tonnes. The main weakness of Sudan's internal trading structure lies in the country's poor infrastructure which, of course, has been dislocated by prolonged civil hostilities and the effects of the drought. However, now (early 1987) that the institutional and climatic factors present fewer obstacles than existed up to the end of 1985, there are likely to be sustained attempts to remedy the infrastructural deficiencies. Attempts have already been made to reduce the cumulative incidence of taxation, in the form of auction royalties, duties and export taxes, on the f.o.b. price, in order to be able to offer a more attractive producer price without affecting the price to the user.

The gum arabic trade in West Africa is far less structured than that in the Sudan, a fact which militates against user confidence. Partly to overcome this deficiency, the major French buyer of gum arabic maintains a network of travelling agents in the francophone producing countries, who foster contact with a wide range of farmers and collectors and help to maintain a regular flow of trade. It is for this reason that, as has already been observed, most West African gum, other than Nigerian, is traded through France, although a few consignments continue to be traded direct to West Germany and North America. This system works particularly well in Mali, where recently the government has encouraged private sector domination of the industry. The Senegalese industry is also still to some extent in private hands, but the aforementioned State involvement in the industries of Mauritania and Niger has brought about a near-disappearance of the the product in both countries. The Nigerian industry is also dominated by the private sector, but has in general lacked the involvement of an external trading company, and in spite of its relatively high level of production by West African standards, the lack of a consistently efficient marketing structure has caused periodic problems and abuses which have done nothing for user confidence.

Much of the gum arabic from the francophone producing countries is traded through the French ports of Rouen, Le Havre and Marseille and the Belgian port of Antwerp. Large quantities of Sudanese gum are also traded through these ports of entry, but much also passes through United Kingdom, United States or West German ports such as London, Felixstowe, Hamburg, New York and the major Japanese ports. The greater proportion of Nigerian gum passes through the United Kingdom, which is any case its largest consumer. It has already been observed that there is considerable cross-border trade within Europe, mainly through the activities of international dealers. There are also a few commissioned brokers in the trade, their charges typically being 1-2% *ad valorem*. Their importance, as is the case in relation to many other commodities, is generally declining, although there are one or two United States 'agents', which are similar but generally take a commission from the seller only (again typically 1-2%), which continue to be influential. Several United States buyers use agents based in New York rather than buy direct.

Terms of trade vary somewhat. Some exporters insist on the opening of letters of credit, especially with smaller buyers, but some of these buyers insist on only half-payment on opening of the letter of credit, the balance being due after inspection of the produce on arrival. In other cases, payment either against or within a few days of receipt of documents (cash against documents, or c.a.d.) is the rule. Most purchases are negotiated on an f.o.b. basis if direct from origin, although c.i.f. or c.& f. basis is not unknown, especially if negotiated through an intermediary.

The substantial reduction in tariffs on a wide range of commodities in recent years, especially on those originating in developing countries, has benefited the gums trade, and in the main markets import duties on gum arabic are nil or negligible.

GENERAL OBSERVATIONS, CONCLUSIONS AND PROSPECTS

The overall tenor of trade comment received during the study tended not to bear out the rather over-optimistic conclusions of the earlier study, in which it was postulated that a considerable increase in worldwide gum arabic consumption would be likely to occur in the event of a stabilisation of supply and price levels coupled with a widely-perceived improvement in the political stability and infrastructure of Sudan. In spite of a number of internationally-financed studies aimed primarily at stabilisation of production, competitive pressures in the international market-place have been steadily eroding the position of gum arabic; at the same time, its technical superiority in a number of applications is steadily being eroded as the performance of the various starches, dextrins and cellulose-based synthetics is continually being improved. Moreover, technological improvements on a broader front are making it possible for cheaper, lower-quality ingredients to be used without any perceptible deterioration in consumer reaction to the final product. On the positive side, if the Sudanese price level for the 'Cleaned' grade can be reduced to below $3 per kg and, if possible, below $2 per kg, perhaps with the aid of adjustments to local farm-gate prices and taxation levels, gum arabic can be expected to maintain its share of the market in those applications where its superiority has been least challenged. However, all recent indications strongly suggest that, after the experiences of the 1984-86 period, it is unlikely that many manufacturers will wish to risk giving gum arabic a major role in new formulations, especially those accustomed to obtaining their raw material supplies on a hand-to-mouth basis rather than to holding substantial stocks. Moreover, it is unlikely that new outlets for the gum will be found, at any rate in the absence of a sustained intensive programme of research to this end.

It is therefore concluded that, unless there is first, a substantial price fall throughout 1987, second, a continuing improvement in the general economic and political conditions in Sudan, third, a degree of improvement in communications between the GAC and overseas buyers, and fourth, a sustained absence of drought in the Sahelian region, gum arabic will be hard pressed to hold its current share of the market. It is certainly to be hoped that the price of the gum is not subjected to upward pressure through extensions to the local grading system, or as a result of a greater degree of local processing; few buyers, if any, would welcome such developments. Since in the absence of further climatic setbacks the current level of world demand for gum arabic can potentially be serviced wholly by Sudan, that is to say discounting West African production, there is no realistic prospect of entry to the market by a new producer. Even the existing minor producers will have to be extremely wary of attempting to increase their long-term production levels, even though short-term minor fluctuations in Sudanese production levels may create temporary opportunities for increases in export revenue.

Section 3

Guar gum

INTRODUCTION AND DESCRIPTION

Guar gum is a galactomannan-type edible carbohydrate polymer obtained from the seeds of the guar plant *Cyamopsis tetragonolobus*, family Leguminosae, a nitrogen-fixing legume which has been grown for centuries in the Indian sub-continent as a food for human and animal consumption. It grows best in temperatures in excess of around 26°C and ideally requires a dry climate with sparse, but regular, rainfall; it is, indeed, most often found in semi-arid areas. The whole guar seed is made up by weight of the following components: hull 14-17%, germ (rich in protein and of value as a cattle feed) 43-7%, and endosperm (containing the gum) 34-42%. When minor components such as moisture, ash and so forth are taken into account, the gum typically accounts for only some 30% of the weight of the whole seed. Genetic breeding programmes have produced strains that yield two crops per season in suitable locations.

Guar gum bears close similarities to another galactomannan-type polysaccharide, namely locust bean gum, which is discussed in Section 6. However, although locust bean gum is regarded as a higher-quality gum in some uses, it has a disadvantage in that it requires the application of heat before it will dissolve readily in water, whereas a primary characteristic of guar gum is its solubility in cold water. The combination of this cold-solubility characteristic, its equally-notable ability to yield high viscosity – and thereby good thickening characteristics – in cold water at relatively low concentrations, and the fact that it has generally been cheap, account for the gum's widespread use, which in volume terms is greater than that of any other water-soluble gum. It should be noted that several of the cheaper modified starches only yield high-viscosity solutions when heat is applied. It is perhaps also worth noting, however, that guar gum offers only limited stability under strongly acid conditions, in contrast with gum tragacanth; it also lacks gel-forming properties on its own. On the other hand it blends well with other gums, especially locust bean gum (q.v.), although it does not create any significant synergistic effects when mixed with other gums, in marked contrast with locust bean gum.

Although guar is occasionally traded as whole beans, it is generally uneconomic to do so on account of the incidence of transport costs on a basically cheap product. It is much more common to dehull the beans to yield their gum-bearing endosperms, generally known in the trade as **splits**. This process is sometimes aided by pre-heating of the beans. One major advantage of processing beans into splits is that, whereas the storage life of guar beans is limited, splits may be stored for a much longer period without risk of deterioration. The next processing stage entails the grinding of the splits into a powder, an operation increasingly being done in the country of origin, although there is a pronounced preference for the splits on the part of some key users, who for reasons both of quality and of secrecy prefer to undertake their own processing.

Guar splits and powder are usually traded on the basis of their viscosity, measured in **centipoise units**, often indicated by the abbreviation 'cP' (e.g. 3,500 cP). The viscosity of guar varies greatly, from around 1,000 cP to 7,000

cP, thereby rendering it extremely adaptable to a wide range of applications. Some food and oilfield applications require a very high degree of viscosity while for other, less demanding applications, lower viscosity is more appropriate. High-viscosity guar is comparatively expensive; a technical problem is that the grinding operation can bring about an appreciable reduction in viscosity, the production of a high-viscosity powder therefore presenting some difficulty.

USES

As already mentioned above, the uses of guar gum are extremely diverse. In some of its key applications, the gum is used in one or other of a number of **chemically-modified forms**; although one or two of these chemical modification processes are beginning to be undertaken in the producing countries, most of these operations continue to take place in the main Western importing countries in the factories of three large multinational companies, and in a number of cases the technical procedures followed are closely-guarded secrets.

The main uses for guar gum are as follows:

Petroleum oil extraction. During the late 1970s and early 1980s, this area of usage overwhelmed all others. The recession of the mid-1980s in the oil-drilling industry and the low oil prices prevailing during 1987 have severely curtailed demand from this sector, although it continues to be the largest single consumer of the gum. Its use in drilling fluids or 'muds' to control viscosity and provide stability in primary drilling operations, although formerly considerable, has declined drastically in favour of more satisfactory alternatives such as modified starches, sodium carboxymethylcellulose (CMC) and xanthan gum. Rather more is used in the water flooding process used in secondary oil recovery, or enhanced oil recovery as it is sometimes known, but again there has been a decline in usage before the advance of xanthan gum and polyacrylamids. Most guar gum usage in the industry is attributable to semi-secondary extraction, that is to say in hydraulic fracturing to stimulate primary production. It should be noted that at times of recession and low prices, extraction techniques other than primary extraction tend to be uneconomic, or at best of very marginal profitability, and will therefore often be set aside until the general climate improves. Opinions in the industry varied quite widely as to the future prospects for guar gum in oil extraction, some holding it to be an excellent and reliable product with few technical drawbacks, others highlighting its limitations (for example, the fact that it cannot be used beyond a certain depth), drawing attention to the advance in new technologies and predicting a further decline in guar usage. Probably the best prospect is for continuing consumption at current levels, virtually none of the various trade representatives consulted foreseeing any return to the former high levels of consumption.

It is this sector which accounts for most of the world demand for chemically modified guar gum, production of which, it will be recalled, is mainly in the hands of three United States-owned multinational firms. These firms, apprehensive of the gradual increase in the ability of the guar-producing countries to manufacture at least some of these derivatives, maintain tight secrecy over both the manufacturing technology and the precise technical requirements of the oil extraction industry.

Mining. Guar gum is used as a flocculant, or settling agent, to concentrate ores and, in particular, tailings (for example, in the so-called 'tailings leach' process). Ores and tailings treated in this way can then be more easily pumped out. The gum is also used as a filtration agent and, in the coal-mining industry, as a friction-reducing and suspension agent. In North America the potash mining industry has been a major user, while smaller quantities have been employed in other parts of the world in copper, nickel and uranium mining.

Food products. Guar gum is widely used as a thickening agent in a wide range of sauces, ketchups and similar types of product. It is also widely used as a thickener, stabiliser and texture improver in ice-cream (especially the 'soft ice' type), some frozen foods, baby foods, pet foods, canned foods, confectionery, soft cheeses and various types of pie and pudding fillings and instant mixes. It is used in some dairy products to inhibit whey separation and to maintain texture after sterilisation. Another important application is improvement of dough texture and consistency in a range of baked products including cake mixes and certain types of bread, although in the case of bread there is great variation in the degree of usage from country to country. In many of these applications guar is used in combination with other natural gums, notably locust bean gum, and with synthetics.

Textiles and carpets. Guar gum is used as a thickener in printing pastes for textiles and carpets, as a sizing agent for various fibre yarns, including cotton, and in various ways to impart improved finishes to fabrics. However, an increasing number of modern carpet dyes do not require the addition of guar gum or comparable products.

Paper. As part of the pulp suspension, guar gum assists in the distribution of fibres during paper sheet formation. The gum is also used as paper size and generally enhances product strength, finish and porosity characteristics.

Water treatment. Guar gum's properties as a flocculant also lend themselves well to certain processes in water treatment plants.

Explosives. Guar gum is used mainly as a thickener and gelling agent in slurry-type explosives, although it has also been used in the waterproofing of stick-type explosives.

Pharmaceuticals and Cosmetics. Guar gum is used for its thickening and suspension properties in various pharmaceuticals and cosmetics, including ointments, lotions, shampoos and tablets. In compressed tablets it is used as a binder. It is also used in certain types of bulk laxative. In the opinion of some trade contacts guar gum's use in pharmaceuticals is small and in decline.

Slimming and Diabetic products. Numerous investigations have been made in recent years of guar gum's potential as a slimming aid, for example in bread, and also for the control of insulin intake in diabetics. The research in many cases is far from complete, but a number of products in this category now contain guar gum, and it is noteworthy that the calorie count of the gum is considerably lower than that of modified starches.

Tobacco. Guar gum is used as a binder in the reconstitution of tobacco fines and sweepings. However, this usage is in decline, mainly because CMC gives fewer undesirable combustion by-products.

Animal feeds. Guar gum has limited application as a suspension and granulation agent in certain calf milk replacements.

Other applications for guar gum include the manufacture of printing inks, ceramics, electro-ceramics, paints, adhesives, polishes, fire-fighting materials, certain photographic materials, battery electrolytes, synthetic resins and a few others.

Apart from the gum, the other parts of the guar bean, notably the germ meal, are very widely used in countries of origin as a cattle feed, although these by-products have so far not found as wide a range of export outlets as has the gum, mainly because their characteristics are by no means universally regarded as suitable for Western cattle breeds. Even so, the large market for guar meal in the Indian sub-continent plays a significant role in keeping the world price of the gum as low as it is.

The balance of usage between the various applications for the gum as described above can be summarised as follows: **technical** applications (oil extraction, mining, papermaking, tobacco, explosives, water treatment, fire-

fighting and so on), 65%; **foodstuff** applications (bakery and dairy products, frozen, canned and baby foods, sauces and dressings, beverages and so on), 30%; **pharmaceuticals and cosmetics** applications, 5%.

It will be apparent from the foregoing analysis that, in spite of guar gum's cheapness, there has been some substitution by xanthan gum, modified starches and other synthetics. To a modest degree, this has been a consequence of a degree of variability in the quality of internationally-traded guar gum, some adverse comments in this regard having been recorded during the fieldwork for this bulletin. However, the main reason for substitution appears to have been the extent of technical advances in alternative products, which have in some cases, in the judgement of users, outweighed their higher cost. Similar considerations also account for the continuing usage of locust bean gum, the characteristics of which in some applications are sufficiently superior to those of guar gum to justify its use in spite of its high price. However, the fact remains that guar gum is widely regarded as a good, cheap product in spite of occasional price and supply fluctuations, and it continues to be popular where its combination of price and technical properties are regarded as compatible with the application.

PRODUCTION AND EXPORTS

World production of guar beans is in the region of 1 million tonnes per annum, although only around one-third of this total is processed to yield the gum. The world market for the gum is around 100,000 tonnes per annum, equivalent to about 330,000-350,000 tonnes of beans. Production of gum in its various forms is dominated by India, with some 60% of the world market, and Pakistan, with about 35%. The United States accounts for 4-5% of world production, and other producers on average 1% or less, although there have been sharp peaks in supplies from minor producers, notably in Africa.

India

Guar is an important crop in several Indian States, mainly the drier areas of Gujarat, Rajasthan and Haryana, the main centre being Jodhpur. Although the crop grows wild, it is widely cultivated. Annual crop levels vary widely, from a low point of 300,000 tonnes of beans to a maximum of 1,100,000 tonnes. However, even when the declared crop is low, there is almost certainly a large untapped reserve. Without doubt the largest outlet for the crop is as cattle feed for domestic use, and the level of supplies to the export sector has varied and on occasion been significantly below the level of world demand. Although it appears to be local policy that the demands of domestic consumers should not prejudice India's ability to service its export markets, local gum processors have frequently experienced difficulty obtaining adequate supplies, and their factories have in consequence operated below optimum capacity. To some extent, however, local farmers have been persuaded of the virtue of not feeding the whole beans to their cattle, but rather the germ meal after removal of the endosperm, thereby releasing more raw material to the millers.

Reference should be made to the table below for details of recent exports of Indian guar. Full details can be found in Appendix A, Table 12. It will be noted that the level of exports has fluctuated strongly from year to year.

Table H

Indian exports of guar gum

(tonnes)

1977/78	56,508
1978/79	74,621
1979/80	54,053
1980/81	59,058
1981/82	113,900
1982/83	43,454

Before the late 1970s there was a considerable export trade in whole beans. In recent years, however, the high impact of transport costs on the whole bean trade has brought about a large increase in local processing capacity, first in the production of splits and, more recently, in the processing of splits into powder. By the mid-1980s trade in whole beans was minimal and the Indian Government was considering banning their export altogether. The precise number of guar processors currently operating in India is unknown; it may be over 100, but fewer than 40 are of any consequence in international trade, which is probably dominated by fewer than 12-15 firms, including the subsidiary operations of at least one major United States-based multinational company. The development of the local processing industry has been marked by very strong growth when overseas demand, particularly from the oil sector, was booming, followed by a sharp contraction in the number of firms when the oil market, and prices, collapsed and gross overcapacity resulted, periodically exacerbated by local failures in electricity supplies. Such a contraction occurred at the beginning of 1985 when huge unsold stocks of guar existed, although a year later, after a poor crop, the position had been rectified and even reversed, with prices rising. The development of the grinding sector of the Indian guar industry has been somewhat unsteady and beset with technical problems. At first the local firms offered powder of '100 mesh' and '200 mesh' grades (*see* next *Grading, quality, toxicology and packaging* section) but subsequently went on to offer powder graded by viscosity (cP units), initially 3,500 cP, and then 4,500-5,500 cP. However, it proved to be a widespread trade view that very few (probably only 3-4) Indian suppliers succeed in fulfilling their claims for their products in respect of viscosity, and that only the United States-owned multinationals and their affiliates can provide guar gum of the high viscosity levels required by the oil industry. The failure of many Indian firms to meet their quality specifications has been deleterious to trade and has exerted a downward pressure on prices, to the detriment of the few firms whose products do meet the more stringent overseas requirements. To some extent this problem has been reconciled with the Indian policy of maximisation of local processing through the establishment of local subsidiaries and affiliates of the major United States-owned multinationals, who alone can provide the technology required for the production of high-viscosity powder, but the fact remains that the bulk of the world's requirements of highest-quality guar products are still produced in the Western industrialised countries. Lower-quality powders, however, are becoming available in large quantities, indeed to such an extent that one United States-owned subsidiary was reported to have experienced increasing difficulty in obtaining adequate supplies of splits for processing. This problem was almost certainly exacerbated by the local system of export incentives, further discussed in a subsequent paragraph.

Even the export trade in splits has not been without its problems in respect of quality, mainly in relation to bacterial contamination levels. To some extent this problem has been mitigated by the use of methylene bromide as a fumigant, but this treatment is not effective enough to meet the standards of the United States Food and Drug Administration.

Attempts to develop the local market for Indian guar gum in the printing, papermaking and textiles industries made only slow progress initially and, in spite of some recent acceleration in the trend, the proportion of local gum production reaching local outlets is still less than 5% of the total. In response to the demands of the textile industry, local production of a few application-specific modified guar derivatives, notably depolymerised guar and carboxy-methyl guar (CMG), has commenced, but the quality of these derivatives is reputed to be rather low, although possibly good enough for undemanding applications in Western markets. The manufacture of high-grade products appears to be beyond local capabilities at present, although this will become increasingly possible if overseas investors expand their local operations.

A feature of the Indian industry is a system of export incentives for powder manufacturers, under which a grant of 12% of the f.o.b. value is made, rising

to 17-18% if total exports exceed a certain value. A similar system operates on the production of splits, although the corresponding grant rates are only 3% and 7% respectively. The obvious effect of such a system is encouragement of overproduction of powder, often at the expense of product quality. Credit arrangements on by-products such as meal are also available during periods of unfavourable climate and consequent shortages; these credits to some extent take the pressure off the dehulling firms and help to keep the price of splits from rising too sharply as a result of the shortages. There is also an increasingly tight degree of central control over the export trade, the Delhi-based Food and Processed Food Export Promotion Council (FEPC) becoming increasingly influential, but at the time of the research the intended final pattern of central control was unclear.

As mentioned in the previous *Uses* section, there is some international trade in guar by-products. It is worth noting, however, that whereas Indian guar meal is non-toxic to Indian cattle, it is widely regarded as unsuitable in its untreated state for many Western breeds. Since it is expensive to transport over long distances, it is unlikely that trade in this commodity will develop, especially as Pakistan already sells as much as the overseas market will take, and its only significance in the current context lies in the fact that its widespread use in India is a factor in the maintenance of a low gum price, in spite of the fact that the local price of the meal is inevitably low.

In recent years there has been an increasing degree of variation in the level of supply of Indian guar gum. A poor harvest in 1986 was expected to be followed by an even poorer harvest in 1987. To some extent this was the result of a period of cut-throat pricing which forced producer prices down and brought producer margins close to zero. Although remedial action should not present difficulty, it may take two years for the Indian production base to re-stabilise.

Pakistan

The volume of Pakistan's annual production of guar is not known with any accuracy, owing to lack of published information, although the available information and the consensus of trade opinion suggests that average production levels are no more than one-quarter those of India's. However, export statistics are published and these are given in Appendix A, Table 13 and summarised in Table I below.

Up until the late 1970s, Pakistan was often as important an exporter of guar gum as India. Nowadays (late 1980s), Pakistan's exports of guar gum typically amount to about one-half those of India, and it can be concluded that a much higher proportion of Pakistan's production of guar beans is destined for the export sector than that of India. For this reason the risk of export shortfalls due to crop failures or inappropriate pricing policies is likely to be greater than in India, where exporters have experienced shortages nonetheless.

