Tropical Products Institute

G171

Selected markets for the essential oils of lemongrass, citronella and eucalyptus

Tropical Products Institute

G171

Selected markets for the essential oils of lemongrass, citronella and eucalyptus

S. R. J. Robbins

March 1983

Tropical Products Institute 56/62 Gray's Inn Road London WC1X 8LU
Overseas Development Administration

This report was produced by the Tropical Products Institute, a British Government organisation which co-operates with developing countries in helping them to derive greater benefit from their plant and animal resources. It specialises in post-harvest problems and will be pleased to answer requests for information and advice addressed to the Director.

Price £2.80 including packing and postage.

No charge is made for single copies of this publication sent to governmental and educational establishments, research institutions and non-profit making organisations working in countries eligible for British Aid. Free copies cannot normally be addressed to individuals by name but only under their official titles.

Tropical Products Institute
ISBN: 0 85954 168 1
ISSN: 0144–9982

Contents

FIGURES IN TEXT

ACKNOWLEDGEMENTS

The information contained in this report is based primarily on the results of interviews conducted with members of the essential oils trade in the USA, the United Kingdom, France, the Federal Republic of Germany, the Netherlands and Switzerland during the period November 1980—February 1981. The author acknowledges with gratitude the assistance and advice given by all the individuals, companies and organisations contacted during the course of the study. Thanks are also due to the staff of the Spices, Essential Oils and Other Plant Extractives Section, TPI, who contributed to the Appendices.

NOTE

The following apply in all tables:

— nil or negligible
... not available

Apparent minor errors in the totals or 'Other countries' category are due to rounding.

In some cases volumes were expressed in litres in the original source. These have been converted to tonnes to facilitate comparison with other tables.

In many cases it will be found that export figures and corresponding import figures do not equate. To some extent such discrepancies are due to time lags in recording but they are also due in part to deficiencies in the recording systems operating in some countries.

Summaries

SUMMARY

Selected markets for the essential oils of lemongrass, citronella and eucalyptus

The essential oils of lemongrass, citronella and eucalyptus have traditionally been regarded as large-volume oils used in a very wide range of perfumery products and, to a much smaller extent, in flavours. They are used either as perfumery oils in their own right or, particularly in the case of lemongrass oil and citronella oil, as sources of individual chemical constituents or their derivatives which are themselves important materials in the perfumery or flavouring industries. As oils in their own right they tend to be used in relatively low-priced products, although some of their derivatives have applications in high-class perfumery. This report contains a review of recent market trends and their implications for the future of these essential oils and for both existing and potential producers. The basic conclusions are as follows:

1 **Lemongrass oil** has traditionally been available in two basic forms, namely 'East Indian' oil, produced in South Asia and 'West Indian' oil, produced in Central and South America, parts of Africa, Indo-China and the Indian Ocean islands. The current level of international trade is under one-third of the levels of the 1960s, and stands at below 500 tonnes per annum. Of this export total, Guatemala accounts for 50% on average, India for 35–40% and China for most of the remainder. Among the minor producers are Sri Lanka, Brazil, Argentina and Indonesia. India and China produce considerably more than they export since they have substantial internal markets for lemongrass oil, while India also possesses extraction facilities for the conversion of lemongrass oil into its derivatives.

2 **Annual consumption** in countries importing lemongrass oil stood approximately as follows at the end of the 1970s:

USA	140 tonnes
United Kingdom	60–70 tonnes
France	35–40 tonnes
Federal Republic of Germany	10–20 tonnes
Netherlands	10 tonnes
Switzerland	10 tonnes
Japan	35 tonnes
Soviet Union	145 tonnes
Other countries	20–40 tonnes

The Soviet Union differs from other consuming countries as most of its trade is conducted on a barter basis, and exclusively with India.

3 The substantial decline in the lemongrass oil trade is due primarily to the advance of synthetic substitutes, mostly derived from turpentine and acetylene, for the various chemical components of lemongrass oil and their derivatives. The main component of lemongrass oil is the chemical citral, which possesses a lemon-like character and is very widely used in perfumery and flavouring. From citral can be manufactured the ionones, an important group of perfumery isolates with distinctive

odour characteristics, and finally vitamins A and E. In the case of the ionones and vitamins, the ex-turpentine or ex-acetylene products are virtually as acceptable as the ex-lemongrass products and are considerably cheaper, and consequently dominate the field. Natural citral, on the other hand, is quite widely regarded as rather superior to synthetic citral in its odour and technical qualities and is consequently still widely used in spite of the price advantage enjoyed by the synthetics. However, lemongrass oil also faces severe competition from another natural source, namely oil of *Litsea cubeba* which is produced in China in very substantial quantities and has had a profound impact on the lemongrass oil market, many users preferring natural citral from *Litsea cubeba* oil to that from lemongrass oil.

4 The use of lemongrass oil as a perfumery oil in its own right has also decreased, but not to the same extent as in the extraction of the derivatives. There has been a tendency for perfumers to move away from the relatively simple types of perfume, based predominantly on lemongrass oil, that were once popular, and in new intermediate and end-products in particular there is substantially less of an inclination to turn to the now relatively expensive lemongrass oil. It is mainly in the cheaper products that lemongrass oil has traditionally been used and it is here that the cost pressures are most intense, precision of fragrance seldom being so critical that slight changes in formulation matter very much.

5 Although the decline in lemongrass oil consumption has very recently flattened off somewhat, the existing producers are at present capable of meeting world demand. However, a number of buyers are reluctant to rely too much on Chinese supplies of lemongrass oil and *Litsea cubeba* oil on account of the unpredictability of Chinese production plans and there is also an element of uncertainty surrounding Indian and Guatemalan supplies. In consequence, although buyers are not at present anxious to see the world production base broadened, it is still not impossible that increased opportunities could eventually arise for existing minor producers or for new producers, provided that the quality of the oil were sufficiently high.

6 **Citronella oil** is available in two forms, namely the Ceylon type, which is produced solely in Sri Lanka and accounts for a very small proportion of world production and exports, and the Java type, which accounts for the bulk of world production and is produced mainly in Indonesia, China, Taiwan and Guatemala. Vietnam and Brazil are prominent among the minor producers, which are found mainly in Central and South America, Asia and Southern Africa. In China, Sri Lanka and possibly Indonesia and Taiwan there are significant internal markets; other producers export most of their products. International trade has fluctuated considerably from year to year, but there would appear to be a strong downward trend, and total trade at the end of the decade was probably little more than 1,750 tonnes per annum. Of this total, Indonesia and China each contribute between 40% and 45%, Taiwan and Guatemala each a little under 3%, Sri Lanka in the region of 6% and Brazil 2%.

7 **Annual consumption** throughout the world at the end of the 1970s was approximately as follows:

USA	550 tonnes
United Kingdom	110 tonnes
France	140 tonnes
Federal Republic of Germany	100 tonnes
Netherlands	150 tonnes
Switzerland	50–100 tonnes
Japan	190 tonnes
Mexico	130 tonnes
Spain, Italy and Belgium	80–90 tonnes (total)
Eastern Europe (including Soviet Union)	80 tonnes
Other countries	150–160 tonnes (minimum)

8 Both the Ceylon-type and, to a lesser extent, the Java-type oils are used in their own right as perfumery oils in inexpensive soaps, detergents and a whole range of

utility household and industrial products, both to impart a fresh fragrance and, in some cases, specifically to mask the unpleasant odour characteristics of certain active ingredients. In these applications there has been a steady decline in usage levels, but not to the same extent as has been evident in the other main area of usage, namely as a source of perfumery isolates such as geraniol, citronellal, citronellol and various derivatives of these isolates, notably hydroxycitronellal. These isolates can be obtained much more cheaply (via α-pinene and β-pinene) from turpentine and the differences in quality, which once quite strongly favoured the natural isolates in spite of their comparatively high price, have lately steadily narrowed to the point at which price is most frequently the dominant criterion of choice. Only in the case of the very important perfumery derivative hydroxycitronellal, do the qualities of the ex-citronella product over-ride price considerations with any frequency but here citronella oil faces very severe competition from another natural essential oil, namely oil of *Eucalyptus citriodora*, which is often the cheaper source.

9 The likelihood of the price of turpentine and its derivatives increasing sharply in real terms in the future is small and citronella oil is likely to continue to be at a severe price disadvantage. Its consumption therefore is likely to continue to decline, if less severely than in recent years on account of the higher proportion of the oil now used in its own right. It is becoming an economically unattractive oil to produce in view of the rising costs of production and reluctance of consumers to purchase it above a certain price level. Low prices in the mid-1970s caused intermittent shortages to occur, particularly in relation to Indonesian oil, but it is more than likely that the existing producers will be able to maintain the balance between supply and demand over time, and even in the event of further shortages it is most unlikely that any prospective new producer would find entry to this declining market worthwhile.

10 The **oils of eucalyptus** are available in three quite distinct forms: firstly, oils rich in cineole, which can be produced from several species and are the most widely used, with very many applications in pharmaceutical and perfumery compounds; secondly, oils rich in citronellal, which are produced exclusively from the species *E. citriodora* and used both *per se* in cheap perfume compounds and, in particular, as a source of the important perfumery isolate citronellal and, from this, hydroxycitronellal; and thirdly, oils rich in phellandrene and, to a lesser extent, piperitone, which are used almost exclusively for the extraction of those isolates for use in perfumery and flavouring. Production of the cineole-rich oils is dominated by China, although the best oils have traditionally been produced by Portugal, Spain and Australia. The Republic of South Africa, Swaziland and Brazil are also producers, although the South African oils have yet to match fully the quality of oils from other sources. China and Brazil dominate exports of oil of *E. citriodora*, and Australia and the Republic of South Africa dominate exports of the phellandrene-rich oils.

11 Total world exports of all types of eucalyptus oils are of the order of 1,500–1,650 tonnes per annum, those of oil of *E. citriodora* and the phellandrene-rich oils being estimated to account for rather over 100 tonnes and 20–30 tonnes per annum respectively. Approaching two-thirds of world exports of the cineole-rich oils are attributable to China, roughly half of the balance being accounted for by Portugal and Spain, and the other half by the Republic of South Africa, Brazil and Australia in that order. Exports of oil of *E. citriodora* and the phellandrene-rich oils are in each case split roughly evenly between the respective producing countries.

12 **Annual consumption** of the eucalyptus oils throughout the world is estimated to have stood approximately as follows at the end of the 1970s:

	Cineole-rich oils	*Oil of* E. citriodora	*Phellandrene-rich oils*
USA	230–250	20–30	10–20
United Kingdom	95–105	40–50	5
France	550–560	20–30	<5

	Cineole-rich oils	*Oil of* E. citriodora	*Phellandrene-rich oils*
Federal Republic of Germany	210–220	< 10	negligible
Netherlands	50	< 5	negligible
Switzerland	20–25	5–10	negligible

(*All quantities in tonnes*)

All other countries (mainly cineole-rich oils) 200–350 tonnes.

13 Eucalyptus oil is generally cheap, and, moreover, price levels have been comparatively steady in comparison with those of many other essential oils, especially since the 1974 commodity boom. In the case of oil of *E. citriodora* and the phellandrene-rich oils, however, the existence of cheap synthetic routes to citronellal, hydroxycitronellal, phellandrene and piperitone has eroded the importance of the natural oils in spite of their low price. Until recently, the special qualities of natural hydroxycitronellal were of sufficient weight to guarantee it a market in spite of its price, but steady improvements in the characteristics of the synthetic alternative are gradually bringing about a new situation in which price will be a much more dominant criterion of choice. Demand for oil of *E. citriodora* is therefore expected gradually to decline to a level roughly equivalent to its level of usage in its own right as a perfumery oil, an area of application which is unlikely to decrease as fast but which is certainly unlikely to increase. The anticipated decline in the consumption of the phellandrene-rich oils may be even more pronounced, as there are proportionately fewer uses for these oils in their own right.

14 The cineole-rich oils enjoy much more favourable prospects than do the other two types, since there are at present no viable alternative routes to cineole and there is little incentive to develop a new route. Generally rising costs may cause production in higher-cost areas such as the Iberian Peninsula and Australia to decline, particularly as Chinese oil is already a cheaper product and the Chinese industry appears to be less susceptible to the same degree of cost increase, and it is likely that in the longer term new producers with access to suitable species of eucalyptus would be able to gain a foothold in the market. Demand for the types of product in which the cineole-rich eucalyptus oils are used is buoyant and there is no reason to expect any downturn in demand in the foreseeable future, although it should be emphasised that the prospects for new producers exist more in the long term than the short term.

RÉSUMÉ

Marchés choisis pour les essences de cymbopogon, citronelle et eucalyptus

Les essences de cymbopogon, de citronelle et d'eucalyptus étaient considérés traditionnellement comme des essences de volume important utilisées dans une très large gamme de produits de parfumerie et, dans une bien moindre mesure, dans les produits aromatiques. Elles sont utilisées ou bien comme essences de parfumerie telles quelles ou bien, en particulier dans le cas de l'essence de cymbopogon et de l'essence de citronelle, comme sources de différents constituants chimiques ou de leurs dérivés qui sont eux-mêmes des éléments importants dans les industries de la parfumerie et des aromates. Comme essences, elles tendent à être utilisées dans des produits de prix relativement bas, bien que certains de leurs dérivés aient des applications en parfumerie de catégorie supérieure. Dans ce rapport, on passe en revue les tendances récentes du marché et leurs conséquences quant à l'avenir de ces essences et de celui des producteurs existants et potentiels. Les principales conclusions sont les suivantes:

1 **L'essence de cymbopogon** existait traditionnellement sur le marché sous deux formes principales, notamment l'essence des 'Indes Orientales' produite dans l'Asie du Sud, et l'essence des 'Antilles', produite en Amérique Centrale et du Sud, dans certaines parties d'Afrique, en Indochine et dans les Iles de l'Océan Indien. Le niveau actuel du marché international représente moins d'un-tiers des niveaux des années 60 et il est inférieur à 500 tonnes par an. Sur ce total d'exportations, le

Guatemala détient en moyenne la moitié, l'Inde 35 à 40 pour cent et la Chine la plus grande partie du reste. Sri Lanka, le Brésil, l'Argentine et l'Indonésie comptent parmi les producteurs de moindre importance. L'Inde et la Chine produisent considérablement plus qu'elles n'exportent, leurs marchés intérieurs pour l'essence de cymbopogon étant relativement importants; l'Inde possède également des usines d'extraction pour la transformation de l'essence de cymbopogon en ses dérivés.

2 **La consommation annuelle** dans les pays importateurs d'essence de cymbopogon était approximativement la suivante à la fin des années 70:

Etats-Unis	140 tonnes
Royaume-Uni	60–70 tonnes
France	35–40 tonnes
République Fédérale d'Allemagne	10–20 tonnes
Pays-Bas	10 tonnes
Suisse	10 tonnes
Japon	35 tonnes
Union soviètique	145 tonnes
Autres pays	20–40 tonnes

L'Union soviétique est différente des autres pays consommateurs en ce sens que son commerce se fait en majeure partie sur une base d'échange et exclusivement avec l'Inde.

3 Le déclin notable du commerce de l'essence de cymbopogon est dû en premier lieu aux progrès des produits synthétiques, dérivés pour la plupart de la térébenthine et de l'acétylène et destinés à remplacer les divers composés chimiques de l'essence de cymbopogon et leurs dérivés. Le principal constituant de l'essence de cymbopogon est le citral, de nature analogue au citron, largement utilisé en parfumerie et dans les produits aromatiques. A partir du citral, on peut obtenir des ionones, important groupe d'isolats de parfumerie avec une odeur caractéristique, et finalement les vitamines A et E. Dans le cas des ionones et des vitamines, les produits d'extraction de la térébenthine ou de l'acétylène sont pratiquement aussi acceptables que les produits d'extraction du cymbopogon, mais ils sont considérablement moins chers et, en conséquence, ils prédominent sur le marché. Le citral naturel, par contre, est largement considéré comme étant supérieur au citral synthétique en ce qui concerne l'odeur et les qualités techniques; en conséquence, il est largement utilisé malgré les prix plus avantageux des produits synthètiques. L'essence de cymbopogon se heurte aussi à une concurrence sévère de la part d'une autre source naturelle, l'essence de *Litsea cubeba*, produite en Chine en quantités très appréciables; son impact sur le marché de l'essence de cymbopogon à été très profond, de nombreux utilisateurs préférant le citral naturel extrait de l'essence de *Litsea cubeba* à celui extrait de l'essence de cymbopogon.

4 L'utilisation de l'essence de cymbopogon telle quelle en parfumerie a également diminué, mais non dans la même mesure que l'extraction des dérivés. On a constaté chez les parfumeurs une tendance à se détourner des types de parfums relativement simples, à base principalement d'essence de cymbopogon, autrefois populaires et, en ce qui concerne les nouveaux produits intermédiaires et finals en particulier, ils ont beaucoup moins tendance à utiliser l'essence de cymbopogon relativement coûteuse. C'est principalement dans les produits meilleur marché que l'essence de cymbopogon était traditionnellement utilisée et c'est là que les pressions des prix se font le plus sentir, la finesse du parfum étant rarement à tel point critique que de légers changements de la formulation aient beaucoup d'importance.

5 Malgré un léger ralentissement qui s'est fait sentir récemment dans le déclin de la consommation de l'essence de cymbopogon, les producteurs existants sont actuellement en mesure de satisfaire la demande mondiale. Cependant, un certain nombre d'acheteurs hésitent à se fier entièrement aux fournitures chinoises d'essence de cymbopogon et d'essence de *Litsea cubeba* à cause du caractère imprévisible des plans de production chinois et il y a également un élément d'incertitude entourant les approvisionnements provenant d'Inde et du Guatemala. En conséquence, bien

que les acheteurs ne se préoccupent pas actuellement de voir s'étendre la base de production mondiale, il n'est pas exclu que des petits producteurs existants et des nouveaux producteurs voient s'ouvrir éventuellement de plus larges horizons à condition que la qualité de l'essence soit suffisamment élevée.

6 **L'essence de citronelle** existe sous deux formes, la variété de Ceylan, produite uniquement à Sri Lanka et qui représente une très faible proportion de la production mondiale et des exportations, et la variété de Java, qui représente le plus grand volume de la production mondiale et est principalement produite en Indonésie, en Chine, à Taïwan et au Guatemala. Le Vietnam et le Brésil sont les plus importants parmi les petits producteurs que l'on trouve principalement en Amérique Centrale et du Sud, en Asie et en Afrique du Sud. En Chine, à Sri Lanka et peut-être en Indonésie et a Taïwan, les marchés intérieurs sont notables; les autres producteurs exportent la majeure partie de leurs produits. Le commerce international a varié considérablement d'une année à l'autre, mais il semblerait présenter une forte tendance à la diminution; à la fin de la décennie, le volume total du marché dépassait probablement à peine 1750 tonnes par an. L'Indonésie et la Chine participent chacune à 40—45 pour cent de ce volume total, Taïwan et le Guatemala à un peu moins de 3 pour cent chacun, Sri Lanka aux alentours de 6 pour cent et le Brésil à 2 pour cent.

7 **La consommation annuelle** dans le monde était approximativement la suivante à la fin des années 70:

Etats-Unis	550 tonnes
Royaume-Uni	110 tonnes
France	140 tonnes
République Fédérale d'Allemagne	100 tonnes
Pays-Bas	150 tonnes
Suisse	50—100 tonnes
Japon	190 tonnes
Mexique	130 tonnes
Espagne, Italie et Belgique	80—90 tonnes (total)
Europe de l'Est (incl. Union soviètique)	80 tonnes
Autres pays	150—160 tonnes (minimum)

8 Les essences de la variété de Ceylan et, dans une moindre mesure, celles de la variété de Java, sont utilisées telles quelles comme essences de parfumerie dans des savons bon marché, des détergents et toute une série de produits utilitaires ménagers et industriels; elles sont utilisées pour conférer une odeur fraîche et, dans certains cas, pour masquer spécifiquement les caractéristiques olfactives désagréables de certains ingrédients actifs. Dans ces applications, l'emploi de ces essences a baissé de façon constante, mais pas autant que dans le principal domaine d'utilisation, à savoir comme source d'isolats de parfumerie, tels que géraniol, citronellal, citronellol et divers dérivés de ces isolats, en particulier, l'hydroxycitronellal. Ces isolats peuvent être obtenus à bien moindre prix (en passant par l'α-pinène et le β-pinène) à partir de la térébenthine et les différences de qualité qui, autrefois, avaient très fortement favorisé les isolats naturels malgré leur prix comparativement éléve, ont fortement diminué dernièrement à tel point que le prix est le plus souvent le principal critère de choix. Ce n'est que dans le cas du très important dérivé de parfumerie, l'hydroxycitronellal, que les qualités de produit extrait de l'essence de citronnelle l'emportent assez fréquemment sur les considérations de prix, mais l'essence de citronelle se heurte à une très forte concurrence de la part d'une autre essence naturelle, à savoir l'essence d' *Eucalyptus citriodora*, qui est souvent la source la moins chère.

9 Il est peu probable que le prix de la térébenthine et de ses dérivés augmente notablement en valeur effective dans l'avenir et l'essence de citronelle continuera probablement à être fortement désavantagée du point de vue prix. Il est probable en conséquence que la consommation continue à baisser, même si c'est moins fortement qu'au cours des dernières années par suite de la plus forte proportion d'essence utilisée maintenant telle quelle. C'est devenu une essence dont la

production n'est pas engageante économiquement à cause des coûts de production croissants et de l'hésitation des consommateurs à acheter au-dessus d'un certain prix. Les prix peu élevés au milieu des années 70 ont provoqué des pénuries passagères, en particulier d'essence provenant de l'Indonésie mais il est plus que probable que les producteurs existants seront à même de maintenir l'équilibre entre approvisionnement et demande pendant un certain temps, et même en cas d'autres pénuries, il est tout à fait improbable qu'un nouveau producteur éventuel trouve de l'intérêt à entrer sur se marché sur son déclin.

10 **Les essences d'eucalyptus** existent sous trois formes tout à fait distinctes: premièrement, les essences riches en cinéol, qui peuvent être obtenues à partir de plusieurs espèces et sont le plus largement utilisées, avec de très nombreuses applications dans les produits pharmaceutiques et en parfumerie; deuxièmement, les essences riches en citronellal, qui sont obtenues exclusivement à partir de l'espèce *E. citriodora,* et sont utilisées à la fois telles quelles dans les produits de parfumerie bon marché et, en particulier, comme source de l'important isolat de pârfumerie citronellal et, à partir de ce dernier, l'hydroxycitronellal; troisièmement, les essences riches en phellandrène et, dans une moindre mesure, en pipéritone, qui sont utilisés presque exclusivement pour l'extraction de ces isolats en vue de leur utilisation en parfumerie et dans les produits aromatiques. La production des essences riches en cinéol est la plus importante en Chine, bien que les meilleures essences aient traditionnellement été fabriquées au Portugal, en Espagne et en Australie. La République de l'Afrique du Sud, le Swaziland et le Brésil sont également des producteurs, bien que les essences de la République de l'Afrique du Sud aient encore à rivaliser avec la qualité des essences des autres provenances. La Chine et le Brésil sont les principaux exportateurs d'essence d' *E. citriodora*, et l'Australie et la République de l'Afrique du Sud sont les principaux exportateurs des essences riches en phellandrène.

11 Le volume total des exportations mondiales de tous les types d'essences d'eucalyptus est de l'ordre de 1500—1650 tonnes par an, les exportations d'essence d' *E. citriodora* et d'essences riches en phellandrène étant estimées respectivement à plus de 100 et 20—30 tonnes per an. Près des deux-tiers des exportations mondiales d'essences riches en cinéol sont attributables à la Chine, en gros la moitié du reste revenant au Portugal et à l'Espagne et l'autre moitié — dans l'ordre — à la République de l'Afrique du Sud, au Brésil et à l'Australie. Les exportations d'essence d' *E. citriodora* et des essences riches en phellandrène sont réparties dans chaque cas en gros de façon uniforme entre les différents pays producteurs.

12 D'après les estimations, **la consommation annuelle** d'essences d'eucalyptus dans le monde a été approximativement la suivante à la fin des années 70:

	Essences riches en cinéol	*Essence d'* E. citriodora	*Essences riches en phellandrène*
Etats-Unis	230—250 tonnes	20—30 tonnes	10—20 tonnes
Royaume-Uni	95—105 tonnes	40—50 tonnes	5 tonnes
France	550—560 tonnes	20—30 tonnes	< 5 tonnes
République Fédérale d'Allemagne	210—220 tonnes	< 10 tonnes	négligeable
Pays-Bas	50 tonnes	< 5 tonnes	négligeable
Suisse	20—25 tonnes	5—10 tonnes	négligeable

Tous les autres pays (principalement essences riches en cinéol) 200—350 tonnes.

13. L'essence d'eucalyptus est en général bon marché et, de plus, les prix sont restés assez stables en comparaison de ceux de beaucoup d'autres essences, en particulier depuis le boom économique de 1974. Mais dans le cas de l'essence d' *E. citriodora* et des essences riches en phellandrène, l'existence de voies de synthèse bon marché pour l'obtention de citronellal, d'hydroxycitronellal, de phellandrène et de pipéritone a réduit l'importance des essences naturelles malgré leur prix peu élevé. Jusqu'il y a peu de temps, les qualités particulières de l'hydroxycitronellal avaient suffisamment de poids pour lui garantir un marché malgré son prix, mais des améliorations constantes des caractéristiques du produit synthétique de remplace-

ment créent progressivement une nouvelle situation dans laquelle le prix deviendra un critère de choix prépondérant. C'est pourquoi on prévoit une chute progressive de la demande pour l'essence d' *E. citriodora* jusqu'à un niveau correspondant en gros à son niveau d'utilisation telle quelle comme essence de parfumerie, domaine d'application qu'il est peu probable de voir diminuer si rapidement mais qu'il est certainement improbable de voir augmenter. La chute prévue de la consommation d'essences riches en phellandrène peut même être plus marquée étant donné que ces essences sont moins utilisées telles quelles.

14 Les perspectives pour les essences riches en cinéol sont bien plus favorables que celles pour les deux autres types; en effet, il n'existe actuellement aucune autre voie d'obtention de cinéol et il y a peu de motifs de chercher à développer une nouvelle voie. Il est possible que la hausse générale des prix provoque une chute de production dans les régions où les prix sont plus élevés, notamment dans la Péninsule Ibérique et en Australie, d'autant plus que l'essence chinoise est déjà moins chère et l'industrie chinoise semble être moins susceptible de subir une hausse des prix d'un degré comparable et il est probable que dans un avenir peu reculé, de nouveaux producteurs ayant accès à des espèces valables d'eucalyptus seront à même de prendre une place dans le marché. La demande se maintient pour les types de produits dans lesquels sont utilisées les essences d'eucalyptus riches en cinéol et il n'y a pas de raison de s'attendre à une diminution de la demande dans un avenir prévisible, mais il faut souligner que les perspectives pour de nouveaux producteurs existent plutôt à long-terme qu'à court-terme.

RESUMEN

Mercados seleccionados para los aceites esenciales del junco oloroso, de la citronela y del eucalipto

Los aceites esenciales del junco oloroso, de la citronela y del eucalipto han sido considerados tradicionalmente como tipos de gran volumen utilizados en una gama sumamente amplia de productos de perfumería y, en proporciones mucho menores, como sabores. Se usan como aceites de perfumería por derecho propio o, particularmente en el caso de la esencia del junco oloroso y del aceite de la citronela, como fuentes de componentes químicos individuales o de sus derivados, los cuales son ellos mismos materiales importantes para las industrias de la perfumería o de los productos aromatizantes. En calidad de aceites por derecho propio, tienden a usarse en productos de precio relativamente bajo, si bien algunos de sus derivados tienen aplicación en la perfumería de alta calidad. Este informe contiene una reseña de las recientes tendencias del mercado así como de sus consecuencias para el futuro de estos aceites esenciales, y para los productores existenses como posibles. Las conclusiones básicas son como siguen:

1 **El aceite del junco oloroso** se ha ofrecido disponible tradicionalmente en dos formas básicas, a saber: el aceite 'indio oriental', producido en Sudasia, y el aceite 'indio occidental', producido en Centroamérica, Sudamérica, ciertas partes de Africa, Indochina y en las Islas del Océano Indico. El nivel actual de comercio internacional está por debajo de un tercio de los niveles registrados en la década de los años 1960, es decir menos de 500 toneladas anuales. De este total de exportación, Guatemala es responsable de la mitad por término medio, la India de un 35—40 por ciento y la China de la mayor parte restante. Entre los países productores de menor cuantía cabe mencionar Sri Lanka, Brasil, Argentina e Indonesia. India y China producen considerablemente más de lo que exportan, ya que poseen importantes mercados interiores para la esencia del junco oloroso, mientras que la India posee también facilidades de extracción para efectuar la conversión de la esencia del junco oloroso en sus derivados.

2 **El consumo anual** de los países importadores de esencia del junco oloroso estaba aproximadamente como sigue a finales de la década de los años 1970:

Estados Unidos	140 toneladas
Reino Unido	60–70 toneladas
Francia	35–40 toneladas
República Federal Alemana	10–20 toneladas
Países Bajos	10 toneladas
Suiza	10 toneladas
Japón	35 toneladas
Unión Soviética	145 toneladas
Otros países	20–40 toneladas

La Unión Soviética difiere de los demás países consumidores en que la mayor parte de su comercio se lleva a cabo a base de trueques exclusivamente con la India.