Table I

Pakistan exports of guar gum

(tonnes)

1978/79	44,201
1979/80	24,736
1980/81	18,435
1981/82	20,664
1982/83	23,187
1983/84	26,980
1984/85	28,146

The structure of the Pakistan guar industry is similar to that of India. Farmers are given appropriate encouragement to have their crops dehulled and much germ meal is consumed within the country as a cattle feed. Guar beans are

not, in general, exported, the export trade being mainly in splits and powder, increasingly the latter. In fact, in spite of the fact that the highest-quality Pakistan guar powder is produced and exported by a United States-owned subsidiary, this firm has increasingly experienced difficulty obtaining sufficient supplies of splits for its operations. This situation has arisen partly as a result of the availability of special credit provisions to powder producers, thereby creating an incentive to overproduction similar to that in India. On the other hand, the average quality of Pakistan guar powder is rather higher than that of the average Indian product, primarily because the processing equipment is generally of a higher standard. There is also, as in India, some local production of modified guar derivatives such as depolymerised guar and CMG for the local textile industry, although these products are of indifferent quality, there being little or no export trade in modified guar products. There are appreciably fewer Pakistan exporters of guar products than Indian exporters, in fact only two or three of major importance, and the consensus of Western trade opinion is that fewer obstacles are encountered when negotiating with the Pakistan trade than with the Indian trade.

The oil price crash brought about a sharp fall in demand for Pakistan guar products, and a major local United States subsidiary found itself with large unsold stocks of guar powder in Karachi. These stocks were eventually cleared, but at the beginning of 1987 there continued to be a degree of instability in the Pakistan guar trade in the wake of a poor 1986 harvest, which may have been partly a result of low producer margins. However, Pakistan appears to be in a favourable position to take a rather larger share of the international guar gum market, partly because of the relatively high quality of its guar powder *vis-à-vis* India, and partly because of the rather better organisation of its export sector.

It is also worth noting that, in spite of local concern over protein shortages, Pakistan, unlike India, has been an important exporter of guar meal. In the 1982/83 season, when 23,187 tonnes of gum were exported, exports of meal totalled 34,030 tonnes. Although the value of the latter tonnage, at 69.6 million rupees, was little more than one-third of the value of the gum exports (201 million rupees), the unit value ratio being less than 1:4, it must nonetheless be concluded that the meal trade is of considerable significance for Pakistan's guar industry. It is unlikely to increase, however, for reasons already discussed in the section on India.

United States

The precise level of guar production in the United States is not known, but all local guar shrubs are cultivated, the plant having originally been introduced into the country. At one time, at the height of the guar boom generated by the oil industry, guar production in the Southern United States, particularly the oil-producing States of Texas and Oklahoma, was increasing at such a rate that there were suggestions in some quarters that the United States could eventually be self-sufficient in the crop. The fact that these expectations were not realised was due first to the oil price crash and second to the fact that, whereas guar meal found a ready market in India and Pakistan as a cattle feed, it never did in the United States, because of the ready availability of preferred alternatives such as cottonseed cake. To be competitive with Asian gum, therefore, United States producers had to be offered an unacceptably low price for their product, to compensate for the negligible local market value of the meal. In spite of the introduction of contract farming systems, the low producer returns, exacerbated by poor yields consequent on excessive variations in local rainfall, has brought about a sharp loss of local interest in guar. The fact that it continues to be produced at all is partly due to Federal Government subsidies on production in the south-western United States, guar being regarded as a product of some strategic importance which might need to be produced locally in large quantities in the event of national emergencies.

Overall, there is little prospect of any resurgence of United States guar production.

An inevitable result of the combination of the decline in United States guar production, the oil recession and the growing availability of inexpensive guar powders from the Asian producers, is that United States guar processing capacity is severely under-utilised. For this reason, the local processors, who are dominated by three large multinational companies, are concentrating increasingly on the production of highly specialised derivatives which cannot be produced elsewhere. However, it should be noted that at least one of the major multinationals prefers to import splits rather than powder for its processing operations, and the export incentives offered to Indian and Pakistan powder manufacturers have, as already mentioned, brought about periodic shortages in the availability of splits. Given the low returns to United States guar producers, therefore, it is not surprising that at least one United States firm should have made attempts to encourage the production of splits in other regions, notably in the southern hemisphere.

Other producers

Other countries or regions where guar production has been attempted or contemplated include Central Africa, South Africa, Brazil, Israel, Sudan, the Philippines and Mexico. Many of these attempts have arisen from the active encouragement of United States multinationals as mentioned in the paragraph above. In the Central African region, **Malawi** produced 12,000-13,000 tonnes just as the oil market went into decline, and found itself unable to sell the product, although this was undoubtedly partly because only the whole beans were offered to the market, no local splitting facilities having been installed. **Zaire** is also reported to have commenced production, but generally of small quantities and the status of local production is at present unknown. The **Republic of South Africa** is a producer, but apparently entirely for local consumption in its mining industry. Of the remaining countries listed above, only **Brazil**, where interest is strong, is likely to have advanced much beyond the appraisal stage; although variety and site trials have been tried in **Sudan**, there have been no reports of attempts to produce the gum on a commercial basis. In all other countries, such plans as may have been drawn up were abandoned in the face of the oil price slide.

Conclusion

The short-term outlook for guar gum production and exports is one of shortage. Poor harvests in India and Pakistan in 1986 brought about a fall in world supplies to below 70,000 tonnes, and the outlook for 1987 is even worse, some observers expecting a total out-turn of little more than 50,000 tonnes. However, since the problem is in part an artificial one brought about by unsatisfactory producer price levels, prompt remedial action should be possible and would, if put into effect, restore the balance within two years. Assuming such steps are taken, the main conclusions to be drawn from this brief survey of production and exports are that on the one hand the existing producers should continue to be more than capable of servicing world demand for guar products, but that on the other hand the balance of production between splits and powder has been distorted in favour of powder by the export incentive schemes offered by the Indian and Pakistan Governments. If this latter situation persists in its present form for much longer, it is just possible that a new entrant into the market for splits might appear; but such an event would fail to rectify the current distortions in the market and in the long run would, through exacerbating general over-production, probably benefit none of the producers, including the newcomer.

GRADING, QUALITY, TOXICOLOGY AND PACKAGING

There are many grading systems for guar, each producing country having its own system; even individual processors and shippers adopt their own approach. As many as 100 grades may be encountered in the chain between producer and final user. However, apart from the obvious basic categories of traded guar, namely beans, splits and powder, the majority of these grades is unimportant, and there are only two important criteria: **mesh size** and **viscosity**. For some users, the former is the more important, mesh size being an important factor in the rate of hydration; for the majority the latter is more critical, but it is evident that the combination of the two counts for most, and there has been some progress towards a degree of standardisation in international grading systems. As already observed, viscosity is stated in cps and may lie anywhere in the range 1,000-7,000 units. Mesh size, as its name implies, is a measure of the size of the powder particles, powder of small mesh size being more expensive because the degree of control needed if undue loss of viscosity is to be avoided during the grinding process.

Extensive reference has already been made to the problems experienced by the Indian industry in maintaining product quality in accordance with declared specifications, especially in relation to viscosity. Guar powder's viscosity is affected by shelf life and prompt delivery is therefore of importance. The bacteriological profile of consignments of splits and powder is also important, especially in food-grade guar. The United States Food and Drug Administration's requirements, which are directed mainly at end-users, are such that importers have to stipulate typical plate count standards of 10,000 colonies per gram (maximum), and zero for enterobacter, the latter presenting the greatest problem for many Indian suppliers. Some United States importers used to sterilise consignments with ethylene oxide (ETO) since the use of the weaker methylene bromide fumigant in India was regarded as inadequate; however, the established toxicological characteristics of ETO have recently brought about a ban on its use in the United States except for the treatment of exceptionally contaminated products. Guar gum does not fall into this category. A less powerful alternative, propylene oxide (PPO), may be used provided residues do not exceed 300 parts per million (ppm); its efficacy can be enhanced by the simultaneous application of heat. The use of gamma-irradiation is not permitted at present but may be eventually, and this technique is more effective than either heat treatment or fumigation with PPO.

In fairness to the Indian producers, however, it should be noted that Pakistan and the United States have also experienced some quality problems. In the case of Pakistan, the problems are of a similar nature to those evident in the Indian industry, although to a lesser degree. In the United States, the problems are mainly due to irregular rainfall.

In the European Community guar gum's acceptability as a food additive was confirmed by a series of toxicological tests which were carried out between 1978 and 1982, and the highest grade of the gum is now classified as 'Acceptable Daily Intake (ADI) Not Specific', under which classification the gum may be used as a food additive up to a limit of 2% of the final product. It carries the official additive code E 412.

Guar splits are usually shipped in gunny (jute) bags of 50 kilogram capacity, or more occasionally polypropylene bags. Guar powder is usually transported in 6-ply paper bags of 25 kilogram capacity, in fibre drums, or, increasingly, in polythene-coated laminated paper bags with a liner, also of 25 kilogram capacity. The standard 20-foot container is widely used for consignments of guar, each container typically holding 18 tonnes of powder.

United States

The United States is the largest single national market for guar gum and its derivatives. Reference should be made to Table J overleaf for a summary of the recent trend in imports, full details being given in Appendix A, Table 14.

To the figures given in Table J should be added the recent annual average of 4,000-5,000 tonnes of guar gum produced domestically. In recent years, the division of imports between splits and powder has been approximately 2:1. About 50% of imported powder is traded through 5-6 intermediaries in the New York area, mainly dealers and agents, the latter taking a 2-3% commission, the remaining 50% of imports being imported direct by processors or end-users. In the case of splits, virtually all imports are purchased direct from source by processors and end-users, who are mainly suppliers to the oil extraction industry, whose requirements are too exacting to be met by the majority of Indian and Pakistan powder manufacturers. Domestically-produced guar is also generally purchased direct by the processors rather than through intermediaries. The major users are the three large multinational firms already frequently referred to, all of which manufacture a wide range of modified guar product. These firms either import splits from independent suppliers or powder from their Asian-based subsidiaries and affiliates; occasionally, if the overseas subsidiaries find themselves with more splits than they require for immediate needs, the parent companies may buy up the excess stocks for resale in the United States, but the steady reduction in the availability of splits will make such operations most unlikely in the forseeable future.

Table J

United States imports of guar gum

(tonnes)

1979	47,083
1980	51,027
1981	75,234
1982	61,368
1983	23,428
1984	30,541
1985	43,960

The quality requirements of most United States users are strict and many criticisms were heard of the quality of Indian consignments, especially of guar powder. It is usual for samples to be shipped from source for examination by United States buyers before shipment of consignments is agreed. Many users are being obliged to increase product quality, and problems with both bacterial contamination and unsatisfactory viscosity levels were mentioned frequently. Although in one case a textile manufacturer rejected a consignment because of excessive viscosity, the textile industry generally requiring low viscosity guar, this was one exception to the general rule that most complaints related to depressed viscosity levels, as discussed in previous sections. The viscosity range within which most United States requirements fall is between a little less than 3,000 cP and around 4,000 cP, the most popular range being 3,500-3,600 cP (these figures based on measurement in 1% solution after 30 minutes); formerly 2,800-3,000 cP was the most popular range. The bacterial loading of Indian consignments presents particular problems since India's treatment with the methylene bromide fumigant fails to destroy many types of contaminant, the use of ethylene oxide (ETO) is banned in the United States, treatment with propylene oxide (PPO), even in the presence of heat, is only partly effective and irradiation with gamma rays is not yet approved and may in any case have technical drawbacks. The quality of Pakistan guar is generally considered to be appreciably better than that of Indian guar, but one result of United States dissatisfaction with the quality of Indian guar has been an intensification of interest in Central African sources. The recession in the oil

industry has dampened this interest lately, and in any case there is no evidence yet that Central African guar production is on a sufficiently reliable footing for a permanent change in the structure of the United States's import trade to be possible. As far as the Asian sources are concerned, United States buyers have in recent years confined most of their purchases to a small handful of the most reputable Indian and Pakistan suppliers, including United States-owned affiliates, in order to minimise the quality problems; a result of this policy has been some easing of price competition.

From mid-1984 imports fell as the oil recession began to take hold and users and intermediaries found themselves with large stocks, sufficent for two years' operations in some cases. This applied in particular to one of the major multinationals serving the needs of the oil industry. The United States market remained depressed for well over a year before there was any sign of a sustained recovery.

The **oil industry** continues to be the main user of guar in the United States. The 1973 oil crisis brought about the start of the boom in guar usage in the United States as enhanced oil recovery through hydraulic fracturing first became economically viable, and at the peak of the boom the oil industry probably accounted for over 90% of United States consumption of guar. Even during the current recession and low prices, the industry probably still accounts for approaching two-thirds of United States guar consumption, although at the beginning of the 1980s it accounted for at least 85% and still accounted for 75-80% at the end of 1984. Usage in this sector is a long way below its peak and is unlikely to recover. The full picture was described in the 'Uses' section but, in summary, guar is now rarely used in the drilling fluids, or 'muds', required for primary drilling, having given way to a number of technically-superior alternatives. In true secondary extraction there has also been some movement away from guar in favour of products such as xanthan gum and polyacrylamides, although guar gum and xanthan gum are used together in some areas of secondary extraction. Guar is not used in tertiary extraction. Its main continuing area of usage is in hydraulic fracturing for the stimulation of primary production, sometimes referred to as semi-secondary oil extraction; guar is usually employed in a chemically-modified form in this application, the use of unmodified guar generally accounting for well under one-quarter of the total. Usage has generally been depressed by the fact that a number of oil-wells are being capped rather than further processed. A clear analysis of the future prospects for guar in the United States oil sector was precluded by the diversity of opinions in the industry, some for example maintaining that xanthan gum is steadily overhauling guar in some applications and that guar's shelf life is too limited, others taking the view that xanthan gum is still too expensive in relation to guar for further large-scale replacement to be likely. Technical variables such as salinity also influence choice of processing material. However, the world industrial capacity for production of xanthan gum is increasing, especially with the introduction of new production capacity in France, and the price of this product may be expected to follow a gradual downward trend; moreover, considerably less of it is needed vis-à-vis guar to achieve a given effect. Also, while it is true that the price of modified starches is not far short of that of guar, the industry is highly competitive and even small price differences may count in the eyes of financial controllers. Moreover, the production of alternative biopolymers such as xanthan gum may increasingly be produced close to the point of usage. On the other hand, it has recently become possible to reduce the residue content of guar gum, thus enhancing its technical effectiveness. The tentative conclusion of this report is that, while guar gum usage in the oil industry will probably not fall much further, it is unlikely to increase greatly even in the event of such a recovery in the world oil price as would restore the economic viability of those secondary processing operations that have been, at least temporarily, abandoned.

Outside the oil sector, United States usage of guar gum amounts to some 9,000-12,000 tonnes of which slightly more than 50% is attributable to the

food industry. The use most commonly cited by trade contacts was **ice-cream**, where it is widely used as a texturiser and stabiliser, even in preference to locust bean gum or xanthan gum, which are considered too expensive in this application; however, its ice-cream usage is mainly restricted to vanilla-flavoured products, far less being used in fruit-flavoured ices or sherbets on account of its tendency to mask the flavour. It is relatively little used in other dairy-based products, such as **icings**, in which locust bean gum and pectin have decided technical advantages, and **cream cheese**, in which again locust bean gum is preferred, although blends of guar gum with locust bean gum and xanthan gum are sometimes used for lower-quality products. Guar is said to impart a slight but undesirable flavour to high-quality cream cheeses, although if the price of locust bean gum increases any more there might be a change to using guar in cheese manufacture. On the other hand, there is modest usage of guar in **ice milks**, although not in ice sherbets. Very little guar gum is used in **bread**, and it is unlikely to be so used in future, most bakers preferring the well-tried CMC; moreover, although guar gum falls into the FDA's GRAS (Generally Recognised as Safe) category, the FDA has temporarily banned the use of guar in bread pending a study on its effects, the main reason for the ban being the importance of bread in the American diet rather than any particular reservation regarding guar's safety. In other **baked goods** such as **cake mixes** and **doughnut mixes** there is a moderate level of guar usage, although many users prefer CMC, agar or locust bean gum in some products because of guar's indifferent heat sensitivity characteristics. Guar is also used in **breakfast cereals** of the 'muesli' type and in some **instant mixes** for pies and puddings but in the instant mix field it faces strong competition from agar and the carrageenans. It finds extensive use in **reconstituted potato** in mashed or fried form**. Pet foods** are another moderate-sized outlet. A little is used in **frozen foods**, especially in dry mixes with other gums, mesh size being critical in this area; but it is mainly synthetics which are used in frozen foods although locust bean gum is also used to some extent. Guar's thickening properties make it appropriate for use in some **sauces and dressings**, but not as much as in other markets, apparently because in certain American-type dressings it presents problems of shelf-life. Other uses include certain **Mexican-type dishes**, **strawberry packaging** just prior to freezing, and a few beverages, but United States consumer preferences in the beverage field are such that CMC and xanthan gum are generally more appropriate. It will also be noted from Section 2 that gum arabic is widely used in the United States beverage industry. One possible growth area, although from a fairly small base, is **diabetic and slimming** foods; 'galactomannan tablets' are already being sold, but the medical and cleanliness aspects of guar usage have yet to be researched exhaustively, and there is so far nowhere near the level of usage evident, for example, in the United Kingdom; it is also noteworthy that pectin is already a well-established component of some nutritional foods. In general, the usage of guar in the United States food industry is level and stable; there has been a small gain at the expense of the increasingly-expensive locust bean gum, but this gain appears largely to have run its course and there has been a corresponding loss to more efficacious alternatives in some areas. It continues to be a well-esteemed product for its stabilising properties and for its cheapness, but it is not expected that United States consumption will increase.

The usage of guar gum in the non-food industry (apart from the oil sector) in the United States is smaller than that in the food sector but substantial nonetheless. Substantial quantities – possibly amounting to several thousand tonnes – continue to be used in the printing process in **carpet** and **textile manufacture**, mainly in a chemically-modified, acid-hydrating form; however, the United States textile industry has been declining before the advance of Far Eastern competition, while the growing use of tufted and non-patterned carpets and modern non-carcinogenic carpet printing dyes and new printing techniques have reduced the need for guar. Guar is also used as a flotation agent in **mining**, notably in the potash industries of the United States and

Canada; in the United States, however, this industry has been in a state of steady decline. Some general-purpose printing inks also incorporate small quantities of guar. Other uses include **slurry explosives**, although the main period of growth in this area has now passed; **firefighting** materials, especially for forest fires; **reconstituted tobacco** made from fines and sweepings, although CMC is now preferred since its combustion by-products are less harmful; **papersizing**; **water treatment**, mainly as a flocculant; **cosmetics**, mainly in cream bases for dermatological products; and **pharmaceuticals**, mainly as a tablet binder and in some ointments and lotions. Guar is not used in large enough quantities for its cheapness to be of significance in relation to its alternatives, while cleanliness requirements have heavily restricted the application of guar in the pharmaceutical field, especially in view of the ban on the use of ETO and the restricted efficiency of PPO. In none of these areas is any market growth evident or likely, and in a number a further decline is very possible.

Although the prospects for guar gum in the United States are distinctly better than those for most other water-soluble gums, all market sectors were described as 'mature' and no significant growth can be expected, although the inexorable growth in the popularity of convenience foods, many of which use appreciable quantities of water-soluble gums, might provide additional outlets. It is a well-liked product and is known to be basically safe for use in food, in spite of the need for cleaning up many consignments. Guar gum's synergistic properties have already been referred to, and indeed in the United States it is sometimes blended with xanthan gum to improve flow characteristics. Any switching to guar from locust bean gum has already spent its force, and in any case it is not directly substitutable in other than a few applications. Moreover, it is doubtful if even a large fall in the price of guar would bring about an appreciable increase in United States consumption, although an increase would be likely to induce greater usage of synthetics. There is, temporarily, a demand in the United States for a new source of guar splits, given the over-production of powder in Asia at the expense of splits, but this situation could fairly easily be rectified and in the longer term there is no real prospect for a new supplier of guar products to the United States market.

As mentioned previously, there is virtually no market for imported guar meal in the United States, in view of quality problems, shipping costs and the strong local preference for alternative products such as cottonseed cake.

Western Europe

Probably the largest market for guar for food use is the European Community. Its use in the offshore oil industry, however, has declined greatly since the downturn in the oil market. Most European imports are nowadays of food-grade gum. Unfortunately the level of consumption in Western Europe as a whole can only be estimated as orders of magnitude, since for some years the import statistics for guar have been combined with those of other products. The export statistics for India and Pakistan, which suggest that during the mid-1980s Western Europe imported between 25,000 and 30,000 tonnes per annum, are of only partial assistance since there is an appreciable level of re-export trade, and internal European consumption may not exceed 20,000 tonnes annually. However, the trends in consumption are fairly clear and are described below.

The **Federal Republic of Germany** is the most important European market for guar gum. Current gross annual imports are estimated from the Asian export statistics to be about 8,500 tonnes, with an underlying trend no better than flat and stable. Hamburg is the main port of entry for European guar imports and there is also an appreciable level of re-exports from the port's bonded warehouses to a wide range of destinations, including Eastern Europe. However, there has been a tendency for the re-export trade to decline in

favour of direct shipments from source to final destination, because of the low price of the product and the consequent high mark-up attributable to shipping costs and intermediaries' margins. In the past the main West German importers of guar were three processors in the south of the country who processed splits into powder, mainly for the textile and carpet printing industries in West Germany and elsewhere. There is some evidence, however, that with the decline of much of the European textile industry and the steady trend in India and Pakistan towards the production of guar powder rather than splits, the importance of these firms is considerably less than it was, and that the number of West German firms importing splits for processing has declined, with perhaps only one firm still undertaking such operations. Guar powder entering West Germany is mainly of three broad qualities: 2,000-3,000 cP, 4,000 cP and 5,000-6,000 cP. Importers frequently voiced criticism of the poor cleanliness of Indian and Pakistan guar. The **bread** industry is the largest West German user, in contrast with other markets where guar is little used in bread. The large West German usage is attributable to the local preference for rye bread, a type consumed far less in other European countries. The gum is said to improve dough consistency and moisture retention. Guar gum is preferred in West Germany for use in **pet foods**, which is one of the larger outlets, but the reverse applies in the case of **baby foods**, in which the bacterial contamination of Asian consignments is often too high for compliance with the official West German limits as set out in the DAB. Other, lesser West German food applications include **ice-cream stabilisers**; a variety of **sauces, ketchups, dressings and dehydrated soups**; and certain **dairy-based products** including yoghurts, mousses and puddings. Outside the food industry, there is minor usage in pharmaceuticals and explosives. Overall usage is not expected to increase, and it is quite possible that there may be a general reduction in the total quantity of guar passing through West Germany as the re-export trade continues to decline somewhat.