3 La disminución considerable registrada en el comercio de la esencia del junco oloroso se debe principalmente a los avances realizados con sustitutos sintéticos, la mayoría derivados de la trementina y del acetileno, para los diversos componentes químicos de la esencia del junco oloroso y sus derivados. El componente principal de la esencia del junco oloroso es citral químico, el cual posee un aspecto parecido al limón y es extensamente utilizado en perfumería y en la aromatización. A partir del citral puede obtenerse ionona, la cual consiste en un importante grupo de aislados de perfumería con características distintivamente aromáticas, y finalmente las vitaminas A y E. En el caso de la iononas y las vitaminas, los productos extraídos de la trementina y del acetileno resultan prácticamente igual de aceptables que los derivados del junco oloroso y son considerablemente más baratos, y por consiguiente son dominantes en el campo. El citral natural, por otra parte, es considerado generalmente como superior al citral sintético, en lo que respecta a sus propiedades aromáticas y técnicas, y por tanto se usa todavía extensamente a pesar de los precios ventajosos ofrecidos por el sintético. Sin embargo, el aceite del junco oloroso sufre una grave competencia por parte de otro producto natural llamado aceite *Litsea cubeba* fabricado en China en cantidades sumamente considerables. Este producto ejerce un impacto profundo en el mercado del aceite del junco oloroso, y numerosos usuarios prefieren el citral natural obtenido del aceite *Litsea cubeba* al obtenido del aceite del junco oloroso.

4 El uso del aceite del junco oloroso por derecho propio en la perfumería también ha disminuido, pero no tanto como en lo que refiere a la extracción de los derivados. Se ha manifestado cierta tendencia entre los productores de perfumes a apartarse de los tipos de perfume relativamente simples, a base principalmente del aceite del junco oloroso, populares en otros tiempos, y en los productos nuevos intermedios y definitivos existe particularmente mucho menos inclinación a utilizar el aceite del junco oloroso en la actualidad relativamente más costoso. Es principalmente en los productos más baratos en los que se ha venido usando tradicionalmente el aceite de junco oloroso, y es aquí donde resultan más intensas las presiones del costo, resultando pocas veces la precisión de la fragancia ser tan importante como para que signifiquen mucho los ligeros cambios en la formulación.

5 Si bien la disminución en el consumo del aceite del junco oloroso ha sido muy recientemente allanada en parte, los productores existentes son capaces de momento de satisfacer la demanda mundial. No obstante, cierto número de compradores están poco dispuestos a confiar demasiado en el suministro de esencia del junco oloroso y de aceite *Litsea cubeba* debido a la incertidumbre de las plantas de producción chinas, existiendo asimismo un elemento de incertidumbre en torno a los suministros procedentes de la India y Guatemala. Por consiguiente, si bien los compradores no están de momento ansiosos de ver la base de la producción mundial ampliada, no resulta aún imposible que pudieran surgir con el tiempo oportunidades aumentadas para productores existentes de pequeña envergadura o bien par nuevos productores, siempre que la calidad del nuevo aceite fuese lo suficientemente elevada.

6 **El aceite de citronela** se ofrece disponible en dos versiones: a saber el tipo de Ceilán, el cual es producido únicamente en Sri Lanka y representa una muy pequeña proporción de la producción y exportación mundiales, y el tipo de Java, el cual representa la mayor parte de la producción mundial y es producido principalmente

en Indonesia, China, Taiwan y Guatemala. Vietnam y Brasil son prominentes entre los países productores de menor cuantía, los cuales se hallan principalmente en Centroamérica, Sudamérica, Asia y Africa Meridional. Existen mercados interiores de importancia en China, Sri Lanka y posiblemente en Indonesia y Taiwan; otros países productores exportan la mayoría de su producto. El comercio internacional ha fluctuado considerablemente de año a año, pero parece registrarse una fuerte tendencia descendente, y el comercio total al final de la década fue probablemente poco más de unas 1.750 toneladas anuales. De este total, Indonesia y China contribuyen cada uno entre 40 y 45 por ciento, Taiwan y Guatemala cada uno un poco menos de un 3 por ciento, Sri Lanka en la región del 6 por ciento y Brasil en un 2 por ciento.

7 **El consumo anual** en todo el mundo a finales de la década de los años 1970 fue aproximadamente como sigue:

Estados Unidos	550 toneladas
Reino Unido	110 toneladas
Francia	140 toneladas
República Federal Alemana	100 toneladas
Países Bajos	150 toneladas
Suiza	50–100 toneladas
Japón	190 toneladas
México	130 toneladas
España, Italia y Bélgica	80–90 toneladas (total)
Europa Oriental (incluida la Unión Soviética)	80 toneladas
Otros países	150–160 toneladas (mínimo)

8 Tanto el tipo de Ceilán como (en menor grado) el tipo de Java se utilizan por derecho propio como aceites de perfumería en jabones económicos, detergentes y en una gama completa de productos utilitarios para el hogar y la industria para proyectar una fragancia fresca y en ciertos casos de manera específica para disimular el olor desagradable característico de ciertos ingredientes activos. En estas aplicaciones se ha registrado una disminución gradual en el nivel de utilización, pero no se ha manifestado hasta el mismo punto en el otro sector principal de utilización, es decir, como fuentes de aislados de perfumería tales como el geraniol, citronelal, citronelol y varios derivados de estos aislados principalmente el hidroxicitronelal. Estos aislados pueden obtenerse mucho más económicante (a través de α-pineno y β-pineno) de la trementina y las diferencias de calidad, las cuales influenciaban en grado sumo la elección de aislados naturales a pesar de su precio comparativamente más elevado, se han reducido gradualmente en los últimos tiempos hasta el punto en que el precio constituye cada vez con más frecuencia el criterio de la elección.

Solamente en el caso del sumamente importante derivado de perfumería hidroxi-citronelal extralimitan las cualidades del producto extraído de la citronela las consideraciones del precio con cualquier frecuencia, pero en este aspecto el aceite citronelal ha de hacer frente a una competencia muy grave por parte de otro aceite esencial natural llamado aceite de *Eucalyptus citriodora*, al cual resulta a menudo ser el más barato de los productos.

9 Es poco probable que el precio de la trementina y sus derivados suba repentinamente en términos reales en el futuro y el aceite de citronela es probable que continúe teniendo un precio sumamente desventajoso. Por consiguiente es posible que su consumo continúe disminuyendo, aunque menos acusadamente de lo que lo ha hecho en años recientes debido a la mayor cantidad de aceite que se usa ahora por derecho propio. Su producción se está haciendo cada vez menos atrayente en términos económicos, en vista del aumento de los gastos de producción y de la poca disposición del consumidor a comprarlo por encima de cierto nivel de precio. Los bajos precios registrados a mediados de la década de los años 1970 hicieron que se produjeran escaseces intermitentes del producto, particularmente en lo que refiere al aceite indonesio, pero es muy probable que los productores existentes sean capaces de mantener un equilibrio entre el suministro y la demanda a lo largo del tiempo, e incluso en el caso de producirse más escaseces es muy poco probable que cualquier

posible nuevo productor pudiera hallar atrayente la entrada en este mercado en disminución.

10 **Los aceites procedentes del eucalipto** se ofrecen en tres formas bien distintas: primeramente los aceites abundantes en cineol, los cuales pueden producirse a partir de varias especies y son los más utilizados, teniendo numerosísimas aplicaciones en los compuestos farmacéuticos y de perfumería. En segundo lugar, aceites abundantes en citronelal, los cuales son producidos exclusivamente a partir de la especie *E. citriodora* y se usan por derecho propio en compuestos de perfumes económicos y, en particular, como fuente del importante aislado de perfumería citronelal y a partir de éste del hidroxicitronelal. Por último, aceites abundantes en feladreno y, de manera menos abundante, en piperitone, los cuales son usados casi de manera exclusiva en la extracción de aquellos aislados utilizados en perfumería y aromatización. La producción de los aceites abundantes en cineol está dominada por China, si bien los mejores aceites han sido tradicionalmente producidos por Portugal, España y Australia. Son también países productores República Sudáfrica, Swaziland y Brasil, aunque los aceites sudafricanos no se han puesto todavía a la altura de los demás en lo que refiere a su calidad. China y Brasil dominan la exportación del aceite de *E. citriodora*, mientras que Australia y República Sudáfrica dominan la exportación los aceites abundantes en feladreno.

11 El total de las exportaciones mundiales de todos los tipos de aceites de eucalipto asciende a unas 1.500—1.650 toneladas anuales, calculándose que el aceite de *E. citriodora* y a los aceites abundantes en feladreno les corresponde más de 100 y 20—30 toneladas anuales respectivamente. Casi dos tercios de la exportación mundial de aceites abundantes en cineol se atribuyen a China, y aproximadamente la mitad del resto le corresponden a Portugal y a España, y la otra mitad a República Sudáfrica, Brasil y Australia en este orden. La exportación del aceite de *E. citriodora* y de los aceites abundantes en feladreno está distribuida casi equitativamente entre los respectivos países productores.

12 **El consumo anual** de los aceites de eucalipto en todo el mundo se calcula registrado aproximadamente como sigue a finales de la década de los años 1970:

	Aceites abundantes en cineol	*Aceita de* E. citriodora	*Aceites abundantes en feladreno*
Estados Unidos	230—250 toneladas	20—40 toneladas	10—20 toneladas
Reino Unido	95—105 toneladas	40—50 toneladas	5 toneladas
Francia	550—560 toneladas	20—30 toneladas	> 5 toneladas
República Federal Allemana	210—220 toneladas	< 10 toneladas	Insignificante
Países Bajos	50 toneladas	< 5 toneladas	Insignificante
Suiza	20—25 toneladas	5—10 toneladas	Insignificante

Demás países (principalmente aceites abundantes en cineol): 200—350 toneladas.

13 El aceite de eucalipto resulta generalmente barato; además, los precios han permanecido relativamente uniformes en comparación con los de numerosos otros aceites esenciales, especialmente a partir de la prosperidad repentina obtenida con los artículos de consumo en 1974. No obstante, en el caso del aceite de *E. citriodora* y de los aceites abundantes en feladreno, la existencia de rutas baratas para la obtención de citronelal, hidroxicitronelal, feladreno y piperitone ha mermado la importancia de los aceites naturales a pesar de su bajo precio. Hasta hace poco tiempo, las propiedades especiales del hidroxicitronelal eran suficientes para garantizar al producto un lugar en el mercado a pesar de su precio, pero las mejoras progresivas realizadas en las características de la alternativa sintética han resultado en una nueva situación en la cual el precio constituye un criterio mucho más dominante en lo que refiere a la elección. Por consiguiente se espera que disminuya gradualmente la demanda de aceite de *E. citriodora* hasta un nivel equivalente aproximadamente al de su utilización por derecho propio como aceite de perfumería, una zona de aplicación en la cual es poco probable que su consumo disminuya tan rápidamente pero que tampoco se espera que aumente. La disminución prevista en el consumo de

aceites abundantes en feladreno puede resultar incluso más acusada, al haber proporcionalmente una menor cantidad de aplicaciones para estos aceites por derecho propio.

14 Los aceites abundantes en cineol gozan de unas perspectivas mucho más favorables que las de los otros dos tipos de aceites, ya que de momento no existen rutas alternativas viables para la obtención del cineol y hay poco incentivo para el desarrollo de una nueva ruta. La subida general de costos puede causar una disminución de la producción en zonas de costos elevados tales como en la Península Ibérica y en Australia, particularmente debido a que el aceite chino resulta ser ya un producto más barato y que la industria china parece ser menos susceptible al mismo grado de aumento del costo, y que es probable a largo plazo que se afiancen en el mercado nuevos productores con acceso a especies apropiadas de eucaliptos. La demanda de tipos de productos que incorporan aceites de eucalipto abundantes en cineol tiene tendencia al alza y, hasta donde se puede ver, no existe motivo para esperar una baja, si bien ha de subrayarse que las perspectivas para los nuevos productores son mejores a largo de lo que son a corto plazo.

Section 1

Lemongrass oil

1.1 DESCRIPTION, USES AND PRINCIPAL SOURCES

Lemongrass oil has long been one of the world's best known essential oils and for many years ranked among the most important in terms of the quantities used. It is a yellow or amber liquid obtained by steam-distillation of certain grasses of the *Cymbopogon* family, namely *Cymbopogon flexuosus* Stapf, which is indigenous to South Asia, and *Cymbopogon citratus* Stapf, which is cultivated mainly in Central and South America although it is also known in parts of Africa, South-East Asia and the Indian Ocean islands. The oils obtained from these two species have traditionally been known as 'East Indian' lemongrass oil and 'West Indian' lemongrass oil respectively but, although there are undoubtedly noticeable differences between the two oils, the distinction is in practice nowadays far less important in the trade than it was twenty or even ten years ago.

Lemongrass oil possesses a strong odour with a basically lemon-like character although it also exhibits herbaceous, verbena-like notes, not possessed, for example, by lemon oil. The lemony character is due to its high content of the aldehyde **citral**, which should in general account for at least 75% of the oil's total constitution. Lemongrass oil can either be used *per se* as a complete oil in its own right, or as a route to the isolation of citral. As well as having numerous uses in its own right, citral can be further processed to isolate a group of chemicals known as the **ionones** (β-ionone, methyl-ionone, etc.), which possess a violet-like fragrance and are important components in many branches of perfumery. A further processing stage makes possible the manufacture of **vitamins**, notably vitamin A, although vitamin E has also been produced via this route.

In spite of all these possible applications, the tendency nowadays is for lemongrass oil to be used mainly *per se*, that is to say unprocessed, in cheap fragrance work. Its many applications include aerosol deodorants, floor polishes, household detergents and a whole range of domestic and industrial products in which a pleasant, fresh fragrance is desired, whether in its own right or as a mask for the unpleasant odours of certain active ingredients. There are one or two flavouring applications but these are of insignificant importance in comparison with fragrance work. Certain animal feedstuffs, bakery products and confectionery products incorporate lemongrass oil, but the quantities are extremely small and it is very much the exception rather than the rule to use lemongrass oil as a flavouring agent, especially as in most cases lemon oil will produce a better effect at little extra cost.

Although terpeneless essential oils are important in some areas of perfumery and flavouring, the deterpenation of lemongrass oil is very rarely, if ever, undertaken.

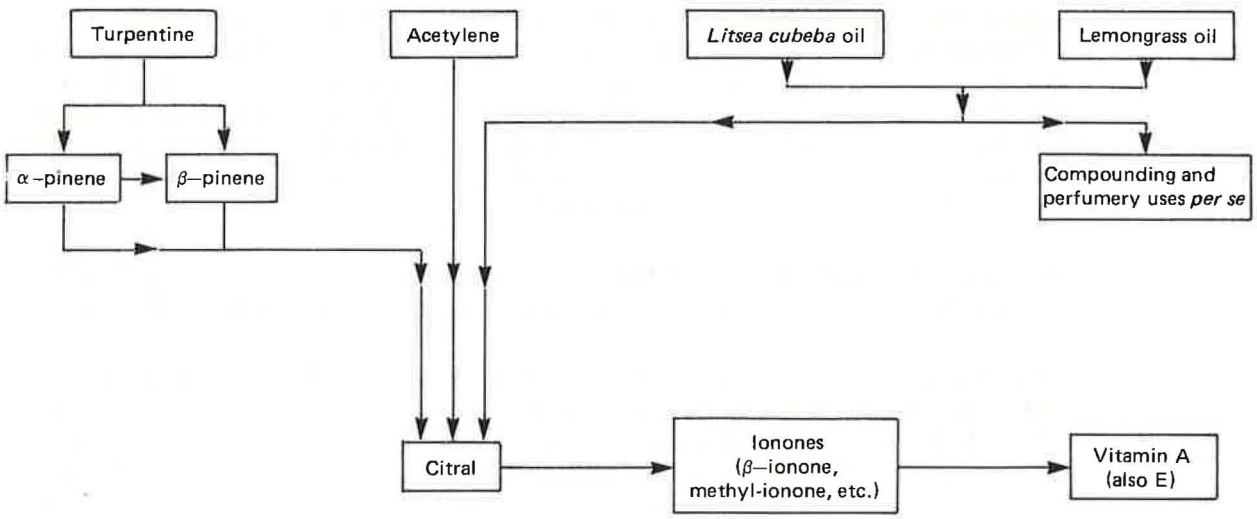
There has for some years been a general tendency for perfumers to move away from the relatively simple types of perfume which used to embody relatively large quantities of cheap oils such as lemongrass oil and citronella oil, and as a result there has been a very definite decline in the use of lemongrass oil in the applications described in the previous paragraphs. However, although there is certainly still a role for lemon-

grass oil as a source of citral, and thence of ionones and vitamins, one or two users still preferring it for these ends, especially citral, it is nonetheless in this area that the oil's decline over the years in Western markets has been most marked, owing to the availability of cheaper alternative sources, both natural and synthetic, of these intermediate and end-products. In the field of natural products, there has for a number of years been very strong competition for lemongrass oil from *Litsea cubeba* oil, a citral-rich oil produced in China from the seed of a fruit. This oil, which is generally cheaper than lemongrass oil, is now traded in much larger quantities and is widely used, although the question of its continued availability in the future is subject to the usual slight degree of uncertainty surrounding Chinese plans for essential oils production generally. The oil can be, and sometimes is, used *per se* in fragrances, although generally in rather higher-quality and higher-value products than is lemongrass oil, and it is occasionally used to 'stretch' lemongrass oil. Mostly, however, it is used as a source of citral, which in turn is sometimes used as a source of the **ionones** and **vitamins**. Many processors maintain that citral ex-*Litsea cubeba* oil is the best available in terms of odour, although it can contain traces of citronellal, which is occasionally undesirable. However, it is clear that the largest proportion of world production of citral, ionones and the relevant vitamins is derived from synthetic sources such as turpentine (via its components β-pinene and, more recently, α-pinene) and petroleum-derived hydrocarbons, mainly acetylene. Isoprene was another source of the same derivatives, but the firm which developed the process eventually closed down the operation on account of its unfavourable economics. Many of the users consulted, although not all, expressed the opinion that synthetically-derived ionones and vitamins are technically the best available, whereas synthetic citral is often said to be rather less good than natural citral, although even here the gap is said to be narrowing fast. All the synthetic derivatives are highly competitive in terms of price and show every sign of remaining so, in spite of the upward movements in the price of petroleum feedstocks.

In spite of some variation in trade opinion, both within and between the countries visited, it is clear that, as a result of steady improvements in the techniques of extraction and isolation, the physico-chemical properties and odour and flavour characteristics of the derivatives of lemongrass oil, *Litsea cubeba* oil, turpentine and the hydrocarbons differ from one another to a far smaller degree than was once the case, and choice of feedstock nowadays depends primarily on economic considerations and therefore on price. It is primarily for this reason that the consumption of lemongrass oil has declined so sharply over the years. Nowadays it is for the most part only used for the extraction of the derivatives where special technical or organoleptic considerations, rather than economics, dictate.

Figure 1 outlines the pattern of uses and processing described in the previous paragraphs.

Figure 1
The broad pattern of usage of lemongrass oil and its competitors



There is some evidence that the overall decline in the use of lemongrass oil, including its uses *per se*, may have begun to level off somewhat and that consumption may be beginning to stabilise at a new, lower, level. An estimate of the volume of world consumption of lemongrass oil cannot be made on account of a lack of knowledge of the extent of utilisation of the oil in India, both *per se* and for manufacture of citral and other derivatives (although it is clear there have been considerable developments in the Indian industry over the past few years). However, it is clear that the volume of lemongrass oil traded internationally has declined considerably over the years, from approaching 1,500 tonnes in the late 1960s to under 500 tonnes at the beginning of the 1980s. Of total world trade, Guatemala accounts for around 50%, India for around 35—40% and China for most of the balance. Among the residual suppliers, Sri Lanka appears to predominate, but intermittent quantities of considerably varying magnitude have been exported from South America, especially from Brazil and Argentina, and occasionally from Indonesia. Insufficient information was available for determination beyond doubt of whether certain countries are in fact producers or merely re-exporters of the oil. However, it is certainly the case that one or two other countries produce lemongrass oil for domestic consumption and this is further discussed in the next section, in which production and exports are analysed.

1.2 PRODUCTION AND EXPORTS

1.2.1 India

At one time India was the dominant supplier of lemongrass oil to the markets covered in this report, but nowadays it is second to Guatemala, for two reasons. Firstly, there is a growing internal market in India for lemongrass oil *per se* and for its derivatives, which can now be produced locally. Secondly, during the past fifteen years there has been a steady development of trade with the Soviet Union by means of barter agreements, as a result of which the Soviet Union has become the main outlet for Indian lemongrass oil and for at least some of the derivatives, as Appendix A, Table 1, shows. Between 1974/75 and 1979/80, 75% of Indian exports of unprocessed lemongrass oil were destined for the Soviet Union, although until 1979 there was a steady and sharp decline, both of total Indian exports and of the Soviet Union's imports. Whether this decline was due to a fall in local production or to an increase in the extent of local processing is not entirely clear, but it was probably the latter, and the Soviet Union is known to have purchased lemongrass derivatives from India in recent years. However, in 1979/80 there was a sharp recovery, as the table shows. Indian production of lemongrass oil is currently somewhere in the region of 500—1,000 tonnes per annum.

The main outlets for Indian lemongrass oil after the Soviet Union are the USA and the United Kingdom.

As already noted, Indian oil has traditionally been known as 'East Indian' or 'Cochin' lemongrass oil, the latter term indicating the location of the main producing area. It has from time to time been marketed in two grades, respectively containing 75% and 80% of citral. However, the oil has occasionally earned the reputation for rather lower citral content than that of oils from sources such as, for example, Guatemala, but this may be due to the effect on the oil of periodic withholding of supplies by Indian exporters in order to drive the price up. Under the conditions of prolonged storage as occur under such circumstances, the citral has sometimes tended to degrade and its overall yield to fall as a result. In general, however, notwithstanding occasional substandard consignments exhibiting, as well as lower than average citral content, a slightly 'burnt' odour, the quality of Indian lemongrass oil has been reported as improving over the years. There have been occasional reports of periodic shortages of Indian oil, which some users prefer to lemongrass oils from other sources, but such shortages are likely to have been due to the impact of large orders from the Soviet Union rather than to any sudden falls in production in India.

1.2.2 Guatemala

Guatemala is nowadays the major supplier of lemongrass oil to the markets studied in this report. However, whereas Indian production has been buoyed up by local demand for lemongrass oil and its derivatives and by large-scale Soviet purchases, Guatemala has a relatively insignificant internal market and no special trading arrangements, and as a result there has been a steady fall in local production in line with the decline in overseas demand. Although statistical information is nowadays scarcer than it once was, it is clear that the current level of production is of the order of 250 tonnes per annum, whereas in the late 1960s it stood at around 600 tonnes. Moreover, the future of production in Guatemala is uncertain, since there has been reported to be a steady trend in local agricultural policies in favour of the production of foodstuffs at the expense of export crops, as a result of which the Guatemalan essential oils industry in general may be in slow decline.

Guatemala is traditionally the main source of the so-called 'West Indian' type of lemongrass oil. However, although it does differ in some respects from the 'East Indian' oil (*see* introduction to Section 1.1) and tends to possess a higher citral content, it must be reiterated that users nowadays set far less store by these differences than they used to. Moreover, some of the Guatemalan producers have in recent years been using East Indian plant material, which has served further to blur the old distinction. Guatemalan lemongrass oil has traditionally been available in a range of citral contents from 75% to 95% although, as with 'East Indian' type oil, 75–80% is the most common range. The relatively high citral yields are mainly achieved through careful processing control rather than as a result of any special attributes of the *Cymbopogon citratus* grass, and indeed it has been said that one of the reasons for introducing the East Indian plant is to render high citral yields less exacting to achieve. Certainly Guatemalan oil has had a consistent reputation for good, even quality over the years, which has ensured its continued popularity, although one or two users regard the tendency of the oil to contain relatively high proportions of methyl-heptanone as a disadvantage in certain circumstances.

The USA is by far the most important buyer of Guatemalan lemongrass oil, followed at some distance by the United Kingdom and France, in that order.

1.2.3 China

The importance of China as a supplier of lemongrass oil has increased steadily over the years, but unfortunately no statistical information on levels of either production or exports is available, apart from the import statistics of the consuming countries, which are sometimes sufficiently broken down to show the quantities coming from China. Similarly, no information is available on the type of plant material used. The comparatively little information which is available suggests that in recent years Chinese exports have been of the order of 60–80 tonnes per annum, with little discernible trend, although local production is likely to be considerably more than this on account of the existence of a substantial local market for the oil. The citral content is typically 80%. The most important buyer of Chinese oil is the USA, with Japan in second place.

As already noted, China is the world's sole supplier of *Litsea cubeba* oil, which has proved such a successful rival for lemongrass oil, particularly for the extraction of derivatives. Production of this oil is an exceptionally labour-intensive operation in that a large labour force is required to collect the fruit which contains the oil-bearing seed, and although there is an abundance of labour in China, it is widely recognised that a relatively small shift in local agricultural and industrial policies might have a disproportionately large effect on production of *Litsea cubeba* oil, and thence on the market for lemongrass oil. As the volume of exports of *Litsea cubeba* oil appears to be at least comparable with total world exports of lemongrass oil (although exact figures are not available), it is not surprising that there should be occasional trade speculation about the oil's long-term future, although in early 1982 there was no sign of any impending cut-back in production. It should also be noted that the Chinese essential oils trade in general is the subject of much uncertainty, since there

appears to be very considerable potential for large-scale production of certain oils but no indication of longer-term local production and trading policy in relation to these products.

The citral content of Chinese *Litsea cubeba* oil is typically 75%.

1.2.4 Sri Lanka

Exports of lemongrass oil from Sri Lanka never appear to have been large, although the level of production may be rather higher as there is likely to be some local consumption of the oil. Annual exports during the latter half of the 1970s averaged 4 tonnes per annum, the main destinations being the USA and the United Kingdom.

While the evidence very strongly suggests that most Sri Lankan lemongrass oil is of the 'East Indian' or 'Cochin' type, one dealer indicated that the 'West Indian' type is also produced there and that care might be needed in ordering the oil if the difference between the two oils was likely to matter. However, the probability remains that the bulk of Sri Lankan exports is closely comparable with India's product. No plans for any substantial increase in production were known to exist at the beginning of the 1980s, but Sri Lankan oil has a steady, if small, following.

1.2.5 Brazil

There is a well-established and expanding perfumery industry in Brazil which appears to be supporting local production of lemongrass oil which may run to several tens of tonnes annually. Brazil, however, is not a significant exporter, average annual exports during the late 1970s being a mere 2 tonnes. Local production is, indeed, buttressed by the rigorous local restrictions on imports of many goods, including perfumery materials. The fact remains, however, that Brazil could rapidly become a substantial exporter of lemongrass oil if international circumstances were favourable to such a move.

1.2.6 Argentina

Argentine lemongrass oil is destined almost exclusively for local consumption, although the oil is not unknown in international trade. It is very possible that there is a local operation for the extraction of citral from locally-produced lemongrass oil but no definite confirmation has been forthcoming. Although Argentina could make some impact on international trade if it wished, it is unlikely that this will in fact happen in the foreseeable future.

1.2.7 Other sources

Production in, and exports from, **Haiti** have been reliably reported, but very intermittently and only on a very small, possibly no more than an experimental, scale. **Indonesia** and **Thailand** are known to have produced, and in the case of the former, exported, the oil but again the impact on world trade has been insignificant. Production in parts of mainland **Africa** and in some of the **Indian Ocean** islands has also been known, but in recent years there have been no indications of any commercial operations. Lemongrass oil has also on isolated occasions appeared in the export statistics of Mexico, El Salvador, Colombia, Paraguay, Taiwan and Iraq but it is virtually certain that the consignments were re-exports. Finally, as is common in the essential oils trade, there have been periodic re-exports from European Community (EC) countries, Switzerland and the USA, but no production whatever takes place in these regions, even in France.

1.3 MARKETS AND PROSPECTS

In the following paragraphs the trends in consumption in the main markets are analysed. Reference to national usage patterns will only be made if they depart appreciably from the general pattern described in Section 1.1.

1.3.1 The USA

Appendix A, Table 2 gives details of imports of lemongrass oil into the USA over the period 1970–80. From the totals it will be clear that, in spite of substantial short-term fluctuations, there has been a general decrease in imports, average annual imports for the 5-year period 1976–80 being over 30% lower than for the previous 5-year period. Imports during the 1960s, moreover, were very much higher than during either of these more recent periods. Annual US imports currently average around 140 tonnes and are still in decline, although to a lesser extent than in earlier years. Although there is a clear preference in the USA for Guatemalan lemongrass oil, mainly for reasons of quality and price, there has been a perceptible decline in Guatemala's market share mainly in favour of supplies from China, although India's share has also increased, in spite of periodic shortages and high prices. This change in the balance of supply perhaps reflects in part periodic trade doubts regarding the long-term future of Guatemala as a supplier, but also owes something to the general improvement in political and trading relations with China. Even so, many US users have a high opinion of the basic characteristics of the Indian oil and would have used more if the quality had been more consistent.

There is unlikely to be any resurgence of lemongrass oil consumption in the USA in the foreseeable future. While flavouring regulations may guarantee natural citral some outlets for some time to come, the special characteristics attributed to it from a perfumery standpoint are likely to decrease in importance as synthetics improve and in any case there is the added competition from citral ex-*Litsea cubeba* oil. Many US users, indeed, already regard citrals from the various sources as fully interchangeable, and for them price is the only criterion for choice. Future demand for lemongrass oil in the USA will therefore continue to depend predominantly on its use *per se* in inexpensive domestic and industrial products. Unfortunately, the increasing sophistication of cheap perfumes, and the constant pressure to reduce their cost, is likely not to work to the advantage of lemongrass oil, the US market for which may therefore continue to decline.

1.3.2 The United Kingdom

A breakdown of lemongrass oil imports into the United Kingdom for the years 1971–76 is given in Appendix A, Table 3. Unfortunately, lemongrass oil is not listed separately in the United Kingdom trade statistics from 1977 onwards, and in consequence recent movements in the pattern of trade could not be detailed. However, average annual consumption of lemongrass oil in the United Kingdom is estimated to be in the region of 60–70 tonnes, allowing for a fairly small amount of re-export trade by the main dealers, and is in slight decline. As in the USA, consumption nowadays is far lower than it was during the 1960s. In all but one year, namely 1973, supplies from Guatemala exceeded those from India. United Kingdom traders confirmed that the Guatemalan oil continues to be dominant but it was noteworthy that one or two buyers felt that the Indian oil was intrinsically the better, even though the superior Guatemalan processing methods tended to give higher citral contents, and a cleaner, more consistent product generally. Chinese oil is still very unimportant in the United Kingdom market although its quality is much liked. Sri Lankan oil is imported, but only in very small quantities, and no increase in imports is expected. Other sources are of little consequence, South American sources being known but generally of little significance in the United Kingdom.

The popularity of *Litsea cubeba* oil in the United Kingdom will be observed by reference to Appendix A, Table 4, which shows that substantially more of it is imported than of lemongrass oil, mostly for extraction of natural citral, for which it is the preferred source. Even allowing for an appreciable level of re-exports, annual consumption is of the order of 100–200 tonnes. In comparison with its natural and synthetic competitors, lemongrass oil is now of relatively minor importance in the United Kingdom and even in its applications *per se*, that is unprocessed, it suffers competition from *Litsea cubeba*, which is generally appreciably cheaper. One company, moreover, has produced a 'synthetic lemongrass oil' from synthetic citral and a number of other cheaply-synthesised compounds and, given that the requirements

for low-cost perfumery generally are not critical, such a product is likely to be used if the price compares favourably with that of the natural product. Overall, therefore, the prospects for lemongrass oil consumption in the United Kingdom are discouraging, and will certainly continue to be so as long as cheap *Litsea cubeba* oil and competitively-priced synthetics are available.

1.3.3 France

Imports of lemongrass oil into France from 1971 to 1980 are shown in Appendix A, Table 5. Total imports for the period 1976–80 were nearly 30% less than those for the immediately preceding 5-year period, although there have been substantial fluctuations, to which the recession of the mid-1970s was a major contributor. Annual consumption of lemongrass oil in France is typically 35–40 tonnes nowadays, although with some year-to-year variations. Guatemala is the main supplier, followed at some distance by India and China, and the balance of supplies is obtained mainly from dealers in other Western importing countries.

Although natural citral is preferred to synthetic citral in France (although not regardless of price), *Litsea cubeba* oil is the source used for all but 20% of local requirements. Most of the ionones and Vitamins A and E used in France are of synthetic origin. Where lemongrass oil is used, mostly *per se* in cheap products, the Guatemalan oil seems to be generally preferred.

The prospects for a revival of large-scale lemongrass oil consumption in France seem distinctly remote. Even if *Litsea cubeba* oil were to become scarce it would be more likely to lead to wholesale adoption of synthetics, unless there were to be a dramatic, and altogether unlikely, change in the relative price levels of lemongrass oil and the synthetics. The outlook appears to be one of continuing slow decline.

1.3.4 The Federal Republic of Germany

The Federal German published statistics for essential oils do not include separate figures for lemongrass oil and in consequence trade estimates have had to be relied upon for an assessment of the local consumption levels. However, the various estimates all suggest that Federal German annual consumption of lemongrass oil is likely to be in the range 10–12 tonnes, making it a comparatively minor user by Western standards, especially on a *per capita* basis. At the beginning of the 1970s consumption was ten times this level. Now it is at best stable or maybe in slight decline.

There is a tendency in the Federal Republic of Germany (West Germany) for users to prefer the Indian oil to the Guatemalan oil on account of the latter's methylheptanone content, which can be undesirable in certain applications. This may well be allied to the fact that a rather higher proportion of national consumption is for the extraction of citral than is the case in the majority of other Western importing countries, some users considering that citral ex-lemongrass oil has desirable characteristics that even citral ex-*Litsea cubeba* oil cannot match, especially for flavour work. The West German flavouring industry is at least as constrained by regulations restricting the use of synthetic products as that in other countries, and natural citral is sometimes used as the basis of cheap lemon-type flavours. However, the fact remains that usage of *Litsea cubeba* oil nonetheless exceeds that of lemongrass oil, which is used as elsewhere *per se* in a whole range of cheap perfume compounds as well as for the manufacture of citral for use in both perfumery and flavouring. Although there is comparatively little interest in lemongrass oil, there seems to be a general feeling that, at the present level of consumption, it is a difficult oil to replace either in its own right or as a source of citral in those applications where it is preferred.

The outlook, therefore, is one of continued consumption at around present levels but with little prospect of any market penetration by new suppliers.

1.3.5 The Netherlands

No published statistics are available for imports of lemongrass oil into the Netherlands and trade opinion suggested that local consumption is now extremely small, in spite of the fact that one or two major international processing companies have large-scale operations there. Local consumption may well be under 10 tonnes per annum. No special preferences were voiced for any particular source of supply and it has been concluded that in the kind of cheap products for which lemongrass oil is required in the Netherlands, mostly *per se*, choice of source is far from critical. Chinese *Litsea cubeba* oil is used in the Netherlands in much larger quantities than is lemongrass oil, and it is used both in its own right and as a source of citral and the ionones. Both natural and synthetic citrals are in demand, but the main criterion of choice is price, in spite of a slight preference for the character of the natural product. In this respect lemongrass oil is regarded as totally uncompetitive.

Even allowing for the relatively small size of the Netherlands as a market, there was scarcely any interest at all in lemongrass oil there, and in its remaining roles its prospects are slowly but steadily declining.

1.3.6 Switzerland

The Swiss market for essential oils is dominated by two internationally-orientated processing houses and one or two medium-sized dealers. The effective market for perfumery and flavouring materials among Swiss consumers is very small, on account of the small size of the population. However, substantial quantities of essential oils enter Switzerland for processing by the major compounding houses, even though most find their way back into international trade in the form of prepared perfume compounds.

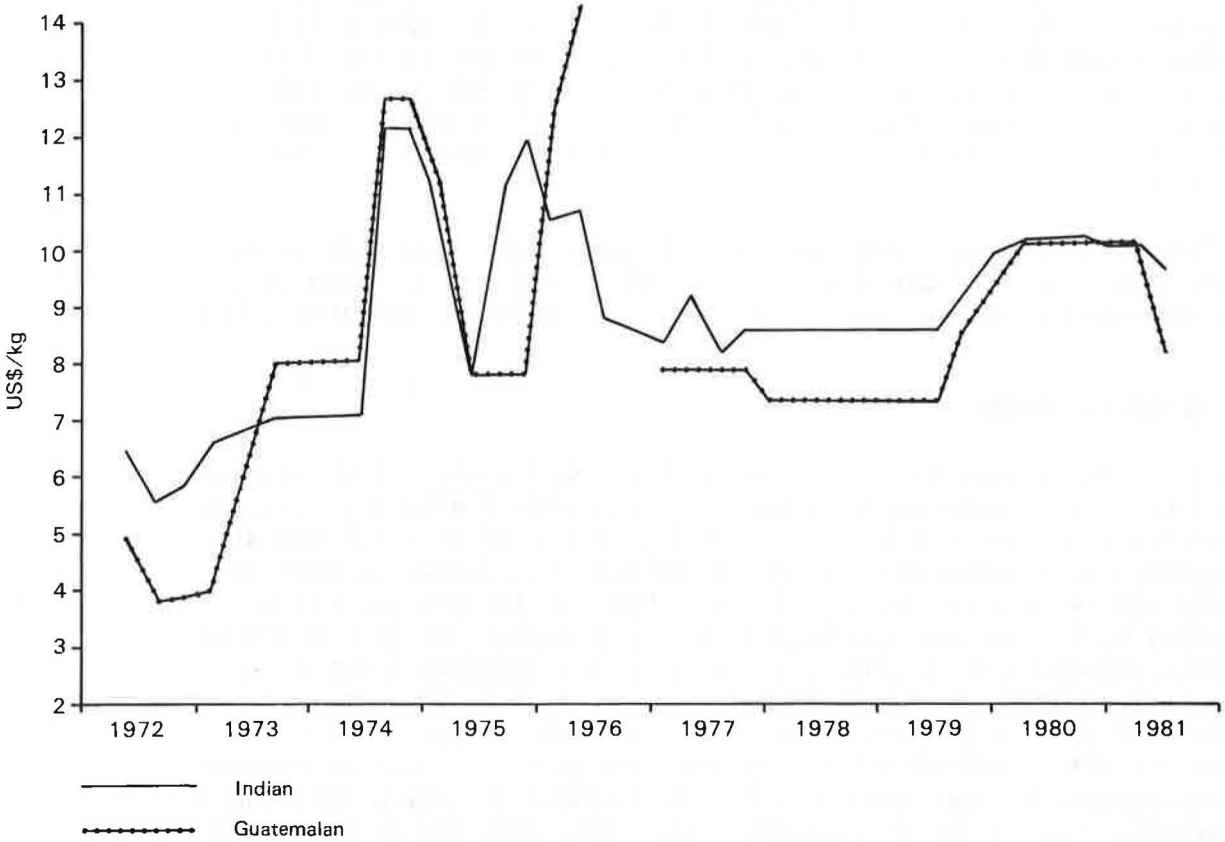
Nevertheless, lemongrass oil is a very minor product in the eyes of Swiss perfumers and of essential oil buying departments. Statistics are unavailable, but imports are unlikely to exceed 10 tonnes per annum. The Indian oil is preferred for its intrinsic character, but it tends to be more expensive than the Guatemalan oil, which is certainly not disliked. As in other countries, however, *Litsea cubeba* oil is used in greater quantities, primarily for citral extraction. Around one-half of Swiss consumption of lemongrass oil is for the extraction of citral, especially the Guatemalan oil, the remainder being used *per se*. As in other countries, the natural citrals are used where their special characters are required, this being mainly in flavour work, but there was general agreement among users that, in terms of quality, citrals from all sources, including turpentine and acetylene, are steadily converging.

Consumption of lemongrass oil in Switzerland, as in other countries, is nowadays far more restricted than it once was, but at its present low level it appears to be stable, although usage may slowly decline further as new products are introduced, in line with the general pattern observed with so many other essential oils.

1.3.7 Other markets

Imports of lemongrass oil into **Japan** are given in Appendix A, Table 6, and averaged 35 tonnes per annum during the years 1976–80. The Guatemalan oil has traditionally been preferred in Japan, but Chinese oil is now being imported in larger quantities. Little is known about the uses of lemongrass oil in Japan, but the long-term consumption pattern appears to be fairly stable in spite of short-term fluctuations in import levels. It will already have been appreciated that the **Soviet Union** is a major user of lemongrass oil and has a long-standing agreement with India for the supply of this oil. Annual trade between the two countries has varied greatly from year to year and was until recently on a strongly downward trend, but it averaged 145 tonnes during the mid-to-late 1970s. The sharp decline in trade between 1975/76 and 1978/79 may have been due to increased shipments from India to the Soviet Union of products derived from lemongrass oil or its constituents, that is to say citral, ionones or Vitamin A, but the trend was reversed in 1979/80. A full picture of the situation could not be obtained, but it is clear that there is a large market in the Soviet Union for these derivatives, and it is believed that most Soviet

Figure 2
Lemongrass oil: quarterly average prices, New York, 1972–81



Source: *Chemical Marketing Reporter*

Note: Prices of Guatemalan oil were not quoted during the period Q3 to Q4 1976

imports of unprocessed lemongrass oil are processed into the derivatives rather than used *per se.*

From Appendix A, Table 1 it will be seen that an annual average of around 10 tonnes of Indian lemongrass oil goes to countries other than those already discussed, and that **Australia** and **Hungary** are prominent among these. Very little is known about the quantities of Guatemalan and Chinese oils destined for other countries, but a realistic estimate for the balance of international trade in lemongrass oil, excluding re-exports, but including the above figure for India, would be 20–40 tonnes. Most of this is likely to be destined for Eastern European and Middle Eastern destinations. South-East Asia and South America tend to be predominantly self-sufficient in lemongrass oil although a little intra-regional trade may take place.

1.4 PRICES AND TARIFFS

Information on movements in the price of lemongrass oil over a period of 10 years is given in Appendix A, Table 7 for both Guatemalan and Indian oil. The same information is presented in graphical form in Figure 2. It will at once be evident that there have been considerable fluctuations, a fact which in part explains the decline in the oil's fortunes. It will also be seen that Indian oil has more often been the more expensive oil, a fact which has helped to maintain the dominance of the Guatemalan oil, although the differential has varied considerably. The fairly sharp price rise during late 1979 and early 1980 mainly reflected shortages rather than any burst in demand, and the current level of US $10 per kilogram is certainly not conducive to an upturn in the level of utilisation.

Price series for *Litsea cubeba* oil are not available, but in early 1980 this oil was priced at between US $7 and US $7.30 per kilogram, that is to say 25–30% below that of either lemongrass oil. A differential of this order in favour of *Litsea cubeba* oil is fairly typical, with the general movements in the price of the oil tending inevitably to follow that of lemongrass oil, although it is also to some extent influenced by the price of synthetic citral. Like the prices of many Chinese essential oils, however, the price of *Litsea cubeba* oil tends to be a little sluggish in its reaction to movements in the price of the lemongrass oils, which has sometimes resulted, during falls in the market, in its price temporarily being higher than that of lemongrass oil.

Tariffs are rarely encountered nowadays in the lemongrass oil trade, imports into the USA and EC being duty-free. Imports into Switzerland of products originating in developing countries are also duty-free if accompanied by a certificate of origin.

1.5 CONCLUSION

Lemongrass oil is one of the easier essential oils to distil, but for distillation to yield a sufficiently attractive return for the grower, the minimum selling price for the oil needs to be at a level which, at any rate for the foreseeable future, will mean that synthetic citral sources such as turpentine and acetylene will have a competitive edge over natural citral. Moreover, for most of the time the price is above this critical level. Notwithstanding the continuing preference of some users for natural citral, particularly in flavouring, and of other users for the blending together of citrals from various sources, the convergence in quality of the various citrals is such as to ensure that to an increasing extent the choice will be made on economic grounds alone except where flavouring regulations apply. However, even legislative constraints of this type are increasingly unlikely to work in favour of lemongrass oil as long as *Litsea cubeba* oil is available at an attractive price. Moreover, while the prices of petroleum-based feedstocks such as acetylene could move in step with the price of petroleum oil, the evidence suggests they have not fully done so in the past and in fact they have remained remarkably stable. More and more, therefore, the future for lemongrass oil is likely to rest on its uses as an oil in its own right, and, although it is a convenient raw material to employ, there is likely to be a distinct tendency for perfumers to use progressively smaller proportions of it in the typical low-cost formulations which are the main area of usage, unless there is a greater degree of price stability and a more consistently competitive price level generally.

The overall prospect, therefore, is for a continuing slow decline in demand. At present, the combined production of Guatemala, India and China can meet this demand, but the outlook is less than certain; Indian supplies to Western markets have been very erratic on account of the unpredictable nature of Soviet purchases. Doubts continue to be expressed about the longer term future of Guatemalan production, and Chinese plans for both lemongrass oil and its natural competitor, *Litsea cubeba,* oil are unknown. In any case, many buyers prefer not to depend too much on Chinese supplies. In conclusion, therefore, although demand is in decline and supply currently broadly in step, it is not inconceivable that there might eventually be improved, if limited, prospects for lemongrass oils from the existing minor sources or even from new sources, particularly if the oil is of a high citral content.

Section 2

Citronella oil

2.1 DESCRIPTION, USES AND PRINCIPAL SOURCES

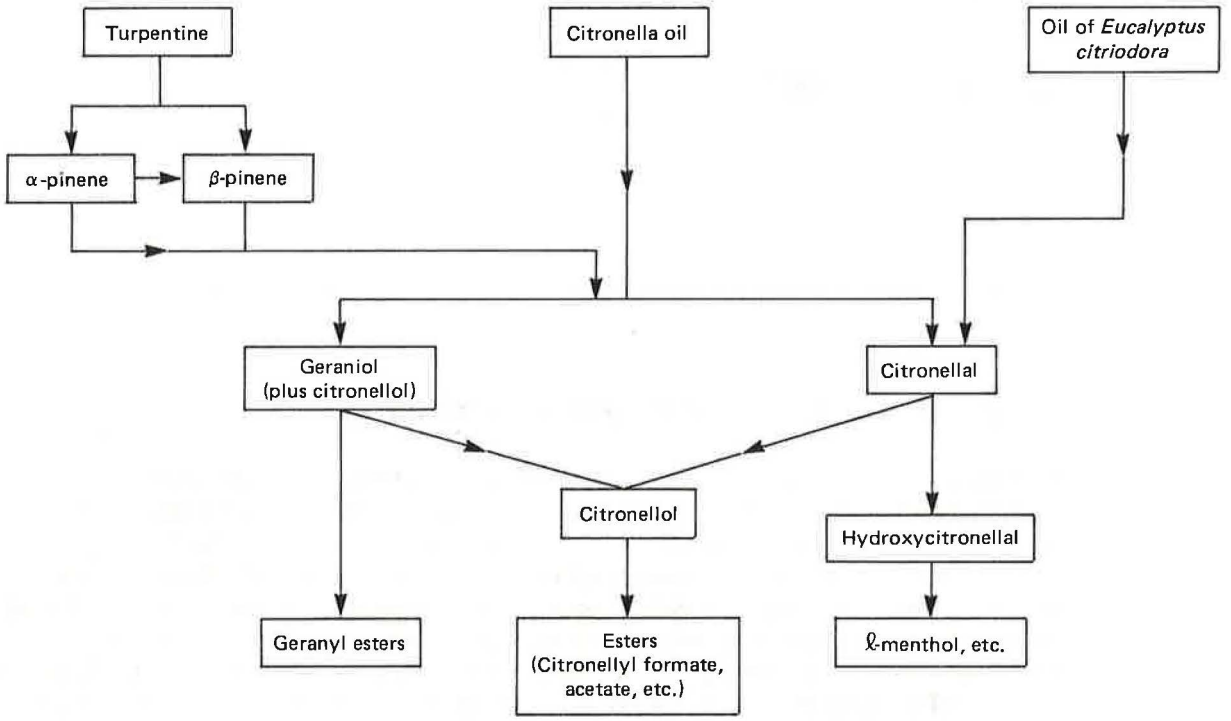
Citronella oil ranks alongside lemongrass oil as one of the most widely-used of all natural essential oils, world consumption having amounted to several thousand tonnes annually until the beginning of the recent sharp decline in the oil's importance. It owes its traditional popularity to its combined virtues of cheapness and pleasant, fresh fragrance, the latter being eminently suitable for use in a whole range of everyday household and industrial products. The citronella plant was probably first exploited in Sri Lanka but it is nowadays widely cultivated throughout Asia and in parts of Central and South America. There are two basic types of citronella oil, closely-related but with distinctive chemical characteristics. The more important is known as Java-type citronella oil; it is produced from the grass *Cymbopogon winterianus* Jowitt and is the type produced in virtually all of the producing countries. The other is known as Ceylon-type citronella oil and in this case is distilled from the grass *Cymbopogon nardus* Rendle. This raw material was the original source of the first known citronella oils but nowadays distillation of it takes place almost exclusively in Sri Lanka.

Both types of citronella oil are used in their own right in perfumery applications, but the Java-type oil has for a long time also been an important source of a number of isolates, many of which have important applications in the perfumery field. Of the various constituents of a typical Java-type citronella oil, 85% are liable to acetylation and are expressed as the predominant alcohol **geraniol,** and within this percentage 35% are carbonyl compounds expressed as the aldehyde **citronellal;** in fact, Java-type oils are frequently specified as '85/35' oils in reference to their geraniol and citronellal contents. The balance of 15% is mainly attributable to a group of chemicals known as terpenes, which in the case of citronella oil are of relatively little value in their own right.

Geraniol and citronellal are both important isolates, the former to some extent in its own right, the latter more as a source of derivatives such as **citronellol** and **hydroxycitronellal** which are important in their own right. From hydroxycitronellal it is also possible to manufacture ℓ-**menthol** although this is rarely done nowadays for economic reasons, while from both geraniol and citronellol it is possible to isolate other important derivatives. The relationships between these isolates is shown in Figure 3.

The applications of these isolates will be briefly outlined, but first it will be appropriate to describe the main uses of citronella oil as an essential oil in its own right. As already implied, the Ceylon-type oil is mainly used *per se,* but the Java-type oil is also quite widely used in this manner. The range of products in which citronella oil is used is very large, and includes cheap household and toilet soaps, many types of detergent, various household and industrial polishes, cleaning compounds, aerosols, bath preparations and so on, while its fresh fragrance is incorporated into many otherwise unpleasant-smelling products in order to mask the undesirable odours of certain active ingredients. Its usage in the food industry is virtually nil, and although it is employed in one or two animal-feed compounds as a very minor flavouring agent,

Figure 3
The derivatives of citronella oil and its competitors



citronella oil is very rarely used in the flavour industry taken as a whole. Turning now to the isolates, citronellal has comparatively few uses in its own right but it is nonetheless used from time to time to impart a fresh lemon-like odour to soaps and detergents, and it possesses the virtue of chemical stability in these applications. As already indicated, however, its main importance is as a source of hydroxycitronellal which is of great importance in its own right, possessing a fragrance reminiscent of lily-of-the-valley and enhancing the character and fullness of a whole range, possibly the majority, of perfume compounds which are used in soaps, cosmetic products, bath preparations and very many other applications. Geraniol and its derivative citronellol (the latter can also be manufactured from citronellal) both possess fragrances reminiscent of rose and are in fact often known as rose alcohols; they are both of considerable importance in an extensive range of perfumery products. Derivatives of citronellol include **esters** such as the **formate** and **acetate,** the former having application in floral compositions of the rose and lily-of-the-valley type, the latter when a more fruity character is required. Other products from geraniol and citronellol include **nerol, laevo-citronellol** and several others, each of which have special uses in different branches of perfumery. As already indicated, ℓ-menthol, which can be made from hydroxycitronellal, is nowadays almost exclusively obtained from other sources on account of changes in the relative prices of the raw materials and in the relative cost of extraction. The uses of citronella oil terpenes are very few, but from time to time they are incorporated into low grade products or artificial essential oils. In this respect it is also worth observing that, for use as an essential oil in its own right, it is not usual to deterpenate citronella oil, there being very few terpeneless citronella oils on the market.

In comparison with the Java-type oil, Ceylon-type citronella oil contains much lower proportions of geraniol and citronellal, and it is for this reason that it is seldom used for extraction, although the practice is not unknown. The geraniol content typically varies between 50% and 60% according to the grade of the oil, while the citronellal content is typically in the region of 15%.

There has in recent years been a steady move away from the relatively simple type of perfume compound based predominantly on cheap oils such as citronella oil, and

although certain types of product, for example large-block household soaps manufactured in Spain and Italy, still depend to a large degree on this type of fragrance, there has been a slow decline in the use of citronella oil as a perfumery oil in its own right. However, the main decline in the world-wide usage of citronella oil has unquestionably been in the extraction of the isolates described previously. Severe competition has steadily arisen over the past fifteen years, mainly from turpentine, which contains large quantities of the **pinene** chemicals which can very readily be used for the production of all the isolates discussed in the previous two paragraphs. Beta-pinene was for a long time the most convenient source but most turpentine contains greater quantities of α-pinene which, because of its chemical structure, has hitherto tended to present more problems as a starting material. In recent years, however, it has proved possible to convert α-pinene to β-pinene, albeit by a rather costly and inefficient process, and more recently still direct chemical routes have been found from α-pinene to the isolates, thus obviating the need for β-pinene at any stage. The synthetic isolates thus produced have in the main been cheap in relation to their counterparts produced from citronella oil and, moreover, their prices have generally been comparatively much more stable. Additional competition for citronella oil has come from another natural essential oil, namely oil of *Eucalyptus citriodora.* This citronellal-rich oil is commonly used as a source of hydroxycitronellal, primarily as in recent years it has quite often been a cheaper source than citronella oil, but also because, in the opinion of some perfumers, the odour characteristics of the hydroxycitronellal from this source are preferable. Further reference will be made to oil of *Eucalyptus citriodora* in this section but for a fuller description of this oil reference should be made to Section 3.

Perhaps the only reason why citronella oil (and, for that matter, oil of *Eucalyptus citriodora*) is used at all nowadays for the isolation of the various derivatives is that there is still a fairly widespread preference on the part of perfumers for the olfactory and even technical properties of some derivatives of natural origin *vis-à-vis* their synthetic competitors. This is particularly true of hydroxycitronellal derived from the natural oils, which is still strongly preferred in higher-class perfumery. Opinions as to the comparative merits and demerits of the natural and synthetic versions of the other isolates were found to vary greatly according to the company concerned, and it was sometimes possible to detect consistent differences in taste according to the country under review. However, there was also a general consensus that the quality of the synthetics is steadily improving and that the differences between the corresponding isolates of each source are decreasing rapidly. Indeed, many firms already regard the various sources as fully interchangeable, at any rate for a majority of the various isolates, and price is accordingly the only criterion of choice. If the decline in world-wide consumption of citronella oil is to be arrested, therefore, there will have to be a favourable long-term movement in its price in relation to that of turpentine which, it should be noted, is produced from renewable natural resources and is less susceptible to the inherent long-term scarcity of a non-renewable source such as petroleum oil, although it is certainly not immune to periodic short-term scarcity. The cost of turpentine production undoubtedly is tending to increase roughly in line with the general increase in world prices, but another of turpentine's advantages is that it is in part a by-product, to the extent that it can be produced during the 'kraft' sulphate process of paper pulp manufacture. This route to turpentine may decrease in importance somewhat in the future as the efficiency of the 'kraft' process increases and the scope for off-take of by-products correspondingly decreases, but in general the pressures on the price of turpentine are unlikely to be excessive in relative terms. Returning to citronella oil, however, it is increasingly evident that the increase in production costs at source, which is in line with cost movements generally, is exerting an upward pressure on the oil's price, whereas the threat from turpentine implies the need for a long-term decrease. The advantage would appear to rest clearly with turpentine at the present time and this is likely to continue to be the case for the foreseeable future.

The fortunes of citronella oil have not been improved in recent times by increases in its price brought about by periodic scarcities. These shortages were a result mainly of the collapse in world prices generally that occurred in 1975 following the 1974 boom. Many plantation owners, with large stocks of the oil on their hands, moved

out of citronella and were reluctant to replant even when prices recovered. Citronella oil is a convenient source of income in that the grass can be harvested, and the oil distilled, in a matter of only a few months after planting, but even before the violent price fluctuations in 1974 and 1975 the profit margin was becoming unattractively small and citronella oil production was tending in general to fall into disfavour. Citronella oil, like so many natural products, was subject to substantial price fluctuations during the period 1977–82 and the average price level has only just been adequate from the point of view of the producers, yet well above the level at which the oil would be competitive with turpentine.

An accurate estimate of current annual world production of citronella oil is precluded by lack of any certain knowledge as to the total levels of production in certain countries, particularly in China, which is a major producer, but also in Brazil, Argentina and one or two other areas. The three countries named are exporters, but also produce substantial quantities for their internal markets. However, international trade in citronella oil has been estimated from statistical information relating to Indonesia, Sri Lanka, China, Taiwan, Guatemala and Brazil to have averaged between 2,000 and 2,500 tonnes per annum in recent years, although on a clearly downward trend. Of this figure, Indonesia has typically accounted for between 40% and 50%; China for slightly less than Indonesia; Taiwan, Guatemala and Sri Lanka each for in the region of 5%; and Brazil for 2%. Other suppliers have included Vietnam, Thailand, India, Mexico, Honduras and the Republic of South Africa, and it is possible that production may have been attempted elsewhere, although no clear evidence has come to light. A brief discussion of each main producing area now follows.

2.2 PRODUCTION AND EXPORTS

2.2.1 Sri Lanka

Although Sri Lanka is a long way from being the world's foremost producer of citronella oil, it is discussed first since, apart from being historically the original source of citronella oil, it is for all intents and purposes the only source of the Ceylon-type oil. In fact, both types of citronella oil are produced in Sri Lanka, and although only a small proportion of local production is attributable to the Java-type oil, one or two buyers indicated that care is sometimes needed when ordering if the desired type is to be obtained. There have, however, been rumours that the Java-type citronella does not grow well in Sri Lanka.