France is only a modest consumer of guar gum. Current gross imports are estimated from the Asian export statistics to be about 3,000-3,250 tonnes per annum, and traders believe local consumption to be flat and stable. As in West Germany, local reprocessing of imported splits into powder, in modified and unmodified form, for use in the textile and oil-drilling industries, declined somewhat during the 1980s, and although the **textile industry** is still a user of guar gum, the industry itself is in decline. However, the French guar gum trade is still mainly in the hands of three or four large importers, there being few, if any, brokers in the trade; re-exports are minimal, although there may be some export of modified guar. A large French consumer of guar is the **pet food industry**, mainly for canned products, with smaller quantities used in **veterinary products** and in certain **animal feeds**. In **ice-cream**, guar gum has to some extent supplanted locust bean gum on grounds of cost, although the latter is still preferred on technical grounds. Limited quantities are used in various types of **sauces, mayonnaise and dressings**, in low-calorie **soups, beverages and bakery products**, and in certain **dairy-based desserts**, although not in yoghurt or processed cheese, in which products the use of guar is officially forbidden. The use of guar is also not permitted in French bread. In the **pharmaceutical** industry, guar is used in laxative-type products in combination with other gums, while other non-food uses include **cosmetics**, **slurry explosives** and **firefighting preparations**. The gum often passes through the hands of specialised processors *en route* from the importers to the final users. Consumption is no better than stable, and no increase is foreseen.

The **United Kingdom** is a smaller user of guar gum than it used to be, owing to a substantial decline in usage in the offshore oil industry. A substantial proportion of the United Kingdom's annual requirements is imported from other EC countries, recent exports from the Asian producers direct to the United Kingdom averaging some 2,250 tonnes which is almost certainly substantially less than internal United Kingdom consumption. A fairly large proportion of the United Kingdom's imports is handled by the four major dealers. In spite of its decline, the **oil sector** is still probably the largest user,

taking in the region of 500-800 tonnes per annum; the nature of usage in this sector is broadly similar to that of the United States industry, and reference should be made to the relevant section and also to the earlier section on uses. The food industry is the second-largest sector, taking some 300 tonnes annually, the main applications including various **sauces, ketchups, dressings, soups and soup mixes**; **pie fillings**; **ice-cream** and **frozen desserts** as a stabiliser; **slimming and diabetic foods**; and **bakery products** including bread, although consumption in bread is in no way as great as that in West Germany. **Canned pet foods** are another major outlet. Non-food outlets include the **papermaking** and **textiles** industries, both of which, however, are in steady decline, and the **pharmaceutical industry**, where the gum is used as a compressed tablet binder and as a laxative. Overall consumption is in slow decline and this trend is not expected to be reversed. The United Kingdom market for guar meal, although once large, has also declined, mainly before the advance of other animal feedstuffs offering better nutritional value.

The Netherlands currently imports an annual average of 4,500-5,000 tonnes of guar gum from the Asian producers, according to the latter's export statistics. However, there appears to be a considerable re-export trade from Amsterdam and Rotterdam, local consumption being estimated by a major local trader to be some 1,500 tonnes per annum. Even this is *prima facie* high on a *per capita* basis, but a considerable proportion of this consumption is attributable to a local processing factory owned by one of the three major United States multinationals, the products of this factory being exported widely, mainly to the oil-drilling industry. A major product of this factory, which mainly processes splits, is 200-mesh powder of 3,000-4,000 cP. Pakistan appears to be the main source of supply; the United States subsidiary imports direct, other imports being handled mainly by dealers, and one Amsterdam-based firm in particular. The main applications for the internal Netherlands market include **papermaking**, which is proportionately a more important outlet than in other markets, and a very wide range of **food products**, including most of those mentioned in the section relating to the United Kingdom. Certain types of Netherlands **bread** also incorporate some guar, but not on a scale comparable with that of West Germany. There is some usage in the 'meat-ball' type of **pet food**, but for the export rather than domestic market. Indian suppliers were criticised for failing to supply powder to the specifications required by the European oil-drilling industry, but in the Netherlands food industry guar is firmly established, its low price ensuring that, in those applications where it performs well, competition from other gums and synthetics is for all practical purposes minimal. Consumption of guar products in the Netherlands is stable and likely to remain, although no appreciable growth is likely.

Other Western European markets for guar gum include **Italy**, which imports around 5,000 tonnes annually from the Asian suppliers mainly for processing by one or two foreign-owned multinationals who export most of their products, mainly high-grade modified guar products, often of high viscosity (5,500 cP or higher). Splits account for a high proportion of imports. However, one United States-owned multinational has ceased its Italian operations during the last few years. Italian consumption of guar is about 1,000 tonnnes per annum and is mainly attributable to the textile industry, which although under increasing pressure from Far Eastern competition, has survived more successfully than other European textile industries; the balance of usage is attributable to food, pharmaceuticals and one or two minor non-food applications. Consumption is not increasing. A similar situation prevails in **Switzerland**, where 7-8 processors and blenders operate, mainly for the export market. Although the average level of imports from the Asian suppliers is around 1,750 tonnes per annum, the Swiss market itself is small, one of the more important uses of guar being as a thickener in ice-cream, often in combination with locust bean gum and alginates. Usage in bread is not permitted under Swiss law. As in Italy, consumption is stable and there is no sign of any growth. The internal market in **Belgium** is also small, although there is some re-export trade from Antwerp and also some local processing capacity for the export market. Similar

comments apply to **Spain**, where there is an internal market for about 300-400 tonnes of guar gum but a much larger export-oriented processing industry which absorbs thousands, rather than hundreds, of tonnes per annum. The existence of the processing capacity in Spain is closely linked to the local locust bean gum industry, Spain being one of the major origins of the latter gum. Recent imports into **Denmark** have averaged 800 tonnes per annum, although these have been to a large extent for local processing and subsequent export. The export statistics of Pakistan suggest that **Norway** is also a significant importer.

Although guar gum is firmly entrenched in many Western European industries, its low price precluding any likelihood of widespread substitution, the results of the survey indicated no sign of any appreciable market growth, while in some sectors – and not only the oil industry – there is still clear evidence of some decline. If there were to be a sustained improvement in the quality of guar powder supplied by the independent Asian producers, there could be some prospect of a gently upward trend, but under present circumstances no more than maintenance of present levels of consumption can be expected.

There is a larger market for guar meal in Europe than in the United States, but on account of quality problems the product usually has to be processed before it can be incorporated into animal feedstuffs. In comparison with the market for the gum, the value of the European trade in guar meal is small and it is of little significance in any assessment of the prospects for guar products in Europe.

Other markets

Markets other than those discussed above were not subjected to research for the purposes of the present study. However, it is noteworthy that the booming **Far Eastern textile industries**, for example those in Thailand, Hong Kong, Taiwan, Korea and elsewhere, are using substantial quantities of guar gum in printing. This may well prove to be one of the few growth market areas for guar gum, although it is also possible that certain African mining economies such as Zambia (copper) and Zimbabwe (nickel) could utilise several thousand tonnes more, notably in tailings leach operations in the Copperbelt.

PRICES

Reference should be made to Appendix A, Table 15 for details of movements in the New York spot price of guar since the year 1978. The main features of price movements in recent years included a steady rise in the early 1980s followed by a very sharp fall in 1983 and 1984 as a result of the onset of the recession in the oil industry. This fall was followed by a recovery in early 1985, and a further rise occurred in 1986 as a result of Indian production difficulties. In mid-1986 the price of guar powder at origin, depending on quality, varied between $500 per tonne and $1,100 per tonne, the prices of the most widely-used grades falling in the range $650-1,000 per tonne, spot prices being appreciably higher. By the beginning of 1987 prices had risen still further and the most widely-used grade was being quoted on the main markets at around $1,500 per tonne. One temporary restraining influence on price rises was a period during which some major United States users showed interest in purchasing from the Central African region on a forward contract basis, leaving the Asian producers to obtain whatever price they could in the remainder of the market. Whether such developments will recur remains to be seen, but in mid-1986 there did not appear to be much guar gum available in Central Africa. In any event, further substantial price rises are not expected, in spite of current production difficulties in Asia. The average difference

between the price of splits and that of a medium-viscosity powder is usually in the $100-200 per tonne range, although when prices were depressed the difference was only half as great. The price of 100-mesh powder is usually a little below that of the medium-viscosity powder. Some price increase has been inevitable, since producer prices in India and Pakistan had fallen to undesirably low levels, although most users still consider current price levels to be reasonable in the context of guar's technical capabilities. In fact, demand for guar appears to be relatively price-inelastic over quite a wide price range.

In 1985-86 the world price of guar meal was usually in the region of $120-130 per tonne.

TRADING STRUCTURES AND PROCEDURES

The structures of the guar industries in the main producing countries, namely India and Pakistan, were described in the Production and Exports section, and will not be discussed further here. Although it may be as well to reiterate that the three major United States-owned multinational guar processors are becoming increasingly influential in the source countries, to a large extent these firms bypass the main trading structures since they mostly supply guar products either to their United States-based headquarters or direct to their customers. Some independent Asian producers supply direct to overseas end-users, and almost all splits are marketed in this way, but many powder suppliers market their products through the international network of dealers and agents based mainly in Hamburg, London, New York, Rotterdam, Amsterdam and Paris. Markets such as Eastern Europe are generally serviced from Hamburg. True commissioned brokers are becoming rare in the guar trade, as is the case with other gums, but one or two continue to flourish, taking typical commissions of 2-3% on the value of their business. A few agents, taking a commission (again typically 2-3%) from the seller only, are also active, although a few suppliers have attempted to set their own sales offices in the main trading centres. The six trading centres mentioned above continue to undertake some entrepôt trade in guar, especially London and Hamburg but, as mentioned elsewhere, the low price of guar and the consequent high relative impact of shipping costs and mark-ups have proved an incentive to direct trading wherever possible.

Purchases from the Asian producers are often on an f.o.b. basis, although some consignments from Pakistan are negotiated c.i.f. Although a few suppliers have been known to require Letter of Credit payment terms, in many cases trade is conducted on the basis of Cash Against Documents (c.a.d.) or else cash within 60 or 90 days of receipt of documents. Samples are usually requested prior to despatch of consignment.

Freight costs from Asian ports to Western European ports are typically $90-100 per tonne, and from Asia to the United States in the region of $150 per tonne including insurance. It is noteworthy that freight from Indian ports to the United States West Coast port of Los Angeles is often cheaper than freight to New York, for which reason New York intermediaries are often prepared to negotiate direct delivery from India to the final customer via Los Angeles, once the samples have been inspected and cleared. In the United States, there is usually an additional $50 per tonne charge at the port of entry for inspection by the United States Department of Agriculture (USDA).

Guar products originating in India and Pakistan are not liable for the imposition of import duty in any Western markets, and although processed or modified guar products produced in Western factories and subsequently exported elsewhere may attract duty in some cases, tariffs in general constitute no constraint to international trade in guar gum.

CONCLUSIONS AND PROSPECTS

In spite of current crop shortfalls, the prevailing trade view is that the market for guar gum is generally over-supplied. There is no early prospect of a major revival of the fortunes of the world petroleum oil industry, and only in the event of a major revival would secondary and semi-secondary oil extraction, the main application of guar products in the sector, be likely to increase. To some extent xanthan gum has displaced guar in applications where its technical capabilities outweigh its high cost, and there are a number of other applications in which technical considerations have dictated the replacement of guar by alginates, pectin, carrageenan, polyacrylamides, modified starches or other alternatives, but in general guar is regarded in the trade as a good-value product with a number of technical advantages. Its reputation is spoilt only by the failure of many Indian consignments to match quoted viscosity specifications or to meet cleanliness requirements. It should therefore continue to be used at roughly present levels of consumption for the foreseeable future; on this basis the prospects for a new producer can in no way be described as promising. The only possible qualification to this conclusion is that there continues to be a shortage of guar splits, a result of excessive financial incentives to Asian producers for the production of more powder than the market can absorb. This imbalance will have to be rectified eventually if the price of powder is to be prevented from slumping, but it is worth noting that one United States processor has formally notified Asian suppliers that it would be prepared to purchase an additional 3,000-3,500 tonnes of splits per annum, provided that consignments are at least 93% dehulled, that the splits contain a minimum of 84% gum and the viscosity is a minimum 6,400 cp (in order that a post-grinding viscosity level of 4,000 cp be achievable). It is possible that one of the other two United States processors may take the same view. If the Asian producers fail to respond to this request in the near future, a temporary market opportunity would appear for a new producer, possibly in South America, although it should be noted that the specifications quoted above are extremely demanding by any standards.

Section 4

Gum tragacanth

INTRODUCTION AND DESCRIPTION

Gum tragacanth is an exudate gum obtained from certain small shrubs of the *Astragalus* genus, the gum being obtained from the tap roots and main stems of the plant. Strict adherence to officially recognised trade descriptions requires that the gum be obtained from Asiatic species such as *A. gummifer* Labillardière or *A. microcephalus*, which together account for most commercially traded gum. The best-quality gum is tasteless, whitish, yellowish or pale-brown in colour, and translucent in appearance. The lower grades are generally more strongly coloured than are the higher grades. The gum is obtained in two basic physical forms, namely **ribbons**, thus named after their long, curved shape and about 5-10 cm in length, and **flakes**, which are of inferior quality as well as of smaller particle size. Ribbons, which represent the best commercial grades of gum tragacanth, are obtained from a slightly different shrub from that which yields flakes, it being impossible to obtain both types from the same shrub. It is, in fact, unusual for both types of shrub to grow in the same locality. However, a range of grades within each type may be obtained from a single bush through successive tappings. Best-quality gum is obtained from artificial incisions rather than from natural exudations. The ideal climate consists of a combination of abundant rainfall prior to, although not during, the tapping season and dry conditions during the picking season. In the case of ribbon tragacanth, blazing is generally carried out in May or June, and collection over a six-week period from about early August. Flake tragacanth is collected over a rather shorter period.

Gum tragacanth, a complex polysaccharide, is an emulsifier and thickener which swells and dissolves in cold water and possesses two outstanding characteristics: first, its ability to form solutions of very high viscosity, and second, its high degree of stability under strongly acid conditions, this second characteristic being shared by no other natural gum in the same degree. The gum's viscosity can be adversely affected by certain processing operations, particularly fumigation or heat treatment to reduce the bacterial loading; it is therefore important that cleanliness be maintained from the earliest harvesting operations, but unfortunately many commercial shipments are of very poor microbiological quality, plate counts as high as 1 million organisms per gram being found. It is also not possible to spray-dry gum tragacanth without unacceptable effects on its technical characteristics.

USES

Of gum tragacanth's various uses, two stand out: first, as a stabiliser and thickener in highly acid food products, notably **salad creams** and **salad dressings**, second, as a binder and emulsion stabiliser in certain **pharmaceutical products**, notably **dermatological creams and lotions**. Its minor applications include ice-creams, mainly as a stabiliser, although guar gum and locust bean gum are much more important in this application; bakery products including icing sugars; flavouring emulsions and syrups; diabetic foods; certain other pharmaceutical uses including hair lotions, ointments, oral suspensions and tablet bindings; cigar manufacture; and, in the case of the poorer grades, in

the sizing and finishing of textiles, although it has largely given way to alginates in this area. It is necessary to emphasise that usage in many of these minor applications is so small as to be virtually negligible, although at one time usage levels were very much higher in some cases.

It is, in fact, the case that gum tragacanth is no longer used, in any of its applications, in anything approaching the quantities in which it used to be employed. Whereas before the mid-1970s usage ran to several thousands of tonnes annually, the current world market is certainly no more than 500 tonnes per annum and may be appreciably less, especially for foodstuffs. The gum's very high price during the mid-1980s, which were largely an indirect consequence of the political upheavals in Iran in the late 1970s, and the increasingly stringent cleanliness standards being observed throughout Western markets in both food and pharmaceutical products, exposed gum tragacanth to severe competition from the biologically derived xanthan gum, from the alginates and from certain other synthetic products. Although xanthan gum technically fails to match the characteristics of the very best grades of gum tragacanth in tastelessness, contribution to smooth pouring characteristics and general 'mouthfeel' in food products, the combination of qualities possessed by xanthan gum, together with the fact that it is still considerably cheaper than gum tragacanth, has assured it a steady penetration into applications previously the sole preserve of gum tragacanth, notably salad dressings. Substitution for gum tragacanth by alginates, mainly in the confectionery and textiles fields, took place at a much earlier stage, xanthan gum having only come to prominence as a major cost-effective force since the mid-1970s.

PRODUCTION AND EXPORTS

World production of gum tragacanth is currently a maximum of 500 tonnes per annum, and may be less. Accurate statistics are unavailable, as nowadays none are regularly published by the producing countries for either production or exports. The main producing countries are **Iran** and **Turkey**. The gum is also known to have been produced in Afghanistan and Syria, but export consignments from those countries are very rare. Although Brazil and India feature as suppliers in the import statistics of the United States and Japan, they are almost certainly re-exporters rather than producers.

Iran

Iran currently produces and exports 300-350 tonnes of gum tragacanth per annum and is the source of the best-quality gum. Production takes place mainly in the semi-desert and mountainous regions in the north-west of the country, and has therefore been little directly affected by the Gulf War, during which the main trading and communication channels have been maintained. However, with the successive petroleum oil price rises of the 1970s, many of the traditional collectors of the gum migrated permanently to the oil-rich regions of the country, thereby placing some strain on the supply side and exerting an upward pressure on prices. The political changes which took place in the country at the end of the 1970s in due course brought about a greater degree of Central Government influence in the industry, and in particular a very sharp price rise during the period 1982-85, much to the detriment of the product's standing in the world market. In 1984 an official Iranian trade delegation, including members of the local association of gum tragacanth exporters, visited Western Europe and were clearly advised by importers of the probable consequence of their pricing policies. It is not entirely clear how many, if any, of the private Iranian suppliers, who number some 5-10, were in sympathy with the official policy, but it seems unlikely that they were all unaware of the risk being taken; nevertheless, neither the influence of any who opposed the policy nor the pleadings of the importers had any immediate effect on the official stance. By mid-to-late 1986, however, there was evidence of a loosening of State control of the industry, the local suppliers appeared to have more freedom of manoeuvre in their communications with the outside

world, and prices had fallen back appreciably. A black market in Iranian gum tragacanth has been reported, operating mainly through Dubai, but it is not at all clear why this came about and it does not appear to be an undue influence on the trade as a whole.

Turkey

Turkey has not been a force in the gum tragacanth market for as long as Iran, having risen to prominence only since the early-to-mid-1970s. Production mainly takes place in the Anatolia region. Annual production and exports are typically in the range 80-120 tonnes, and the number of local suppliers to the international market is probably no greater than five. The local gum is perceptibly different in character from the Iranian product, mainly on account of differences in soil and in the sub-species of *Astragalus* which is exploited locally. Opinions among users differed to a surprising degree on the question of whether Turkish gum tragacanth is or is not inferior to the Iranian gum, but it is certainly a cheaper product and a majority of users regarded it as more restricted in application and generally much less clean microbiologically than the Iranian product. It is said to stand up to 'shear' less well than Iranian gum. There is unquestionably no Turkish equivalent of the best Iranian ribbons. However, Turkish gum tragacanth has a firm following, and some Western buyers have entered into long-term supply arrangements with Turkish suppliers.

Other producers

Gum tragacanth from Afghanistan had been seen mainly by one or two buyers in the United States, but in very small quantities and its cleanliness was said to be poor. Nothing is known of the nature or structure of local production, either in Afghanistan or in Syria, from where the gum is shipped even more rarely.

GRADING, QUALITY, TOXICOLOGY AND PACKAGING

The Iranian grading system for gum tragacanth is more clearly defined than the Turkish. There are about sixteen known Iranian grades and they include the following:

Ribbons, Nos. 1, 2, 3, 4 and 5
Mixed Ribbons
Flakes, Nos. 25, 26, 27, 28, 31, 55, 101, 102
Nubs
Siftings

In commercial practice the most important grades are Ribbons Nos. 3 and 4 and Flakes Nos. 26-28. The other grades are purchased at irregular intervals, and generally very infrequently; the Ribbons No. 1 grade is far too expensive for more than very specialised use, and even the No. 2 grade, although used more widely than No. 1, is too costly for many large-volume uses, while the Ribbons No. 5 grade is not strictly a food or pharmaceutical grade. In practice some variation in quality often occurs within each grade, even at the highest grades, mostly according to the practices of each individual supplier. In many cases the variations are too small to matter, but in rarer cases individual consignments contain gum of several grades in spite of a single-grade specification. In the United States some traders employ an alternative grading system based on United States Pharmacopoeia and Food Chemical Codex requirements using letter designations (A, B, C, etc.), these grades approximating closely to the Iranian grades.

The Turkish grading system is much less standardised than the Iranian system; it would appear that to a certain extent each supplier has developed an individual system, the names of the grades often reflecting the names of

the shippers. However, the following grades appear to be fairly widely recognised:

Fior	(the top grade, equivalent to Iranian Ribbons Nos. 4 or 5)
Bianca	(an average grade, equivalent to Iranian Flakes No. 27)
Pianto	(a low grade, falling roughly between Iranian Flakes No. 28 and Flakes No. 55)

There are also inferior grades known as 'Bitlis' and 'Traganton', the latter not being produced from an *Astragalus* species. It must be emphasised, however, that other grading designations exist. Problems with foreign matter content and high bacterial loads appear to be more common with Turkish gum tragacanth than with the Iranian product.

On the whole, the number of grades is gradually falling over time, and the highest grades are traded increasingly infrequently owing to their high price. The various grades are allocated according to appearance, freedom from an excessive number of breakages, and also, to an increasing extent, viscosity. Although some cleaning takes place at source, no other processing is undertaken before export. It has already been implied above that the need for sterilisation treatment of the gum in the importing countries, to reduce the content of salmonella and other bacteria, may bring about a downgrading of a consignment owing to loss of viscosity caused by the cleaning process. This is true of the otherwise effective treatment with ethylene oxide (ETO), but this process, although temporarily permitted in Europe for a three-year period from 1986, is increasingly being restricted or even banned on account of excessive toxic residue levels. Treatment with ethanol presents fewer residue problems, but re-use of process ethanol presents technical problems which render the process economically unviable, to the extent that a few firms using this process have had to close. Treatment with propylene oxide (PPO), sometimes in the presence of a limited amount of heat and with careful humidity control to minimise viscosity loss, is used in the United States and is still widely permitted but may not achieve the degree of 'kill' required for attainment of the bacterial limits specified for certain food and pharmaceutical applications, although 'kill' rates of 90% are possible. The use of intensive heat treatment to destroy bacteria is highly detrimental to the gum's quality, and it is possible that the same may prove to be true of gamma-irradiation, the use of which, although effective from the point of view of sterilisation, has yet to be officially cleared as safe. Other methods of treatment are under study in certain countries. It is also worth noting that gum tragacanth should be used as soon as possible after harvesting, and where extended storage cannot be avoided, care must be taken to monitor storage conditions closely in order to minimise loss of viscosity, particularly after grinding.