Appendix A, Table 8 gives details of Sri Lanka's exports in recent years, and it will be seen that during the period 1977–80 they averaged around 120 tonnes annually. The total level of local production is probably higher than this, for Sri Lanka regularly consumes a proportion of its local production of essential oils. The United Kingdom and the USA are the dominant buyers, followed at some distance by France. Other EC countries and Switzerland together take appreciable quantities, and of the remaining importers New Zealand is a significant buyer. The overall level of exports has been comparatively stable, although 1976 saw an unexpected peak. This stability is in some respects a reflection of the fact that the Ceylon-type oil, with its low geraniol and citronellal contents and special odour characteristics, is generally used as an oil in its own right rather than as a source of chemical isolates, and it will be recalled that the decline in world demand for citronella oil has been least evident in those applications where the whole oil is required. Among the special applications mentioned for this oil were citronella candles, which are used as a mosquito repellent.

Ceylon-type citronella can be grown in poorer, drier soils than can Java-type citronella, which may be partially responsible for the fact that it tends to be cheaper. It is produced in three grades: 'Common' quality, containing a minimum of 50% geraniol; 'Ordinary' quality, for which the minimum geraniol content must be 52%; and

'Estate' quality, with a minimum specified geraniol content of 55%. The difference in price between adjacent grades is generally very small, typically of the order of 2.5%. There tends also to be a slight difference between the price charged by the largest exporter of citronella oil and that charged by the smaller exporters, but this does not seem to create any difficulties for the trade. Further information on prices can be found in Section 2.4.

Although production of citronella oil in Sri Lanka is nowadays at a much lower level than it once was, it appears currently to be stable and is likely to remain so, particularly as demand for it is declining only slowly, although periodic shortages in supplies of citronella oil from other sources may also help to maintain the level of demand for Sri Lanka's product.

2.2.2 Indonesia (Java)

As would be expected, Indonesia was the first supplier of commercial quantities of the Java-type citronella oil and it has to date been the world's most important supplier of citronella oil, although very recently it has been challenged by China for this position. Appendix A, Table 9 shows exports for the period 1974–80, and illustrates a downward trend which intensified after 1976 to an annual average of 20% per annum, exports falling well below 1,000 tonnes, the average for 1978–80 being around 730 tonnes. There are two reasons for this decline. Firstly, two major international processing houses now have operations in Indonesia for the processing of locally-produced essential oils, and whereas most of the citronella oil produced in Indonesia used to be exported unprocessed, nowadays a proportion is processed into geraniol and citronellal before export, as a result of which the level of exports of citronella oil as such has declined. Secondly, production of the oil has declined as a result mainly of a combination of the 1975 price slump and the accelerating impact of rising production costs following the petroleum oil price rises of 1973 and thereafter. A steady decline in the number of citronella distilleries locally in operation has been recorded, as a result of which there have been frequent oil shortages which in turn were largely responsible for the 1979 price peak. As yet this last-mentioned peak has not shown any sign of having any effect on production levels; indeed, although production recovered a little in 1980 to 900–1,000 tonnes, there were reports in early 1982 of a substantial further fall in 1981.

As Table 9 shows, the USA, Western Europe (particularly the Netherlands) and Japan are important buyers of Indonesian citronella oil, but a very noticeable feature of the trade in Indonesian oil is the prominence among importers of Taiwan. As will be discussed subsequently, Taiwan is a producer of citronella oil but it is also both a re-exporter and processor of Indonesian oil. Although a marked decline in this trade was recorded in 1980, this may have been only temporary. The exact proportions of Taiwanese imports that are respectively re-exported and processed are difficult to assess owing primarily to a lack of information on the level of Taiwan's domestic production, but it is clear that substantial quantities of Indonesian oil have been processed there into geraniol and citronellal for subsequent export. It is also reported that an increasing proportion of the USA's intake of Indonesian citronella oil has been received via Taiwan, although this is less likely to be true of Western European buyers on account of the proportionately greater impact of the extra shipping costs attributable to such trade. Singapore, in contrast, conducts only a very modest level of entrepôt trade in Indonesian oil.

Indonesian citronella oil is mainly sold on specification rather than by sample, that is to say on the '85/35' basis in respect of its percentage content of constituents expressed respectively as geraniol and citronellal. In the early 1980s there were reports of attempts to cultivate new strains of citronella grass yielding oils containing 90% and 40% respectively of constituents liable to acetylation expressed as geraniol, and carbonyl compounds expressed as citronellal, but by early 1982 no such '90/40' oils had appeared on the export market. It is likely that such oils would be welcomed by the trade, especially if they were also of a high standard of cleanliness and purity, for there have been reports of adulteration of Indonesian

citronella oils with materials such as kerosene, turpentine and even vegetable oils. Such practices may well reflect the very severe pressures on profit margins in the citronella industry, but the fact remains that, when they occur, they cause considerable concern to buyers for whom the cost of cleaning and rectification is constantly increasing.

2.2.3 China

Estimates of the volume of production of Chinese citronella oil vary widely but it is clear that it runs to thousands of tonnes, making China certainly a larger producer than Indonesia, although it used to be a clear second to Indonesia in terms of export levels. In contrast with Indonesia, there is a substantial internal market for citronella oil in China. Chinese citronella oil is of the Java-type and is sold on the usual '85/35' specification already referred to. It has an excellent reputation for cleanliness and good packaging, and is widely liked by dealers and perfumers. Published export statistics are not available but such evidence as is available, including the opinions of dealers, strongly suggests that during the mid-1970s annual exports averaged a little over 1,000 tonnes but thereafter declined somewhat, in line with the general decline in world demand for citronella oil. At the beginning of the 1980s export levels were reported as having been below 800 tonnes, which was nonetheless closely comparable with the Indonesian export levels at the time. It is not wholly clear whether Chinese pricing policies have been partially responsible for the decline in exports. At times of falling world prices, Chinese prices have tended to be slow to follow the downward movement evident elsewhere, which has caused periodic temporary loss of overseas interest in the oil. On the other hand there have been trade reports of periodic price undercutting by the Chinese suppliers, to the severe detriment of other supplying countries. However, part of the decline may also be attributable to the fact that China has recently started extracting geraniol and citronellal from citronella oil for the export market. These derivatives are of high quality but are said to be rather expensive in comparison with similar products from other sources, and there have also been reports that there have been frequent attempts by the Chinese to sell the residual citronella terpenes with the derivatives as part of an indivisible 'package'. As a result, Chinese citronella derivatives do not command the level of overseas interest that they otherwise might.

Overall, however, there is little prospect of China's importance as a supplier of citronella oil diminishing and it is likely to continue to play an important role in world trade for the foreseeable future.

2.2.4 Taiwan

Taiwan has already been mentioned in the section relating to Indonesia's production and exports as an important re-exporter and processor of Indonesian citronella oil. It is also a producer of citronella oil in its own right but trade opinions differ greatly as to the volume produced locally and no reliable published information appears to be available. However, it can be said that Taiwan's labour costs have been rising faster than those of most other producers in recent times, and the likelihood of local citronella oil production continuing to be economic is very small. The export figures shown in Appendix A, Table 10 include re-exports as well as domestic exports and show a substantial increase during the period 1976–79, and although it is far from clear whether this is part of a longer-term trend, particularly in view of the marked reversal in 1980, it is clear from Table 10 that increased trade with the USA has played a major part in the increase.

Information on current developments in Taiwan's citronella oil industry is scarce but the available evidence suggests that there nowadays takes place in Taiwan, as in China, a considerable volume of reprocessing of citronella oil into its derivatives, mainly geraniol and citronellal. A comparison of Taiwan's export statistics with the quantities shipped from Indonesia to Taiwan (*see* Table 9), whether direct or via Singapore, suggests that, at any rate until 1978, the greater part of Taiwanese imports of Indonesian oil has in fact been reprocessed rather than re-exported *per se*. Whether this will continue to be the case, bearing in mind the increase in US pur-

chases of unprocessed citronella oil from Taiwan, remains to be seen, although the 1979–80 figures suggest that the pattern may have started to change.

Both the unprocessed citronella oil and, in particular, the citronella derivatives exported from Taiwan have had a reputation for being expensive. This probably reflects the relatively high local wages and also the high shipping cost element attendant on Taiwan's comparative remoteness from the main markets, Japan apart. In the case of the unprocessed oil this is not invariably a handicap, since re-exported oil is often checked, and if necessary treated, before shipping, in consequence of which there is less likelihood of consignments of Indonesian oil being adulterated if they are purchased via Taiwan rather than direct from Jakarta. North American buyers seem to be appreciative of this fact although little interest was evident among Western European buyers in purchasing from Taiwan, regardless of quality considerations. In the case of the derivatives, however, the high Taiwanese prices appear to have had a uniformly depressing effect on overseas sales, and Western buyers indicated that there was no advantage in buying these products from Taiwan.

It is difficult to assess the likely future for Taiwanese supplies of citronella oil and its derivatives, but on balance the level of local costs is likely to preclude any increase in the importance of Taiwan as a producer.

2.2.5 Singapore

Before moving away from the Asian producers, it will be appropriate to consider briefly Singapore's role in the trade, even though little or no citronella oil is actually distilled in Singapore itself. Unfortunately the published statistics exhibit discrepancies which render an accurate analysis difficult. Information on recent imports, exports and re-exports are shown in Appendix A, Tables 13 and 14. However, the import figures appear for some reason to exclude trade with Indonesia which, as Table 9 clearly shows, is substantial. However, if the export and re-export figures given in Table 13 are subtracted from the combined total of those imports shown in Table 14 and those implied by Table 9, it is concluded that during the period 1974–80 the excess of imports over exports averaged over 25 tonnes per annum and was on a broadly rising trend, although with substantial year-to-year fluctuations. This fairly appreciable level of retained imports is consistent both with a local market of modest size for the oil as such and also with the known existence of local processing facilities for the extraction of moderate quantities of citronellal and geraniol for subsequent export. Provided that the c.i.f. prices of the locally-produced derivatives are competitive with those produced elsewhere, for example in Western Europe, North America and Japan, there is every reason for the current level of retained imports to be maintained. On the other hand Singapore's formerly considerable role as an entrepôt in the citronella oil trade, is likely, on balance, to decline, in spite of some recovery of the export and re-export trade, as well as of imports, in 1980. Trade with Taiwan has fallen to nil, that with Peninsular Malaysia remains small, and in spite of some increase in trade with Western Europe and North America, the volume of trade is small in comparison with the overall level of trade in Asian citronella oils. Some Western buyers clearly appreciate the high quality standards set by Singapore's exporters and value their cleaning and filtering facilities, but even so a growing number of buyers recognise that it is cheaper to clean and filter the oil themselves rather than incur the costs and mark-up passed on by Singapore's exporters.

2.2.6 Guatemala

Guatemala's importance as a citronella oil exporter, as is the case with most other essential oils that have been produced there, has diminished since the 1960s, when annual exports averaged in excess of 500 tonnes. Annual exports in the mid-1970s averaged around 225 tonnes (*see* Appendix A, Table 11). Export figures for 1977 and thereafter were not available in early 1982 but it is thought that there may have been a substantial decrease. Java-type oil is produced in Guatemala, and although the quality of the oil is widely regarded as good, it has an olfactory character slightly different from that of the Asian Java-type oils, although the technical specifications

are similar. An increasing proportion of exports from this source have been destined for Mexico and, to a lesser extent, other Latin American countries and Spain, while exports to major Western importers such as the USA and the United Kingdom have declined. Little appears to be consumed domestically. Guatemala's importance as a producer may well continue to decline, particularly in view of an increasing local emphasis on food crop production, which is tending to have the effect of displacing traditional export crops.

2.2.7 Brazil

The volume of production of citronella oil in Brazil is unknown but there is a substantial internal market for the oil, which is to some extent a result of severe import restrictions. In some recent years appreciable quantities have been available for export, as Appendix A, Table 12 shows. In 1979 and 1980, however, there was a substantial reduction in exports, from over 60 tonnes per annum up until 1978, down to 16 tonnes in 1980. The reduction has taken place mainly in exports to Mexico, the most important market for Brazilian citronella oil.

2.2.8 Other sources

Vietnam was once a regular supplier of citronella oil to the world market but the military conflicts in South-East Asia have depressed production levels and the exact status of Vietnamese production is unclear, although small export consignments from this source are still recorded with fair regularity. **Thailand** was also a producer, but not for the international market and, although no firm evidence is available, it would appear that local production has dwindled to negligible levels and may have ceased altogether. Thai oil was used in locally-made soaps and mosquito coils, but it would appear that the growing demand for locally-made detergents, which apparently do not incorporate as much citronella oil, has seriously depressed demand for the oil. **India** has produced Java-type citronella oil in the past, but one firm reported that production has declined on account of the oil's mediocre quality and low geraniol content. Such production as still exists is almost certainly geared primarily to local rather than overseas demand. The **Republic of South Africa** has recently attempted to penetrate the market, but the quantities involved have been small and, although the oil produced is Java-type, the geraniol content is reported to have been too low. Among Latin American producers, **Argentina** is a widely-known producer and exporter of a Java-type oil and several firms reported having purchased small quantities of the oil from time to time, but as with other Argentinian essential oils, most of the locally-produced oil is consumed domestically and Argentina ranks behind Brazil as an exporter. **Honduras** has been known to produce citronella oil, but the current status of local production is unclear and no export consignments have been recorded in recent years. **Mexico** was certainly once a producer, but production levels are now negligible and Mexico is now a major importer of the oil, partly for production of various derivatives. **Hong Kong** is a trans-shipment point for citronella oil, but no production or processing is known to take place there. It is possible that other producers of citronella oil exist but none is likely to be of significance in world production or trade.

2.3 MARKETS AND PROSPECTS

The trends in consumption of citronella oil in each of the main markets will now be analysed. The pattern of usage, however, will only be discussed where there are significant deviations from the worldwide pattern discussed in Section 2.1.

2.3.1 The USA

The USA is the world's largest importer of citronella oil. Details of imports are given in Appendix A, Table 15. Although no published figures are available, it would appear that a small proportion of imports is re-exported. The table shows that there was a substantial decline in the level of annual imports during the 1970s, from around the 1,000 tonne mark to around 550 tonnes on average. Although one contributory reason for this decline is that a greater quantity of citronella oil derivatives,

as distinct from the oil itself, is imported than was previously the case, the main reason is quite simply that, as a source of the derivatives, citronella oil has for some time been consistently out-priced by turpentine-based synthetics and sometimes also, where production of hydroxycitronellal is concerned, by oil of *Eucalyptus citriodora.*

Comparatively speaking, imports of the Ceylon-type oil from Sri Lanka have held up fairly well, which is to be expected, since consumption of citronella oil as a perfumery oil *per se* has declined far less sharply than has been the case where isolate extraction is concerned. However, of the Java-type oils, there has been a sharp fall in imports from Indonesia although, as mentioned earlier, a rather higher proportion of Indonesian oil is now purchased via Taiwan. However, the overall level of imports from Taiwan has also declined, this decline having mainly affected citronella oil distilled within Taiwan's borders. The level of imports from China has been very variable, while the average level of imports from Guatemala has been in decline since the mid-1970s. Imports from other suppliers have varied greatly. At present China and Taiwan are the main suppliers of Java-type oil to the US market, followed by Indonesia, Guatemala and Argentina. Taiwan's popularity as a source, at any rate prior to 1980, was due mainly to quality considerations, Taiwanese prices generally being comparatively uncompetitive. Generally speaking, opinions tended to differ as to the extent to which Java-type oils from different sources vary in terms of their technical and olfactory characteristics, and the extent to which such variations are transmitted to the derivatives. Chinese oil is marginally favoured over Indonesian oil as it is less likely to be adulterated.

The basic uses for the derivatives of citronella oil and the comparable derivatives of turpentine, already described in the introductory section, apply in the USA. Some US users still prefer natural, rather than synthetic, geraniol and hydroxycitronellal, but for the latter, *Eucalyptus citriodora* oil is often the preferred source. Sri Lankan oil appears to be favoured for the manufacture of mosquito-repellent citronella candles.

The prospects for citronella oil on the US market are generally poor. Even its use *per se* in cheap products is likely to decline gradually under the influence of the severe pressures on the profit margins of perfume compounders. There is also an increasing tendency for some US users of citronella derivatives to import them rather than to manufacture them themselves, mainly as a result of steady increases in local processing costs, although there have also been reports of environmental problems associated with the extraction processes. This trend is likely to be to some extent constrained by the comparatively high cost of Chinese and Taiwanese derivatives, but other sources may develop. To conclude, no US user of citronella oil foresaw any difficulties with future supplies and there is no room for an additional supplier to the US market, although there may be very limited opportunities for producers of competitively-priced derivatives.

2.3.2 The United Kingdom

Annual consumption of citronella oil in the United Kingdom averaged around 110 tonnes during the period 1978–80. The long-term trend is downward. Appendix A, Tables 16 and 17 give details of the United Kingdom's trade in citronella oil, and show that about one-third of all United Kingdom imports are subsequently exported to other destinations, mainly elsewhere in Western and Eastern Europe, although not exclusively. The continued existence of prominent and respected dealers and brokers of international standing in the United Kingdom ensures the continuation of this export trade.

The United Kingdom purchases its supplies of citronella oil from many sources. The Sri Lankan oil continues to be imported in fair, although in the long term gradually declining, quantities for *per se* applications in low-cost products, while for the Java-type oils China and Indonesia predominate as suppliers, other significant, if irregular, suppliers having included Taiwan, Vietnam, Brazil and Guatemala. The services of entrepôts such as Singapore and Hong Kong are utilised comparatively infrequently, while purchases are made from US and continental European dealers if either rapid

delivery or guaranteed high quality is essential. It is not clear whether the occasional supplies from India were of Indian oil or of re-exported oil originating elsewhere. There was a fairly widespread feeling in the United Kingdom that the quality of Indonesian oil has once again started to improve, whereas while the high quality of Taiwanese and Chinese citronella oils is generally acknowledged in the United Kingdom, these are quite widely regarded as inclined to be scarce and expensive. The Indonesian oil may therefore strengthen its position in the United Kingdom market.

All firms contacted in the United Kingdom agreed that the consumption of citronella oil is in steady decline, even in *per se* applications. As elsewhere, even where a preference for hydroxycitronellal derived from natural oils exists, it is generally the case that oil of *Eucalyptus citriodora,* rather than citronella oil, is the preferred natural source.

The general situation in the United Kingdom as far as citronella oil is concerned, therefore, is very similar to that currently applying in the USA, the prospects for the oil being far from encouraging. Although supply shortages have been experienced, it is unlikely that any new producer could obtain a permanent foothold in the United Kingdom market.

2.3.3 France

Statistics of French imports and exports of citronella oil are given in Appendix A, Tables 18 and 19. A substantial proportion of all essential oils entering France are subsequently re-exported, either unprocessed or after further processing, and citronella oil is no exception. As Appendix A, Table 19 shows, French re-exports of citronella oil are predominantly destined for other Western European countries, Eastern Europe (especially the Soviet Union and Bulgaria), the Near East and South America. Internal consumption of citronella oil averaged around 140 tonnes annually during the period 1978–80, but there have been substantial year-by-year fluctuations and the trend has been firmly downward. Indonesia and China dominate supplies of the Java-type oils although it will be seen from Appendix A, Table 18 that imports from China have declined more than those from Indonesia. Taiwan, Argentina and Vietnam have also been significant suppliers and there have been periodic purchases from elsewhere. In comparison with other importing countries the proportion of total imports attributable to Ceylon-type oil from Sri Lanka is small, and it would appear that, where citronella oil is used in its own right, a comparatively large proportion of Java-type oil is used.

French dealers and processors showed very little interest in citronella oil generally and its importance is declining both as an oil in its own right and as a source of derivatives, especially as price is fast overtaking quality as the dominant criterion. The outlook for citronella oil in France is even less encouraging than it is in the USA and the United Kingdom.

2.3.4 The Federal Republic of Germany

Annual consumption of citronella oil in the Federal Republic of Germany (West Germany) has declined since the mid-1970s and at the end of the decade stood at around 100 tonnes. There does not appear to be a major re-export trade. Import statistics for recent years are given in Appendix A, Table 20, from which it will be evident that a decline set in in 1978 and 1979. Whether this sudden fall was only short-term in nature has yet to become clear, but trade opinion in West Germany left no room for doubt that the long-term trend in consumption is decidedly downward.

In particular, the annual intake of citronella oil by two of West Germany's largest processing companies is now only a small fraction of what it was in the early 1970s. Unfortunately, statistics for imports from Sri Lanka have not been available in recent years, but it would appear that the Ceylon-type oil is well known and still quite widely used. The pattern of consumption of citronella oil is typical of the worldwide pattern, although a few firms also use citronella terpenes in low-quality

products, these being produced as part of the extraction processes. The natural derivatives still command a strong following in West Germany, but the underlying trend is clearly as elsewhere.

There is no prospect of any change in current trends and, as in other importing countries, the West German market for citronella oil offers no encouragement whatsoever to new suppliers.

2.3.5 The Netherlands

Although there is a little re-export trade from the Netherlands in citronella oil, the import statistics given in Appendix A, Table 21 can be taken as an approximate guide to local consumption levels, that is to say 140—150 tonnes per annum during the period 1978—80. As is to be expected, given the Netherlands' historic links with Indonesia, the latter country is the dominant source, followed by China. The remaining suppliers, among which are other EC countries, are individually of minor consequence. Buyers mentioned periodic problems of adulteration of Indonesian oil with turpentine, kerosene and vegetable oils, but its cheapness would appear to offset this disadvantage in the main.

The Netherlands perfumery industry is dominated by one or two very large international processing companies and a small number of dealers. All the individuals contacted agreed that consumption of citronella oil had steadily declined, primarily as a result of the cheapness of turpentine-based substitutes, and also of the fact that, where natural derivatives were still favoured, it was mainly *Eucalyptus citriodora* oil, rather than citronella oil, that benefitted.

In conclusion, the general trends in the Netherlands market are in line with trends elsewhere, and the prospects for the oil are poor, the likelihood being one of a slow continuing decline.

2.3.6 Switzerland

Import statistics for citronella oil are not available for Switzerland. As already mentioned in Section 1, consumption of essential oils in Switzerland is dominated mainly by two major international processing and compounding companies, most of whose products are sold in other countries, the internal Swiss consumer market being very small. Unfortunately, no accurate estimates were available, although it is likely that the quantities of citronella oil processed in Switzerland are of the order of 50—100 tonnes annually, and possibly more. Although minor differences between Java-type oils from different sources are recognised, purchases are made mainly on the basis of price, which tends to favour Indonesian oil. Even so, Chinese oil is also purchased where its special attributes are relevant.

Swiss consumption of citronella oil is almost certainly in decline as those consulted maintained that the qualitative differences between natural and synthetic isolates are diminishing to the point at which they are ceasing to matter. As there is comparatively little consumption in Switzerland of citronella oil as a perfumery material in its own right, which, as already pointed out, tends to be a more stable component of overall consumption, the overall decline is likely to be all the more marked.

2.3.7 Other markets

From Appendix A, Table 22 it will be seen that **Japan** is a major market for citronella oil, annual imports have averaged just over 190 tonnes during the period 1978—80. However, there is a clear downward trend, as in other countries. The Japanese perfumery industry is likely to absorb considerable quantities of the oil as a perfumery material in its own right, but there is also a large local extraction industry, producing large quantities of citronella isolates each year, some of which are exported. A continuing decline in imports and consumption seems inevitable, as there is no reason to believe that the synthetic isolates are any less competitively priced in Japan than they are elsewhere. **Mexico's** annual imports have been of the order of 130 tonnes per annum, but again declining. Although the existence of

local extraction facilities is likely to be a major reason for this considerable volume of imports, Mexico is the type of populous developing country where a cheap perfumery oil such as citronella oil can be expected to be popular in its own right. The decline in imports is likely to be mainly the result of a decline in demand for the natural derivatives. Of the Western European consuming countries not already mentioned, **Spain, Italy** and **Belgium** appear to import a total of around 80–90 tonnes per annum. In the case of Spain and Italy, the continuing popularity of citronella oil in its own right as a perfumery material in utility household soaps could cause any future decline in consumption to be less pronounced than in most of the countries that were visited during the survey. Consumption in **Eastern Europe,** including the Soviet Union, appears from the available statistics to be at least 80 tonnes per annum and possibly considerably more, although no details are available of the pattern of consumption there. Imports into **Australia** and the **Republic of South Africa** appear to be of the order of 15 tonnes and 6 tonnes respectively per annum, but the Republic of South Africa is also reported to have exported some citronella oil. **Singapore's** retained imports, as discussed in an earlier section, are of the order of 25–30 tonnes per annum.

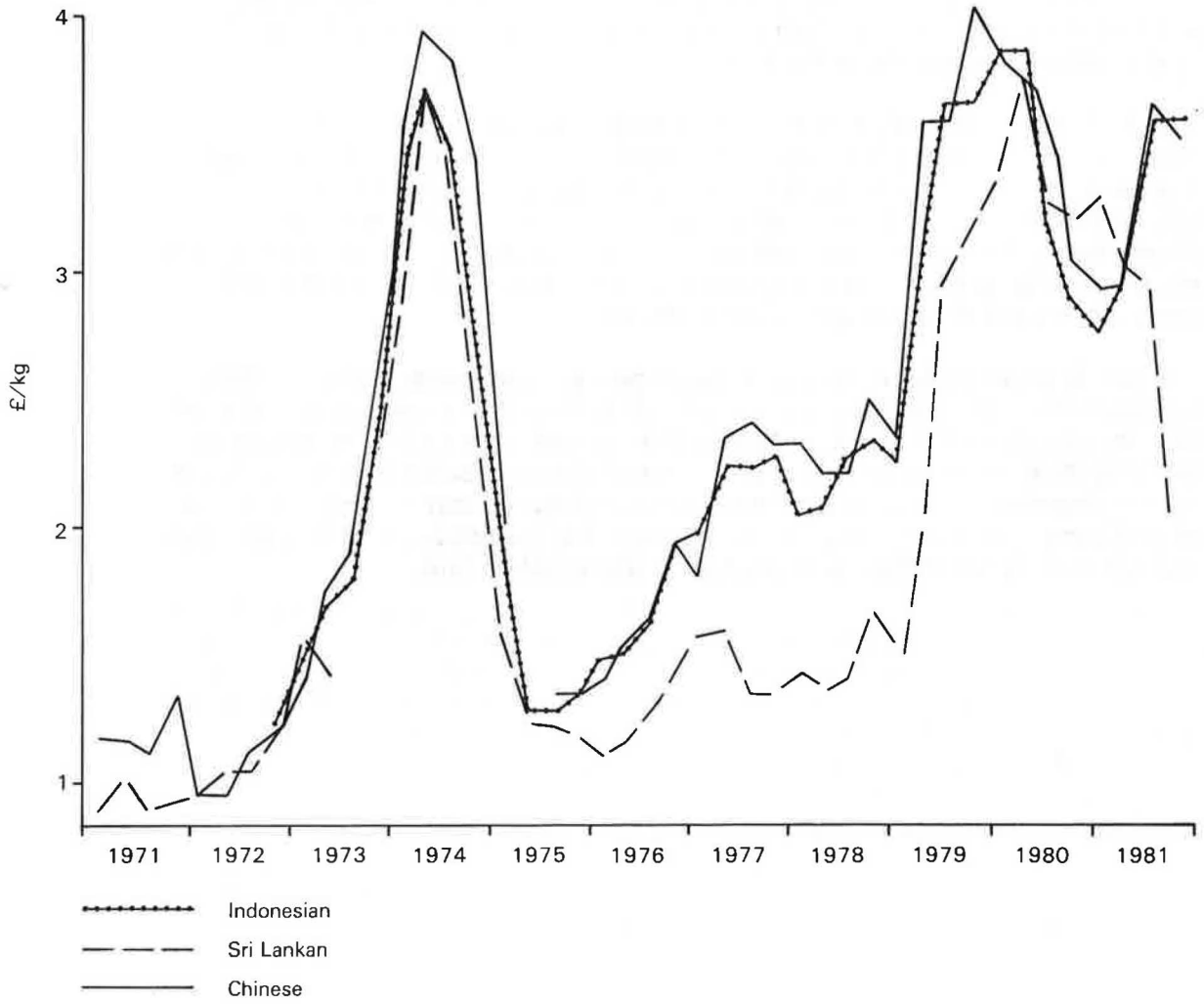
Markets for citronella oil in countries other than those already discussed are likely to be significant. Unfortunately, complete statistics are unavailable and, moreover, there could be an appreciable amount of unrecorded trade in some parts of the world. However, citronella oil has long enjoyed world-wide use as an inexpensive and convenient perfumery oil in a very wide range of cheap products and its use is certainly more widespread than for the majority of other essential oils. It is likely that the total usage of internationally-traded oil in other markets is in excess of 100 tonnes per annum and it could be considerably more. Moreover, it is in these markets, many of which are in the developing countries, that the prospects for citronella oil are least discouraging, primarily because the oil is mainly used as it is, rather than as a source of derived perfumery products.

2.4 PRICES AND TARIFFS

Details of price movements for citronella oil over the period 1971–81 can be found in Appendix A, Table 23, and are illustrated in Figure 4. This shows that the last decade has been dominated by two major price peaks. The first occurred in 1974 and was a direct result of the world-wide commodity boom that occurred in that year. Thereafter there was recession and an accompanying price slump which affected many commodities, including citronella oil, and although there was a gradual recovery, the ensuing period of relatively low prices caused a number of producers, especially in Indonesia, to cease production, as a result of which shortages began to occur intermittently. Market uncertainty and some consequential speculative buying at the start of 1979 drove prices up to 1974 levels again. Moreover, although prices subsequently fell back, the absence of any recovery in production caused another upturn in 1981. The general decline in usage can therefore be expected to continue. The price of the Ceylon-type oil from Sri Lanka has traditionally been rather lower than that of the Java-type oils, but has often moved in step with them as there are several areas in which the oils are interchangeable, particularly in inexpensive products. There have even been times when Sri Lankan oil has been the most expensive, as Figure 4 shows, but the traditional pattern has generally reasserted itself within a short period of time and, at the end of 1981, the Sri Lankan oil was markedly cheaper than the Java-type oils, mainly because of its relatively ready availability.

Price series for the derivatives and for oil of *Eucalyptus citriodora* are not available. The prices of many synthetic derivatives are more than 50% cheaper than those of the natural equivalents and differentials of 20–30% are extremely common. There have been periods when turpentine was in short supply and the prices of its derivatives rose to or above the levels ruling for their natural competitors, but such periods have been rare and brief. The price of oil of *Eucalyptus citriodora* on the London market in August 1981 was under £2.50 per kilogram (compared with the £3.60 per kilogram for the Java-type Indonesian oil), and this is not atypical.

Figure 4
Citronella oil: quarterly average prices, c.i.f. London, 1971–81



Source: *Public Ledger*

Virtually no obstacles to trade in citronella oil exist in the form of tariff barriers. The oil enters the USA and EC countries free of duty, and imports into Switzerland of products originating in developing countries are also duty-free if accompanied by a certificate of origin.

2.5 CONCLUSION

Citronella oil is a comparatively simple product to manufacture and the grass can be harvested for distillation within only a few months of planting. However, it has been suggested by more than one trade source that the minimum c.i.f. price at which an economic return can be expected to accrue to the producers of Java-type oil, even in a low-wage country like Indonesia, is nearer the maximum price level reached during the 1970s than the minimum level (*see* Figure 4), and there is no doubt that most users regard the current price levels as being on the high side. Moreover, the steady improvement in the quality of the synthetic isolates will ensure that price will increasingly be the main criterion of choice, even if the qualitative gap is never fully bridged. Some increase in the price of turpentine and its pinene-based derivatives can be expected, but the increase is unlikely to be sufficient to mitigate the pressure on the citronella oil market. The future for the oil must, inevitably, therefore increasingly rest on its usage as a perfumery oil in its own right, and even here there is a tendency for perfumers to move away from traditional simple compounds which

rely to a relatively large degree on cheap natural oils, and in any case the cost pressures on the perfumery industry are such that perfumers increasingly seek to employ the cheapest available materials, especially for products at the cheap end of the market. Citronella oil is no longer, in real, historic terms, a particularly cheap oil, and the sheer size of the price fluctuations that occurred during the 1970s was a source of profound anxiety to the trade.

It is, furthermore, unlikely that there is a very great future for trade in natural derivatives of citronella oil manufactured in producing countries. The conversion process is expensive on account of the cost of the capital equipment and even low wage levels do not completely offset this drawback. The recent price history of derivatives of Chinese and Taiwanese origin provide supporting evidence for this view, and comparatively few Western buyers give the impression of showing sustained interest in natural derivatives produced at source.

The overall prospects for citronella oil are therefore discouraging. Although there have been shortages, the existing producers still have more than adequate production capacity to cope with demand, and although long-term price levels may have to rise gradually in order to equate supply with demand, demand itself will be falling. In conclusion, therefore — and in spite of periodic trade doubts about the long-term plans of the Chinese producers — there is no real scope for new producers of citronella oil and this is likely to continue to apply for the foreseeable future.

Section 3

Eucalyptus oil

3.1 DESCRIPTION, USES AND PRINCIPAL SOURCES

There are several hundred species of eucalyptus, but only a few are of importance where production of the essential oil is concerned. The oil is distilled mainly from the leaves of the trees and occasionally the twigs. In commerce, the term 'eucalyptus oil' in reality denotes three quite distinct groups of essential oil: firstly, a group distinguished by their high content of **cineole**, which possesses a basically camphoraceous character; secondly, one or two oils in which the principal constituents possess a basically citrus-like character, for example **citronellal**; and thirdly, those comparatively rich in the chemicals **phellandrene** or **piperitone**, particularly the former. The first type of oil is often referred to as 'medicinal eucalyptus oil', on account of the medicinal properties of cineole, and included within this definition, somewhat confusingly, is an oil from China that is not distilled from eucalyptus at all, but from a species of **camphor**, and yet is still referred to as 'eucalyptus oil' in the trade. The second type is sometimes referred to as 'perfumery eucalyptus oil', although this term is inclined to be confusing as all three basic types of eucalyptus oil have applications in perfumery. The following list gives the main species of eucalyptus which are currently commercially distilled to give the three types of oil described:

Medicinal-type (Cineole-rich)	*Perfumery-type*	*Phellandrene-rich type*
Eucalyptus globulus	*E. citriodora*	*E. dives,* Type and var. 'A'
E. australiana	*E. macarthurii*	*E. australiana,* var. 'B'
E. smithii		
E. dives, var. 'C'		

It is quite possible that oils from other eucalyptus species have from time to time been produced and marketed, but the evidence is scanty. It should also be noted that the species listed are of widely-varying importance and that the market is dominated by oils produced from only a few of them, notably from *E. globulus* and *E. citriodora.* For convenience and clarity the subdivisions used in the analyses in this Section will be as follows: cineole-rich oils; oil of *E. citriodora;* other eucalyptus oils.

Cineole-rich oils. True oil of *E. globulus* is produced mainly in Spain and Portugal. Brazil is a minor producer, and there is evidence that the oil was produced at one time in Zaire. Its cineole content varies from 70% to 85%. There are two basic trade classifications, namely '70/75' and '80/85', these figures denoting the percentage range in which the cineole content should fall, although most buyers prefer the actual figure to be near the top of the range. Oils of the '80/85' type tend to have been subjected to rectification, it being comparatively difficult to produce an '80/85' oil at the first distillation. A natural eucalyptus oil very similar to oil of *E. globulus* is produced in very substantial quantities in China, but it is generally believed that the species used is other than *E. globulus.* In addition, as already mentioned, the Chinese also market the cineole-rich fraction of camphor oil as 'eucalyptus

oil', and indeed this product is very similar to true *E. globulus*-type oil, although differences exist. Of the other cineole-rich species, the exploitation of *E. smithii* takes place primarily, and on a substantial scale, in Southern African countries such as the Republic of South Africa and Swaziland, while exploitation of *E. australiana* and *E. dives* var. 'C' has traditionally taken place in Australia, but also occurs nowadays in the Southern African region. The cineole content of these oils tends to be lower than that of oil of *E. globulus* and is not usually greater than 70–75%. Although 75–80% cineole has been claimed for oil of *E. smithii,* there tends to be considerable variation and there have, in practice, been several reported instances of consignments of this oil containing considerably less than 70% cineole.

The cineole-rich oils are used in pharmaceutical products, household utility products and in perfumery and general flavouring applications. Among their pharmaceutical applications are various types of pastilles, lozenges and syrups for the treatment of coughs, colds and chest complaints, and also skin rubs and other products for the treatment of skin complaints. In fact, eucalyptus oil is still widely retailed *per se* in bottles by chemists and pharmacists, although only the very finest oils can be employed in this outlet. For use in pharmaceutical applications, eucalyptus oil must satisfy the requirements laid down in the various Pharmacopoeias, such as those published in the United Kingdom, the USA and West Germany (i.e. BP, USP, DAp).* The oil's medicinal properties also render it suitable for use in disinfectants and a range of household cleaning and sanitary products, to which it also imparts a pleasant fragrance which helps to mask the less pleasant odours of other active ingredients. In the perfumery field, it is used in certain soaps, eaux-de-Cologne, air fresheners and bath oils, while in certain scent products it helps to provide a useful burst of 'top-note' fragrance from the main constituents without drawing attention to itself. The extent of its usage in perfumery varies very considerably from firm to firm; some firms hardly rely on it at all, others use large quantities. In the flavouring field, the cineole-rich eucalyptus oils are used mainly in certain types of boiled sweet, quite often in conjunction with menthol and peppermint oil.

There is also an extensive degree of usage of pure cineole extracted from eucalyptus oil. As would be expected, cineole is more expensive than the basic oil and it is used mainly in higher-quality products. It has a smoother character than has the basic oil and this is sometimes needed when quality considerations are particularly critical. The range of applications is broadly similar to that applicable to the basic oil, although it is far less likely to be used in cheaper products such as household disinfectants.

Both the cineole-rich oils and natural cineole itself face very little challenge from synthetic substitutes, as they are generally competitively priced. There were no signs of this situation altering in early 1982.

Oil of *Eucalyptus citriodora.* This oil, as already mentioned, differs fundamentally from the cineole-rich oils in that its principal constituent is the lemon-like citronellal, which may account for between 65% and 85% of the oil's total constituents. It is produced mainly in Brazil and China, although it also used to be produced regularly in Zaire, very occasional consignments still emanating from there. The oils from each of these sources are for all practical purposes identical chemically and olfactively. Although the oil is mainly used as a source of citronellal and, in particular, indirectly of **hydroxycitronellal** through chemical processing of the citronellal, it is also still quite widely used in its own right, mostly in cheap soaps, perfumes and disinfectants where low ingredient cost is important. Citronellal as extracted from *E. citriodora* oil is used in mid-market washing and washing-up detergents and similar products, but most is further processed into hydroxycitronellal, which is used in a very wide range of perfumery products, at both the cheap and expensive ends of the market. Indeed hydroxycitronellal is one of the

* BP = British Pharmacopoeia
USP = United States Pharmacopoeia
DAp = Deutsches Apotheker buch

most widely used of all perfumery materials, but it can be produced from several sources, including citronella oil (q.v., Section 2) and turpentine. There is some disagreement among perfumers as to the relative technical and olfactory merits of the hydroxycitronellals from the three sources but there is still a tendency for hydroxycitronellal derived from natural essential oils to be preferred, some perfumers favouring citronella oil as a starting material, others *E. citriodora* oil. However, the differences between the derivatives of the two natural oils is not great and price is the most common determinant of choice, which in recent years has quite often favoured oil of *E. citriodora.* However, the quality and characteristics of hydroxycitronellal ex-turpentine are also improving rapidly, and it is likely that eventually price will be the sole determinant of choice, regardless of whether the starting material is a natural essential oil or turpentine, and on present indication this would bring about a decrease in usage of *E. citriodora* oil. In the case of citronellal, the synthetic is already dominant and the usage of *E. citriodora* oil as a source of citronellal, which already accounts for a very minor proportion of total consumption of the oil, is much more likely to decrease than increase.

The other 'perfumery eucalyptus oil', namely oil of *E. macarthurii,* which is rich in geranyl acetate, is at present very seldom used and detailed comment would be superfluous.

Other eucalyptus oils. The oils of *E. dives,* Type and var. 'A' and *E. australiana,* var. 'B', were originally exploited in Australia and still are to some extent, but there is now some production of this type of oil in Southern Africa. Of the two *E. dives* oils, it is the var. 'A' which is more commonly used nowadays, as the phellandrene content is much higher at 60–80%, whereas the 'Type' variety is less rich in phellandrene than in piperitone, which is much less commonly extracted from eucalyptus oil nowadays than it used to be. The phellandrene content of *E. australiana,* var. 'B' is 35–40%, cineole predominating among the other constituents. Phellandrene is used mainly in perfumery, often in cheap products, although it is also used in certain spice products and pickling applications, as well as in a very few other flavouring outlets. There are, however, other routes to phellandrene and also to piperitone, and the eucalyptus oils are becoming increasingly uneconomic as sources. Their usage for the production of these isolates, already unimportant, can be expected to decline further.

Oils distilled from other eucalyptus species are traded very rarely nowadays. Two members of the US essential oils trade reported having occasionally seen consignments of oil distilled in Brazil from *E. staigeriana,* which is comparatively rich in ℓ-limonene, citral, geraniol and geranyl acetate, but such an oil would have only very limited and specialised uses, and be vulnerable to competition from synthetics. It is therefore more likely to be used locally than to become a regularly traded item. With the exception of oil of *E. maideni* (*see* Section 3.2.1), no other eucalyptus oils were mentioned to the author by members of the trade during the course of the survey.

An assessment of world production of the oils of eucalyptus is very difficult because of lack of knowledge of levels either of local production or of consumption in the producing countries themselves. Moreover, some producing countries are also importers of eucalyptus oil and their imports are often not recorded separately. China and Brazil are without doubt major consumers of their domestically-produced oils and it is very likely that Spain, Portugal, Australia and the Republic of South Africa also consume a significant proportion of their own production. Total world exports are currently of the order of 1,500–1,650 tonnes per annum, mainly of the cineole-rich types, including the Chinese product derived from camphor. World trade in oil of *E. citriodora* accounts for only a small proportion of the total, and although an accurate estimate of the quantities traded is precluded by the fact that the oil is not separated from the cineole-rich oil in the trade statistics, annual world trade is unlikely to be much over 100 tonnes and could be less. Trade in the phellandrene-rich oils is unlikely to be more than 20–30 tonnes annually and, again, could be less than this. A brief discussion of the main producing countries follows.

3.2 PRODUCTION AND EXPORTS

3.2.1 The Iberian Peninsula

Portugal and Spain have traditionally been the main producers and suppliers of oil of *E. globulus.* Oil of *E. citriodora* is not produced in either country. Perfumers still tend to favour the Iberian oils for their quality, but their price has tended to rise in relation to oils from other sources, mainly on account of growing labour shortages as more attractive opportunities drain labour away from this type of industry. Spain's domestic production and overseas trade, however, has fallen considerably more than has Portugal's, primarily because Spanish oil has hitherto attracted import duty in its overseas markets more widely than has Portuguese oil. Tables 24 and 25 (Appendix A) show recent export figures for Portugal and Spain, the respective average for each country being around 400 tonnes and just under 200 tonnes. However, both countries are also importers. Import statistics are available for Spain and are shown in Appendix A, Table 26; the average for recent years has been under 150 tonnes, which implies that net production of eucalyptus oil within Spain for export has been around 50 tonnes annually. The level of imports into Portugal is not known with certainty and could be in excess of 100 tonnes, the net level of domestic production for export therefore being 300 tonnes per annum or less. Both countries, particularly Spain, are known to import South African oil of *E. smithii* which is then rectified locally for re-export. Spain also is understood to blend oil of *E. maideni* with domestically-produced oil, but the quantities involved are unknown.

Eucalyptus oils exported by Spain and Portugal are generally of very high quality and meet BP specifications. Oils of the '70/75' type are the most common, but '80/85' oils are also exported. Spain and Portugal are also exporters of cineole of between 95% and 100% purity.

Although exports from both countries have been fairly steady in recent years, a growing proportion appears to have been of oil of other origins, whether rectified before export or not. Rising local costs and aforementioned labour shortages are likely to ensure that a substantial and growing proportion of future Iberian supplies will consist of oil from other origins, although probably locally rectified. Supplies of the true Iberian oils are not, however, expected to disappear completely.

The main destinations for Iberian exports are North America, Western and Eastern Europe and Japan, as Tables 24 and 25 in Appendix A show.

3.2.2 China

Little is known of the levels of production of the eucalyptus oils in China, but an examination of the statistics of the various importing countries reveals that recent Chinese exports have averaged around 1,000 tonnes, making China the world's largest exporter by far. Of this total, probably only 5% (around 50 tonnes) consists of oil of *E. citriodora,* the balance consisting, in roughly equal parts, of natural eucalyptus oil distilled from a species very closely resembling *E. globulus,* and the cineole fraction of white camphor oil (marketed as eucalyptus oil — *see* Section 3.1). There is also believed to be a very substantial production of oils of low cineole content (around 35%), but it has not proved possible for the Chinese to market such oils overseas in any quantities. The natural oil tends to be marketed in rather higher cineole contents ('80/85' as well as '70/75') than the ex-camphor oil, and possesses marginally superior technical properties, and in consequence it is preferred by the trade in spite of being slightly higher-priced, but the overall difference between the two oils is said to be small. Chinese oil is rather less well-regarded by the trade than is Iberian oil, its odour tending to be poorer and its specifications often below BP standards, but it is cheaper and therefore very widely used. There is also some export of extracted cineole from China, but generally not in quite the degree of purity associated with the equivalent Iberian product. On the other hand, the quality of Chinese oil of *E. citriodora,* which is traded in quantities comparable with those exported by China's main rival, Brazil, is well liked and is comparable with the best available.

As with all Chinese essential oils, there is always uncertainty about future production and export levels, and even relatively small fluctuations in the quantities offered by the Chinese export corporations could have a disproportionately disruptive effect on world markets.

3.2.3 Australia

Australia has always been associated with eucalyptus and at one time was a very important exporter of the oil, but current export levels are low, primarily as a result of the progressive impact of rising local costs. As will be apparent from Appendix A, Table 27 recent average export levels have not been much in excess of 50 tonnes, and it has been reported that a proportion of these exports has in fact consisted of re-exports of oil of Southern African origin, although no information is available on the exact quantities involved. The oils are of both the cineole-rich and phellandrene-rich types, produced from variants of the *E. dives* and *E. australiana* species, and although the exact quantitative division between the two types is not clear from the statistics, the likelihood is that the greater part of exports is of phellandrene-rich oils, there being generally ample supplies of the cineole-rich oil from other sources at competitive prices. Australia is also an exporter of extracted phellandrene. The main destinations of Australian exports of eucalyptus oil are East and South-East Asia, Western Europe, New Zealand and the USA. Although demand for the phellandrene-rich oils may remain at around its present level for a while, it is likely that the underlying tendency will be for Australian exports to decrease, on account of local cost factors.

3.2.4 Southern Africa

The main producers of eucalyptus oils in the Southern African region are the Republic of South Africa and Swaziland. South African exports are estimated to be around 200 tonnes per annum although production levels are probably higher, there being appreciable local demand. Exports from Swaziland are estimated to be of the order of 10–20 tonnes per annum. The main type of eucalyptus distilled in the region is, as already mentioned, *E. smithii,* which is a cineole-rich species. However, in comparison with other oils of this type, the cineole content of oil of *E. smithii* is inclined to be very variable, and although a 70–80% content can certainly be achieved in practice, there have been several reports of consignments of Southern African oil containing less than 70% cineole, and in some instances less than 60%. These occurrences, together with the oil's reported tendency to possess a rather acrid odour, have hindered the rapid development of trade in the oil, which often needs rectification before use. Indeed, a considerable proportion of South African exports pass through Spain and Portugal, where the oil is rectified, before it reaches its final destination.

Phellandrene-rich eucalyptus oils are also produced in the Southern African region, mainly in the Republic of South Africa rather than Swaziland, but in considerably smaller quantities than is *E. smithii* oil. They are produced from the aforementioned variants of the *E. dives* and *E. australiana* species. On the basis of various reports and opinions expressed by traders, it would appear that at least a proportion of these oils is exported to Australia, where they are either processed into phellandrene or resold overseas as they are. The steady increase in Australia's local production and distillation costs is gradually switching the emphasis from indigenous Australian exports to re-exports, and in consequence this type of trade may increase.

There would appear to be scope for expansion of production of eucalyptus oils in the Southern African region and there has certainly been a considerable amount of activity there in recent years. Provided quality variations can be minimised, it is likely that the region's share in world exports will increase.

3.2.5 Brazil

Appendix A, Table 28 gives details of recent exports of eucalyptus oil from Brazil, and it will be seen that the level of exports has been remarkably stable in recent years, averaging around 160 tonnes per annum up until 1979, although there was a

decline in 1980. Of this total, probably 50 tonnes consists of oil of *E. citriodora,* of which Brazil is one of the world's two main producers, the balance being mostly cineole-rich oil, although it is not entirely clear from precisely which eucalyptus species the latter is produced. Very occasional consignments of oil of *E. staigeriana* have been reported by US traders, as already mentioned, but it is not clear how this oil is used, and it is unlikely that the trade will develop, although it could well be used locally. Brazilian eucalyptus oils are sold mainly in the USA, Latin American countries and Western Europe.

The quality of Brazilian cineole-rich oils is reported not to equal that of the Iberian oils, and in consequence it has to be cheaper. Some appears to be sold to Spain, where it is rectified. However, the quality of local oil of *E. citriodora,* the oil for which Brazil is mainly noted in spite of the fact that it accounts for only a comparatively small proportion of total trade in Brazilian oil, is widely recognised as good.

It is likely that Brazil will continue to be an important supplier of eucalyptus oil; although there is a very substantial internal demand for locally-produced oils, there appears to be sufficient local production capacity to maintain exports at least at present levels for the foreseeable future.

3.2.6 India

India is a regular exporter of eucalyptus oil, mainly of the cineole-rich type, but the quantities are very variable and usually small. Details are given in Appendix A, Table 29. Most recent trade appears to be with the Soviet Union under barter agreements. On the available evidence, there seems little likelihood of India becoming an appreciable force in Western markets as a supplier of eucalyptus oil, particularly as the price is fairly widely reported to be rather uncompetitive.

3.2.7 Other sources

Zaire was once an important producer of oil of *E. citriodora* and still occasionally exports small consignments. Cineole-rich oils have also been produced there, but there have been no reports of overseas sales in recent years. The prospects for increased production of eucalyptus oils in Zaire seem poor. In South America, **Argentina** is reported to have supplied very occasional and very small consignments of *E. citriodora* oil, but no statistical information is available either for this source or for **Peru,** which has also been reported as being a very occasional supplier, the quantities involved again being miniscule. Some French users reported that **Morocco** supplies small quantities of an oil very similar to Spanish *E. globulus* oil, and there have also been reports of the **Soviet Union** producing high-cineole oils for export to France. However, again no statistical information is available. **Singapore** has generally been a very minor supplier, as can be seen from Appendix A, Table 30, probably of rectified imported oil, the main outlets being within the South-East Asian region. There are not known to be any other producers of consequence.

3.3 MARKETS AND PROSPECTS

The trends in consumption of eucalyptus oil in the main markets will now be discussed. Local patterns of usage, however, will only be highlighted where they deviate significantly from the worldwide pattern discussed in Section 3.1.

3.3.1 The USA

The USA is the second largest importer of eucalyptus oil after France; Appendix A, Table 32 gives details of the USA's imports. The market appears to be stable, and even buoyant, and the recent average intake of all types of oil has been around 280 tonnes per annum. There appears to be very little re-export trade in eucalyptus oil from the USA, and the above figure probably accurately represents the recent average level of annual internal consumption. Of the import total, an estimated

20–30 tonnes consists of *E. citriodora* oil and maybe 10–20 tonnes of phellandrene-rich and piperitone-rich oils.

The cineole-rich oils enjoy steady demand in the USA, mainly in their own right, although cineole is sometimes extracted for use in more demanding applications. China has steadily increased its share of this market, and now dominates it. Although the Iberian oils are very much liked by perfumers, they are regarded as comparatively expensive, while some US buyers, although not all, maintained that the Chinese oil's quality has improved to a point at which it can compete in every respect with Iberian oil, while one major dealer stated that Chinese oil is easier to obtain in the '80/85' grade. Southern African oil of *E. smithii* is not yet used in large quantities, as its characteristics tend to be disliked. There is a tendency, in the USA, for pure cineole to be used in perfumery rather than the basic oil, as it has better odour characteristics.

US usage of *E. citriodora* oil proved, as anticipated, to be more susceptible to challenge from synthetics, particularly where the production of hydroxycitronellal is concerned. There is comparatively little usage of this oil in its own right. China appears to have overtaken Brazil as the principal supplier of the oil to the US market, one or two buyers reporting occasional shortages of the Brazilian oil. The prospects for the oil will increasingly depend very much on the relative movements in its price in relation to those of citronella oil and turpentine, and in the long run seem unlikely to be particularly favourable.

There continues to be some usage of the phellandrene-rich and piperitone-rich eucalyptus oils for extraction of phellandrene and piperitone, but it is probable that the synthetic sources of these isolates will eventually take over in the remaining applications in which the natural derivatives are still being used. There is no longer any production in the USA of menthol from eucalyptus sources. The phellandrene-rich oils were formerly obtained mainly from Australia, but the Republic of South Africa is now the main supplier.

While the overall prospects for the cineole-rich oils in the USA are undoubtedly favourable, those for the other types of eucalyptus oil are much less so. However, it is the former which dominate usage in the USA, and the overall level of demand for eucalyptus oil should continue to be buoyant.

3.3.2 The United Kingdom

Appendix A, Tables 33 and 34, give details of the United Kingdom's trade in eucalyptus oil. It will be seen from Table 34 that there is a considerable entrepôt trade in eucalyptus oil, although some oil is undoubtedly reprocessed before export, rather than being merely exported from a bonded warehouse. Internal consumption appears to have averaged around 150 tonnes per annum in recent years, of which maybe 40–50 tonnes consists of oil of *E. citriodora* and no more than 5 tonnes of phellandrene-rich oils, the balance being cineole-rich oil. There appears to be an upward trend, albeit with appreciable year-to-year variations.

The cineole-rich oils undoubtedly enjoy the best prospects of all the eucalyptus oils used in the United Kingdom. The Iberian oils are plainly preferred for their quality by users, but the Chinese oils are nonetheless the most widely used on account of their much greater availability and lower price. Both the natural and ex-camphor Chinese oils are used, although the former is preferred. Oil of *E. smithii* from Southern Africa is used more widely in the United Kingdom than in the USA, but it is still not regarded as the equal of either the Iberian or the Chinese oils, and it tends to need rectification.

Oil of *E. citriodora* is used in the United Kingdom both as a perfumery oil in its own right and as a starting material for the production of hydroxycitronellal, but mainly for the latter. Consumption has increased quite markedly in recent years and the special character of the hydroxycitronellal produced from this oil seems to have found considerable favour lately amongst some users, but the apparent con-

sensus is that usage of synthetic hydroxycitronellal will steadily increase, assuming that its price advantage holds. As a perfumery oil in its own right *E. citriodora* oil is relatively unimportant, although in these applications there is less likely to be a decline from current levels of usage.

There is comparatively very little extraction of phellandrene or of piperitone from eucalyptus oils in the United Kingdom and the prospects for increased usage are poor.

The overall prospects for consumption of eucalyptus oil in the United Kingdom seem fairly favourable although, as in the USA, the proportion of consumption attributable to oil of *E. citriodora* and the phellandrene-rich oils is likely to decline.

3.3.3 France

France is the world's largest consumer of imported eucalyptus oil. From Appendix A, Tables 35 and 36, it will be seen that average annual imports in recent years (1978–80) have been around 650 tonnes, of which on average a little over 50 tonnes have subsequently been re-exported. China has been the principal supplier, followed by the Republic of South Africa, Portugal and Spain. French re-exports are destined largely for other EC countries, the USA and Eastern Europe.

The reason for the high level of consumption in France is not entirely clear, but as elsewhere the bulk of consumption is of the cineole-rich oils, which are used in a very wide range of compounds for use in general perfumery, as well as in pharmacy. Among the perfumery outlets are various types of eau-de-Cologne. The Iberian oils are recognised as being the best in terms of odour quality, but the Chinese oils are more widely used as a result of their price and availability, and little distinction is made between the natural and ex-camphor oil of this source. Oil of *E. smithii* from the Republic of South Africa is also used, but rectification is often needed. Oil of *E. citriodora* is a comparatively unimportant item on the French market, local consumption probably not exceeding 20–30 tonnes. French users generally take the common view that the use of *E. citriodora* oil as a source of isolates is likely to decrease gradually as synthetics improve in quality. Both Brazilian and Chinese oils are used. Small quantities of phellandrene and piperitone are extracted from imported eucalyptus oils rich in these isolates, but this outlet is of distinctly minor importance and is declining. There are no synthetic substitutes in France for the cineole-rich oils or their derivatives and, as these oils account for the bulk of the eucalyptus oils consumed in France, the overall prospects for eucalyptus oils on the French market are reasonably favourable, although it is perhaps unlikely that the rate of growth of consumption will be very great.

3.3.4 The Federal Republic of Germany

The average level of imports of eucalyptus oil into the Federal Republic of Germany (West Germany) in recent years has been around 250 tonnes. Details are given in Appendix A, Table 37. There is a moderate re-export trade, averaging 25–30 tonnes annually, and it is concluded that consumption within West Germany is around 220–230 tonnes per annum and that it is more or less stable.

As is to be expected, the cineole-rich oils dominate West German demand for eucalyptus oils. The Chinese oils are the most widely used and, as in France, not much distinction is made between the natural and ex-camphor oils. Portuguese oils are the next most widely used, followed by Spanish oils, both being highly regarded for their quality. West German users also buy cineole, in purities ranging from 90% to 100%, from both China and the Iberian peninsula. Southern African oil of *E. smithii* is less liked on account of its relatively poor odour, often low cineole content and an alleged comparative instability. The main broad area of usage in West Germany for this type of oil appears to be in pharmaceutical products rather than perfumery compounds although there is no doubt that the latter absorb large quantities.

Only a few tonnes of *E. citriodora* oil are used annually in West Germany, and there seems to be a greater degree of usage *per se* than in other countries. Extraction of citronellal is certainly undertaken, but mostly by the firms intending to use it. Local consumption of *E. citriodora* oil seems stable in comparison with the trend in some other countries, but it should be emphasised that it is a minor product and that there is no likelihood of any increase in consumption.