The cleanliness problems associated with gum tragacanth, which repeatedly fails to meet the clearly-stated requirements of the various Pharmacopoeias, and the difficulty of reducing bacterial levels satisfactorily, have cast an increasingly long shadow over the gum's future; moreover, the suitability of the gum *per se* for use in food products, quite apart from the cleanliness problems, has also been called into question. In recent years, in spite of the fact that the European Community still provisionally, and exceptionally, recognises gum tragacanth as a legitimate food additive insofar as it temporarily carries the official additive code E 413 (albeit without any Acceptable Daily Intake [ADI] recommendation), these problems have been the focus of a number of detailed studies of the gum by highly influential organisations. The UN World Health Organization's Joint Expert Committee on Food Additives (JECFA) is in the process of studying the gum, while the findings of an extensive and prolonged toxicological and reproduction study carried out by the United States Food and Drug Administration on rats have yet to be made available to the general public. Similarly, the European Community authorities have been reviewing the gum's characteristics, especially in relation to the use of ETO. The deadline for the termination of the gum's temporary listing has been finally extended to the end of 1988, by which time the gum's long-term legal

status should finally be confirmed. This prolonged period of doubt as to the gum's future has taken the form of a self-fulfilling prophecy, many firms no longer building the gum into their formulations, in spite of its many inherently desirable characteristics. The possibility of technical drawbacks to the use of gamma-irradiation, even if it is eventually permitted, have already been referred to.

Packaging of gum tragacanth for shipment varies somewhat. The higher-grade ribbons are fragile and it is common for them to be packed in wooden cases for maximum protection, of gross weight 100 kg and net weight 80 kg. For the lower grades of gum, hessian bags are often used; net weight varies, but the typical range is 60-75 kg.

IMPORTS AND MARKETS

United States

The recent trend of imports of gum tragacanth into the United States is shown in Table K below.

Table K

United States Imports of gum tragacanth

(tonnes)

1979	173
1980	221
1981	291
1982	133
1983	100
1984	118
1985	176

These quantities were mainly for internal use, the re-export trade apparently being fairly small; reference should be made to Appendix A, Table 16 for full details. Most United States gum tragacanth imports pass through the hands of a few intermediaries in the New York area, some of whom undertake a degree of further processing. For political reasons, imports of Iranian gum reach the United States indirectly, for example via Hamburg, in spite of appearing in the statistics as apparently direct imports. Current usage levels are only one-tenth of their peak levels. The gum is mainly used in **salad creams and dressings** and in certain **pharmaceutical** and **cosmetic products** such as skin creams. Minor uses include most of those listed in the 'Uses' section. Because of the very high price of the gum's top grades, the most common grades imported are the Iranian Flakes Nos. 27 and 28, whereas formerly it was the USP-standard Ribbons No. 1 grade that was most in demand. Ribbons are still imported, but in comparatively small quantities, and mainly for pharmaceutical applications, most food manufacturers using flakes of the above grades. Even so, grades such as Ribbons No. 3 and Flakes No. 55 are occasionally imported. However, in spite of the fact that high-grade gum tragacanth is classed as GRAS (Generally Recognised As Safe) in the United States, even the high-grade ribbons contain too high a bacterial loading for use as imported. Partly under the influence of prolonged political tension between the United States and Iran, imports of Turkish gum have increased greatly during the past 5-10 years, although some buyers still consider that it contains an unacceptable level of foreign matter, and many users continue to prefer the Iranian product. There can be little doubt that, in spite of the gum's high price and bacterial problems, it still stands very high in the esteem of United States users, especially salad cream manufacturers who are now much more numerous than they were, many of the newer smaller firms using gum tragacanth in preference to its competitors; even the larger users, who used to account for 80% of the salad cream market, still use it to some extent. A typical salad cream contains 1% of gum tragacanth by volume. Xanthan gum is widely believed to impart an undesirable taste to salad creams and its 'pourability'

characteristics are considered decidedly inferior to those of the natural exudate gum; even when chemically modified, xanthan gum cannot wholly equal the best grade of gum tragacanth, of which the acid resistance characteristics in salad dressings and binding characteristics in certain pharmaceutical products cannot be equalled. In some applications, including salad creams, gum tragacanth is blended with xanthan gum and locust bean gum or guar gum to reduce costs, but generally at some penalty in quality and shelf-life. The fact remains, however, that the increasing incompatibility of the foreign matter and bacterial contents of gum tragacanth with the demands of the FDA, together with price considerations, have steadily taken their toll of the gum's prospects in the United States. Very few pharmaceutical manufacturers now using gum tragacanth in new formulations, although it has often been tried and tested. There can be little doubt that, in the event firstly of eventual FDA approval of a satisfactory method of cleaning and sterilisation of the gum which leaves no harmful residues and does not impair its essential properties unduly, and secondly of an appreciable price fall, there would probably be an appreciable reversion to the use of gum tragacanth on the part of many United States users. For the time being, however, the long-term future for the gum remains in some doubt, although many United States users are sceptical of any suggestion that the gum will ever disappear completely.

Western Europe

The future of gum tragacanth in Europe is probably under greater threat from possible widespread bans than it is in the United States, the outlook of European users as a whole being more pessimistic than that of United States users. Unfortunately import statistics for gum tragacanth are not published separately, the gum being included in composite categories in the official returns. The composite categories in some cases itemise Iran among the various sources (*see* Appendix A, Tables 33-38). However, although gum tragacanth is the only water-soluble gum exported by Iran, the totals may include other types of product as well as some re-exports; moreover, as explained in the previous section on the United States market, much Iranian gum tragacanth reaches the United States via Hamburg, and the figures for West Germany must therefore be interpreted in the light of the Hamburg-United States trade. The problem is further compounded by the fact that, firstly, the Turkish trade is not itemised and, secondly, significant quantities of gum tragacanth are re-exported from European trading centres, especially by one or two major dealers in Hamburg and Paris, to destinations other than the United States, including Eastern Europe. Any attempt at indirect estimation of European consumption from the tables in question is therefore liable to a considerable degree of inaccuracy. However, allowing for the limitations of the statistical data and taking account of trade opinion, it is estimated that annual consumption of gum tragacanth in Western Europe is currently about 200-250 tonnes. The distribution of consumption between the various national markets of Western Europe is not known with any accuracy.

Federal Republic of Germany

In the Federal Republic of Germany gum tragacanth is still used in the food and – to a lesser extent – pharmaceutical industries but in both cases lower bacterial loading levels are often required than exist in most untreated import consignments. However, the use of ETO is not permitted, heat cannot be used for technical reasons and irradiation has not so far been approved; for these reasons, an increasing number of users are under pressure to reduce their intake of the gum. The West German textile companies used to use 20-30 tonnes per annum for sizing and finishing operations but no longer do so on a significant scale. West German importers noted that consignments of gum tragacanth are usually delivered on time and that the suppliers generally honour agreed trading procedures; these observations relate equally to Turkish suppliers, whose products were not, on the whole, considered inferior to

Iranian gum. But most traders felt that gum tragacanth was steadily disappearing from the West German market, partly for the above reasons and partly because of the gum's uncompetitive price, particularly during the mid-1980s when there were large unsold stocks of the gum in Hamburg.

United Kingdom

In the United Kingdom the main uses for gum tragacanth, as elsewhere, are in salad dressings and pharmaceutical creams and emulsions, the highest grades being required by the pharmaceutical industry. The use of ETO is still permitted for sterilisation, although this may change in the event of an eventual adverse European Community ruling on the practice. The gum is imported by the four major importers of water-soluble gums, most of whom clean, grind and blend the gum according to user requirements. In spite of the use of ETO treatment, xanthan gum has already made substantial inroads into gum tragacanth's traditional areas of usage. The pharmaceutical industry can afford to pay for the highest grades of gum but can also afford the costs of reformulation, and the overall outlook for the gum is generally poor.

France

In France gum tragacanth is generally considered to be too expensive for use in food products. It is, however, used to some extent in pharmaceutical products and in a few hair preparations. It should perhaps be noted that there is a noticeable vogue for products of natural origin in France and, although the use of xanthan gum is increasing at the expense of natural gums, its progress is slower than in some other countries. Annual consumption of gum tragacanth is said to vary considerably from year to year, and the gum usually passes from the importers to end-users through specialised processors.

Netherlands

The Netherlands imports gum tragacanth from both Iran and Turkey, but more from the former. The main grades imported are Ribbons Nos. 3 and 4 and Flakes No. 27. The Netherlands followed the West German line on the use of ETO, which is therefore now banned, and consumption of the gum in the Netherlands is extremely low, only very small quantities being used in pharmaceuticals. The gum's use in textile sizing and finishing has disappeared before the advance of alginates. Most Netherlands imports are routed through Hamburg, the requirements of most importers being too small for direct trade with origin to be worthwhile.

Belgium

In Belgium gum tragacanth has minor uses in the food industry and in pharmaceuticals, as well as in some cosmetic creams, but xanthan gum is rapidly displacing it. Market trends in Belgium correspond closely to those in the Netherlands, and the use of ETO is banned.

Switzerland

In Switzerland annual usage of gum tragacanth may be a few tens of tonnes. The import trade is conducted via London and Hamburg, rather than from source. There are seven or eight Swiss gum blenders who produce a range of composite products largely for the export market, and the gum is used mainly in face cream preparations.

Other Western European markets

Apart from Italy, where the demand pattern is no more encouraging than in other European countries, there are no other Western European markets of any consequence. The overall picture is one of steady, slow decline and very few traders foresaw any likelihood of a reversal of the trend.

Other markets

Although markets outside Western Europe and the United States were not investigated, gum tragacanth is itemised separately in the trade statistics of **Japan**. These are shown in Appendix A, Table 17 and, on the assumption that the level of re-exports from Japan is negligible, suggest that Japanese consumption during the early 1980s has averaged around 30 tonnes per annum.

PRICES

Reference should be made to Appendix A, Table 18 for details of recent price trends for gum tragacanth. The effect of the official Iranian policy on prices imposed in the early 1980s, discussed above, is very evident. At the beginning of 1985 prices on the New York market ranged from about $15,000 per tonne for low quality Iranian Flakes to over $70,000 per tonne for highest quality Ribbons, with many grades priced at between $30,000 and $50,000 per tonne. The price of Turkish gum is generally a little below that of the equivalent Iranian grades. In sharp contrast, at the beginning of 1985 the price of xanthan gum was $7,000 per kg. By the beginning of 1987, however, prices had fallen back to around 60% of their 1985 levels. In the view of some traders, spot prices in the main trading centres such as London and New York have fluctuated more than prices at origin.

Freight rates from source to the main markets are typically in the range £120-170 per tonne, the precise figure depending on the origin and on whether shipment is overland or by sea.

TRADING STRUCTURES AND PROCEDURES

Gum tragacanth is traded through all the usual channels for the water-soluble gums. Hamburg is a major entrepot for the gum, as is London, and there are about ten traders active in the gum in these centres. Consignments of Iranian gum destined for the United States are routed through Hamburg because of the current severe restrictions on direct commercial and trading contacts between Iran and the United States, although there are no such restrictions on trade in Turkish gum. Although some major United States users purchase direct from Hamburg or from Turkey, many use the New York area's network of dealers and agents, the latter taking a commission from the seller only. European users generally purchase through local importer-processors rather direct from origin.

Although the Letter of Credit system is required by certain suppliers from time to time, the majority of consignments are traded on a Cash Against Documents (c.a.d.) basis. The terms of payment are more often c.i.f. or cost and freight (c.a.f.) than f.o.b., but some Iranian suppliers appear to prefer to operate on f.o.b. terms. Defaulting and late delivery is said to be rare, in spite of the general disruption caused by the Gulf War.

Tariffs constitute no constraint on trade in gum tragacanth, the rate of import duty on consignments of gum from source being zero in all major markets.

CONCLUSIONS AND PROSPECTS

In spite of its basic reputation as a fine product with some incomparable technical characteristics, gum tragacanth has suffered disastrously in the face of competition, in particular from xanthan gum, following growing concern about the gum's inability to meet modern standards of bacterial contamination levels and the unavailability of sterilisation methods that are both fully effective and, in the opinion of the key health authorities, safe. Inappropriate pricing policies at source during the early-to-mid-1980s have only accelerated the product's decline. In the event of the rulings by the United States FDA and by the European Community, still pending at the time of writing (early 1987),

on key aspects of utilisation of the gum in food and pharmaceutical products, proving favourable, there could be a renaissance in the use of the gum, especially if a more realistic price structure is arrived at. From mid-1986 there were signs of reduced State involvement in the Iranian gum trade, communications were improving and the price had fallen well back from its peak, although it would be necessary for the prices of the better grades to be no higher than, say, 30-50% above that of xanthan gum for the substitution trend to be effectively checked. If, on the other hand, the rulings go against the product, there could be a continuous further decline to a level of maybe only 100-200 tonnes per annum world-wide, regardless of price reductions. Even if the more optimistic assumption proves to be justified, however, the prospects for a new producer of gum tragacanth can only be described as poor, since the existing producers are almost certainly more than capable of servicing any foreseeable level of world demand.

Section 5

Gum karaya

INTRODUCTION AND DESCRIPTION

Gum karaya is the dried exudate obtained from the tapping or blazing of the mature *Sterculia urens*, a large, bushy tree which grows widely throughout the Indian sub-continent. The closely related species *S. villosa* is also sometimes tapped, as are some other trees of the *Sterculia* (family Sterculiaceae) and *Cochlospermum* (family Bixaceae) genera; for example, the gum can also be obtained from the *S. setigera* tree which is found in Sudan and other North African countries. Under current legal definitions of the gum, any *Sterculia* species may be used. The gum is produced mainly, although not exclusively, in India, the best production area being Madhya Pradesh State, although there is also production in Gujarat and Maharashtra States. Harvesting takes place between April and June. Further information on Indian production is given in a subsequent section.

The gum is an acidic, partially acetylated polysaccharide with high water absorption characteristics, which *inter alia* prevent the formation of ice crystals. It possesses an ability to form thick suspensions and is a good emulsifying agent. It does not dissolve completely in water to give a true solution, although solubility is aided by heating under pressure. It does not possess the 'pourability' characteristics of gum tragacanth but shows good stability in acidic preparations. It has a relatively short shelf life, prolonged storage affecting both its colour and, more seriously, its viscosity. The gum, as traded, often requires cleaning but it is extremely sensitive to the various cleaning techniques available, many of which can adversely affect the gum's characteristics. This is further discussed subsequently. To some extent gum karaya used to be regarded as an inferior substitute for gum tragacanth, and indeed used to be known by some traders as 'Indian tragacanth'.

USES

Probably the most common use of gum karaya in the markets is as a major ingredient in medical **colostomy bag fixings**, in which the gum's qualities are difficult to equal, although in recent years sophisticated substitutes based on sodium carboxymethylcellulose (CMC) and, to a very much smaller extent and mainly in the United States, pectin, have begun to appear. A second major, although apparently steadily declining, use is in **dental fixatives**, mainly for false teeth; to some extent the gum has been replaced by alginates, agar and CMC in this application. It is also used to a small extent in **bulk laxatives**, mainly in the form of chocolate-flavoured granules. In some countries it is used in small amounts in **ice-creams** as a texturiser and stabiliser, and also, to a diminishing extent, in **ice pops** and **sherbets**. In one or two markets very small quantities are used in skin fixings for medical electrodes, in salad dressings and in rubber backings for bathroom mats. Its former use in the textile industry has almost entirely given way to other products, and although it was once used as a thickener in orange crushes, this is no longer the case. In general, the use of gum karaya in food and beverages is small, and in some countries is banned, at least for the time being. In the United States, however, there has recently been an increasing use of small quantities of gum karaya

in the oil-drilling industry, in blends with xanthan gum, although it remains to be seen how far this application develops.

PRODUCTION AND EXPORTS

World production of gum karaya is currently about 5,500 tonnes per annum, and on a declining trend. **India** is the only regular producer, overwhelmingly dominating international trade in the gum. Details of recent Indian exports are given in Appendix A, Table 19. The local industry is forest-based and both production and marketing have been relatively unorganised, particularly in comparison with the guar gum trade (*see* Section 3). Picking, cleaning and sorting of the gum is all done manually. Little or no research has been carried out on yields or productivity and there has been no regular system of export incentives or of loans by purchasers to the collectors, who are mostly very poor and collect the gum from wild-growing trees. There are many intermediate traders between the collectors and the shippers, and the collectors frequently receive an extremely low price for their labour, many consequently being lost to formal training in agricultural cultivation techniques. However, a rudimentary system of production and export licensing operates, and this system has enabled the authorities to close off a number of production areas to collectors on the grounds that the trees have been over-tapped. Re-planting is only an effective remedy in the long term, as only mature trees are tapped. The overall effect of this background, combined with periodic bad weather conditions, has been that of a decline in production and, during the mid-1980s, of a rise in the gum's price and increasing pressure for fairer wages for the collectors. Moreover, from the beginning of 1987 sales contracts with overseas buyers and shipments may only be organised under the aegis of the Indian organisation NAFED (National Association for Export Development), partly in order to enforce a fair price to the collectors; further upward pressure on prices is therefore possible. Grading is already under Indian Agmark control.

Estimates as to the number of shippers of gum karaya vary from as few as five to as many as fifteen, although it is likely that the bulk of the trade is in the hands of five or six exporters. Bombay is the main port of despatch.

A few overseas buyers claimed to have purchased consignments of gum karaya from **Pakistan**, but many others had not even heard of Pakistani gum, and it seems unlikely that Pakistan is a significant force on the gum karaya market, although it is possible that consignments of 200-300 tonnes are occasionally shipped. Attempts at production of the gum have also been made in **Sudan** and **Burma**; in the case of Sudan, irregular trade consignments have been recorded, but none in the case of Burma. The present status of production in Sudan is far from clear, but in general there are no signs of any significant increase in regular production outside India.

GRADING, QUALITY, TOXICOLOGY AND PACKAGING

The grading system used for gum karaya has varied somewhat over time but the main Indian Agmark grades used in international trade are currently as follows:

Superior, No.1, No.2, No.3, No.4, Siftings

One New York broker offers the gum in an alternative grading system (Superior 1 and 2, Ordinary 1 and 2, Siftings 1, 2, 3); other local systems are in existence, for example in the United States based on the requirements of the National Formulary, but it is the Indian system which is most widely recognised. Some dealers claimed that only the top three grades are export grades but this has not been confirmed, and in any case it was evident that at least some consignments of the Siftings grade reach Western markets. In earlier days grading was based on colour, but nowadays the gradings are allocated mainly on a BFOM basis (i.e. Bark and Foreign Organic Matter

content). At one time Grades 1, 2 and 3 corresponded to 0.5%, 1.5% and 3% BFOM maxima respectively, but standards have slipped somewhat over the years and the corresponding maxima are nowadays around 1%, 2% and up to 4% respectively, although BFOM levels of 1.3% have been known in Grade 1 consignments, and a 3% limit for Grade 3 is still recognised by the Food Chemical Codex and the United States National Formulary. In fact, the progressive deterioration of grading standards was largely responsible for the introduction of the highest-quality Selected grade. Quality problems are frequent and inconsistency is common; many impurities are introduced at the tapping stage. Viscosity standards have proved difficult to meet, especially as it is usual for the gum to require sterilisation before use.

It is in the sterilisation operations that further serious problems arise, for gum karaya does not respond well to treatment with ethylene oxide (ETO), toxic residual levels being higher than for some other gums. Moreover, the application of heat easily affects viscosity levels adversely, and although the joint application of propylene oxide (PPO) and carefully controlled gentle heat can sometimes bring bacterial plate counts down to acceptable levels without undue loss of viscosity, PPO is not as efficient as ETO, although it is safer.

Gum karaya's problems have been compounded in recent years by doubts in some quarters as to its suitability *per se* as a food additive, quite apart from the difficulties associated with cleaning. At the beginning of 1987 gum karaya was still temporarily recognised by the EC as a legitimate food additive insofar as it carried the temporary official additive code 416 and a recommended Acceptable Daily Intake (ADI) rating of 0-12.5 mg per kg of body weight, pending proof of safety. The deadline for the expiry of the temporary European listing of the gum has finally been extended until the end of 1988, by which time the gum's long-term legal status should be confirmed. This prolonged period of uncertainty, together with the fact that many users require British Pharmacopoeia standards of microbiological cleanliness that can only be attained through the use of ETO, has given rise to several studies of the gum, for example by the United States Food and Drug Administration and the Indian National Institute of Nutrition (NIN). The latter organisation's study was a response to an EC demand for a thorough examination of the product and was based on observation of the effects of the gum on monkeys. Other studies, including one carried out on rats, were sponsored by the International Gums Association for Research (INGAR). The future of gum karaya in the United States appears to be less threatened than in Europe, mainly because non-ETO cleaning methods appear to work more to the satisfaction of United States users than for European users. Some EC countries, notably West Germany, already prohibit or heavily restrict the use of gum karaya in food products, in spite of at least one temporary EC reprieve, and there is certainly no guarantee that, in the event of a favourable outcome from the NIN study, these countries would fall into line and de-restrict the product, particularly West Germany, where the gum has been banned for many years.

Gum karaya is mainly shipped in lined jute bags of 50 kg capacity, often in container loads.

IMPORTS AND MARKETS

The world market for gum karaya outside India is currently in the region of 5,500 tonnes per annum. There appears to be some demand for the gum from within India, in view of the apparent existence of non-export grades, but this has not been further investigated.

United States

The recent trend of imports of gum karaya into the United States is shown in Table L below, which is based on the more detailed data presented in Appendix A, Table 20.