There appears to be negligible interest in phellandrene-rich oils in West Germany, and it would appear that local requirements of phellandrene tend to be imported.

Overall prospects for consumption of the eucalyptus oils in West Germany appear to be firm and a small rate of growth may be expected, provided prices remain at a level which deters any inroad from synthetics. This conclusion applies, of course, mainly to the cineole-rich oils, there being no likelihood of any growth in consumption of the other oils.

3.3.5 The Netherlands

As Appendix A, Table 38 shows, annual imports of the eucalyptus oils into the Netherlands have averaged 50—60 tonnes in recent years. The re-export trade is small, averaging around 5 tonnes per annum, and a figure of 50 tonnes may be regarded as a reasonable estimate of annual internal consumption in the Netherlands. The main suppliers are China, Spain and Portugal in that order. Consumption in the Netherlands appears to be restricted mainly to a few large compounding houses.

Among the cineole-rich oils, the Chinese products are used extensively, relatively speaking, on account of their availability and low price, but it is the Spanish oil which is preferred where cost considerations allow. Portuguese oil is also well liked, however. Little or no Southern African oil is used in the Netherlands. There is a tendency for pure cineole rather than the basic oil to be used in flavour work. Consumption of oil of *E. citriodora* is small, and mainly for the extraction of the currently-favoured natural citronellal. Phellandrene-rich eucalyptus oils appear not to be used in the Netherlands, phellandrene being imported as required, as in West Germany.

No viable synthetic substitutes exist in the Netherlands for the cineole-rich oils and the overall outlook for continued consumption of eucalyptus oils in the Netherlands is therefore moderately favourable, although no appreciable market growth is expected.

3.3.6 Switzerland

No import statistics are available for Switzerland in relation to eucalyptus oil. Consumption in Switzerland is dominated by two large processing firms who sell a very large proportion of their output of intermediate and end-products outside Switzerland's borders, effective consumption by Swiss consumers being very small. No information was obtainable on the actual levels of consumption, but the firms mentioned indicated that their consumption is small, and the author's tentative estimate, based on export figures, is 30 tonnes per annum. The cineole-rich oils are used mainly for their olfactive values rather than their cineole content as such, and it would appear that most is purchased from China, Spain and Portugal, although it was pointed out that some of the oils obtained from Spain and Portugal are in fact ultimately of South African origin. Oil of *E. citriodora* is used in comparatively large quantities, that is, in relation to consumption of the cineole-rich oils. Phellandrene-rich oils appear not to be used to any degree in Switzerland. The overall prospects for future consumption appear to be firm without much likelihood of growth, and in the case of oil of *E. citriodora* the trend is likely to be downward, as elsewhere.

3.3.7. Other markets

Tables 39, 40, 41 and 31 (in Appendix A) respectively give details of recent imports into **Italy** (average annual imports 35 tonnes), **Denmark** (25 tonnes), **Japan** (40 tonnes) and **Singapore** (70 tonnes). No obvious trend in consumption is evident for any of these importers other than Singapore (where the trend is upwards), and little is known about the structure of usage, although it is unlikely to differ appreciably from that applicable elsewhere in Western Europe and in North America. In the case of Singapore the level of exports has already been referred to in Section 3.2 (*see* also Appendix A, Table 30) and it will be evident that the level of apparent internal consumption is still in excess of 30 tonnes annually. As Singapore is not a large enough market to absorb these quantities internally, it is probable that a large proportion is processed into cineole which is then exported, this being consistent with Singapore's activities in relation to certain other essential oils. The statistics of the various exporting countries indicate that a very large number of other countries import eucalyptus oil, the main areas worth noting being Latin America, particularly Mexico, and Eastern Europe. It is difficult to estimate accurately the total quantities imported into these other markets, but they are likely to fall in the range 100—250 tonnes per annum.

3.4 PRICES AND TARIFFS

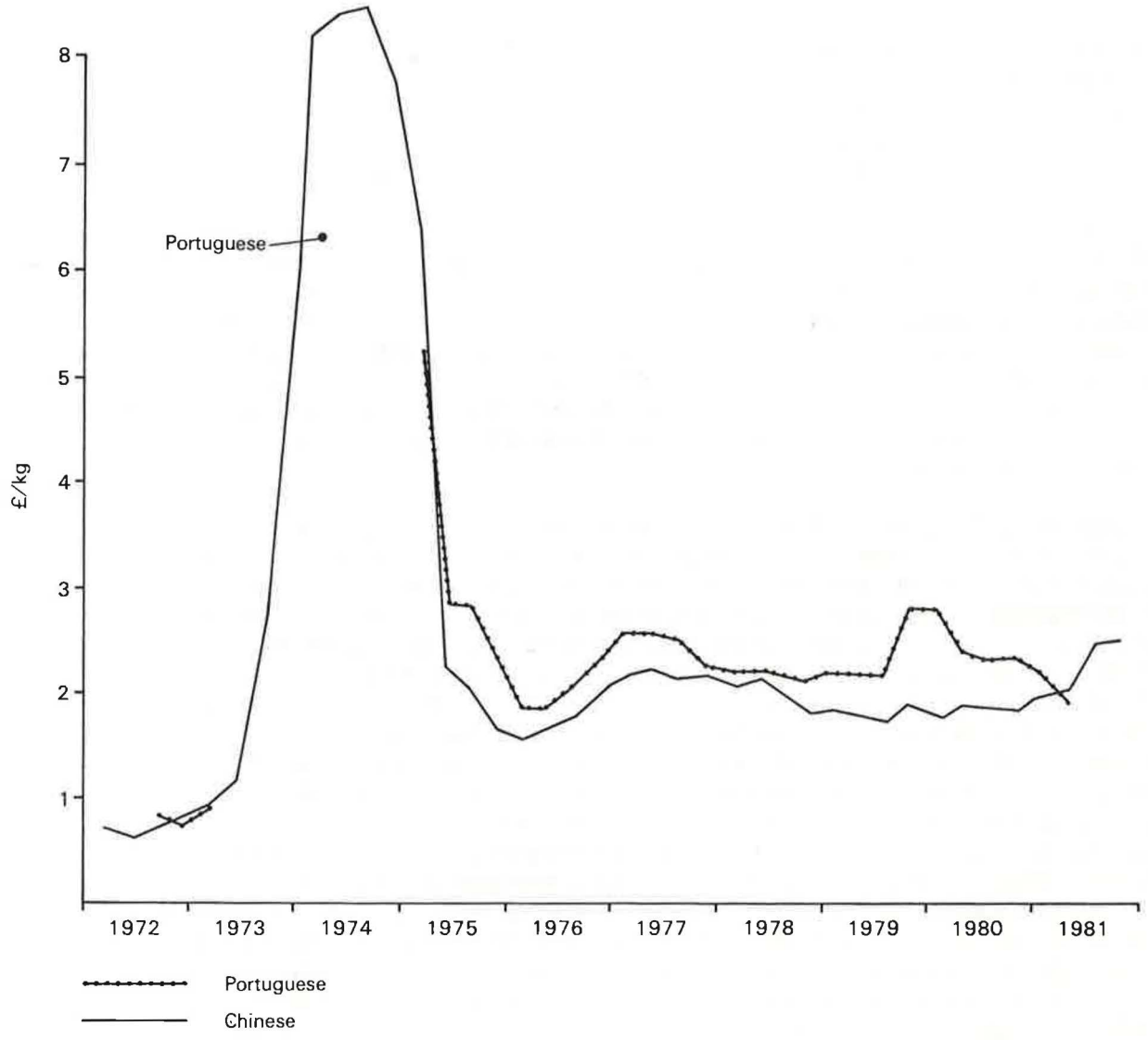
Cineole-rich oils. Appendix A, Table 42 gives details of quarterly movements in the prices of Portuguese *E. globulus* oil and its Chinese equivalents during the decade 1972—81. This information is illustrated graphically in Figure 5.

In comparison with many other essential oils, the prices of the cineole-rich eucalyptus oils have been remarkably stable over the period, apart from the violent movements during 1974 and 1975 which, however, affected all essential oils. It is this stability, together with the fact that these oils are basically inexpensive, that has contributed to the oil's secure market position. From 1975 until early 1981 Chinese oil was consistently cheaper than Portuguese oil, and although the difference was sometimes small, it was generally sufficient to offset the small qualitative advantage of the Portuguese oil. In 1981, however, scarcities caused the price of Chinese oil to rise sharply and exceed that of the Portuguese oil, although the latter subsequently became temporarily unavailable and consequently expensive, prices in excess of £3 per kilogram being recorded in early 1982. The difference in price between '70/75' and '80/85' oils from a given source is usually no more than around 5%, and while the true Chinese eucalyptus oil is usually a little more expensive than the ex-camphor oil, the difference is again of little consequence. Southern African oil, however, is generally appreciably cheaper, this reflecting the oil's frequent need of rectification in the buying countries. The rather high prices ruling for the medicinal eucalyptus oils in early 1982 were not expected to be prolonged, as the longer-term supply outlook is regarded as favourable.

Oil of *E. citriodora*. It was not possible to provide price series for this oil, which is much less well documented than are the cineole-rich oils. However, traders indicated that there has been a tendency for the pattern of movements in its price to follow that of citronella oil (q.v., Section 2), which is to some extent to be expected in view of the fact that both oils are used as starting materials for the production of hydroxycitronellal. At the same time, its typical price level has been comparable with that of the cineole-rich oils. For example, in mid-1980 the price of Chinese oil of *E. citriodora* was £2.50 per kilogram (forward delivery); by late 1980 it had fallen to £2.19 per kilogram and in May 1981 it stood at £2.13 per kilogram. In recent years there has been little difference between the prices of Chinese and Brazilian oils.

Phellandrene-rich oils. No published information was available in early 1982, indeed prices seem to be published only rarely. However, oils produced in Australia are known to be generally considerably more expensive than those produced in the Republic of South Africa, for both quality and cost reasons. It

Figure 5
Eucalyptus oil: quarterly average prices and annual range, London, 1972–81



Source: *Public Ledger*

Note: Prices of Portuguese oil were not quoted during the periods Q2 1973 to Q1 1974 and Q3 to Q4 1974

would appear that in any case the prices of these oils are unlikely to prove competitive in the long run and already they are at a disadvantage *vis-à-vis* other sources of the relevant isolates.

Although import duties are sometimes encountered in the eucalyptus oil trade, they are in practice unlikely to prove an obstacle to trade. For the vast majority of producers in the developing countries, the Generalised System of Preferences (GSP) and other concessional arrangements have ensured that eucalyptus oil, including Chinese oil, enters the EC duty free. Imports into the USA attract duty at the rate of 3.5% *ad valorem* and occasionally at higher rates, but exemptions are possible. Imports into Switzerland attract duty at the rate of 20SF per 100 kilograms unless they originate in developing countries, in which case the duty is waived if the goods are accompanied by a certificate of origin.

3.5 CONCLUSION

Of the various types of eucalyptus oil, the outlook for the cineole-rich oils seems to be by far the most promising. Consumption of these oils is steady and maybe rising

slightly, and there are no viable synthetic challengers to the oil, either in its own right or as a source of cineole. In spite of rising production costs, prices have generally been remarkably stable, and there is no doubt that price stability is very greatly appreciated by perfumers and other buyers. The Chinese tend to move their prices in line with movements elsewhere, although often with something of a lag, but as they have experienced comparatively little pressure from the production cost end, they have been able to hold their prices somewhat below those charged by other producers, and in consequence they have rapidly come to dominate the market. Spain, Portugal and Australia, in contrast, are more likely to experience severe pressures on operating margins, and the decline in production already evident in Spain and Australia is likely to continue, and may in due course spread to Portugal. As many buyers are reluctant to rely too exclusively on China or the Republic of South Africa as suppliers, there may therefore eventually be prospects for new producers in lower-cost areas with adequate supplies of suitable species of eucalyptus, particularly as the Southern African oils have yet fully to meet buyers' requirements consistently. Although supply and demand were roughly in balance in early 1982, the cineole-rich eucalyptus oils probably offer better long-term prospects for new producers in developing countries than do the majority of other natural essential oils. There are unlikely to be appreciable opportunities in the short term, however.

The prospects for oil of *E. citriodora* and the phellandrene-rich oils, in contrast, are much less good. Alternative sources of phellandrene and piperitone exist, and it is certain that the existing producers of the phellandrene-rich eucalyptus oils will be more than able to cope with the foreseeable demand, which is likely to decline. In the case of oil of *E. citriodora,* the oil is likely to hold its own as a source of hydroxycitronellal only in relation to its natural competitor, namely citronella oil, in the long term, and then only if its price is competitive. In spite of the fact that, of all the perfumery isolates of turpentine, synthetic hydroxycitronellal experienced the greatest difficulty in penetrating the traditional areas of application of the naturally-derived products, its quality is now such that the consumption of hydroxycitronellal produced from natural essential oils can be expected to begin to decline more rapidly, for in spite of fluctuations in the price of turpentine, the price of synthetic hydroxycitronellal in relation to its quality has become generally very competitive. The level of consumption of oil of *E. citriodora* as an oil in its own right is less likely to be susceptible to a sharp decline, but it is certainly unlikely to increase, and the prospects for new producers of oil of *E. citriodora* are therefore poor, especially as China and Brazil seem more than capable of meeting any likely levels of world demand for the foreseeable future.

Section 4

Trading structures and procedures

To market any essential oil successfuly, it is fully as important that the nature of the channels and procedures by which the oil passes from the distiller to the end-user is understood as that the size of the market is known. Many potentially successful essential oils undertakings have failed solely on account of a faulty understanding of the operation of the market.

Nowadays it is most important that new producers of essential oils should make a practice of establishing and maintaining a constant and two-way flow of communication with the main end-users, or with the key intermediate links in the trading chain, who will normally be dealers, but might on occasion be brokers, export houses or general produce merchants in the importing countries. Any producer who is contemplating the production of a known commercial oil in an untried location, or the substantial expansion of existing production needs both to ensure that a sufficient number of buyers are in basic sympathy with the scheme and also, assuming the scheme does have support, that the oil is supplied in the right quantities, in the preferred types of package, and at the right time as well as, of course, within the accepted quality standards and specifications. Correct documentation and payment procedures are also of paramount importance and need to be the subject of advance negotiation. The steady improvement in international communications is removing many of the difficulties formerly encountered in maintaining close and constant contacts along these lines, and without such contacts the chances of a successful and lasting trade being established are greatly reduced.

In spite of the substantial recent decline in demand for some of the essential oils covered in this report, in all cases the volume of trade remains sufficiently large for the number of participants in the trade to have become considerable, and these oils are very typical of essential oils generally in the manner in which they are traded. Also, some of the consuming countries individually import more than they consume, on account of their function as entrepôts in essential oils, a proportion of their intake being subsequently re-exported to other countries. This supplements the special role of traditional entrepôt centres such as Singapore, where internal consumption is often very small in relation to the re-export trade. Re-exports play an important part in the minimisation of the irregularities and imbalances in trade brought about variously by seasonal shortages, inadvertent overstocking and sudden peaks in demand in a particular country. It should be understood, however, that the use of the term 're-exports' does not necessarily imply that the oil is imported no further than a bonded warehouse, although this is certainly implied by the traditional, formal definition of the word. Many dealers import the oils directly into the countries where they are physically located, and then subsequently re-export them if orders are received. In some cases the oils may be to a greater or lesser degree cleaned, filtered, or further refined before re-export. This is not to suggest that there is no true re-export trade in the traditional sense, but rather that it may not necessarily be more than a fairly small proportion of re-export in the wider sense. Nonetheless, there still exist one or two Western ports in which a substantial amount of the traditional type of re-export trade is undertaken, a major example being Rotterdam in the Netherlands.

The basic marketing chain applicable to essential oils can be outlined as follows:

A Exporter
B Entrepôt (e.g. Singapore)
[C Commissioned broker/agent]
D Dealer or merchant
[E Commissioned broker/agent]
F Processing/compounding house
G End-products manufacturer (who may buy the oil already incorporated into a perfume compound, for example)

It should be noted that the terms used above are as defined and understood by the United Kingdom trade. For example, a broker is defined in the United Kingdom as an intermediary operating on a commission basis. Traditionally brokers invariably acted on behalf of 'principals', that is buyers or sellers, but this distinction is becoming blurred and brokers may increasingly act on their own behalf. Dealers and merchants, in contrast with brokers, purchase, hold and sell produce, the former often in anticipation of market movements, the latter more frequently against orders from customers. Since they have physical possession of the produce, they can hold stocks as required. The brackets around 'C' and 'E' indicate that the oil does not normally pass through the hands of brokers or of the overseas agents of producers or exporters. It is not even necessary for the goods to pass through the country in which the broker or agent is located. For example, a London-based intermediary could negotiate a trading agreement between an Asian producer and a Continental European buyer, the goods being shipped direct, only the documentation passing through London.

In some cases there can be more than one dealer or merchant in the chain, with or without a corresponding additional broker or agent. This often occurs as a result of re-export trade, defined in the broader sense outlined previously, and is sometimes necessary to correct stock imbalances. The link between 'F' and 'G' is usually direct (as shown), it being in the very nature of the industry that end-product manufacturers normally enter into direct agreement and contracts with processors, although there are end-product manufacturers who do their own blending, in which case stage 'F' is bypassed. Direct 'A—G' links are uncommon at present, and although direct 'A—F' links are becoming more common, the brokers, agents, and, in particular, the dealers and merchants, continue to retain their importance in the trade. The most common marketing chain is probably 'A—C—D—F—G'. It is unusual for brokers or agents to feature twice in the progress of a consignment from exporter to final user.

Under the sustained influence of price inflation in recent years there has been a certain amount of pressure in favour of a reduction of the number of links in the marketing chain, in order to reduce the impact of the intermediaries' commission or mark-up in the final price. Even smaller firms, who formerly would have regarded themselves as possessing insufficient resources for direct contacts with exporters in the producing countries, have in some cases attempted to open direct lines of communication with the producers, although a fair proportion of such attempts has only served to prove that the increased inconvenience and cost of such communications tends to eclipse the intended savings. In general, only those firms handling relatively large quantities of essential oils have found that the savings sufficiently outweigh the cost and inconvenience of bypassing dealers. Only in the event of the major end-users taking on a much greater proportion of their own perfume compounding – and the trend would appear to be otherwise – could there be a major decline in the role of dealers and merchants in the world essential oils trade. Some continuation of the slow decline in the importance of the intermediaries seems a possibility, however. In the case of brokers, it is link 'E' rather than 'C' which will be more prone to a diminution in importance, on account of the relative ease with which both small and large compounders and end-users can make direct contact with dealers and merchants, although even 'C' may decline further. On the other hand, it is unlikely that brokers will disappear altogether, for many users or compounders who could not afford direct links with exporters could afford

'half-way' arrangements, involving the use of a single broker or agent between them and the exporter. It is, however, the role of dealers and the larger merchants in the monitoring of the quality of individual brands of oil that is particularly appreciated in the trade and the ability of intermediaries in general to arrange financing is also widely valued.

For most oils, trading may take place on either a 'future delivery' or 'spot' basis, the former involving an agreement on a firm price for delivery at a specified future date, the latter involving direct purchases from a dealer's or merchant's existing stock. Normally higher prices are payable on the spot market, recourse to this market usually being made when very small quantities of the oil are required or when supplies are needed very urgently. Payment may either be against documents (c.a.d.) or on a 'letter of credit' basis, considerable variation in practice being encountered in this respect. The method chosen is a matter for individual negotiation between the parties involved.

For the most part, it has been concluded that the existing trading patterns and procedures work fairly satisfactorily in relation to the oils under study. Where adverse criticism was encountered, it mainly concerned the over-rigid trading practices encountered in certain producing countries where strong centralised control had existed, but there are signs that some of these practices are being relaxed as part of general liberalisation policies.

Few special observations are necessary in relation to the individual oils covered by this report. In the case of the more specialised, low-volume eucalyptus oils there perhaps tends to be a greater degree of direct trading than in the case of the higher-value general-purpose oils, but this is of little importance. Most citronella oils, and many eucalyptus and lemongrass oils, are bought from origin on the basis of their technical description (e.g. citral content in the case of lemongrass, '85/35' geraniol/citronellal in the case of citronella, and '70/75', '80/85', etc. cineole content in the case of eucalyptus) rather than on the sample basis more common with many other oils, although oils from the less familiar sources are rather more likely to be sold on a sample basis. In the case of purchases from dealers by processors and end-users, there appears to be a roughly even split between purchases on specification and purchases on sample. New producers, however, would almost certainly have to sell on a sample basis during the early stages of production, at any rate until trade confidence in their product had built up sufficiently.

Appendices

APPENDIX A: STATISTICAL TABLES

Table 1

Lemongrass oil: exports from India, 1974/75 – 1979/80

		1974/75[a]	1975/76[a]	1976/77[a]	1977/78[a]	1978/79[a]	1979/80[a]
TOTAL	tonnes	*124*	*374*	*174*	*149*	*72*	*249*
	£'000	*464*	*1,084*	*685*	*652*	*319*	*1,002*
of which to:							
Soviet Union	tonnes	94	322	122	114	25	190
	£'000	352	942	486	509	109	748
Hungary	tonnes	–	1	12	6	3	1
	£'000	–	4	49	28	13	5
USA	tonnes	8	22	9	19	23	26
	£'000	29	59	35	74	102	105
United Kingdom	tonnes	12	17	18	3	11	12
	£'000	41	45	64	14	46	56
Germany, Federal Republic of	tonnes	2	4	6	–	5	12
	£'000	9	14	24	–	25	54
France	tonnes	2	–	–	1	1	4
	£'000	9	–	2	5	3	14
Australia	tonnes	4	6	5	2	4	1
	£'000	19	18	21	10	19	5
Other countries	tonnes	2	2	2	4	–	2
	£'000	6	3	4	13	2	15

Source: *Monthly Statistics of the Foreign Trade of India*, Department of Commercial Intelligence and Statistics

Note: [a]April – March

Table 2

Lemongrass oil: imports into the USA, 1970–80

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*166.0*	*211.1*	*210.7*	*239.8*	*229.1*	*111.8*	*110.8*	*162.1*	*159.2*	*179.7*	*79.8*
	$'000	*792.4*	*807.6*	*726.4*	*941.3*	*1,585.0*	*483.0*	*469.7*	*919.2*	*996.4*	*1,214.4*	*644.7*
of which from:												
Guatemala	tonnes	138.2	196.7	186.5	163.9	136.3	66.8	73.5	71.1	99.0	88.2	60.8
	$'000	635.2	767.2	633.5	602.3	963.0	269.0	309.7	470.9	626.1	591.9	478.2
India	tonnes	18.9	7.0	19.1	30.4	9.7	16.9	13.1	21.4	14.1	33.6	7.9
	$'000	118.6	27.8	79.1	190.7	93.0	93.0	83.8	145.8	113.7	300.0	71.3
China	tonnes	–	–	1.7	26.8	81.0	27.6	16.9	58.7	32.1	49.7	8.7
	$'000	–	–	4.7	92.8	515.0	118.0	47.6	258.4	182.7	272.7	64.1
Sri Lanka	tonnes	–	–	–	–	–	–	2.4	2.6	0.9	1.6	0.4
	$'000	–	–	–	–	–	–	12.0	13.6	5.9	11.8	3.0
Argentina	tonnes	3.6	–	–	0.8	–	–	–	–	–	–	–
	$'000	14.2	–	–	4.2	–	–	–	–	–	–	–
United Kingdom	tonnes	0.3	6.0	2.9	8.7	–	–	0.5	2.5	–	5.2	0.9
	$'000	3.0	3.0	6.9	18.2	–	–	2.9	10.9	–	32.0	11.1
Netherlands	tonnes	–	0.4	–	4.4	–	–	–	–	–	–	–
	$'000	–	4.6	–	12.7	–	–	1.0	–	–	–	0.3
Other countries	tonnes	5.0	1.1	0.6	4.9	2.2	0.5	4.4	5.9	13.1	1.3	1.1
	$'000	21.4	5.0	2.1	20.3	14.0	3.0	12.7	19.6	68.1	5.9	16.9

Source: US Trade Returns

Table 3

Lemongrass oil (not terpeneless): imports into the United Kingdom, 1971–76[a]

		1971	1972	1973	1974	1975	1976
TOTAL	tonnes	*66*	*116*	*103*	*71*	*46*	*66*
	£'000	*109*	*162*	*219*	*223*	*104*	*188*
of which from:							
India	tonnes	29	38	50	14	11	24
	£'000	51	69	132	46	27	83
Guatemala	tonnes	36	75	44	48	29	35
	£'000	58	86	68	142	61	86
China	tonnes	–	2	2	2	1	2
	£'000	–	3	4	7	3	4
Sri Lanka	tonnes	–	–	2	2	1	2
	£ 000	–	–	4	5	2	8
USA	tonnes	–	–	2	1	–	1
	£'000	–	–	6	7	1	4
France	tonnes	–	–	–	–	2	–
	£'000	–	–	1	–	6	2
Other countries	tonnes	–	1	3	4	2	1
	£'000	–	4	4	16	4	2

Source: *Overseas Trade Statistics of the United Kingdom,* HM Customs and Excise

Note: [a] Lemongrass oil was not shown separately in the United Kingdom trade statistics after 1976

Table 4

Litsea cubeba oil: imports into the United Kingdom, 1973–80

		1973	1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*76*	*321*	*179*	*502*	NOT SHOWN		*272*	*226*
of which to:	£'000	*100*	*624*	*310*	*787*	SEPARATELY		*749*	*603*
China	tonnes	73	240	73	305			239	206
	£'000	97	449	139	486			588	518
USA	tonnes	–	69	20	160			14	10
	£'000	–	152	31	234			84	30
Netherlands	tonnes	3	5	33	3			16	–
	£'000	3	9	52	5			50	1
Switzerland	tonnes	–	2	33	17			–	2
	£'000	–	5	47	34			–	7
France	tonnes	–	4	2	3			1	2
	£'000	–	8	3	4			22	22
Other countries	tonnes	–	1	18[a]	14[b]			2	6
	£'000	–	1	38	24			5	24

Source: *Overseas Trade Statistics of the United Kingdom,* HM Customs and Excise

Notes: [a] Mainly from the Federal Republic of Germany
[b] Mainly from Hong Kong

Table 5

Lemongrass oil: imports into France, 1971–80

		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*71*	*101*	*46*	*22*	*7*	*24*	*26*	*39*	*37*	*53*
	£'000	*104*	*93*	*84*	*75*	*17*	*74*	*95*	*119*	*136*	*186*
of which from:											
Guatemala	tonnes	55	96	32	16	...	11	9	26	23	43
	£'000	76	80	52	60	...	39	43	75	75	144
China	tonnes	5	...	...	...	...	...	2	6	7	4
	£'000	9	...	...	...	...	...	8	19	23	14
India	tonnes	3	...	...	...	...	...	–	4	5	4
	£'000	6	...	...	...	...	...	–	17	23	16
Other countries	tonnes	8	5	14	6	7	13	15	3	2	2
	£'000	13	13	32	15	17	35	44	8	15	12

Sources: *Statistiques du Commerce Extérieur de la France,*
Direction Générale des Douanes et Droits Indirects
Nimexe Analytical Tables,
Statistical Office of the European Communities

Table 6

Lemongrass oil: imports into Japan, 1976–80

		1976	1977	1978	1979	1980
TOTAL	tonnes	*28*	*43*	*29*	*44*	*30*
	£'000	*73*	*180*	*115*	*149*	*101*
of which from:						
China	tonnes	9	10	7	24	18
	£'000	21	36	26	79	62
Guatemala	tonnes	17	32	20	18	12
	£'000	47	142	80	67	38
India	tonnes	–	–	–	–	–
	£'000	–	–	1	–	1
USA	tonnes	2	1	2	1	–
	£'000	4	2	9	3	–

Source: *Japan Exports and Imports,*
Japan Tariff Association

Table 7

Lemongrass oil: annual average prices and annual range, New York, 1972–81

US $ per kilogram

		Annual average	Annual range Low	High
Guatemalan (f.o.b. prices)	1972	4.05[a]	3.53	5.29
	1973	6.63	3.86	8.27
	1974	10 33	7.72	12.68
	1975	8.54	7.72	12.68
	1976	—[b]	7.72	14.33
	1977	7.72	7.17	8.27
	1978	7.17	7.17	7.17
	1979	7.53	7.17	9.37
	1980	9.87	9.37	10.14
	1981	10.28	7.72	10.14
Indian (f.o b. prices up to end 1975, c.i.f. from 1976)	1972	5.79[a]	5.51	6.61
	1973	6.82	5.84	7.17
	1974	9.51	6.61	12.13
	1975	10.29	7.72	12.13
	1976	9.40	7.28	15.43
	1977	8.54	7.72	9.26
	1978	8.43	8.27	8.60
	1979	8.63	8.27	9.92
	1980	10.05	7.50	12.68
	1981	12.46	7.50	17.97