Table L

United States imports of gum karaya (tonnes)

1979	2,734
1980	2,422
1981	2,920
1982	4,026
1983	2,131
1984	2,482
1985	1,522

Allowing for a very small level of re-exports, United States annual consumption during the period 1980-84 averaged around 2,750 tonnes, no obvious trend being evident prior to 1985 when a sharp fall was recorded. It should be noted that, although India overwhelmingly dominates supplies to the United States, there was an exceptional consignment of 1,207 tonnes from Sudan in 1982. The gum is imported mainly through the network of five or six dealers and agents in the New York area, some of which undertake a degree of further processing. However, a few users purchase direct from source. The main application for the gum is in colostomy discs; although pectin has been tried in this application, it is too early to predict how far, if at all, it will supplant gum karaya, and the general consensus of opinion in the United States is that gum karaya is unmatched in this area of usage. Its use in dental fixings has declined, firstly on account of technological advances which favour the use of alternatives such as agar and CMC, secondly because of the immense improvement in the general dental health of the United States population, which has reduced demand for dental services generally. Lesser United States applications include chocolate-granule laxatives, although in declining quantities, and ice-creams, ice pops and sherbets, also in dwindling quantities. Still smaller applications include rubber backings for bathroom mats and skin fixings for medical electrodes, while textile usage has all but disappeared. A relatively recent innovation entails the use of gum karaya in oil-drilling in combination with xanthan gum, but how far this area of usage will grow cannot yet be ascertained.

Although gum karaya still has GRAS (Generally Recognised As Safe) status in the United States, little is used in food and some users believe that its use in food could eventually be banned by the FDA, although the latter body has yet to publish any adverse findings on the gum. The use of ETO in the United States is already banned, combinations of PPO and heat treatment being employed instead. Many buyers commented on the product's inconsistency of quality, on the rise in the gum's price during the early-to-mid-1980s and on the failure of some suppliers to meet delivery dates. But on the whole the product enjoys a stable position in the United States market, and there is no obvious prospect of an early decline in consumption.

Western Europe

Unfortunately, the trade statistics of the EC and other Western European countries do not itemise gum karaya separately. Moreover, although the 'miscellaneous gums' category in the European trade returns itemises India as a source, the statistics include the larger volume guar gum in addition to karaya gum. An estimate of import levels can, however, be derived from the Indian export statistics (*see* Appendix A, Table 19), these suggesting that Western European imports of gum karaya averaged some 2,400 tonnes per annum during the early 1980s. However, considerable quantities are re-exported, and it is unlikely that internal Western European consumption exceeds 1,500-1,750 tonnes per annum. **West Germany** has, as already mentioned, for long banned the use of gum karaya in food products, usage there being restricted mainly to colostomy rings and dental fixatives. There

are four or five importers of the gum, mostly in Hamburg, and there is some re-export of the gum to other markets including Eastern Europe. In the **United Kingdom** the two main uses apply although there has been some movement away from gum karaya in colostomy rings in favour of sophisticated CMC-based synthetics, while usage in dental fixatives is to a growing extent giving way to alginates. There is some usage in laxative products but very little in foodstuffs. There are four main importers in the United Kingdom. In **France** the pattern is similar to that in the United Kingdom, and although the evidence of an advance by synthetics into the gum's main applications is less clearly defined, the French market as a whole is in decline, mainly on account of quality problems. A feature of the French market is the gum's use in ice-cream as a substitute for expensive locust bean gum, although whether this will continue to apply in the light of the general rise in the price of gum karaya is a very open question. Gum entering the French market is sold mainly to processors who in turn sell to end-users. Very little is used in the **Netherlands**, in spite of the product's not being banned in food; small quantities of the Selected and No.1 grades are used in dental fixatives. The gum is imported mainly via Hamburg, local requirements being too small for direct trade with origin to be worthwhile. Usage in **Belgium** is also minimal and confined to laxative products and dental fixatives. In **Switzerland** the gum is also mainly used in these applications, but there is also an appreciable level of usage by seven or eight local blenders for the food industry, and the strongly export-oriented nature of the Swiss industry ensures that consumption levels there are proportionally higher than would be expected merely on the basis of population size. Without doubt the rise in the gum's price during the early-to-mid-1980s constituted a strong incentive to European users to minimise their usage of the gum wherever possible.

PRICES

Recent movements in the price of gum karaya are shown in Appendix A, Table 21. Whereas a price level of around £1,000 per tonne was typical in 1981 for the top grade, the closure of some production areas by the Indian authorities combined with bad weather brought about a major upward trend to a peak of £2,900 per tonne. By the end of 1986 the price had moved back down towards the £1,850 per tonne level for top-grade gum, but the recent involvement of NAFED in the trade (*see Production and Exports* section) could bring about a resumption of the upward trend. As a rough indication of the differential between grades, Grades 1 and 2 are typically priced at 85% and 80%, respectively, of the Selected grade. The cost of cleaning can increase the price of the gum by one-third at current levels.

TRADING STRUCTURES AND PROCEDURES

The recent involvement in the gum karaya trade of the Indian NAFED organisation has already been noted. The gum is traded through the usual network of dealers, agents and brokers, mainly in Western Europe (especially Hamburg and London) and the New York area of the United States. Brokers are of diminishing importance in the trade, the New York agents taking a commission from the sellers only. Some users and processors purchase direct from origin, by-passing the intermediaries. London and Hamburg are important trans-shipment centres. The terms of trade may be either f.o.b., c.i.f. or c.a.f. according to the shipper, and payment either on the opening of a Letter of Credit or on the basis of cash against receipt of documents (c.a.d.).

A typical freight rate from India to Europe is $1,500-2,000 for a 16-tonne container, equivalent to approximately $90-$120 per tonne. A corresponding rate to the United States would be in the region of $150 per tonne or possibly a little higher.

No import duty is levied on imports of gum karaya into any of the major markets.

CONCLUSIONS AND PROSPECTS

The future prospects for gum karaya depend in part on the outcome of the toxicological study originally demanded by the European Community and undertaken by the Indian NIN. If, in spite of the general efforts of the INGAR organisation to have the product cleared for use in food, a ban were to be imposed as a result of the findings, its use in colostomy rings and dental fixings would probably not be significantly affected since, in spite of some substitution by synthetics, it continues to be very highly regarded on technical grounds in those applications, in spite of the price in the mid-1980s. It would therefore in principle continue to enjoy a reasonably stable market. However, it is clear that there is room for various improvements at origin, mainly in handling from the tapping operation onwards, with a view to raising cleanliness standards and reducing bacterial loading to an appreciable degree. If appropriate steps in this direction were taken, the product might regain some of its lost ground even in non-food uses, especially in the medical and pharmaceutical areas. There also appears to be some room for improved practices in adherence to delivery dates, failure in this area being a major cause of ill-will among buyers. The involvement of NAFED in the trade could be a force for either good or ill; many buyers are strongly suspicious of any State involvement in a traditional private trade, but if the result of the new development is the bringing about of an improved structure and of a greater degree of order, stability and control over quality in the local production and trading system, then much good may be done, even at the expense of a rather higher average price level. There appears to be little prospect for successful entry into the gum karaya trade on any significant scale by any other producers, for in spite of recent Indian production problems, India almost certainly continues to possess the resources for the servicing of any foreseeable level of world demand.

Section 6

Locust bean gum

INTRODUCTION AND DESCRIPTION

Locust bean gum is obtained from the tree botanically known as *Ceratonia siliqua*, also widely known as the carob tree. The gum is also known as carob bean gum or even St John's bread after the Biblical reference to the use of 'locusts' as a food. The carob tree is an evergreen growing up to 9 metres in height, and grows well in poor, rocky soil in which many other plants could not survive. The tree does not usually produce fruit in any quantity until it is 15 years old and may not be fully grown until it is 50 years old. Hot, dry weather is needed for good yields. The fruit consists of chocolate-coloured pods containing the locust beans or carob beans, and are ready for harvesting between September and November. The gum is extracted from the endosperm of the seed kernels and careful processing is required to give gum of good colour and viscosity.

Locust bean gum is a seed galactomannan-type gum in many ways similar to, although in no way wholly interchangeable with, guar gum (q.v., Section 3). In particular, the ratio of the constituents mannose and galactose is 4:1 in locust bean gum but 2:1 in guar gum. Unlike guar gum, it is only partly soluble in cold water, full solubility only being achieved at temperatures of 85 degrees Celsius and above. For some applications this is an advantage, as will be discussed in the sub-section on uses, but in many other applications in which the role of heat is not critical, guar has the advantage, especially as it is already much cheaper than locust bean gum, the price difference being accentuated by the need to apply heat to the latter. Locust bean gum has better water retention characteristics than has guar gum. The gum is sometimes chemically modified (e.g. 'clarified locust bean gum') and in some modified forms it is cold-water-soluble, but of course the modification process adds to its cost. Locust bean gum possesses high viscosity at low concentrations. Although its gelling properties on its own are only modest, it combines with some other gums, notably xanthan gum, to give very effective gels, no other natural gum having this property; but in no form is it a substitute for gelatine. A further property of the gum is its very strong synergistic action in combination with other products, including carrageenan and agar. In general, it possesses excellent stabilising, thickening and emulsifying properties.

USES

Probably the most important applications for locust bean gum are **ice-creams**, **baby foods** and **canned pet foods**, in which its texturising properties in particular are of great value and hard to replicate fully using other products. In ice-cream the gum slows the rate of melt-down and improves the ability of the product to withstand transportation and prolonged storage. It is also used in other products of the food industry, notably **soups**, in which its property of fully dissolving and thickening only at high temperatures is of critical importance; **sauces**, including barbecue sauces; **cream cheese**, especially in the United States; **sausage products**, mainly as a binder and lubricant; **powdered desserts** and **fruit-filling mixes** in bakery products, the gum also having good dough-softening characteristics; **jelly toppings**; **salad creams**; **sherbets** and **ice**

pops; and, particularly in the United States, in various **dairy products**. Its use in many of these products owes much to its texturising, emulsifying and 'mouthfeel' characteristics. In some, it is used in combination with xanthan gum. Outside the food industry it has few uses, small quantities being used in **papermaking** and **textile printing and sizing**. It is also used together with guar gum in certain preparations used in welding operations.

Locust bean pods were for a very long time used as a cattle-feed; to some extent this still applies, but in some of the major producing countries their use has declined, thereby significantly affecting the economics of exploitation of the locust tree and in part causing a major rise in the price of the gum during the 1980s.

PRODUCTION AND EXPORTS

Production statistics on locust bean gum are not available, and the difficulty of estimating world production is compounded by the fact that substantial quantities are consumed at or near source. However, trade statistics are more widely published for locust bean gum than for many other gums, although the information is far from complete. Total world exports of locust bean gum are currently about 12,000 tonnes per annum.

The main producing countries are Spain, Italy (partly in Sicily) and Portugal, the best-quality gum being produced in Portugal and Italy. Other known producing countries include, in particular, Morocco, Greece, Cyprus and Algeria; Turkey, Israel, India and Pakistan also exploit the tree to some extent, but only infrequently trade in the gum. Although Greek gum is regularly traded, it does not compare in quality with Iberian or Italian gum. In many cases wild trees are exploited but in the main producing countries, for example in Spain, some farmers own carob plantations. Export statistics for Spain and Italy are given in Appendix A, Tables 22 and 23; reliable information for Portugal is unavailable, although an estimate of Portuguese exports has been derived from the various import statistics, in which Portugal is usually itemised. The distribution of world exports is approximately as follows:

Spain	5,000-5,500 tonnes
Italy	3,000-3,250 tonnes
Portugal	1,500-1,750 tonnes
Other producers	2,000-2,500 tonnes (rough estimate)

Of the total given above for 'other producers', Morocco probably has the largest share, its exports regularly exceeding 1,000 tonnes per annum.

Much, but not all, of the gum is exported after being ground and often further processed, and in Italy blends of locust bean gum and guar gum are known to be produced and exported. The processing operations are not easy to carry out, complete removal of the seed coat presenting frequent problems but being of critical importance in applications such as ice-cream and cream cheese in which any dark-coloured foreign matter easily shows up. A consequence of these problems is that the processing operations are nowadays handled by only a handful of companies equipped with the advanced facilities needed to ensure complete removal of the seed coats. Some importing countries have their own grinding operations, Switzerland being an example.

A combination of labour shortages brought about by urban development and growth of the tourist industry, the afore-mentioned decline of the south-west European market for locust pods in cattle feed, and bad weather has brought about supply shortages and sharp price increases in recent years. These developments have caused increasing anxiety on the part of many users, the more so since locust trees take long to reach maturity and the production base cannot easily be switched to regions where the tree is not already abundant.

GRADING, QUALITY, TOXICOLOGY AND PACKAGING

The grading system applicable to locust bean gum varies somewhat according to the supplier, individual shippers often having their own specifications. Both viscosity (expressed in centipoise units, or cP) and mesh size (particle size) are important but current grades mainly reflect viscosity and four were identified:

3,000-3,200 cP, mainly used in baby foods
2,800-3,000 cP
2,500-2,800 cP, a typical pet food grade
1,800-2,000 cP

There are, however, a few localised grading systems; for example, one United States dealer specifies a Superior 2,700 cP grade and an Extra 3,400 cP grade. In general terms, however, the top two grades in the above list are normally required for food usage, and indeed it is these grades that are most in demand. For some critical applications, a degree of refining may be applied to the top grade. Lower-quality pet food, on the other hand, often incorporates gum of viscosity 2,500 cP or less. Most of the gum supplied by minor producers such as Greece and Algeria is of the lower grades, the better qualities emanating mainly from Iberia and Italy. As indicated in an earlier paragraph, quality to some extent depends on processing, care being required to ensure that no traces of the seed coat, that could cause speckiness in pale food products, remain.

Locust bean gum is regarded as a comparatively clean product and has Generally Recognised As Safe (GRAS) status in the United States. In Europe, toxicological studies carried out between 1978 and 1982 culminated in the gum being accorded a 'Acceptable Daily Intake Non-Specific' rating as a permitted food additive, the highest of the ADI ratings, and the gum carries the additive code number E 410.

Locust bean gum is usually shipped in jute or plastic bags of 25-50 kg capacity, often in container-loads.

IMPORTS AND MARKETS

United States

Reference should be made to Appendix A, Table 24 for details of the recent trend of imports into the United States. There is relatively little re-export trade, and annual consumption is currently in the region of 2,200-2,300 tonnes and, according to traders, in decline on account of the gum's high price. The gum is imported direct from origin by some large end-users, the remainder passing through the hands of the United States network of agents and dealers located mainly in the New York area; about five of these intermediaries are dominant, and one or two are also processors. Spain, Portugal and Italy are the main suppliers, other sources usually being avoided on account of frequent poor quality. Some users appeared to favour Italian gum. The four basic grades described in the previous sub-section are all used in the United States, but the top two grades are dominant, the top grade in particular. The two principal United States applications are ice-cream and cream cheese, mainly as a stabiliser and texturiser. Locust bean gum is greatly preferred to guar gum in cream cheese, and while guar gum is widely used in vanilla flavour ice-cream, locust bean gum is preferred in flavoured ices, sherbets and ice pops. Salad creams are another important outlet. However, it would appear that locust bean gum is used less in baby foods than in European markets, while its use in pet foods is unquestionably much lower than in Europe, mainly because

of the relatively low importance of canned foods in the United States pet food market. To the extent that seed galactomannan-type gums are of importance in the pet-food market, it is mainly guar gum that is used. Other applications include baked goods, icings and bakery emulsions, in which there has been some movement in favour of guar gum although locust bean gum is preferred on account of its superior water-retention properties; and various dairy-type products such as yoghurt bases, creamers, imitation whipped cream, individual milk portions and frozen dairy desserts. A little is used in sauces, although in the popular barbecue sauce there has been some substitution by xanthan gum. Some health food shops sell candies based on locust bean gum rather than chocolate. Usage in the non-food sector is negligible, mainly on account of the low solubility of the gum in cold water.

Considerable concern was voiced by United States users regarding the recent high price of the gum, which has had the effect of eclipsing the gum's high technical qualities in the eyes of many users. In cream cheese, for which locust bean gum is strongly preferred for its qualities, xanthan gum has made some inroads, and blends of locust bean gum, guar gum and xanthan gum are also increasingly common. Carrageenan, sodium carboxymethylcellulose (CMC) and modified starches have also made advances at the expense of locust bean gum. Were it not for the necessity of altering product labels in the event of reformulation, it is widely believed in the United States that the decline in the locust bean gum market would have been even more rapid. At the beginning of 1987, the price situation had not greatly improved and some further substitution was considered likely.

Western Europe

Average annual imports of locust bean gum into the main Western European consuming countries are currently about 7,000 tonnes (*See* Appendix A, Tables 22-23 and 25-30) but substantial quantities are re-exported. In **West Germany**, the gum is used mainly in ice-creams, baby foods and soups; in pet foods guar gum is often preferred. In the **United Kingdom**, the main areas of usage are pet foods (especially canned dog foods) and ice-creams, in that order, with some usage in sauces and sausage-type products. A little is also used in paper and textile printing, often together with guar gum. In **France** the main applications are ice-cream and, to a smaller extent, powdered desserts, although consumption is falling because of the high price. The Portuguese gum is preferred, in spite of its price premium over gum from sources such as Morocco. In the **Netherlands**, baby foods are the predominant outlet, others outlet include ice-cream, certain pudding preparations, lower grade pet foods and textiles, although the last-mentioned item is almost certainly of scant significance. In **Switzerland** the seven or eight local blenders, many of whose products are exported, prefer the Spanish gum, although Portugal is also a supplier. Outlets for the gum, whether *per se* or as part of blends, include sauces, soups and salad creams as an emulsifier or thickener; ice-cream, although guar gum has to some extent been substituted; and fruit-pie filling mixes. It is noteworthy that the gum's use is prohibited by law in certain fruit juices, jams and beverages, the use of pectin being required in these applications. Sometimes locust bean gum is blended with alginates or carrageenan before use. Outside the food industry, it is occasionally used with guar gum in the preparation of compounds for use in welding operations. Although other European markets were not specifically investigated, usage elsewhere in Europe is almost certainly very limited. As in the United States, the prolonged recent period of high prices is beginning to tell on locust bean gum consumption, many users being increasingly ready to discard the gum where the availability of adequate substitutes allows.

Other markets

Although markets other than those itemised above were not investigated, it will be seen from Appendix A, Table 31, that **Japan** imports an average of

some 1,500 tonnes annually, the trend in this case being upward. It is also evident from Appendix A, Tables 22-23, that **Australia** annually imports some 750 tonnes from Italy and Spain, and **Argentina** well over 100 tonnes per annum from Italy. The level of re-exports from Western European countries has already been mentioned, the destinations of such re-exports including Scandinavia, Eastern Europe and markets further to the East, but the trend of demand in these markets has not been ascertained.

PRICES

The trend in the price of locust bean gum since 1980 is shown in Appendix A, Table 32. The sharp upward movement during the mid-1980s is very obvious. By the end of 1986, the price on the London market for high-grade locust bean gum was £7/kg, equivalent to around $10/kg; this represents a modest fall from the peak levels recorded in 1986, when supplies were very short and the New York price was $14/kg, but is still equivalent to around a three-fold increase on the levels prevailing at the beginning of the 1980s. The prices of the second, third and fourth grades are generally all within 5% of that of the top grade. The reasons for the price rise have already been discussed in the *Production and exports* sub-section. Some users expect no recovery in locust bean gum consumption unless the price falls to $3 per kg or lower.

TRADING STRUCTURES AND PROCEDURES

Locust bean gum is sometimes purchased direct from source by the larger end-users, who may have long-term contracts with certain suppliers. However, much is traded via the New York, London, Hamburg and other European trading centres, mainly through commodity dealers, agents and, to a diminishing extent, brokers; five intermediaries are dominant in New York, and about seven or eight in the European trading centres. Commissioned brokers and agents typically charge a total of 2-3% *ad valorem* for their services, the charge sometimes being split between seller and buyer, sometimes – especially in the United States – being levied wholly on the seller. Trade with Eastern Europe is often conducted via Hamburg. The terms of trade vary a little but are frequently cost and freight basis (c.a.f) with payment made against receipt of documents (c.a.d.). Freight rates from Mediterranean producer to North America are typically $175 per tonne.

In contrast with other natural water-soluble gums, locust bean gum, which is mainly produced in the more developed countries, incurs import duty in some markets. Like Italian gum, Iberian and Greek gum no longer incurs duty in most European markets now that Spain, Portugal and Greece are members of the European Community, although Switzerland still levies a tariff. Although there is an external European Community tariff on locust bean gum of either 3% or 6% *ad valorem* according to source, North African producers often receive a degree of preferential treatment in European markets, mainly on account of their close historical connections with France. Locust bean gum enters the United States and Japan duty-free.

CONCLUSIONS AND PROSPECTS

As explained in the *Introduction* (Section 1), inclusion of locust bean gum in this study is justified only on account of its similarity to guar gum, which is mainly produced in the developing world. Under present circumstances, it cannot be said to pose an appreciable threat to guar gum, the recent rise in its price having caused many users to place price considerations above technical considerations. Guar gum has, indeed, gained at its expense, but the threat to locust bean gum from xanthan gum, CMC and even modified starches is probably greater. Some users observed that CMC and some modified starches offer both higher viscosity and a lower price, although some of locust bean gum's technical characteristics are undoubtedly superior. Unless the very recent downturn in the gum's price were to maintain its momentum for an extended period, bringing it back to a maximum of $3-4 per kg for the best

grades and or even lower, the movement away from the gum, albeit sluggish, is unlikely to be checked, although on the other hand such low price levels could constitute a strong disincentive to the producers to maintain supplies of the gum. In early 1987, when this report was written, there was no evidence that the easing of the price was likely to be other than short-term, and in spite of some recovery in supply levels, general economic developments in Iberia and Italy are likely to bring about further shortages. In the event of a substantial movement of the production base from the northern shores of the Mediterranean Sea to the lower-wage economies of North Africa such as Algeria and Morocco, or in the event of larger quantities of better-quality gum emanating from south-eastern Europe and Asia Minor than has so far occurred, prices might begin to fall back, but there is little sign of any such development. It can therefore be concluded that locust bean gum does not constitute a major competitive factor in the markets for other water-soluble gums produced in developing countries, and is unlikely to.

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Appendices

APPENDIX A: STATISTICAL TABLES

Table 1

Exports of gum arabic*, 1978-85

Tonnes

	1978	1979	1980	1981	1982	1983	1984	1985
Sudan	28,961	38,929	31,645	35,709	27,778	27,285	29,408	...
West Africa†	4,750	4,250	4,500	4,500	...	...	...	...

Source: Sudan: Foreign trade statistics (excluding 1981)
Ministry of Finance and Economic Planning
Gum Arabic Co., Khartoum (1981)

West Africa: various, including exporting organisations

Notes: * including gum hashab and gum talha
† *see* text: mainly Nigeria, Mali, Senegal, Niger, Chad and Mauritania; minor producers include Tanzania and Kenya; figures are estimates
... not available

Table 2

Gum arabic: imports into France, 1979-85

		1979	1980	1981	1982	1983	1984	1985*
Totals	tonnes	13,622	11,939	12,051	12,382	15,064	10,564	9,559
	m Fr	68.4	65.7	86.5	114.3	170.1	135.1	129.0
	£ '000	7,580	6,682	7,846	9,935	14,712	11,572	11,076
	fr/t	5,022	5,502	7,176	9,232	11,291	12,793	13,497
of which from:								
Sudan	tonnes	10,454	9,009	9,333	8,901	13,299	9,682	7,870
	£ '000	5,984	5,296	6,627	7,674	13,441	10,763	8,775
Mali	tonnes	2,188	1,978	1,737	855	779	438	778
	£ '000	664	660	507	321	399	323	531
Senegal	tonnes	410	370	181	465	416	...	223
	£ '000	257	215	116	323	345	...	345
Mauritania	tonnes	120	...	...	300	...	...	...
	£ '000	77	...	...	217	...	...	...
Nigeria	tonnes	47	151	252	696	255	150	256
	£ '000	25	42	134	487	202	106	312
Other countries	tonnes	403	431	548	1,666	315	294	432
	£ '000	573	469	462	912	324	380	1,113
Exports	tonnes	8,252	8,330	8,287	8,108	9,654	7,654	5,558
Net imports	tonnes	5,370	3,609	3,764	4,274	5,410	2,910	4,001

Sources: Imports – *Statistiques du Commerce Extérieur de la France*
Exports – NIMEXE analytical tables of foreign trade

Note: * provisional

Table 3

Gum arabic: imports into the United Kingdom, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	5,162	3,917	4,889	4,532	10,089	8,851	6,653
	£ '000	3,742	2,674	3,773	4,015	9,830	9,454	11,179
	£/t	725	683	772	886	974	1,068	1,680
of which from:								
Sudan	tonnes	2,007	989	1,956	1,684	7,276	6,329	3,642
	£ '000	1,270	604	1,416	1,409	6,808	6,626	6,405
Nigeria	tonnes	896	758	583	963	403	228	750
	£ '000	645	456	369	635	290	201	1,043
Mali	tonnes	–	14	–	–	–	–	215
	£ '000	–	3	–	–	–	–	186
France	tonnes	1,894	1,743	1,962	1,597	2,194	2,018	913
	£ '000	1,548	1,261	1,653	1,595	2,588	2,420	1,728
Other countries	tonnes	365	413	388	288	216	276	1,133
	£ '000	279	350	335	376	144	207	1,817
Exports	tonnes	544	649	584	877	3,814	6,901	5,463
Net imports	tonnes	4,618	3,268	4,305	3,655	6,275	1,950	1,190

Sources: Imports – United Kingdom Trade Statistics, HM Customs and Excise

Exports – NIMEXE analytical tables of foreign trade

Table 4

Gum arabic: imports into Italy, 1979-85

		1979	1980	1981	1982	1983	1984	1985*
Totals	tonnes	3,089	2,698	3,810	2,693	3,529	3,780	3,074
	m lira	3,704	3,382	6,632	6,071	8,886	10,825	12,471
	£ '000	2,101	1,698	2,877	2,564	3,856	4,610	5,038
	'000 lira/t	1,199	1,254	1,741	2,254	2,518	2,864	4,057
of which from:								
Sudan	tonnes	2,390	1,911	3,026	1,688	2,354	2,768	2,237
	£ '000	1,531	1,122	2,151	1,490	2,296	3,094	2,725
Senegal	tonnes	4	100	–	–	–	–	–
	£ '000	1	49	–	–	–	–	–
France	tonnes	595	629	672	891	867	616	399
	£ '000	453	467	591	922	1,183	969	1,339
Other countries	tonnes	102	59	112	114	308	396	438
	£ '000	115	59	135	152	377	547	974
Exports	tonnes	29	22	11	18	25	23	107
Net imports	tonnes	3,060	2,676	3,799	2,675	3,504	3,757	2,967

Sources: Imports – *Statistics Mensile del Commercio con L'estero*

Exports – NIMEXE analytical tables of foreign trade

Note: * provisional

Table 5

Gum arabic: imports into the Federal Republic of Germany, 1979-85

		1979	1980	1981	1982	1983	1984	1985*
Totals	tonnes	3,276	3,714	3,861	2,843	3,608	4,547	4,628
	'000 DM	8,044	9,522	11,997	10,976	14,375	18,914	26,755
	£ '000	2,069	2,252	2,618	2,584	3,799	4,973	7,011
	DM/t	2,455	2,564	3,107	3,861	3,984	4,160	5,781
of which from:								
Sudan	tonnes	2,049	2,479	2,347	2,307	2,326	3,282	2,250
	£ '000	1,295	1,543	1,762	2,194	2,633	3,780	3,414
Senegal and Mauritania	tonnes	159	276	67	88	...	...	253
	£ '000	96	154	37	88	...	...	282
Mali	tonnes	...	...	226	133	...	...	252
	£ '000	...	...	100	74	...	...	151
Nigeria	tonnes	358	388	200	156	781	725	1,303
	£ '000	146	150	112	119	771	660	2,100
Tanzania	tonnes	154	83	...	129	129	30	252
	£ '000	64	28	...	84	90	32	459
France	tonnes	351	243	228	...	...	...	...
	£ '000	373	269	247	...	...	...	...
Chad	tonnes	...	...	...	...	...	...	94
	£ '000	...	...	...	...	...	...	112
Other countries	tonnes	205	245	793	30	372	510	224
	£ '000	95	108	360	24	305	501	493
Exports	tonnes	1,890	2,299	2,180	2,081	2,095	3,106	3,664
Net imports	tonnes	1,386	1,415	1,681	762	1,513	1,441	964

Sources: Imports – *Aussenhandel nach Waren und Landern*
Exports – NIMEXE analytical tables of foreign trade

Note: * Provisional

Table 6

Gum arabic: imports into the Netherlands, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	411	483	515	382	466	625	467
	ECU '000	607	701	871	728	979	1,387	1,605
	£ '000	392	420	482	408	575	819	945
	ECU/t	1,477	1,451	1,691	1,906	2,101	2,219	3,437
of which from:								
Sudan	tonnes	232	217	250	195	193	200	81
	£ '000	162	141	196	175	195	227	157
Germany, Fed. Rep. of	tonnes	90	69	54	54	23	57	36
	£ '000	123	86	72	58	31	78	77
United Kingdom	tonnes	5	131	127	103	138	270	219
	£ '000	17	124	136	127	203	387	495
France	tonnes	31	16	8	14	47	4	48
	£ '000	30	16	8	29	72	8	41
Other countries	tonnes	53	50	76	17	65	94	83
	£ '000	60	52	70	18	74	119	175
Exports	tonnes	29	92	90	29	52	48	160
Net imports	tonnes	382	391	425	353	414	577	307

Source: NIMEXE analytical tables of foreign trade

Table 7

Gum arabic: imports into Belgium and Luxembourg, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	990	1,011	1,294	1,305	1,175	1,560	1,250
	m fr	43.1	45.8	76.0	94.9	98.9	142.8	201.9
	£ '000	694	674	1,009	1,187	1,434	1,850	2,623
	'000 fr/t	43.6	45.3	58.7	72.8	84.2	91.5	161.5
of which from:								
Sudan	tonnes	763	822	1,125	1,113	905	1,162	320
	£ '000	478	499	845	972	1,026	1,323	469
France	tonnes	56	47	61	48	...	161	214
	£ '000	67	48	67	57	...	238	356
Germany, Fed. Rep. of	tonnes	76	35	65	66	...	...	170
	£ '000	71	37	53	70	...	...	397
Other countries	tonnes	95	107	43	78	270	237	546
	£ '000	78	90	44	88	408	289	1,401
Exports	tonnes	297	308	492	545	464	809	767
Net imports	tonnes	693	703	802	760	711	751	483

Sources: Imports – *Bulletin Mensuel du Commerce Extérieur*
Institut National de Statistique

Exports – NIMEXE analytical tables of foreign trade

Table 8

Gum arabic: imports into selected Scandinavian countries, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Sweden	tonnes	947	1,223	1,267	925	967	599	374
	kr '000	6,052	7,812	10,541	10,109	12,817	9,319	9,009
	£ '000	665	794	1,027	919	1,102	843	808
	kr/t	6,391	6,388	8,320	10,929	13,254	15,558	24,088
Norway	tonnes	555	926	676	859	953	794	585
	kr '000	4,523	7,733	7,398	10,367	13,431	12,222	20,405
	£ '000	421	673	635	918	1,213	1,121	1,831
	kr/t	8,150	8,351	10,944	12,069	14,093	15,393	34,880
Finland	tonnes	888	905	235	1,239	595	671	...
	mk '000	4,415	4,496	1,798	8,428	5,510	6,719	...
	£ '000	534	518	205	999	652	836	...
	mk/t	4,972	4,968	7,651	6,802	9,261	10,013	...

Source: Trade Returns

Table 9

Gum arabic: imports into the United States, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	9,882	9,922	8,645	6,658	8,647	11,574	7,205
	US$ '000	13,473	14,488	14,409	11,085	12,896	19,041	12,326
	£ '000	6,350	6,228	7,105	6,332	8,501	14,249	9,509
	US$/t	1,363	1,460	1,667	1,665	1,491	1,645	1,711
of which from:								
Sudan	tonnes	9,037	8,967	8,010	5,259	6,694	8,054	3,631
	£ '000	5,839	5,682	6,699	4,889	6,448	9,665	3,716
India	tonnes	163	50	...	91	142	360	90
	£ '000	118	33	...	105	166	420	106
Pakistan	tonnes	...	...	...	657	...	...	...
	£ '000	...	...	...	579	...	...	...
France	tonnes	608	878	532	594	973	1,011	1,837
	£ '000	341	484	329	608	1,028	1,607	3,388
United Kingdom	tonnes	...	...	...	...	764	1,843	658
	£ '000	...	...	...	...	765	2,259	904
Other countries	tonnes	74	27	103	57	74	306	989
	£ '000	52	29	78	151	94	298	1,395

Sources: US *Imports for Consumption and General Imports FT246*

US Department of Commerce, Bureau of the Census

Table 10

Gum arabic: imports into Japan, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	2,834	2,140	2,596	2,118	1,824	2,194	2,304
	m yen	824	725	969	909	739	913	2,457
	£ '000	1,563	1,375	2,168	2,086	2,050	2,876	7,944
	'000 yen/t	291	339	373	429	405	416	1,066
of which from:								
Sudan	tonnes	2,500	1,953	2,567	2,065	1,779	2,170	1,731
	£ '000	1,453	1,289	2,129	2,052	2,003	2,838	5,947
Nigeria	tonnes	266	146	–	30	28	15	148
	£ '000	61	48	–	13	13	9	428
Other countries	tonnes	68	41	29	23	17	9	425
	£ '000	49	37	39	21	33	29	1,569

Sources: Japan Imports and Exports
Japan Tariff Association

Table 11

Gum arabic: quarterly and annual average prices, London market

£/tonne

Grade	Year	Q1	Q2	Q3	Q4	Annual average
Cleaned (Kordofan)	1978	775	798	775	775	781
	1979	775	775	775	775	775
	1980	775	775	775	775	775
	1981	775	775	775	915	810
	1982	895	895	895	970	914
	1983	990	1,050	1,080	1,047	1,042
	1984	1,025	1,015	1,116	1,540	1,174
	1985	1,650	2,133	2,000	n.a.	1,927
	1986	n.a.	n.a.	n.a.	n.a.	n.a.

Source: *Public Ledger*

Note: n.a. not available due to shortage

Table 12

Guar gum: exports from India, 1977/78-1982/83

		1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Totals	tonnes	56,508	74,621	54,053	59,058	113,900	43,454
	m rs	191	305	354	527	1,081	381
	£ '000	12,495	19,394	20,527	28,820	61,554	23,004
of which to:							
Belgium	tonnes	–	65	246	31	15	–
	£ '000	–	23	83	18	9	–
France	tonnes	2,586	3,264	2,173	2,302	3,617	2,822
	£ '000	540	983	800	1,158	1,946	1,060
Netherlands	tonnes	835	1,065	1,210	217	1,611	210
	£ '000	100	257	527	85	831	71
Germany, Fed. Rep. of	tonnes	3,729	12,223	7,808	4,195	7,201	6,666
	£ '000	863	2,868	2,924	2,099	4,105	2,719
Italy	tonnes	3,847	6,092	4,794	3,392	4,322	2,955
	£ '000	880	1,729	1,786	1,607	2,438	1,143
United Kingdom	tonnes	2,834	4,413	1,181	558	1,522	1,601
	£ '000	737	421	498	279	933	711
Denmark	tonnes	–	3,110	–	1	103	2
	£ '000	–	219	–	6	59	1
Spain	tonnes	1,885	2,012	1,300	954	2,065	1,692
	£ '000	390	528	461	456	1,086	658
Switzerland	tonnes	400	555	1,130	1,091	2,347	1,257
	£ '000	81	153	418	572	1,182	397
Greece	tonnes	180	65	75	32	5,005	92
	£ '000	38	19	9	21	3,444	46
Hong Kong	tonnes	–	6	–	–	–	–
	£ '000	–	2	–	–	–	–
Japan	tonnes	1,104	530	755	1,051	1,425	1,443
	£ '000	266	151	326	593	894	739
Singapore	tonnes	–	1	–	17	7	31
	£ '000	–	–	–	13	3	15
United States	tonnes	31,582	34,215	27,941	42,152	75,804	18,858
	£ '000	7,061	10,051	10,591	20,342	40,163	13,020
Swaziland	tonnes	–	–	–	208	2,604	2,772
	£ '000	–	–	–	89	1,355	1,004
Other East African countries	tonnes	1,906	3,404	3,016	1,437	2,459	1,207
	£ '000	372	944	1,135	717	1,304	439
Other countries	tonnes	5,620	3,602	2,424	1,628	3,793	1,877
	£ '000	1,167	1,046	969	765	1,802	981

Source: Foreign Trade of India
Department of Commercial Intelligence and Statistics

Table 13

Guar gum: exports from Pakistan, 1978/79-1984/85

		1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85
Totals	tonnes	44,201	24,736	18,435	20,664	23,187	26,980	28,146
	m. Rs	190.8	218.6	231.0	235.0	201.0	204.1	258.7
	£ '000	9,622	9,893	10,191	12,123	9,809	10,426	13,164
of which to:								
Belgium	tonnes	57	–	710	693	316	158	175
	£ '000	15	–	463	452	144	65	74
Denmark	tonnes	5,753	262	77	213	540	691	940
	£ '000	568	137	41	149	264	307	459
France	tonnes	100	60	100	109	193	370	245
	£ '000	29	19	59	61	92	122	113
Germany, Fed. Rep. of	tonnes	2,662	3,326	1,659	2,075	2,239	2,791	2,429
	£ '000	786	1,483	943	1,265	1,084	1,290	1,166
Italy	tonnes	1,926	1,711	1,027	1,103	1,266	1,239	2,122
	£ '000	599	701	592	676	539	466	964
Japan	tonnes	2,872	2,901	1,012	2,554	2,418	2,514	2,458
	£ '000	891	1,306	629	1,755	1,239	1,221	1,279
Lesotho	tonnes	2,600	2,600	1,396	592	3,246	2,818	2,274
	£ '000	525	892	674	274	1,201	1,012	912
Netherlands	tonnes	5,363	1,808	373	2,549	3,543	4,605	3,963
	£ '000	1,044	515	232	1,000	1,388	1,677	1,747
Norway	tonnes	3,184	165	226	330	2,120	2,392	561
	£ '000	354	62	100	195	261	410	268
Singapore	tonnes	31	10	51	–	–	–	18
	£ '000	3	4	5	–	–	–	10
Spain	tonnes	2,227	720	531	223	134	97	208
	£ '000	581	268	323	124	58	38	111
Switzerland	tonnes	–	–	938	50	40	486	38
	£ '000	–	–	410	32	24	142	19
United States	tonnes	15,547	9,257	8,236	8,196	4,774	5,792	8,961
	£ '000	3,673	3,678	4,645	4,845	2,300	2,331	4,240
United Kingdom	tonnes	655	730	811	824	916	784	1,294
	£ '000	199	313	456	537	467	373	598
Other countries	tonnes	1,224	1,186	1,288	1,153	1,442	2,243	2,460
	£ '000	354	514	618	758	749	977	1,205

Source: Foreign Trade Statistics of Pakistan
Statistical Division, Government of Pakistan

Table 14

Guar gum: imports into the United States 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	47,083	51,027	75,234	61,368	23,428	30,541	43,960
	US$ '000	30,668	58,553	97,033	70,995	15,400	21,005	30,650
	£ '000	14,455	25,170	47,849	40,557	10,152	15,719	23,644
	US$/t	651	1,147	1,290	1,157	657	688	697
of which from:								
United Kingdom	tonnes	...	...	...	125	389	747	1,126
	£ '000	...	...	...	114	330	785	895
Spain	tonnes	354	185	114	151	99	132	259
	£ '000	238	180	168	198	94	199	422
Italy	tonnes	729	415	258	108	38	475	60
	£ '000	386	411	267	212	57	229	54
India	tonnes	33,414	36,969	63,122	48,667	18,690	21,031	33,497
	£ '000	10,048	18,635	39,897	31,871	7,359	9,912	16,815
Pakistan	tonnes	9,766	10,639	9,570	8,159	4,137	7,753	8,802
	£ '000	3,226	5,503	7,074	5,292	2,225	4,411	5,198
Switzerland	tonnes	705	...	...	4,080	...	...	...
	£ '000	231	...	...	2,793	...	...	...
Malawi	tonnes	1,910	2,627	1,941	...	...	...	...
	£ '000	215	303	310	...	...	...	...
Other countries	tonnes	205	192	230	78	76	403	216
	£ '000	111	138	133	77	87	183	260

Sources: *US Imports for Consumption and General Imports FT246*
US Department of Commerce, Bureau of the Census

Table 15

Guar gum: quarterly and annual average prices (New York)

US$/kg

Grade	Year	Q1	Q2	Q3	Q4	Annual average
Edible, in bags, carload, shipment point	1978	1.57	1.57	1.57	1.57	1.57
	1979	1.57	1.57	1.57	1.57	1.57
	1980	1.57	1.57	2.87	1.96	1.98
	1981	1.76	1.87	1.96	1.98	1.90
	1982	1.98	1.98	1.98	1.98	1.98
	1983	1.81	1.81	1.81	1.81	1.81
	1984	1.81	1.81	1.76	1.76	1.79
	1985	1.61	1.39	1.39	1.39	1.46
	1986	1.39	1.39	1.39	1.39	1.39
Industrial, in bags, high viscosity, shipment point	1978	1.23	1.12	1.12	1.12	1.12
	1979	1.23	1.12	1.12	1.12	1.12
	1980	1.23	1.23	2.65	2.65	1.94
	1981	2.65	2.54	2.54	2.54	2.56
	1982	2.54	2.23	2.16	2.16	2.27
	1983	2.16	2.16	2.16	2.16	2.16
	1984	2.16	2.16	2.16	2.16	2.16
	1985	1.94	1.50	1.50	1.50	1.61
	1986	1.50	1.50	1.50	1.50	1.50
Industrial, in bags, medium viscosity, shipment point	1978	1.12	1.12	1.12	1.12	1.12
	1979	1.12	1.12	1.12	1.12	1.12
	1980	1.12	1.12	2.65	2.65	1.90
	1981	2.65	2.73	2.73	2.73	2.71
	1982	2.73	2.73	2.73	2.73	2.73
	1983	2.73	2.73	2.73	2.73	2.73
	1984	2.73	2.73	2.73	2.73	2.73
	1985	2.73	n.s.	n.s.	n.s.	2.73
	1986	n.s.	n.s.	n.s.	n.s.	n.s.