Source: *Chemical Marketing Reporter*

Schell
100 Church Street
New York City

Notes: [a]May – Dec only
[b]Jan – April only
– Not quoted

Table 8

Citronella oil: exports from Sri Lanka, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*102*	*227*	*131*	*127*	*131*	*107*
	RS'000	*2,023*	*3,543*	*2,253*	*4,869*	*7,260*	*11,926*
	£'000	*129*	*232*	*141*	*163*	*220*	*310*
of which to:							
USA	tonnes	39	53	73	32	49	38
	£'000	54	56	84	43	80	112
United Kingdom	tonnes	36	116	17	61	47	37
	£'000	43	114	16	72	81	104
France	tonnes	7	20	19	6	10	8
	£'000	7	21	18	8	16	23
Germany, Federal Republic of	tonnes	1	5	1	3	2	–
	£'000	2	6	2	7	4	–
Netherlands	tonnes	2	3	1	2	2	3
	£'000	3	3	1	2	5	10
Belgium	tonnes	5	1	–	1	3	–
	£'000	6	1	–	1	4	–
Switzerland	tonnes	4	1	5	3	4	5
	£'000	4	1	5	3	10	17
Spain	tonnes	–	6	5	2	1	–
	£ 000	–	6	5	2	2	1
Italy	tonnes	7	9	1	1	6	8
	£'000	8	10	1	1	8	20
Australia	tonnes	–	1	1	1	1	–
	£'000	–	1	1	2	2	–
New Zealand	tonnes	–	6	5	3	4	1
	£'000	–	6	5	3	6	3
Other countries	tonnes	1	6	3	12	2	7
	£'000	2	7	3	19	2	21

Source: *External Trade Statistics,* Sri Lanka Customs

Table 9

Citronella oil: exports from Indonesia, 1974–80

		1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*1,950*	*1,782*	*1,677*	*1,133*	*841*	*731*	*624*
	US$'000	*8,155*	*3,508*	*2,603*	*1,895*	*1,418*	*2,434*	*2,220*
	£'000	*3,486*	*1,579*	*1,441*	*1,085*	*739*	*1,147*	*955*
of which to:								
Singapore	tonnes	18	4	173	67	70	23	72
	£'000	30	1	95	23	43	17	61
Taiwan	tonnes	–	240	509	371	304	103	28
	£'000	–	169	476	427	230	270	84
Japan	tonnes	110	351	112	96	51	30	4
	£'000	201	343	83	78	27	25	6
Australia	tonnes	3	10	11	10	14	17	–
	£'000	6	8	4	5	9	12	–
USA	tonnes	650	191	197	35	46	97	78
	£'000	1,275	196	177	47	29	143	133
United Kingdom	tonnes	127	56	76	83	31	33	14
	£'000	243	51	80	119	26	20	8
France	tonnes	363	379	170	174	94	101	111
	£'000	588	355	180	134	63	84	88
Germany, Federal Republic of	tonnes	306	340	117	62	28	38	23
	£'000	523	280	90	40	16	30	31
Netherlands	tonnes	317	167	229	189	159	205	211
	£'000	527	136	186	190	230	426	505
Belgium and Luxembourg	tonnes	22	3	3	–	–	1	3
	£'000	27	3	2	–	–	2	3
Spain	tonnes	4	15	40	27	–	12	30
	£'000	6	15	30	9	–	28	11
Italy	tonnes	2	14	13	9	5	36	3
	£'000	3	7	14	8	3	33	4
Other countries	tonnes	28	12	27	10	39	35	46
	£'000	57	15	24	5	63	57	21

Source: *Foreign Trade Statistics*
Central Bureau of Statistics, Indonesia

Table 10

Citronella oil: exports from Taiwan, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*69*	*25*	*35*	*168*	*366*	*47*
	NTS'000	*10,107*	*4,054*	*6,709*	*22,827*	*77,562*	*11,864*
	£'000	*120*	*59*	*101*	*322*	*1,022*	*142*
of which to:							
Singapore	tonnes	1	–	–	25	6	11
	£'000	10	1	–	38	19	26
Hong Kong	tonnes	–	–	–	–	15	–
	£'000	–	–	–	–	56	–
Japan	tonnes	49	24	20	34	37	22
	£'000	67	56	52	75	111	73
USA	tonnes	–	–	13	47	123	4
	£'000	–	–	27	88	342	11
United Kingdom	tonnes	–	–	–	5	34	4
	£'000	–	–	–	9	111	12
France	tonnes	–	–	–	17	89	2
	£'000	–	–	–	34	204	5
Germany, Federal Republic of	tonnes	–	–	–	8	19	–
	£'000	–	–	–	16	56	–
Netherlands	tonnes	–	–	–	32	34	4
	£'000	–	–	–	60	105	11
Mexico	tonnes	17	–	1	–	5	–
	£'000	30	–	20	–	11	–
Australia	tonnes	1	1	1	–	1	1
	£'000	2	2	1	–	4	4
Other countries	tonnes	1	–	–	–	3	–
	£'000	11	–	1	2	3	–

Source: Taiwan Trade Statistics

Table 11

Citronella oil: exports from Guatemala, 1972–76

		1972	1973	1974	1975	1976
TOTAL	tonnes	*262*	...	*379*	*112*	*192*
	Quetzales'000	*634*	...	*2,074*	*503*	*516*
	£'000	*253*	...	*887*	*226*	*286*
of which to:						
USA	tonnes	51	...	152	4	20
	£'000	50	...	304	4	28
United Kingdom	tonnes	70	...	72	21	9
	£'000	67	...	128	74	16
France	tonnes	15	...	2	–	2
	£'000	14	...	7	–	5
Netherlands	tonnes	–	...	11	–	3
	£'000	–	...	34	–	6
Spain	tonnes	32	...	49	–	13
	£'000	31	...	101	–	20
El Salvador	tonnes	10	...	4	2	11
	£'000	10	...	12	3	16
Honduras	tonnes	3	...	–	2	–
	£'000	3	...	–	2	–
Mexico	tonnes	80	...	87	84	107
	£'000	76	...	299	144	156
Nicaragua	tonnes	2	...	–	–	–
	£'000	2	...	1	–	–
Other countries	tonnes	–	...	2	–	17
	£'000	–	...	1	–	39

Source: *Anuario de Comercio Exterior,*
Direccion General de Estadistica

Table 12

Citronella oil: exports from Brazil, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*88*	*61*	*69*	*71*	*28*	*16*
	Cruzeiros'000	*3,421*	*1,728*	*3,635*	*4,506*	*4,753*	*6,414*
	£'000	*189*	*90*	*147*	*130*	*83*	*52*
of which to:							
USA	tonnes	–	–	2	–	17	3
	£'000	–	–	4	–	61	10
United Kingdom	tonnes	6	16	–	9	–	6
	£'000	7	24	–	17	–	20
France	tonnes	–	26	5	–	–	–
	£'000	–	36	8	–	–	–
Germany, Federal Republic of	tonnes	–	–	5	–	–	–
	£'000	–	–	10	–	–	–
Spain	tonnes	3	5	1	–	–	–
	£'000	4	7	2	–	–	–
Mexico	tonnes	79	14	56	61	10	7
	£'000	177	23	123	113	22	23
Other countries	tonnes	–	–	–	1	1	–
	£'000	1	–	–	–	–	–

Source: *Comércio Exterior do Brasil,*
Ministério da Fazenda

Table 13

Citronella oil: exports and re-exports from Singapore, 1974–80

		1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*37*	*2*	*173*	*94*	*58*	*38*	*74*
	S$'000	*211*	*24*	*882*	*691*	*582*	*661*	*1,322*
	£'000	*37*	*5*	*198*	*162*	*133*	*143*	*265*
of which to:								
Peninsular Malaysia	tonnes	22	2	13	5	8	5	5
	£'000	23	4	16	5	14	9	9
USA	tonnes	–	–	–	–	18	11	28
	£'000	–	–	–	–	35	37	126
United Kingdom	tonnes	–	–	–	3	4	3	4
	£'000	–	–	–	5	8	5	10
France	tonnes	–	–	–	8	8	4	...
	£'000	–	–	–	17	19	10	...
Germany, Federal Republic of	tonnes	–	–	–	–	5	13	30
	£'000	–	–	–	–	17	80	107
Netherlands	tonnes	–	–	11	–	–	–	2
	£'000	–	–	15	–	–	–	5
Switzerland	tonnes	13	–	–	–	–	–	...
	£'000	10	–	–	–	–	–	...
Japan	tonnes	–	–	10	–	7	–	...
	£'000	–	–	18	–	23	–	...
Taiwan	tonnes	–	–	140	78	6	–	...
	£'000	–	–	148	134	6	1	...
Australia	tonnes	1	–	–	–	–	1	...
	£'000	4	–	–	–	–	2	...
Other countries	tonnes	1	–	–	–	2	1	5
	£'000	–	1	1	1	11	–	7

Source: *Singapore Half-yearly Trade Statistics,* Department of Statistics

Table 14

Citronella oil: imports into Singapore, 1974–80

		1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*38*	*17*	*23*	*18*	*46*	*14*	*69*
	S$'000	*339*	*104*	*109*	*65*	*313*	*173*	*1,147*
	£'000	*59*	*20*	*24*	*15*	*72*	*38*	*230*
of which from:								
China	tonnes	2	2	6	1	8	2	50
	£'000	6	4	9	2	18	4	196
Taiwan	tonnes	10	–	–	–	25	6	10
	£'000	32	–	1	–	40	20	27
Vietnam	tonnes	–	–	2	–	2	–	...
	£'000	–	–	2	–	3	–	...
Peninsular Malaysia	tonnes	–	–	–	1	1	–	...
	£'000	–	–	–	1	1	–	...
United Kingdom	tonnes	–	11	15	14	8	6	...
	£'000	–	9	12	10	6	11	...
Netherlands	tonnes	–	4	–	1	1	–	...
	£'000	–	6	–	2	2	–	...
Switzerland	tonnes	25	–	–	–	–	–	...
	£'000	22	–	–	–	–	–	...
Other countries	tonnes	1	–	–	1	–	1	9
	£'000	–	1	–	–	2	2	7

Source: *Singapore Half-yearly Trade Statistics,* Department of Statistics

Table 15

Citronella oil: imports into the USA, 1970–80

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*1,244*	*727*	*1,072*	*1,057*	*1,364*	*374*	*1,035*	*502*	*476*	*646*	*512*
	$'000	*3,104*	*1,843*	*2,450*	*3,545*	*9,592*	*1,712*	*2,651*	*1,681*	*1,804*	*3,474*	*4,108*
of which from:												
Indonesia	tonnes	276	81	388	435	608	238	230	57	36	101	64
	$'000	581	193	805	1,355	3,981	875	504	179	127	548	500
Sri Lanka	tonnes	50	48	63	55	45	46	56	69	35	50	41
	$'000	90	101	150	185	325	170	109	141	77	178	289
China	tonnes	–	–	31	214	192	–	507	166	125	145	148
	$'000	–	–	70	764	1,208	–	1,412	547	457	596	1,110
Taiwan	tonnes	794	467	500	186	353	75	88	140	186	317	132
	$'000	2,151	1,240	1,216	697	3,015	563	394	573	802	1,976	1,220
Hong Kong	tonnes	–	–	–	16	9	–	40	5	–	–	–
	$'000	–	–	–	44	73	–	100	18	–	–	–
Japan	tonnes	–	–	10	5	–	–	–	–	–	–	–
	$'000	–	–	22	20	–	–	–	–	–	–	–
Guatemala	tonnes	39	23	51	103	107	–	18	46	50	12	48
	$'000	94	55	122	336	648	–	49	162	198	66	343
Brazil	tonnes	–	1	–	–	–	–	–	2	–	8	4
	$'000	–	1	–	–	–	–	–	8	–	53	34
Argentina	tonnes	84	107	27	37	49	–	21	14	22	4	52
	$'000	187	252	62	119	341	–	48	46	73	23	398
France	tonnes	–	1	–	–	–	–	–	–	–	6	–
	$'000	–	1	–	–	–	–	–	–	–	22	–
Other countries	tonnes	1	–	1	7	–	14	12	1	21	3	22
	$'000	1	–	4	24	1	104	35	7	69	13	213

Source: US Trade Returns

Table 16

Citronella oil (not terpeneless): imports into the United Kingdom, 1976–80

		1976	1977	1978	1979	1980
TOTAL	tonnes	*446*	*297*	*195*	*212*	*178*
	£'000	*590*	*574*	*358*	*585*	*591*
of which from:						
Indonesia	tonnes	45	94	37	10	29
	£'000	64	185	73	31	82
Sri Lanka	tonnes	119	14	53	48	34
	£'000	126	20	69	99	108
Taiwan	tonnes	–	–	–	31	11
	£'000	–	–	–	100	40
China	tonnes	150	140	59	41	61
	£'000	220	269	123	101	210
Vietnam	tonnes	22	4	8	–	–
	£'000	24	7	17	–	–
Hong Kong	tonnes	–	–	–	31	–
	£'000	–	–	–	100	–
Singapore	tonnes	1	2	–	9	2
	£'000	1	3	–	19	5
India	tonnes	–	5	–	13	–
	£'000	–	6	–	30	–
Guatemala	tonnes	–	23	5	3	–
	£'000	–	47	9	10	–
Brazil	tonnes	16	–	9	–	–
	£'000	27	–	19	–	–
USA	tonnes	1	1	2	1	1
	£'000	3	2	2	6	7
France	tonnes	6	3	3	38	–
	£'000	12	6	10	142	1
Germany, Federal Republic of	tonnes	39	–	–	1	–
	£'000	40	–	–	3	1
Netherlands	tonnes	45	11	8	3	33
	£'000	70	21	15	10	114
Other countries	tonnes	2	–	11	11	8
	£'000	3	8	21	28	22

Source: *Overseas Trade Statistics of the United Kingdom*, HM Customs and Excise

Table 17

Citronella oil (not terpeneless): exports from the United Kingdom, 1976–80

		1976	1977	1978	1979	1980
TOTAL	tonnes	*51*	*137*	*107*	*93*	*61*
	£'000	*70*	*313*	*185*	*223*	*295*
of which to:						
USA	tonnes	29	10	–	–	3
	£'000	39	18	–	–	12
France	tonnes	6	15	12	9	11
	£'000	8	31	9	19	42
Germany, Federal Republic of	tonnes	2	1	9	3	7
	£'000	2	3	15	10	26
Netherlands	tonnes	3	18	3	15	1
	£'000	4	35	6	48	4
Belgium and Luxembourg	tonnes	1	4	3	2	2
	£'000	2	6	5	5	8
Italy	tonnes	–	6	9	4	2
	£'000	–	19	21	10	6
Spain	tonnes	2	11	–	–	1
	£'000	5	27	–	2	2
Switzerland	tonnes	–	6	–	11	3
	£'000	–	13	–	25	103
Soviet Union	tonnes	–	51	44	–	–
	£'000	–	133	91	–	–
Poland	tonnes	1	7	2	–	–
	£'000	1	14	5	–	–
Turkey	tonnes	2	–	10	3	7
	£'000	2	–	4	6	27
South Africa, Republic of	tonnes	1	–	–	23	6
	£'000	1	–	–	66	21
Singapore	tonnes	–	–	–	10	–
	£'000	–	–	–	6	–
Australia	tonnes	–	4	–	1	1
	£'000	–	7	–	3	3
Other countries	tonnes	4	4	15	12	16
	£'000	6	7	29	23	43

Source: *Overseas Trade Statistics of the United Kingdom,* HM Customs and Excise

Table 18

Citronella oil: imports into France, 1970–80

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*1,111*	*390*	*692*	*567*	*764*	*707*	*742*	*503*	*251*	*366*	*299*
	fr'000	*11,496*	*5,827*	*8,626*	*8,817*	*26,459*	*11,408*	*9,691*	*8,662*	*4,649*	*8,086*	*9,767*
	£'000	*862*	*432*	*684*	*807*	*2,352*	*1,198*	*1,123*	*1,010*	*537*	*896*	*1,114*
of which from:												
Indonesia	tonnes	...	106	143	198	324	325	120	256	77	115	135
	£'000	...	118	146	298	998	577	187	530	164	304	540
Sri Lanka	tonnes	9	15	20	13	11	...	20	25	7	14	11
	£'000	7	13	19	17	34	...	24	34	9	28	37
China	tonnes	1,095	204	434	317	312	339	531	195	104	108	99
	£'000	846	229	424	429	960	563	805	396	235	234	358
Taiwan	tonnes	...	39	74	23	57	...	...	–	31	81	9
	£'000	...	44	72	32	172	...	...	–	67	223	31
Argentina	tonnes	...	14	...	5	23	...	21	–	27	12	34
	£'000	...	16	...	9	81	...	32	–	53	38	131
Brazil	tonnes	...	6	...	...	...	...	26	5	–	–	–
	£'000	...	6	...	...	...	...	41	10	–	–	1
Guatemala	tonnes	...	...	12	5	7	...	...	–	–	–	–
	£'000	...	...	12	9	20	...	...	–	–	–	–
Vietnam	tonnes	...	...	...	...	17	27	21	7	3	–	2
	£'000	...	...	...	...	56	39	27	12	4	–	7
USA	tonnes	...	...	...	–	2	...	...	–	–	16	6
	£'000	...	...	...	1	6	...	...	–	–	36	2
European Community countries	tonnes	...	...	...	...	...	...	...	5	2	5	–
	£'000	...	...	...	...	...	...	...	16	2	12	1
Other countries	tonnes	7	6	9	6	11	16	3	10	–	15	3
	£'000	10	6	11	12	26	19	7	12	3	21	6

Sources: *Statistiques du Commerce Extérieur de la France,*
Direction Générale des Douanes et Droits Indirects
Nimexe Analytical Tables,
Statistical Office of the European Communities

Table 19

Citronella oil: exports from France, 1976–80

		1976	1977	1978	1979	1980
TOTAL	tonnes	*107*	*95*	*100*	*160*	*233*
	fr'000	*1,381*	*1,341*	*2,004*	*3,079*	*7,379*
	£'000	*160*	*156*	*231*	*341*	*768*
of which to:						
United Kingdom	tonnes	...	–	7	19	11
	£'000	...	–	15	69	45
Germany, Federal Republic of	tonnes	...	2	2	2	5
	£'000	...	3	7	7	18
Netherlands	tonnes	...	–	6	3	–
	£'000	...	1	13	8	1
Switzerland	tonnes	...	2	11	18	1
	£'000	...	3	25	45	4
Spain	tonnes	...	4	2	2	4
	£'000	...	10	4	4	16
Italy	tonnes	18	21	25	22	40
	£'000	34	45	57	68	127
Soviet Union	tonnes	...	–	20	–	117
	£'000	...	–	50	–	416
Poland	tonnes	...	5	–	1	4
	£'000	...	8	–	2	7
Bulgaria	tonnes	40	21	8	13	18
	£'000	38	26	20	28	60
Turkey	tonnes	...	–	–	5	9
	£'000	...	–	–	10	21
Egypt	tonnes	...	3	–	52	2
	£'000	...	3	–	48	6
Peru	tonnes	...	25	8	–	5
	£'000	...	28	11	–	6
Panama	tonnes	...	2	2	5	8
	£'000	...	2	2	8	13
Other countries	tonnes	49	10	9	18	9
	£'000	88	27	27	44	27

Source: *Statistiques du Commerce Extérieur de la France,*
Direction Générale des Douanes et Droits Indirects

Table 20

Citronella oil: imports into the Federal Republic of Germany, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*231*	*226*	*239*	*111*	*91*	*80*
	DM'000	*2,226*	*1,491*	*2,050*	*817*	*848*	*1,064*
	£'000	*407*	*328*	*506*	*212*	*218*	*252*
of which from:							
Indonesia	tonnes	170	77	10	14	14	15
	£'000	314	114	23	29	35	50
Sri Lanka	tonnes	...	...	...	...	...	...
	£'000	...	...	...	...	...	...
China	tonnes	...	89	49	30	30	44
	£'000	...	129	114	66	83	149
Taiwan	tonnes	...	...	116	11	36	...
	£'000	...	...	277	23	78	...
Vietnam	tonnes	...	...	26	19	...	...
	£'000	...	...	47	39	...	...
European Community countries	tonnes	36	16	3	6	2	3
	£'000	67	24	5	12	5	10
Other countries	tonnes	25	44	35	31	9	18
	£'000	26	61	40	43	17	42

Source: *Aussenhandel nach Waren und Ländern,* Statistisches Bundesamt Wiesbaden

Table 21

Citronella oil: imports into the Netherlands, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*33*	*237*	*198*	*141*	*145*	*154*
	gld'000	*312*	*1,635*	*1,863*	*1,195*	*1,574*	*2,499*
	£'000	*56*	*342*	*435*	*288*	*370*	*540*
of which from:							
Indonesia	tonnes	29	170	92	60	70	90
	£'000	49	217	199	122	166	318
Sri Lanka	tonnes	–	1	...	2	1	...
	£'000	–	2	...	2	2	...
China	tonnes	1	34	80	41	32	16
	£'000	2	58	173	84	75	58
Taiwan	tonnes	–	–	...	15	15	8
	£'000	–	–	...	31	46	28
Singapore	tonnes	–	11	...	...	...	10
	£'000	–	15	...	...	...	33
Guatemala	tonnes	–	–	...	...	13	15
	£'000	–	–	...	...	44	51
United Kingdom	tonnes	...	9	10	...	...	5
	£'000	...	12	20	...	...	18
France	tonnes	2	8	3	16	7	3
	£'000	3	29	18	33	19	11
Germany, Federal Republic of	tonnes	...	...	7	...	...	...
	£'000	...	...	14	...	...	...
Other European Community countries	tonnes	1	4	–	3	4	1
	£'000	1	8	–	6	9	7
Other countries	tonnes	–	–	6	4	3	5
	£'000	–	–	11	10	9	10

Source: *Maandstatistiek van de Buitenlandse Handel,* Centraal Bureau voor de Statistiek

Table 22

Citronella oil: imports into Japan, 1976–80

		1976	1977	1978	1979	1980
TOTAL	tonnes	*484*	*352*	*166*	*274*	*132*
	Yen'000	*396,778*	*354,991*	*135,843*	*289,151*	*257,351*
	£'000	*741*	*757*	*336*	*622*	*486*
of which from:						
Indonesia	tonnes	146	91	31	50	4
	£'000	218	193	71	106	14
China	tonnes	314	241	91	193	103
	£'000	464	511	164	428	382
Taiwan	tonnes	24	20	45	30	26
	£'000	58	53	101	87	90

Source: *Japan Exports and Imports,* Japan Tariff Association

Table 23

Citronella oil: annual average prices and annual range, c.i.f. London, 1971–81

£ sterling per kilogram

		Annual average	Annual range	
			Low	High
Indonesian	1971	–	–	–
	1972	–	–	–
	1973	1.87	1.22	2.95
	1974	3.30	2.35	4.09
	1975	1.41	1.25	2.35
	1976	1.60	1.40	1.94
	1977	2.18	1.97	2.35
	1978	2.18	1.95	2.48
	1979	3.21	2.20	3.95
	1980	3.47	2.85	4.05
	1981	3.23	2.70	3.60
Sri Lankan	1971	0.92	0.85	1.01
	1972	1.03	0.87	1.22
	1973	1.57	1.25	2.28
	1974	3.12	1.85	3.60
	1975	1.26	1.06	1.80
	1976	1.20	1.06	1.40
	1977	1.43	1.24	2.20
	1978	1.44	1.32	1.72
	1979	2.39	1.42	3.50
	1980	3.42	3.10	4.22
	1981	3.00	1.90	3.50
Chinese	1971	1.17	1.00	1.95
	1972	1.03	0.92	1.30
	1973	1.93	1.30	2.90
	1974	3.79	3.45	4.15
	1975	1.48	1.30	2.00
	1976	1.59	1.30	2.02
	1977	2.21	1.29	2.50
	1978	2.28	2.11	2.55
	1979	3.23	2.32	4.12
	1980	3.55	3.00	4.05
	1981	3.27	2.85	3.75

Source: *Public Ledger*

Note: – Not quoted

Table 24

Eucalyptus oil: exports from Portugal, 1974–79

		1974	1975	1976	1977	1978	1979
TOTAL	tonnes	*501*	*392*	*443*	*331*	*394*	*368*
	esc'000	*151,173*	*48,325*	*45,427*	*52,809*	*68,425*	*86,024*
	£'000	*2,544*	*851*	*832*	*790*	*811*	*739*
of which to:							
USA	tonnes	158	141	133	67	100	103
	£'000	796	288	234	144	180	209
United Kingdom	tonnes	80	62	73	82	86	66
	£'000	404	146	148	196	193	137
France	tonnes	102	43	93	57	58	69
	£'000	509	100	162	144	120	127
Germany, Federal Republic of	tonnes	103	35	78	75	116	86
	£'000	523	73	151	188	246	181
Netherlands	tonnes	5	11	19	11	10	5
	£'000	21	23	39	25	20	8
Switzerland	tonnes	4	7	11	3	3	5
	£'000	18	15	22	10	6	11
Spain	tonnes	8	83	10	15	–	11
	£'000	39	172	19	29	–	19
Soviet Union	tonnes	–	–	12	–	4	–
	£'000	–	–	24	–	7	–
Mexico	tonnes	4	3	–	1	6	–
	£'000	18	14	–	3	12	–
Brazil	tonnes	1	3	4	–	–	–
	£'000	11	8	11	–	–	1
Other countries	tonnes	36	4	10	20	11	24
	£'000	205	12	22	51	27	47

Source: *Estatísticas de Comércio Externo,* Instituto Nacional de Estatística

Table 25

Eucalyptus oil: exports from Spain, 1975–79

		1975	1976	1977	1978	1979
TOTAL	tonnes	*185*	*221*	*172*	*218*	*191*
	pesetas '000	*65,358*	*53,064*	*52,109*	*67,678*	*65,140*
	£'000	*512*	*439*	*393*	*460*	*457*
of which to:						
USA	tonnes	10	28	51	47	10
	£'000	22	51	95	84	21
United Kingdom	tonnes	11	33	4	23	6
	£'000	51	62	10	46	16
France	tonnes	21	17	6	16	28
	£'000	52	35	20	38	68
Germany, Federal Republic of	tonnes	55	55	25	28	12
	£'000	154	114	62	63	29
Netherlands	tonnes	12	14	9	12	22
	£'000	37	29	25	30	55
Belgium and Luxembourg	tonnes	9	3	2	3	2
	£'000	23	8	6	8	5
Italy	tonnes	5	13	8	9	10
	£'000	14	27	22	24	28
Switzerland	tonnes	13	7	12	20	27
	£'000	38	14	31	48	69
Austria	tonnes	1	1	–	1	1
	£'000	3	1	–	2	4
Denmark	tonnes	11	8	21	11	9
	£'000	28	18	50	27	23
Poland	tonnes	5	4	5	4	17
	£'000	16	10	14	10	38
Czechoslovakia	tonnes	7	3	3	3	–
	£'000	15	6	7	7	–
Mexico	tonnes	4	3	–	3	2
	£'000	10	7	1	7	7
Japan	tonnes	4	10	11	15	19
	£'000	18	23	29	34	47
Other countries	tonnes	17	22	15	23	26
	£'000	31	34	21	32	47

Source: *Estadistica del Comercio Exterior de España,* Direccion General de Aduanas

Table 26

Eucalyptus oil: imports into Spain, 1975–79

		1975	1976	1977	1978	1979
TOTAL	tonnes	*82*	*109*	*123*	*127*	*300*
	pesetas '000	*21,565*	*18,507*	*29,775*	*25,574*	*62,386*
	£'000	*169*	*153*	*225*	*174*	*438*
of which from:						
Portugal	tonnes	68	–	1	–	34
	£'000	151	–	4	–	63
Brazil	tonnes	14	36	41	–	80
	£'000	18	57	85	–	112
China	tonnes	–	13	4	3	68
	£'000	–	18	11	6	101
South Africa, Republic of	tonnes	–	50	49	115	78
	£'000	–	62	79	155	113
Swaziland	tonnes	–	5	9	7	27
	£'000	–	6	20	9	34
Other countries	tonnes	–	5	19	2	13
	£'000	–	10	26	4	15

Source: *Estadistica del Comercio Exterior de España,*
Direccion General de Aduanas

Table 27

Eucalyptus oil: exports from Australia, 1973/74–1978/79

		1973/74	1974/75	1975/76	1976/77	1977/78	1978/79
TOTAL	tonnes	*117*	*104*	*41*	*65*	*62*	*78*
	A$'000	*407*	*611*	*186*	*281*	*291*	*367*
	£'000	*252*	*356*	*118*	*189*	*180*	*208*
of which to:							
USA	tonnes	27	15	1	4	2	...
	£'000	41	47	4	13	8	...
United Kingdom	tonnes	19	15	2	2	2	...
	£'000	40	47	5	6	7	...
France	tonnes	7	7	3	3	–	...
	£'000	18	21	5	5	–	...
Germany, Federal Republic of	tonnes	16	10	2	7	5	8
	£'000	39	34	4	21	10	19
Netherlands	tonnes	5	7	–	–	–	...
	£'000	10	17	–	–	–	...
Hong Kong	tonnes	3	11	3	7	13	18
	£'000	4	34	11	23	42	54
Singapore	tonnes	7	7	9	4	12	15
	£'000	28	27	26	12	35	42
Malaysia	tonnes	4	3	5	7	9	15
	£'000	7	19	14	20	27	42
Thailand	tonnes	6	13	6	18	11	13
	£'000	21	57	20	56	33	33
New Zealand	tonnes	11	8	3	8	6	5
	£'000	18	24	9	16	15	9
Other countries	tonnes	12	8	7	5	2	4
	£'000	26	29	20	17	3	10