Source: *Chemical Marketing Reporter* **Note:** n.s. not shown

Table 16

Gum tragacanth, natural: imports into the United States 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	173	221	291	133	100	118	176
	US$ '000	2,935	2,543	2,144	1,850	1,958	2,084	2,314
	£ '000	1,383	1,093	1,057	1,057	1,291	1,560	1,785
	US$/t	16,935	11,507	7,368	13,910	19,580	17,661	13,178
of which from:								
Turkey	tonnes	6	11	35	...	19	36	23
	£ '000	54	84	215	...	235	421	164
Iran	tonnes	137	96	33	63	78	51	72
	£ '000	1,252	793	431	883	1,031	1,036	1,358
Brazil	tonnes	...	72	214	65	...	...	...
	£ '000	...	105	400	131	...	...	...
Other countries	tonnes	30	42	9	5	2	31	81
	£ '000	78	111	11	44	25	103	263

Sources: *US Imports for Consumption and General Imports FT246*
US Department of Commerce, Bureau of the Census

Table 17

Gum tragacanth: imports into Japan 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	118	73	28	30	43	20	18
	m yen	517.6	304.3	135.5	135.2	250.9	113.6	115.1
	£ '000	1,113	577	303	310	696	358	372
	'000 yen/t	4,387	4,169	4,840	4,508	5,834	5,679	6,393
of which from:								
Turkey	tonnes	48	40	19	25	28	10	8
	£ '000	333	133	92	164	262	18	26
Iran	tonnes	63	31	8	1	12	9	9
	£ '000	705	441	198	17	422	335	329
India	tonnes	–	2	–	–	–	–	–
	£ '000	–	2	–	–	–	–	–
Other	tonnes	7	2	1	4	3	1	1
	£ '000	76	2	13	129	12	5	17

Source: Japan Imports and Exports
Japan Tariff Association

Table 18

Gum tragacanth: quarterly and annual average prices, London market

£/kg

Grade	Year	Q1	Q2	Q3	Q4	Annual average
Ribbons No. 1	1978	26.10	26.10	26.10	26.10	26.10
	1979	26.10	26.10	26.10	26.10	26.10
	1980	25.00	25.00	25.00	25.00	25.00
	1981	27.30	27.30	27.30	27.30	27.30
	1982	34.00	34.00	34.00	39.30	35.30
	1983	42.00	42.00	42.00	42.00	42.00
	1984	42.00	42.00	42.00	48.40	43.60
	1985	51.50	51.50	51.50	45.30	50.00
	1986	44.00	34.70	31.00	30.30	35.00
Ribbons No. 3	1978	23.00	23.00	23.00	23.00	23.00
	1979	23.00	23.00	23.00	23.00	23.00
	1980	23.00	23.00	23.00	23.00	23.00
	1981	25.00	25.00	25.00	25.00	25.00
	1982	31.00	31.00	31.00	34.30	31.80
	1983	34.00	34.00	34.00	35.30	34.30
	1984	36.00	36.60	36.00	36.00*	36.20
	1985	n.s.	n.s.	n.s.	n.s.	n.s.
	1986	n.s.	n.s.	n.s.	n.s.	n.s.
Ribbons No. 5	1978	15.00	15.00	15.00	15.00	15.00
	1979	15.00	15.00	15.00	15.00	15.00
	1980	12.00	12.00	12.00	12.00	12.00
	1981	13.00	13.00	13.00	13.00	13.00
	1982	16.00	16.00	16.00	18.30	16.60
	1983	19.00	19.00	19.00	21.70	19.70
	1984	22.00	22.00	21.00	23.30	22.10
	1985	24.00	24.00	24.10	20.20	23.10
	1986	19.40	17.30	17.00	18.30	18.00

Source: *Public Ledger*

Notes: n.s. not shown
* based on 3 quarters only

Table 19

Gum karaya: exports from India, 1977/78-1982/83

		1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Totals	tonnes	6,838	6,649	5,589	4,816	5,315	4,930
	m. Rs	80.4	94.6	79.1	64.7	80.2	112.4
	£ '000	5,274	6,014	4,588	3,537	4,568	6,794
of which to:							
Belgium	tonnes	67	32	12	57	184	222
	£ '000	64	37	14	53	190	337
France	tonnes	1,267	1,028	1,322	988	1,209	1,502
	£ '000	1,076	1,016	1,228	713	991	2,050
Germany, Fed. Rep. of	tonnes	249	172	199	137	98	136
	£ '000	258	156	177	108	80	218
Italy	tonnes	52	86	84	86	68	51
	£ '000	53	95	77	104	71	104
United Kingdom	tonnes	1,106	1,345	962	837	554	741
	£ '000	930	1,274	852	650	479	1,039
Spain	tonne	200	10	200	–	–	–
	£ '000	38	11	59	–	–	–
Japan	tonnes	52	68	124	79	106	101
	£ '000	59	83	142	96	144	170
Singapore	tonnes	10	14	9	6	8	9
	£ '000	11	19	13	7	11	9
United States	tonnes	3,639	3,779	2,492	2,380	3,047	1,964
	£ '000	2,708	3,216	1,893	1,614	2,559	2,697
Other countries	tonnes	196	115	185	245	41	204
	£ '000	77	107	133	192	43	170

Source: Foreign Trade of India
Department of Commercial Intelligence and Statistics

Table 20

Gum karaya, natural: imports into the United States 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	2,734	2,422	2,920	4,026	2,131	2,482	1,522
	US$ '000	4,813	4,105	5,330	7,982	4,884	6,553	4,004
	£ '000	2,269	1,765	2,628	4,560	3,220	4,904	3,089
	US$/t	1,760	1,695	1,825	1,983	2,292	2,640	2,631
of which from:								
India	tonnes	2,649	2,382	2,834	2,755	1,805	2,213	1,308
	£ '000	2,212	1,743	2,563	3,314	2,853	4,436	2,639
Sudan	tonnes	50	...	...	1,207	252	...	...
	£ '000	33	...	...	1,162	239	...	...
Other countries	tonnes	35	40	86	63	74	269	214
	£ '000	24	21	66	84	128	468	450

Sources: *US Imports for Consumption and General Imports FT246*
US Department of Commerce, Bureau of the Census

Table 21

Gum karaya: quarterly and annual average prices, London market*

£/tonne

Grade	Year	Q1	Q2	Q3	Q4	Annual average
No. 1 (Super Fine)	1978	1,250	1,183	1,350	1,300	1,271
	1979	1,167	1,100	1,100	1,100	1,117
	1980	950	957	870	850	907
	1981	870	970	1,217	1,183	1,060
	1982	1,242	1,967	1,800	2,000	1,752
	1983	2,000	2,067	2,100	1,967	2,034
	1984	2,067	2,500	2,367	2,767	2,425
	1985	2,900	2,800	2,467	2,233	2,600
	1986	1,950	1,700	1,800	1,867	1,829
No. 2 (Superior)	1978	1,087	1,133	1,300	1,200	1,180
	1979	1,100	1,050	1,050	1,050	1,063
	1980	840	820	743	710	778
	1981	680	853	967	983	871
	1982	1,117	1,783	1,650	1,800	1,588
	1983	1,817	1,917	1,850	1,867	1,863
	1984	2,033	2,350	2,117	2,450	2,238
	1985	2,550	2,467	2,100	1,833	2,238
	1986	2,550	1,433	1,483	1,600	1,768
No. 2 (f.a.q.)	1978	967	1,067	1,250	1,150	1,109
	1979	1,037	980	980	980	994
	1980	720	708	648	597	668
	1981	590	737	767	883	744
	1982	927	1,527	1,517	1,600	1,393
	1983	1,600	1,667	1,533	1,517	1,579
	1984	1,467	1,817	1,800	1,833	1,729
	1985	1,967	1,850	1,483	1,333	1,658
	1986	1,283	1,233	1,183	1,317	1,254

Source: *Public Ledger*

Note: * spot prices

Table 22

Mucilages and thickeners extracted from locust beans or seeds: exports from Spain, 1979-84

		1979	1980	1981	1982	1983	1984
Totals	tonnes	6,989	5,718	5,406	4,642	4,540	6,352
	m pesetas	687	1,073	1,238	1,704	1,917	3,135
	£ '000	4,822	6,430	6,614	8,861	8,811	14,592
of which to:							
France	tonnes	431	525	272	394	391	591
	£ '000	268	560	268	618	657	1,175
Germany Fed. Rep. of	onnes	610	501	508	290	358	456
	£ '000	510	582	763	646	698	1,118
United Kingdom	tonnes	1,988	1,950	1,839	1,319	911	1,765
	£ '000	1,058	1,511	1,594	1,914	1,074	2,852
Denmark	tonnes	348	222	286	229	276	243
	£ '000	287	322	437	503	572	978
Switzerland	tonnes	435	313	291	229	195	242
	£ '000	359	358	394	406	323	589
United States	tonnes	1,482	1,146	1,049	1,043	1,108	1,257
	£ '000	1,320	1,948	1,797	2,630	2,824	3,936
Japan	tonnes	351	178	221	263	334	295
	£ '000	124	280	365	619	858	881
Australia	tonnes	662	548	593	491	425	610
	£ '000	270	446	520	654	609	979
Other countries	tonnes	682	335	347	384	542	793
	£ '000	627	424	476	872	1,197	2,086

Source: Estadistica del Comercio Exterior, Direccion General de Aduanas

Table 23

Mucilages and thickeners extracted from locust beans or seeds: exports from Italy, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	3,853	3,724	3,829	3,471	3,279	3,674	2,035
	ECU '000	6,181	8,762	9,812	11,762	11,588	15,528	10,718
	£ '000	3,992	5,230	5,374	6,570	6,787	9,135	6,267
of which to:								
France	tonnes	318	209	251	266	189	167	121
	£ '000	234	186	245	357	267	335	301
Germany, Fed. Rep. of	tonnes	687	768	834	657	624	481	249
	£ '000	1,046	1,314	1,131	1,185	1,129	1,017	326
United Kingdom	tonnes	952	331	203	243	250	366	159
	£ '000	632	472	418	524	561	740	396
Denmark	tonnes	155	171	129	298	281	267	225
	£ '000	145	258	193	703	709	848	738
United States	tonnes	613	774	643	454	709	1,130	430
	£ '000	672	1,002	887	1,118	1,803	3,321	1,760
Argentina	tonnes	154	220	149	147	173	73	94
	£ '000	110	212	202	245	346	189	233
Japan	tonnes	163	167	255	126	102	265	122
	£ '000	160	269	372	313	264	497	461
Australia	tonnes	71	91	244	281	229	229	107
	£ '000	76	128	223	335	256	359	208
Mexico	tonnes	132	261	314	182	85	126	20
	£ '000	110	334	401	304	149	378	117

Source: Trade Returns

Table 24

Locust bean gum: imports into the United States, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	3,282	2,054	2,495	1,869	2,361	2,522	1,654
	US$ '000	5,553	7,873	9,048	8,566	9,360	10,199	9,815
	£ '000	2,617	3,384	4,462	4,893	6,170	7,632	7,572
	US$/t	1,692	3,833	3,626	4,583	3,964	4,044	5,935
of which from:								
Spain	tonnes	1,334	1,131	1,251	915	1,229	1,236	1,034
	£ '000	1,261	2,075	2,294	2,475	3,228	3,478	5,044
Portugal	tonnes	588	196	509	390	340	343	91
	£ '000	619	341	897	978	889	1,090	586
Italy	tonnes	1,264	652	663	467	731	841	434
	£ '000	699	894	1,179	1,248	1,886	2,715	1,545
India	tonnes	...	...	...	18	...	...	...
	£ '000		...	...	53	...	...	...
Pakistan	tonnes	...	...	52	...	...	...	...
	£ '000	...	...	44	...	...	...	...
Other countries	tonnes	95	76	20	79	62	102	95
	£ '000	39	74	48	139	166	349	397

Sources: *US Imports for Consumption and General Imports FT246*
US Department of Commerce, Bureau of the Census

Table 25

Mucilages and thickeners extracted from locust beans or seeds: imports into the Federal Republic of Germany, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	1,995	1,850	1,932	1,553	1,482	1,383	1,533
	ECU '000	4,156	4,991	6,191	6,139	5,815	6,141	10,169
	£ '000	2,686	2,987	3,424	3,441	3,413	3,627	5,989
	ECU/t	2,083	2,698	3,204	3,953	3,924	4,440	6,633
of which from:								
Italy	tonnes	898	904	994	687	618	497	416
	£ '000	1,543	1,500	1,715	1,152	1,073	1,058	1,440
Switzerland	tonnes	256	251	185	144	143	157	246
	£ '000	270	411	300	367	393	490	1,117
Portugal	tonnes	132	91	105	88	25	30	–
	£ '000	142	127	158	196	65	89	–
Spain	tonnes	571	443	402	339	326	410	512
	£ '000	501	540	614	775	699	1,045	2,071
Other countries	tonnes	138	161	246	295	370	289	359
	£ '000	231	409	637	951	1,183	945	1,361

Source: NIMEXE analytical tables of foreign trade

Table 26

Mucilages and thickeners extracted from locust beans or seeds: imports into the United Kingdom, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	3,243	2,595	2,655	3,144	2,503	3,946	2,426
	ECU '000	3,040	4,331	4,831	7,956	6,463	11,943	10,936
	£ '000	1,965	2,592	2,672	4,459	3,794	7,054	6,441
	ECU/t	937	1,669	1,820	2,531	2,582	3,027	4,508
of which from:								
Italy	tonnes	858	264	162	184	277	519	130
	£ '000	496	291	260	404	568	1,247	337
Spain	tonnes	1,724	1,793	2,052	1,328	983	1,738	1,329
	£ '000	1,029	1,628	1,971	2,108	1,369	3,044	3,050
Portugal	tonnes	363	307	106	88	141	407	232
	£ '000	278	404	121	134	196	659	564
Morocco	tonnes	–	–	–	1,116	1,009	1,187	591
	£ '000	–	–	–	1,205	1,415	1,874	2,077
Cyprus	tonnes	–	145	252	378	–	–	39
	£ '000	–	161	208	503	–	–	81
Other countries	tonnes	298	86	83	50	93	95	105
	£ '000	162	108	112	105	246	230	332

Source: NIMEXE analytical tables of foreign trade

Table 27

Mucilages and thickeners extracted from locust beans or seeds: imports into France, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	858	807	667	815	755	873	673
	ECU '000	1,009	1,779	1,493	2,608	2,336	3,273	4,312
	£ '000	652	1,065	826	1,462	1,371	1,933	2,540
	FCU/t	1,176	2,204	2,238	3,200	3,094	3,749	6,407
of which from:								
Germany,	tonnes	1	12	23	19	15	12	11
Fed. Rep. of	£ '000	2	33	55	52	34	25	23
Italy	tonnes	298	84	185	245	215	160	119
	£ '000	207	78	192	344	333	337	349
Spain	tonnes	430	562	307	396	438	586	433
	£ '000	298	676	293	660	771	1,251	1,651
Portugal	tonnes	80	41	63	39	46	54	40
	£ '000	90	66	94	78	108	132	163
Denmark	tonnes	4	27	37	65	5	3	9
	£ '000	5	78	117	192	14	9	29
Switzerland	tonnes	25	33	28	39	28	27	32
	£ '000	28	62	56	95	84	94	224
Other countries	tonnes	20	48	24	12	8	31	29
	£ '000	22	71	19	40	27	85	101

Source: NIMEXE analytical tables of foreign trade

Table 28

Mucilages and thickeners extracted from locust beans or seeds: imports into the Netherlands, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	567	449	500	483	453	639	398
	ECU '000	801	1,002	1,461	1,939	1,940	3,384	2,948
	£ '000	518	600	808	1,087	1,139	1,999	1,736
	ECU/t	1,413	2,232	2,922	4,014	4,283	5,296	7,407
of which from:								
Italy	tonnes	45	71	63	28	16	81	60
	£ '000	74	94	107	57	58	294	234
Spain	tonnes	217	13	19	3	3	191	124
	£ '000	192	10	16	4	6	589	592
Portugal	tonnes	284	343	368	383	395	290	161
	£ '000	222	465	600	903	968	879	704
Denmark	tonnes	–	11	22	43	15	24	7
	£ '000	–	11	30	49	32	38	27
Other countries	tonnes	21	11	28	26	24	53	46
	£ '000	30	20	55	73	75	199	179

Source: NIMEXE analytical tables of foreign trade

Table 29

Mucilages and thickeners extracted from locust beans or seeds: imports into Belgium/Luxembourg, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	183	220	193	150	153	158	106
	ECU '000	278	588	547	559	535	588	569
	£ '000	180	352	303	313	314	347	335
	ECU/t	1,519	2,673	2,834	3,727	3,497	3,722	5,368
of which from:								
Italy	tonnes	13	111	103	62	63	85	43
	£ '000	12	157	169	77	113	132	91
Portugal	tonnes	60	50	40	50	10	30	35
	£ '000	52	86	53	127	29	94	139
France	tonnes	5	28	–	–	21	–	–
	£ '000	14	48	1	–	21	–	–
Germany, Fed. Rep. of	tonnes	36	2	5	–	3	2	2
	£ '000	21	2	9	–	8	7	9
Other countries	tonnes	26	10	15	9	7	8	4
	£ '000	23	22	24	24	16	10	10

Source: NIMEXE analytical tables of foreign trade

Table 30

Mucilages and thickeners extracted from locust beans or seeds: imports into Italy, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	402	226	62	71	107	172	192
	ECU '000	598	526	274	319	327	770	1,388
	£ '000	387	315	152	179	192	455	818
	ECU/t	1,488	2,327	4,419	4,493	3,056	4,478	7,229
of which from:								
Portugal	tonnes	379	180	–	60	–	–	–
	£ '000	339	235	–	150	–	–	–
Spain	tonnes	6	35	35	8	33	164	156
	£ '000	6	51	47	18	77	431	643
Germany, Fed. Rep. of	tonnes	7	1	20	–	–	–	13
	£ '000	19	4	85	1	1	1	59
Other countries	tonnes	10	10	7	3	74	8	23
	£ '000	23	25	19	10	114	23	116

Source: NIMEXE analytical tables of foreign trade

Table 31

Locust bean gum: imports into Japan, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	1,774	1,510	1,276	1,304	1,503	1,560	1,624
	m. Yen	1,001	1,461	1,427	1,957	2,229	2,144	2,692
	£ '000	2,152	2,769	3,191	4,489	6,185	6,754	8,704
	'000 Yen/t	564	968	1,118	1,501	1,483	1,374	1,658
of which from:								
Spain	tonnes	145	179	231	237	300	279	391
	£ '000	148	338	416	620	849	924	1,645
Portugal	tonnes	588	485	352	429	418	521	472
	£ '000	562	845	720	1,118	1,194	1,808	2,202
Italy	tonnes	284	175	185	127	111	144	81
	£ '000	287	330	343	337	320	463	327
Germany, Fed. Rep. of	tonnes	89	51	68	46	54	104	89
	£ '000	75	49	59	49	55	99	87
Netherlands	tonnes	467	278	221	185	183	148	182
	£ '000	343	250	227	283	198	185	317
Denmark	tonnes	49	69	138	203	343	247	302
	£ '000	238	369	898	1,425	2,962	2,245	3,045
United States	tonnes	99	77	48	47	42	73	61
	£ '000	462	478	407	523	416	785	706
India	tonnes	–	85	–	–	–	1	–
	£ '000	–	46	–	–	–	4	–
Pakistan	tonnes	20	99	–	–	–	–	–
	£ '000	11	72	–	–	–	–	–
Other countries	tonnes	33	12	33	30	52	43	46
	£ '000	26	21	122	135	191	241	305

Source: Japan Imports and Exports
Japan Tariff Association

Table 32

Locust bean gum: quarterly and annual average prices, New York

US$/kg

Grade	Year	Q1	Q2	Q3	Q4	Annual average
Powdered, in bags	1980	4.17	6.06	6.06	4.92	5.31
	1981	4.30	4.30	4.52	4.74	4.48
	1982	4.74	5.14	5.14	5.14	5.09
	1983	5.25	5.25	5.11	5.07	5.16
	1984	5.07	5.07	5.07	5.07	5.07
	1985	5.07	6.28	6.90	11.66	7.47
	1986	14.84	14.84	14.84	14.84	14.84

Source: *Chemical Marketing Reporter*

Table 33

Natural gums, resins and balsams other than conifer resins and gum arabic: imports into the Federal Republic of Germany, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	4,235	2,281	2,104	2,389	2,111	2,889	4,271
	ECU '000	6,699	5,273	6,699	8,253	8,328	9,557	10,263
	£ '000	4,330	3,156	3,705	4,625	4,889	5,645	6,045
of which from:								
France	tonnes	204	110	81	71	65	141	89
	£ '000	173	151	237	180	146	284	247
Netherlands	tonnes	338	93	7	17	9	10	12
	£ '000	105	54	23	35	30	30	37
Iran	tonnes	738	500	186	360	185	403	307
	£ '000	1,949	1,441	1,613	2,368	2,283	2,029	1,623
India	tonnes	409	354	236	275	213	283	249
	£ '000	326	249	155	256	321	413	449
Indonesia	tonnes	300	252	541	324	346	705	1,923
	£ '000	143	103	169	149	145	327	895
Malaysia	tonnes	448	195	304	364	253	305	146
	£ '000	134	59	103	127	96	145	68
Singapore	tonnes	539	192	219	351	359	247	562
	£ '000	223	105	162	265	283	203	341
Philippines	tonnes	153	77	80	56	21	60	25
	£ '000	59	32	42	54	17	43	16
China	tonnes	500	–	–	–	1	5	21
	£ '000	123	–	–	–	22	102	214
Other countries	tonnes	606	508	450	571	659	730	937
	£ '000	1,094	962	1,202	1,192	1,546	2,069	2,155

Source: NIMEXE analytical tables of foreign trade

Table 34

Natural gums, resins and balsams: imports into the United Kingdom, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	2,480	2,204	1,973	2,334	1,929	1,592	4,550
	£ '000	3,190	3,038	2,819	4,058	3,988	4,460	5,674
of which from:								
Germany,	tonnes	63	40	47	110	34	73	42
Fed. Rep. of	£ '000	193	105	226	444	136	284	210
Iran	tonnes	76	146	84	51	60	90	36
	£ '000	600	1,153	730	720	717	1,610	459
India	tonnes	1,121	788	1,001	1,286	840	452	260
	£ '000	1,050	695	826	1,624	1,405	772	531
Pakistan	tonnes	18	109	79	3	–	19	21
	£ '000	33	73	49	3	1	11	18
Singapore	tonnes	723	604	411	393	360	302	517
	£ '000	444	412	332	368	399	383	424
Sudan	tonnes	2	211	25	–	245	39	2,315
	£ '000	1	118	14	–	126	42	1,800
Other countries	tonnes	477	306	326	491	390	617	1,359
	£ '000	869	482	642	899	1,204	1,358	2,232

Source: United Kingdom trade statistics
HM Customs and Excise

Table 35

Natural gums, resins and balsams other than conifer resins and gum arabic: imports into France, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	3,116	2,940	2,627	2,960	3,026	3,328	4,547
	fr '000	68,722	48,002	60,516	79,418	100,560	114,271	116,970
	£ '000	7,614	4,882	5,491	6,903	8,698	9,784	10,042
of which from:								
Germany,	tonnes	178	135	78	96	15	21	27
Fed. Rep. of	£ '000	637	196	224	487	37	58	137
Senegal	tonnes	–	9	14	–	159	414	942
	£ '000	–	5	10	–	193	583	1,243
Somalia	tonnes	208	114	171	121	95	212	152
	£ '000	351	200	421	324	268	746	596
Iran	tonnes	360	271	293	193	310	184	784
	£ '000	3,573	1,513	2,244	1,747	3,103	2,984	2,947
Pakistan	tonnes	3	5	3	3	4	–	10
	£ '000	10	15	12	9	14	–	29
India	tonnes	1,182	1,345	1,298	1,608	1,477	1,271	1,068
	£ '000	1,188	1,158	1,078	2,144	2,324	2,074	1,865
Indonesia	tonnes	147	161	159	90	158	221	200
	£ '000	107	120	159	167	264	240	181
Malaysia	tonnes	96	73	67	54	49	62	50
	£ '000	80	79	113	93	97	156	136
Singapore	tonnes	183	202	125	167	204	143	275
	£ '000	104	112	138	166	235	163	292
Philippines	tonnes	206	121	69	221	130	225	105
	£ '000	100	50	41	164	82	152	86
Turkey	tonnes	21	30	17	20	28	37	34
	£ '000	145	142	99	179	319	475	322
Other	tonnes	532	473	333	390	397	538	900
	£ '000	1,319	1,292	952	1,422	1,762	2,153	2,208

Source: *Statistiques du Commerce Extérieur de la France*

Table 36

Natural gums, resins and balsams other than conifer resins and gum arabic: imports into the Netherlands, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	675	230	246	202	180	346	496
	ECU '000	921	445	855	728	888	1,318	1,414
	£ '000	595	266	473	408	521	778	833
of which from:								
France	tonnes	16	5	5	27	17	21	37
	£ '000	77	42	16	89	65	67	153
Belgium/ Luxembourg	tonnes	–	–	–	72	43	38	114
	£ '000	–	–	–	6	59	59	138
Germany, Fed. Rep. of	tonnes	76	39	79	65	86	114	96
	£ '000	206	70	230	198	303	416	259
United Kingdom	tonnes	16	24	29	5	8	8	9
	£ '000	62	50	94	35	29	47	37
United States	tonnes	3	11	25	19	3	6	3
	£ '000	17	16	51	50	17	26	15
Ethiopia	tonnes	23	10	–	–	–	–	–
	£ '000	41	15	–	–	–	–	–
India	tonnes	4	3	19	11	14	153	188
	£ '000	9	3	17	22	31	134	194
China	tonnes	500	–	–	–	–	–	–
	£ '000	100	–	–	–	–	–	–
Singapore	tonnes	5	61	–	1	2	1	2
	£ '000	3	17	–	2	4	8	9
Other countries	tonnes	32	77	89	2	7	5	47
	£ '000	80	53	65	6	13	21	28

Source: NIMEXE analytical tables of foreign trade

Table 37

Natural gums, resins and balsams other than conifer resins and gum arabic: imports into Belgium/Luxembourg, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	231	151	370	336	534	242	399
	ECU '000	438	349	906	990	1,173	790	1,099
	£ '000	283	208	497	553	687	465	641
of which from:								
Germany, Fed. Rep. of	tonnes	25	15	18	32	46	37	25
	£ '000	49	52	64	75	81	67	53
France	tonnes	28	32	30	28	17	13	21
	£ '000	69	44	55	64	51	64	78
Netherlands	tonnes	5	1	12	28	141	13	21
	£ '000	8	2	12	12	28	12	16
United Kingdom	tonnes	7	6	27	17	31	13	9
	£ '000	13	8	40	32	67	47	13
Iran	tonnes	6	7	7	1	1	8	22
	£ '000	49	23	31	6	8	35	59
India	tonnes	28	26	207	182	133	88	83
	£ '000	31	23	209	249	242	189	219
Indonesia	tonnes	24	36	24	21	72	42	55
	£ '000	12	23	14	16	55	41	36
Singapore	tonnes	5	13	23	1	8	...	...
	£ '000	3	9	17	7	6	...	...
Sudan	tonnes	...	7	12	8	38	21	149
	£ '000	...	10	13	13	35	31	96
Other countries	tonnes	103	8	10	18	47	7	14
	£ '000	49	14	42	79	114	*	71

Source: NIMEXE analytical tables of foreign trade **Note:** * figure not confirmed

Table 38

Natural gums, resins and balsams other than conifer resins and gum arabic: imports into Italy, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	438	309	304	196	303	222	319
	ECU '000	986	803	812	904	1,162	1,203	1,463
	£ '000	633	481	449	507	682	711	862
of which from:								
France	tonnes	31	22	49	42	7	11	35
	£ '000	63	39	72	94	22	43	146
Netherlands	tonnes	8	11	15	11	9	5	12
	£ '000	19	26	35	34	28	17	35
Germany, Fed. Rep. of	tonnes	15	17	15	34	91	26	36
	£ '000	63	55	56	141	284	138	74
United Kingdom	tonnes	77	19	7	9	6	26	13
	£ '000	101	32	32	34	28	82	75
Greece	tonnes	15	–	34	1	1	–	1
	£ '000	6	–	22	10	15	9	16
United States	tonnes	19	11	20	7	4	7	15
	£ '000	15	17	30	21	13	15	38
Iran	tonnes	13	16	2	2	16	2	3
	£ '000	112	114	39	14	88	86	43
India	tonnes	70	39	39	12	19	75	50
	£ '000	89	51	38	12	19	187	151
Indonesia	tonnes	131	130	94	31	101	31	75
	£ '000	87	80	70	43	99	48	62
Other countries	tonnes	59	44	29	47	49	39	79
	£ '000	50	67	55	104	86	86	222

Source: NIMEXE analytical tables of foreign trade

Table 39

Natural gums, resins and balsams: imports into Singapore, 1979-85

		1979	1980	1981	1982	1983	1984	1985
Totals	tonnes	3,075	3,738	2,504	1,305	2,637	2,824	2,214
	S$ '000	5,342	7,514	6,836	3,194	4,884	4,453	5,049
	£ '000	1,158	1,509	1,596	853	1,524	1,562	1,770
of which from:								
China	tonnes	2,371	3,002	1,412	900	1,500	2,009	672
	£ '000	535	952	637	335	416	597	224
India	tonnes	57	28	37	43	37	148	63
	£ '000	62	32	46	61	57	178	80
Sudan	tonnes	441	329	679	189	516	215	601
	£ '000	300	200	509	169	530	253	654
United Kingdom	tonnes	13	113	28	11	148	35	28
	£ '000	27	42	60	24	124	81	90
United States	tonnes	136	120	170	32	60	17	22
	£ '000	142	160	134	97	185	78	75
Vietnam	tonnes	3	–	–	–	135	200	394
	£ '000	21	–	–	–	38	101	139
Other countries	tonnes	54	146	178	130	241	200	434
	£ '000	72	122	209	166	173	274	508

Source: Singapore Trade Statistics
Department of Statistics, Singapore

Table 40

Natural gums and resins n.e.s.: imports into Japan, 1980-85

		1980	1981	1982	1983	1984	1985
Totals	tonnes	222	226	286	249	261	291
	m. Yen	162.0	121.5	188.3	168.2	170.5	204.7
	£ '000	307	272	432	466	537	662
of which from:							
Singapore	tonnes	10	20	20	23	2	13
	£ '000	6	15	16	21	2	12
Philippines	tonnes	18	7	15	10	10	10
	£ '000	8	4	10	7	8	9
Indonesia	tonnes	23	34	20	32	32	18
	£ '000	19	35	23	41	46	19
India	tonnes	108	93	134	101	101	118
	£ '000	136	130	244	229	309	375
Germany, Fed. Rep. of	tonnes	48	50	73	67	51	58
	£ '000	64	59	105	122	106	138
United States	tonnes	12	8	10	8	4	12
	£ '000	25	14	22	26	15	50
Brazil	tonnes	–	12	11	7	60	48
	£ '000	–	7	6	4	44	34
Other countries	tonnes	3	2	3	1	1	14
	£ '000	49	8	6	16	7	25

Source: Japan Imports and Exports
Japan Tariff Association

APPENDIX B: STANDARD SPECIFICATIONS FOR, AND REGULATORY STATUS OF, WATER-SOLUBLE GUMS

The gums dealt with in this report (gum arabic, guar gum, gum tragacanth, gum karaya, locust bean gum) are not covered by any standards issued by the British Standards Institution (BSI) or the International Organisation for Standardization (ISO). Specifications for some of the gums are, however, given in various Pharmacopoeias, and those from the British, European and United States Pharmacopoeias are summarised in this appendix in tabular form under the names of the individual gums (gum arabic, gum tragacanth and gum karaya only).

The use of such gums in food products in the United States is governed by regulations given in the United States Code of Federal Regulations, Title 21, Chapter 1, Part 121 (Food Additives). These regulations refer to the Food Chemicals Codex (published in the United States by the National Research Council) for quality criteria for the gums, and they indicate for which of the gums satisfying these criteria their use in foods has been accorded the status 'GRAS' (i.e. Generally Recognised As Safe). They also give maximum permitted levels for the gums in various food products. The United Kingdom's Emulsifiers and Stabilisers in Food Regulations also refer to the Food Chemicals Codex for quality criteria for the individual gums. These regulations contain a list of permitted emulsifiers and stabilisers together with the corresponding 'E-numbers' (assigned by EC) where these exist. The relevant EC legislation is given in Council Directive no. 74/329/EEC of 18 June 1974 and its subsequent amendments and supplements. This Directive established (in Annex I) a list of emulsifiers, stabilisers, thickeners and gelling agents which might be authorised by member states for the treatment of foodstuffs, and laid down the general criteria of purity which the agents must satisfy. All of the gums covered by the present report, except gum karaya, were listed in Annex I together with their E-numbers. Gum Karaya was not assigned an E-number, but was included in Annex II, which covered substances which member states might permit until July 1979, when they would be reviewed. Subsequently the temporary number 416 was assigned to gum karaya, and toxicological studies were initiated. A ban on its use exists in some European countries, but in the United Kingdom its use is still permitted.

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) has established specifications for all five of the gums covered by this report, and these are summarised below in tabular form under the names of the individual gums, as are the requirements of the EC Directive and the Food Chemicals Codex.

Acceptable Daily Intake (ADI) values for the gums have not been established by JECFA, except that a temporary ADI of 0–20* mg per kg of body weight was allocated to gum karaya in 1983 (*FAO Food and Nutrition Paper No. 28*, p. 57). Microbiological safety criteria are becoming increasingly important for all foodstuffs (and their ingredients and additives) in the major consuming countries of Western Europe and North America. This is now making itself felt in relation to gums for use in foods (as indicated in the relevant sections of this report), and already JECFA has established limits for *E. coli* and *Salmonellae* in gums tragacanth and karaya (see tables below). Such limits are likely to be established for other gums and in other sets of specifications in the future.

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* It should be noted that the maximum ADI set by the EC for gum karaya is 12.5 mg per kg of body weight (*see* p. 63).

In the tables which follow, the following abbreviations are used:

BP	British Pharmacopoeia
EP	European Pharmacopoeia
USP	United States Pharmacopoeia
FCC	Food Chemicals Codex
FAO/WHO	Specifications prepared by the Joint Food and Agriculture Organisation/World Health Organisation Expert Committee on Food Additives (JECFA).
GRAS	Generally Recognised As Safe
TLC	thin-layer chromatography

Gum arabic (E 414)

Definition: Gum arabic is a dried exudation obtained from the stems and branches of *A. senegal* (L.) Willdenow or the related species of *Acacia* (Fam. Leguminosae). It consists mainly of high molecular-weight polysaccharides and their calcium, magnesium and potassium salts, which on hydrolysis yield arabinose, galactose, rhamnose and glucuronic acid. The article of commerce may be further specified as to viscosity.

Summary of specifications

	BP 1980	EP vols I & III 1978**	FAO/WHO 1975 (suppl) 1969, 1977	USP XIX	FCC 3rd Edition 1981	EEC*
Identification tests	Microscopy Solubility Precipitation and colour reactions Optical rotation (10% solution laevorotatory) TLC identification of sugars after hydrolysis				Microscopy Precipitation with lead subacetate	
Purity criteria						
Loss on drying, % max.	15.0	15.0	15.0	15.0	15.0	15.0
Total ash, % max.			4.0	4.0	4.0	4.0
Sulphated ash, % max.	5.0	5.0				
Acid-insoluble ash, % max.			0.5	0.5	0.5	0.5
Acid-insoluble matter, % max.	0.5	0.5	1.0	1.0	1.0	1.0
Dextrin and starch	Not detectable by colour test with iodine					
Sucrose and fructose	Not detectable					
Agar and tragacanth	Not detectable					
Agar and Karaya	Not detectable					
Tannins	Not detectable by ferric chloride test					
Arsenic, % max.			0.0003	0.0003	0.0003	0.0003
Lead, % max.			0.001	0.001	0.001	0.001
Heavy metals, % max.			0.004	0.004	0.004	
Copper and zinc, % max.						0.005
Zinc, % max.						0.0025
Foreign matter, % max.						
Microbial contamination	1 g free from *E. coli*†				Free from *Salmonellae*	

Gum arabic was affirmed as GRAS in the United States in 1976 (*Federal Register*, 1976, **41**, 53608)

Notes: * Council Directive No. 74/329/EEC of 18 June 1974, as amended and supplemented
** FAO Food and Nutrition Paper No. 4, pp. 11–13
† Powdered gum arabic only

Guar gum (E 412)

Definition: Guar gum is primarily the endosperm of *Cyamopsis tetragonobulus* (L) Taub., (Fam. Leguminosae). It consists mainly of polysaccharides of high molecular weight composed of galactomannans. It contains no added borate. The article of commerce may be further specified as to viscosity.

Summary of specifications

	FAO/WHO*	FCC 3rd Edition 1981	EEC**
Identification tests	Microscopy Solubility in cold water Gel formation with sodium borate Little change in viscosity of solution after heating TLC identification of sugars after hydrolysis		
Purity criteria			
Loss on drying, % max.	15.0	15.0	14.0
Total ash, % max.	1.5	1.5	
Acid insoluble matter, % max.	7.0	7.0	4.0
Borate	Not detectable		
Protein, % max.	10.0	10.0	7.0
Starch	Not detectable		
Galactomannans, % min.		66.0	75.0
Arsenic, % max.	0.0003	0.0003	0.0003
Lead, % max.	0.001	0.001	0.001
Heavy metals, % max.	0.002	0.002	
Copper and zinc, % max.			0.005
Zinc, % max.			0.0025

Guar gum was affirmed as GRAS in the United States in 1976 (*Federal Register*, 1976, **41**, 53611)

Notes: * *FAO Food and Nutrition Paper No. 4*, p. 21
** Council Directive No. 74/329/EEC of 18 June 1974, as amended and supplemented

Gum tragacanth (E 413)

Definition: Gum tragacanth is a dried exudation obtained from the stems and branches of *Astragalus gummifer* Labillardiere and other Asiatic species of *Astragalus* (Fam. Leguminosae). It 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*.

Summary of specifications

	BP 1980 EP vol III 1975	FAO/WHO 1975	USP XIX 1983*	FCC 3rd Edition 1981	EEC**
Identification tests		Microscopy			
	Precipitation with barium hydroxide and cupritartrate solutions	Insolubility in ethanol; swelling in water but not in 60% ethanol; precipitation with cupric acetate; identification of sugars		Swelling in water	
Viscosity				Not less than 250 centipoises for a 1% solution	
Purity criteria					
Loss on drying, % max.		16.0			
Total ash, % max.				3.0	3.5
Sulphated ash, % max.	4.0†	4.0	4.0		
Acid-insoluble ash, % max.			0.5	0.5	0.5
Acid insoluble matter, % max.			2.0		
Dextrins	Not detectable				
Agar	Not detectable				
Acacia and other soluble gums	Not detectable				
Karaya gum	Not detectable				
Arsenic, % max.			0.0003	0.0003	0.0003	0.0003
Lead, % max.			0.001	0.001	0.001	0.001
Heavy metals, % max.			0.004	0.004	0.004	
Copper and zinc, % max.						0.005
Zinc, % max.						0.0025
Foreign matter, % max.	1.0	1.0			
Microbial contamination	1 g free from *E. coli*‡	1 g free from *E. coli* and salmonellae			

Gum tragacanth was affirmed as GRAS in the United States in 1976 (*Federal Register*, 1976, **41**, 53617)

Notes:
* *FAO Food and Nutrition Paper No. 28*, pp. 136-138.
** Council Directive No. 74/329/EEC of 18 June 1974, as amended and supplemented
† 5.0% maximum for powdered tragacanth
‡ Powdered tracaganth only

Gum karaya (E 416)

Definition: Gum Karaya is a dried exudation from the stems and branches of *Sterculis urens* Roxburgh and other species of *Sterculia* (Fam. Sterculiaceae) or from *Cochlospermum gossypium* A.P. De Candolle or other species of *Cochlospermum* (Fam. Bixaceae). It consists mainly of high molecular-weight acetylated polysaccharides, which on hydrolysis yield galactose, rhamnose and galacturonic acid, together with minor amounts of glucuronic acid.

Summary of specifications

	BP 1980	FAO/WHO 1983**	FCC 3rd Edition 1981	EEC*
Identification tests	Microscopy: Swelling in Water;	Swelling in Water and 60% Ethanol	White Precipitate with Millon's Reagent	
	Insolubility in ethanol; Red precipitate formed with cupritartrate; Brown colour with NaOH.	Red colour with HCl		
Viscosity			Within range claimed by vendor for a 1% solution	
Purity criteria				
Loss on drying, % max.		20.0	20.0	
Total ash, % max.	7.0	8.0		NO
Acid-insoluble ash, % max.	1.0	1.0	1.0	SPECIFIC
Acid-insoluble matter, % max.		3.0	3.0	CRITERIA
Volatile acid, % min.	14.0†	10.0		
Starch		Not detectable	Not detectable	
Arsenic, % max.		0.0003	0.0003	0.0003
Lead, % max.		0.001	0.001	0.001
Heavy metals, % max.		0.004	0.004	
Copper and zinc, % max.				0.005
Zinc, % max.				0.0025
Foreign matter, % max.				
Microbial contamination	1 g free from *E. coli*†	1 g free from *E. coli* and *Salmonellae*		

Gum karaya was affirmed as GRAS in the USA in 1976 (Federal Register, 1976, *41*, 53610)

Notes: * Council Directive No. 74/329/EEC of 18 June 1974, as amended and supplemented
** *FAO Food and Nutrition Paper No. 28*, pp. 57-59
† For powdered gum karaya, not less than 10.0% (calculated as acetic acid in both cases)

Locust bean gum (E 410)

Definition: Locust bean gum is primarily the endosperm of *Ceratonia siliqua* (L.) Taub, (Fam. Leguminosae). It consists mainly of polysaccharides of high molecular weight composed of galactomannans. The article of commerce may be further specified as to viscosity*.

Summary of specifications

	FAO/WHO* (tentative)	FCC 3rd Edition 1981	EEC**
Identification tests	Microscopy; Solubility in hot water; Insolubility in ethanol; Gel formation with sodium borate; Appreciable change in viscosity of solution after heating; TLC identification of sugars after hydrolysis.		
Purity criteria			
Loss on drying, % max.	15.0	15.0	14.0
Total ash, % max.	1.2	1.2	1.2
Acid insoluble matter, % max.	4.0	5.0	4.0
Protein, % max.	7.0	8.0	7.0
Starch	Not detectable		
Galactomannans; % min.		73.0	75.0
Arsenic, % max.	0.0003	0.0003	0.0003
Lead, % max.	0.001	0.001	0.001
Heavy metals, % max.	0.002	0.002	
Copper and zinc, % max.			0.005
Zinc, % max.			0.0025
Microbial contamination	Information required		

Notes: * *FAO Food and Nutrition Paper No. 28*, pp. 22-24.
** Council Directive No. 74/329/EEC of 18 June 1974, as amended and supplemented

APPENDIX C: LIST OF TRADING CONTACTS

The following list is in no way intended to be exhaustive and is to a large extent based on contacts made by the author during the course of the survey. Inclusion of a firm's name implies no knowledge on the Institute's part of the financial standing of the firm concerned.

United States

Celanese Water-Soluble Polymers Celanese Corporation One Riverfront Plaza Louisville KY 40202	Importers and processors (mainly guar gum)
Chart Corporation Inc. 519 Broad Street Glen Rock New Jersey NJ 07452	Processors
Colony Export and Import Corporation 101 West 31st Street New York NY 10001	Importers and processors
Gumix International Inc. 241 Main Street Hackensack NJ 07601	Processors
Henkel Corporation 7900 West 78th Street Minneapolis MN 55435	Importers and processors (mainly guar gum)
Hercules Inc. Hercules Plaza Wilmington DE 19894	Importers and processors (mainly guar gum)
Kelco (division of Merck & Co. Inc.) 8355 Aero Drive P.O. Box 23076 San Diego CA 92123	Importers and processors (mainly guar gum)
Dr Madis Laboratories Inc. 375 Huyler Street South Hackensack NJ 07606	Processors
P.L. Thomas and Co. Inc. P.O. Box 449 75 Claremont Road Bernardsville NJ 07924	Agents and importers
T.I.C. Inc. 144 East 44th Street New York NY 10017	Importers
George Uhe Co. Inc. 76 Ninth Avenue New York NY 10011	Importers and agents

United Kingdom

Agrisales Ltd. (a division of Agriproducts Holdings Ltd.) Royal Oak House 45a Porchester Road London W2 5NR	Importers
Arthur Branwell and Co. Ltd. Bronte House 58-62 High Street Epping Essex CM16 4AE	Importers
Red Carnation Gums Ltd. Sir John Lyon House 5 High Timber Street Upper Thames Street London EC4V 3PA	Importers and processors
Robert Stewart and Sons Ltd. 1-5 Queen Street London EC4N 1SP	Importers

France

Société Alland et Robert 9 rue de Saintonge 75003 Paris	Importers
Ets A Arnaud S.A. 68 Av. du General Michel-Bizot 75012 Paris	Importers
Iranex S.A. 4 rue Frederic Passy 92200 Neuilly-sur-Seine	Importers
Ste d'Exploitation des Ets. Louis Laprade 19 rue de Milan 75009 Paris	Importers

Federal Republic of Germany

Cornehls und Bosse Lademannbogen 6 2 Hamburg 63	Agents and brokers
Laxmichand Dayabhai (Export) Co. Schippelsweg 57 Niendorf 2 Hamburg 61	Agents and importers
C. E. Roeper Klosterallee 74 2 Hamburg 13	Importers
Alfred L. Wolff (GmbH & Co.) Grosse Backerstrasse 13 2 Hamburg 1	Importers
E. H. Worlee & Co. Bellevue 7-8 2 Hamburg 60	Importers

Belgium

Donck-Food
Terlochtweg 1
2620 Hemiksen
Antwerp

Importers and processors

Netherlands

Handelmaatschappij Ferdiwo B.V.
Backershagen 99d
1082 GT Amsterdam

Importers and processors

Italy

Index
Corso de Porto Nueva 46
Milan

Importers

Switzerland

Paul Brem AG
CH-8102 Oberengstringen

Agents

SUGRO AG
Sevogelstrasse 21
CH-4002 Basle

Agents and importers

(3668/87) Hobbs the Printers of Southampton