Source: *Overseas Trade,*
Australian Bureau of Statistics

Table 28

Eucalyptus oil: exports from Brazil, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*171*	*149*	*165*	*170*	*146*	*117*
	cruzeiros '000	*3,654*	*4,140*	*7,094*	*8,087*	*11,535*	*30,363*
	£'000	*202*	*215*	*287*	*233*	*202*	*248*
of which to:							
USA	tonnes	12	24	24	45	11	3
	£'000	15	44	42	65	15	7
United Kingdom	tonnes	4	2	–	8	5	17
	£'000	4	3	–	9	5	33
France	tonnes	77	43	23	50	5	3
	£'000	92	49	39	66	6	6
Germany, Federal Republic of	tonnes	13	12	23	14	4	8
	£'000	13	18	43	18	6	17
Netherlands	tonnes	33	14	5	–	–	–
	£'000	36	20	7	–	–	–
Switzerland	tonnes	2	2	10	15	16	8
	£'000	2	3	16	15	29	18
Spain	tonnes	11	30	44	3	59	5
	£'000	11	40	75	7	71	7
Argentina	tonnes	4	3	–	2	4	2
	£'000	7	5	–	4	5	4
Venezuela	tonnes	–	6	3	–	–	–
	£'000	–	11	6	–	–	–
Mexico	tonnes	12	13	27	21	39	64
	£'000	17	21	48	30	60	139
Other countries	tonnes	3	–	6	12	3	6
	£'000	5	1	11	19	5	17

Source: *Comércio Exterior do Brasil,*
Ministério da Fazenda

Table 29

Eucalyptus oil: exports from India, 1974/75–1979/80

		1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
TOTAL	tonnes	*108*	*4*	*52*	*13*	*2*	*5*
	Rp'000	*6,819*	*164*	*1,624*	*675*	*121*	*372*
	£'000	*360*	*9*	*100*	*44*	*8*	*22*
of which to:							
USA	tonnes	–	–	17	–	–	–
	£'000	–	–	28	–	–	–
United Kingdom	tonnes	89	–	1	–	–	–
	£'000	303	–	1	–	–	–
France	tonnes	15	–	–	–	–	–
	£'000	46	–	–	–	–	–
Soviet Union	tonnes	–	–	30	10	–	–
	£'000	–	–	64	34	–	–
Other countries	tonnes	4	4	4	3	2	5
	£'000	11	9	7	10	8	22

Source: *Monthly Statistics of the Foreign Trade of India,*
Department of Commercial Intelligence and Statistics

Table 30

Eucalyptus oil: exports and re-exports from Singapore, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*7*	*8*	*3*	*8*	*8*	*38*
	S$'000	*166*	*181*	*47*	*140*	*52*	*455*
	£'000	*31*	*40*	*11*	*32*	*11*	*91*
of which to:							
Thailand	tonnes	–	4	1	5	4	11
	£'000	–	31	5	21	6	18
Peninsular Malaysia	tonnes	6	3	1	2	3	10
	£'000	29	4	3	3	4	33
Other countries	tonnes	1	1	1	1	–	17
	£'000	2	5	3	8	1	40

Source: *Singapore Half-yearly Trade Statistics,* Department of Statistics

Table 31

Eucalyptus oil: imports into Singapore, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*21*	*43*	*17*	*34*	*78*	*96*
	S$'000	*405*	*370*	*205*	*364*	*774*	*1,008*
	£'000	*77*	*83*	*48*	*83*	*168*	*202*
of which from:							
Australia	tonnes	8	6	7	11	16	28
	£'000	29	19	22	36	45	74
China	tonnes	11	36	10	22	58	67
	£'000	37	62	24	47	118	127
Other countries	tonnes	2	–	–	–	3	1
	£'000	11	2	2	–	5	1

Source: *Singapore Half-yearly Trade Statistics,* Department of Statistics

Table 32

Eucalyptus oil: imports into the USA, 1970–80

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*313*	*176*	*340*	*273*	*249*	*170*	*216*	*287*	*271*	*277*	*355*
	$'000	*433*	*269*	*558*	*682*	*2,639*	*909*	*846*	*965*	*840*	*916*	*1,163*
of which from:												
Spain	tonnes	93	5	56	61	21	22	36	63	47	10	–
	$'000	123	9	84	160	405	128	137	227	186	53	–
Portugal	tonnes	137	127	231	117	137	107	106	81	121	90	72
	$'000	184	190	372	265	1,446	559	325	270	360	367	261
United Kingdom	tonnes	1	–	3	5	7	–	7	–	4	8	5
	$'000	1	–	7	14	102	–	176	–	31	38	37
Brazil	tonnes	36	16	29	32	29	...	24	26	48	6	8
	$'000	66	32	59	99	132	...	78	76	123	16	34
Australia	tonnes	14	12	12	28	22	11	7	12	12	6	7
	$'000	16	18	20	58	118	99	28	50	14	15	15
South Africa, Republic of	tonnes	–	–	–	–	10	–	22	21	4	19	23
	$'000	–	–	–	–	99	–	70	74	8	48	44
Zaire	tonnes	16	15	3	11	10	–	–	–	–	–	–
	$'000	22	15	3	33	117	–	–	–	–	–	–
China	tonnes	–	–	–	1	–	–	–	57	35	125	205
	$'000	–	–	–	4	–	–	–	185	118	339	675
Other countries	tonnes	15	2	6	18	13	30	13	25	–	13	34
	$'000	21	6	12	47	219	122	32	84	–	40	99

Source: US Trade Returns

Table 33

Eucalyptus oil: imports into the United Kingdom, 1974–80

		1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*368*	*138*	*191*	*241*	*244*	*447*	*217*
	£'000	*1,812*	*691*	*339*	*484*	*433*	*755*	*380*
of which from:								
Portugal	tonnes	66	37	48	45	66	56	41
	£'000	374	81	90	100	126	124	94
Spain	tonnes	15	13	21	5	25	10	1
	£'000	69	37	41	11	48	24	3
China	tonnes	131	50	102	157	96	332	130
	£'000	811	428	162	312	169	463	205
Brazil	tonnes	9	4	–	–	8	5	–
	£'000	22	5	–	–	12	7	–
Australia	tonnes	10	2	1	2	1	2	2
	£'000	45	9	3	6	3	4	4
South Africa, Republic of	tonnes	14	3	3	8	17	–	–
	£'000	67	5	4	14	24	–	–
India	tonnes	100	29	1	–	–	–	–
	£'000	282	121	1	–	–	–	–
USA	tonnes	6	–	1	–	2	–	1
	£'000	54	1	12	1	6	–	9
France	tonnes	–	–	1	14	12	17	5
	£'000	2	–	2	20	20	92	6
Germany, Federal Republic of	tonnes	–	1	5	2	3	–	6
	£'000	2	5	8	4	5	–	14
Netherlands	tonnes	5	–	–	3	11	23	29
	£'000	34	–	2	7	18	37	40
Other countries	tonnes	12	–	8	5	3	2	2
	£'000	50	–	14	9	2	4	5

Source: *Overseas Trade Statistics of the United Kingdom,* HM Customs and Excise

Table 34

Eucalyptus oil: exports from the United Kingdom, 1976–80

		1976	1977	1978	1979	1980
TOTAL	tonnes	*103*	*127*	*108*	*197*	*137*
	£'000	*409*	*362*	*338*	*432*	*370*
of which to:						
France	tonnes	3	22	7	20	2
	£'000	5	40	17	30	4
Germany, Federal Republic of	tonnes	2	6	3	7	2
	£'000	3	11	4	11	3
Spain	tonnes	–	4	3	33	7
	£'000	3	10	5	55	13
Sweden	tonnes	–	2	1	3	1
	£'000	1	4	1	6	1
USA	tonnes	7	17	–	15	12
	£'000	83	45	–	28	29
Canada	tonnes	5	6	5	3	7
	£'000	28	24	19	10	23
Australia	tonnes	1	10	–	–	–
	£'000	2	17	1	–	–
Singapore	tonnes	–	–	–	24	–
	£'000	1	1	1	41	–
Thailand	tonnes	8	6	9	2	2
	£'000	61	33	42	8	9
Philippines	tonnes	1	3	4	4	3
	£'000	2	11	14	10	9
Nigeria	tonnes	29	10	32	10	32
	£'000	72	39	85	28	103
Ghana	tonnes	8	2	1	3	–
	£'000	15	8	2	9	–
Zambia	tonnes	–	1	–	7	–
	£'000	1	2	1	19	–
South Africa, Republic of	tonnes	1	5	9	10	13
	£'000	4	11	21	28	31
Mexico	tonnes	13	7	4	17	17
	£'000	38	18	22	48	55
Venezuela	tonnes	1	5	4	4	1
	£'000	14	20	14	10	1
Other countries	tonnes	24	19	26	35	38
	£'000	76	68	89	91	91

Source: *Overseas Trade Statistics of the United Kingdom,* HM Customs and Excise

Table 35

Eucalyptus oil: imports into France, 1970–80

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*427*	*358*	*388*	*486*	*601*	*243*	*1,524*	*431*	*443*	*859*	*652*
	fr'000	*3,433*	*3,380*	*3,364*	*5,495*	*20,188*	*4,301*	*6,783*	*6,940*	*6,792*	*9,258*	*9,618*
	£'000	*258*	*251*	*267*	*503*	*1,794*	*452*	*786*	*809*	*784*	*1,026*	*1,097*
of which from:												
Portugal	tonnes	56	39	38	66	101	31	70	49	48	94	39
	£'000	31	26	28	65	481	70	141	120	105	114	89
Spain	tonnes	7	...	9	28	42	17	19	4	23	28	16
	£'000	5	...	7	35	210	50	41	11	56	63	38
China	tonnes	251	63	184	179	117	46	1,280	286	189	628	482
	£'000	151	41	124	187	314	56	415	533	303	727	827
Australia	tonnes	18	6	14	5	12	...	...	–	–	–	–
	£'000	15	5	12	5	43	...	...	–	–	–	–
South Africa, Republic of	tonnes	87	143	84	136	142	37	93	31	106	80	97
	£'000	50	81	47	111	307	75	104	48	124	76	98
Zaire	tonnes	...	14	11	19	...	...	...	16	–	–	–
	£'000	...	13	10	31	...	...	...	24	–	–	–
Brazil	tonnes	...	82	35	41	152	81	49	22	60	–	5
	£'000	...	76	31	55	346	134	63	41	96	–	10
Other countries	tonnes	8	11	13	12	35	31	13	23	17	29	13
	£'000	6	9	8	14	93	67	22	32	100	46	35

Source: *Statistiques de Commerce Extérieur de la France,*
Direction Générale des Douanes et Droits Indirects

Table 36

Eucalyptus oil: exports from France, 1976–80

		1976	1977	1978	1979	1980
TOTAL	tonnes	*50*	*32*	*53*	*69*	*84*
	fr'000	*1,009*	*759*	*1,022*	*1,442*	*1,603*
	£'000	*117*	*88*	*118*	*160*	*167*
of which to:						
USA	tonnes	...	–	–	5	32
	£'000	...	–	–	6	38
United Kingdom	tonnes	...	–	11	1	1
	£'000	...	–	18	2	1
Germany, Federal Republic of	tonnes	...	3	3	2	9
	£'000	...	7	6	3	18
Belgium and Luxembourg	tonnes	...	1	2	–	3
	£'000	...	3	4	–	7
Italy	tonnes	19	16	23	34	25
	£'000	39	42	55	85	64
Switzerland	tonnes	...	1	1	1	1
	£'000	...	3	2	4	2
Czechoslovakia	tonnes	...	8	9	20	6
	£'000	...	19	18	42	14
Other countries	tonnes	31	3	4	6	7
	£'000	78	14	15	18	23

Source: *Statistiques de Commerce Extérieur de la France,*
Direction Générale des Douanes et Droits Indirects

Table 37

Eucalyptus oil: imports into the Federal Republic of Germany, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*130*	*193*	*596*	*240*	*207*	*282*
	DM'000	*2,087*	*1,729*	*4,410*	*1,897*	*1,506*	*2,332*
	£'000	*382*	*380*	*1,088*	*492*	*387*	*551*
of which from:							
Portugal	tonnes	37	48	37	79	57	81
	£'000	116	104	86	160	124	178
Spain	tonnes	57	58	28	30	21	23
	£'000	195	126	79	67	57	54
China	tonnes	9	48	503	87	113	137
	£'000	20	75	851	168	170	234
Brazil	tonnes	...	11	...	13	...	8
	£'000	...	19	...	26	...	22
Zaire	tonnes	...	12	...	...	...	...
	£'000	...	23	...	...	...	...
South Africa, Republic of	tonnes	...	...	...	15	...	...
	£'000	...	...	...	27	...	...
European Community countries	tonnes	7	6	10	7	5	15
	£'000	16	11	24	13	9	29
Other countries	tonnes	20	10	18	9	11	18
	£'000	35	22	48	31	27	34

Source: *Aussenhandel nach Waren und Ländern,*
Statistisches Bundesamt Wiesbaden

Table 38

Eucalyptus oil: imports into the Netherlands, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*39*	*94*	*30*	*24*	*89*	*64*
	gld'000	*396*	*792*	*323*	*229*	*604*	*670*
	£'000	*70*	*166*	*75*	*55*	*142*	*145*
of which from:							
Portugal	tonnes	1	10	6	8	–	...
	£'000	2	21	17	18	–	...
Spain	tonnes	8	15	10	13	19	28
	£'000	27	33	31	32	50	69
China	tonnes	1	33	11	2	69	24
	£'000	2	50	20	3	88	52
Brazil	tonnes	25	14	...	–	–	...
	£'000	32	22	...	–	–	...
South Africa, Republic of	tonnes	3	...	...	–	–	...
	£'000	4	...	...	–	–	...
USA	tonnes	–	10	...	–	–	...
	£'000	–	15	...	–	–	...
European Community countries	tonnes	1	10	–	–	1	3
	£'000	2	19	–	1	4	9
Other countries	tonnes	–	2	3	1	–	9
	£'000	1	6	7	1	–	15

Source: *Maandstatistiek van de Buitenlandse Handel,* Centraal Bureau voor de Statistiek

Table 39

Eucalyptus oil: imports into Italy, 1975–80

		1975	1976	1977	1978	1979	1980 (p)
TOTAL	tonnes	*15*	*49*	*32*	*58*	*25*	*21*
	lire (million)	*61*	*135*	*132*	*200*	*113*	*111*
	£'000	*42*	*90*	*86*	*123*	*64*	*56*
of which from:							
Spain	tonnes	5	10	7	10	13	...
	£'000	14	25	21	25	36	...
China	tonnes	2	8	4	4	4	...
	£'000	2	14	10	12	7	...
Brazil	tonnes	–	2	1	1	–	...
	£'000	1	4	3	2	1	...
France	tonnes	6	17	16	42	4	...
	£'000	18	37	42	81	12	...
Other countries	tonnes	2	12	4	1	2	21
	£'000	7	10	10	3	8	56

Source: *Statistica Annuale del Commercio con l'Estero,* Instituto Centrale di Statistic

Note: (p) = Provisional

Table 40

Eucalyptus oil: imports into Denmark, 1975–80

		1975	1976	1977	1978	1979	1980
TOTAL	tonnes	*21*	*19*	*26*	*23*	*23*	*29*
	kr'000	*1,076*	*494*	*711*	*585*	*622*	*911*
	£'000	*84*	*45*	*68*	*55*	*56*	*69*
of which from:							
Portugal	tonnes	7	7	5	9	12	17
	£'000	41	18	13	21	30	42
Spain	tonnes	13	9	21	12	9	9
	£'000	32	20	54	30	23	42
Other countries	tonnes	2	3	–	2	1	2
	£'000	11	7	1	4	3	3

Source: *External Trade of Denmark*

Table 41

Eucalyptus oil: imports into Japan, 1976–80

		1976	1977	1978	1979	1980
TOTAL	tonnes	*38*	*49*	*34*	*46*	*31*
	yen'000	*38,032*	*51,158*	*32,439*	*44,747*	*36,892*
	£'000	*71*	*109*	*80*	*96*	*70*
of which from:						
China	tonnes	23	22	12	24	19
	£'000	32	45	22	43	35
Portugal	tonnes	–	2	–	1	4
	£'000	1	4	–	1	10
Spain	tonnes	13	21	20	18	7
	£'000	31	51	54	43	21
Other countries	tonnes	2	4	2	3	1
	£'000	7	9	4	9	4

Source: *Japan Exports and Imports,*
Japan Tariff Association

Table 42

Eucalyptus oil: annual average prices and annual range, c.i.f. London, 1972–81

£ sterling per kilogram

		Annual average	Annual range	
			Low	High
Portuguese	1972	0.75 (a)	0.70	0.89
	1973	– (b)	0.80 (b)	0.93 (b)
	1974	– (c)	6.00 (c)	6.73 (c)
	1975	3.06	1.95	5.70
	1976	1.93	1.72	2.25
	1977	2.41	2.00	2.50
	1978	2.11	2.05	2.20
	1979	2.31	2.10	2.85
	1980	2.39	2.25	2.85
	1981	1.98 (d)	1.75	2.35
Chinese 80%	1972	0.69	0.59	0.92
	1973	2.72	0.79	6.44
	1974	8.35	7.50	9.30
	1975	3.00	1.50	7.50
	1976	1.67	1.45	2.15
	1977	2.10	2.02	2.25
	1978	1.92	1.75	2.10
	1979	1.74	1.55	1.86
	1980	1.79	1.75	1.90
	1981	2.19	1.85	2.45

Source: *Public Ledger*

Notes: (a) July–Dec only
(b) Jan–March only
(c) April–May only
(d) Jan–June only
– Not quoted

APPENDIX B: QUALITY ASSESSMENT AND STANDARD SPECIFICATIONS FOR THE OILS OF LEMONGRASS, CITRONELLA AND EUCALYPTUS

The quality of an essential oil may be assessed by a buyer on the basis of a number of criteria: the odour and/or flavour character, the chemical composition and certain physical properties, freedom from adulteration, and general cleanliness and appearance. The relative importance of each of these criteria will depend upon the individual essential oil and its intended end-use. For example, if the oil is to be employed *per se* for perfumery or flavouring applications, the acceptability of the odour or flavour character are of primary importance to the buyer and these properties are assessed by subjective means; whereas an oil which is to be subjected, by the buyer, to further processing (fractionation) to obtain isolates will be principally evaluated on the relative abundance of the desirable chemical components.

The following notes highlight the important quality assessment criteria for each of the oils covered in this report.

Standard specifications for these oils have been published by a number of organisations, mainly national standards bodies or trade associations in the major consuming countries. The following notes include, where applicable, summaries of the main points of the standard specifications published by the International Organization for Standardization (ISO), the British Standards Institution (BSI) and the Essential Oil Association of the USA (EOA); the last named organisation has now been subsumed by the Fragrance Manufacturers Association (FMA) of the USA, which is now responsible for issuing and revising the standards. The addresses of these three bodies from which the complete standards may be obtained are listed at the end of the fourth paragraph.

The published standard specifications include a definition of the acceptable botanical source and processing method for the particular oil, a description of the colour and

odour, specifications for certain physico-chemical properties and the analytical procedures to be used. All exporters should ensure that their products conform to the requirements of the ISO standard specifications or, where appropriate, those of the national standards body of the particular importing country. However, it must be appreciated by exporters that the standard specifications are principally of guidance value, defining the minimum requirements of buyers; some buyers have more stringent 'in-house' quality criteria and the standard specifications cannot adequately define those properties which involve a buyer's subjective judgement, specifically the odour and flavour character.

Addresses:

International Organization for Standardization, PO Box 56, CH–1211 Geneva 20, Switzerland
British Standards Institution, British Standards House, 2 Park Street, London W1A 2BS
Essential Oil Association of the USA Inc., 60 East 42nd Street, New York, NY 10017, USA

Oils of lemongrass

'West Indian' and 'East Indian' lemongrass oils possess somewhat different properties, but are assessed for quality on similar criteria. The main quality criteria are the odour character, the aldehyde (citral) content and the solubility in 70% alcohol. Most commercial oils contain between 75% and 90% aldehydes, and a high value is desired if the oil is intended for fractionation and the isolation of citral. Oils of a high solubility and a good aroma are preferred for direct perfumery applications. Other factors of significance in quality assessment are the appearance and cleanliness.

Oil of West Indian lemongrass: the standard specifications of the ISO (*ISO 3217–1974*), the BSI (*BS2999/35:1971*) and the EOA (*EOA No. 7:1963*) define this oil as the product of steam distillation of the grass of *Cymbopogon citratus* Stapf. The main requirements of these standards are:

	ISO 3217–1974	*BS2999/35: 1971*	*EOA No. 7: 1963*
Relative density at 20/20°C:	0.872 to 0.897	–	–
Apparent density at 20°C, g ml $^{-1}$:	–	0.870 to 0.895	–
Specific gravity at 25/25°C:	–	–	0.869 to 0.894
Refractive index at 20°C:	1.4830 to 1.4890	1.4830 to 1.4890	1.4830 to 1.4890
Optical rotation at 20°C:	–3° to +1°	–3° to +1°	–3° to +1°
Total aldehydes (carbonyls), expressed as citral:	75%, minimum	75%, minimum (denoted in the standard as a minimum carbonyl value of 276)	75%, minimum
Solubility in 70% (v/v) ethanol:	Freshly distilled oil soluble at 20°C	–	Soluble with cloudiness at 25°C

Oil of East Indian lemongrass: the standard specifications of the BSI (*BS2999/35: 1971*) and the EOA (*EOA No. 7:1963*) define this oil as the product of steam distillation of the grass of *Cymbopogon flexuosus* Stapf. The main requirements of these standards are:

	BS2999/35: 1971	*EOA No. 7: 1963*
Apparent density at 20°C, g ml $^{-1}$	0.893 to 0.903	–
Specific gravity at 25/25°C:	–	0.894 to 0.904
Refractive index:	1.4830 to 1.4890 at 20°C	1.4830 to 1.4890 at 25°C
Optical rotation at 20°C:	–3° to +1°	–3° to +1°
Solubility in 70% (v/v) ethanol:	1 volume in 3 volumes at 20°C	1 volume in 2–3 volumes at 25°C
Total aldehydes (carbonyls), expressed as citral:	72%, minimum (denoted in the standard as a minimum carbonyl value of 265)	75%, minimum

Oils of citronella

The principal quality assessment criteria for both Java-type and Ceylon-type citronella oil are the odour character and the chemical composition. In the case of Java-type citronella oil, particularly when purchased for fractionation purposes, the

minimum requirement for chemical composition specified in a contract is often 85% total alcohols (expressed as geraniol) and 35% total aldehydes (expressed as citronellal).

Oil of citronella, Java-type: the standard specifications of the ISO (*ISO 3848–1976*), the BSI (*BS2999/19: 1972*) and the EOA (EOA No. 14) define this oil as the product of steam distillation of the leaves of *Cymbopogon winterianus* Jowitt. The main requirements of these standards are:

	ISO 3848–1976	*BS2999/19:1972*	*EOA No. 14*
Relative density at 20/20°C:	0.880 to 0.895	–	–
Apparent density at 20°C, g ml $^{-1}$:	–	0.880 to 0.892	–
Specific gravity at 15/15°C:	–	–	0.883 to 0.900
Refractive index at 20°C:	1.4660 to 1.4730	1.4660 to 1.4730	1.4660 to 1.4750
Optical rotation at 20°C:	−5° to 0°	−5° to 0°	−6° to −0° 30′
Solubility in 80% (v/v) ethanol at 20°C:	1 volume in 2 volumes	1 volume in 2 volumes	1 volume in 1–2 volumes
Total alcohols, expressed as geraniol:	85%, minimum (denoted in standard as ester value after acetylation of 250, minimum)	85%, minimum (denoted in standard as ester value after acetylation of 251, minimum)	85% to 97%
Total aldehydes, expressed as citronellal:	35%, minimum (denoted in standard as carbonyl value of 127, minimum)	35%, minimum (denoted in standard as carbonyl value of of 127, minimum)	30% to 45%

Oil of citronella, Ceylon-type: the standard specifications of the BSI (*BS2999/18: 1972*) and the EOA (*EOA No. 12*) define this oil as the product of steam distillation of the leaves of *Cymbopogon nardus* (L.) Rendle var. *nardus*. The main requirements of these standards are:

	BS2999/18: 1972	*EOA No. 12*
Apparent density at 20°C, g ml $^{-1}$:	0.893 to 0.910	–
Specific gravity at 15°C:	–	0.898 to 0.910
Refractive index at 20°C:	1.4790 to 1.4850	1.4790 to 1.4850
Optical rotation at 20°C:	−18° to −9°	−18° to −9°
Solubility in 80% (v/v) ethanol at 20°C:	1 volume in 2 volumes	1 volume in 1–2 volumes
Total alcohols, expressed as geraniol:	59% to 65% (denoted in standard as ester value after acetylation of 185 to 201)	55% to 65%
Total aldehydes, expressed as citronellal:	7% to 15% (denoted in standard as carbonyl value of 25 to 55)	7% to 15%

Oil of *Eucalyptus citriodora*

Oil of *Eucalyptus citriodora* is primarily assessed on its odour character and its total aldehyde content (expressed as citronellal); the latter is of principal importance when the oil is to be used as a source of citronellal.

Standard specifications have been published by the ISO (*ISO 3044–1974*), the BSI (*BS2999/23:1972*) and the EOA (*EOA No. 130*) and these define the oil as the product of steam distillation of the leaves (and terminal branchlets) of *E. citriodora* Hook. The main requirements of these standards are:

	ISO 3044–1974	*BS2999/23:1972*	*EOA No. 130*
Relative density at 20/20°C:	0.858 to 0.877	–	–
Apparent density at 20°C, g ml $^{-1}$:	–	0.856 to 0.875	–
Specific gravity at 25/25°C:	–	–	0.860 to 0.875
Refractive index at 20°C:	1.4500 to 1.4590	1.4500 to 1.4590	1.4510 to 1.4640
Optical rotation at 20°C:	−2° to +4°	−2° to +4°	−0.5° to +2°
Solubility in ethanol at 20°C:	1 volume in 2 volumes of 80% (v/v) ethanol	1 volume in 2 volumes of 80% (v/v) ethanol	1 volume in 3 volumes of 70% (v/v) ethanol
Total aldehydes, expressed as citronellal:	70% (m/m), minimum	70%, minimum (denoted in standard as carbonyl value of 255, minimum)	65% to 85%

'Medicinal type' eucalyptus oils

'Medicinal type' eucalyptus oils are assessed primarily on their cineole content, the odour character and also, if intended for direct incorporation into medicinal formulations, on the content of undesirable constituents, specifically phellandrene

and isovaleraldehyde. An unrectified oil possessing a good cineole content (70% +) may suffer price penalties if it contains appreciable amounts of isovaleraldehyde; unrectified *E. smithii* oil, for example, can encounter this problem.

Standard specifications for the oil obtained by steam distillation of the leaves and terminal branchlets of *Eucalyptus globulus* Labillardiere have been published by the ISO (*ISO 770–1980*) and the BSI (*BS2999/53:1975*). The latter states that certain other (unspecified) species of eucalyptus may be used, but that the standard applies to oils rectified after distillation. The ISO has published a further standard (*ISO 3065–1974*) for oil of Australian eucalyptus (80–85% cineole content), which defines the oil as the product of the steam distillation of foliage of appropriate species of eucalyptus of Australian origin and possessing a cineole content in the range of 80% to 85%. The main requirements of these standards are:

	ISO 770–1980	*ISO 3065–1974*	*BS2999/53: 1975*
Apparent density at 20°C, g ml $^{-1}$:	–	–	0.904 to 0.924
Relative density at 20/20°C:	0.906 to 0.925	0.918 to 0.928	–
Refractive index at 20°C:	1.4590 to 1.4670	1.4580 to 1.4650	1.4580 to 1.4700
Optical rotation at 20°C:	0° to +10°	−2° to +2°	−5° to +10°
Solubility in 70% (v/v) ethanol at 20°C:	1 volume in 5 volumes	1 volume in 3 volumes	1 volume in 5 volumes
Cineole content (m/m)	70%, minimum	80% to 85%	70%, minimum

The requirements of the British Pharmacopoeia (1980) for rectified eucalyptus oil to be employed in medicinal formulations are rather more stringent. An oil which may conform to the ISO or BSI Standards can fail the BP requirement for the maximum permissible content of aldehydes.

APPENDIX C: FIRMS IN THE ESSENTIAL OILS TRADE (IN THE MARKETS SURVEYED)

The following list is not intended to be exhaustive and the inclusion of a firm's name implies no knowledge on the Institute's part of the financial standing of the firm concerned.

THE USA

Biddle Sawyer Corporation
2 Penn Plaza
New York
NY 10001
— Dealer

Bush Boake Allen Inc.
475 Walnut Street
Norwood
NJ 07648
— Processors/compounders

L.A. Champon and Co. Inc.
70 Hudson Street
Hoboken
NJ 07030
— Agents/brokers

Citrus and Allied Essences
65 S. Tyson Avenue
Floral Park
NY 11001
— Processors/compounders

Crompton and Knowles Corporation
17–01 Nevins Road
Fair Lawn
NJ 07410
— Compounders

Colgate–Palmolive Co. 300 Park Avenue New York NY 10022	End-users
Firmenich Inc. PO Box 5880 Princeton NJ 08540	Processors/compounders
Felton International Inc. 599 Johnson Avenue Brooklyn NY 11237	Flavour house
Fritzsche Dodge and Olcott Inc. 76 Ninth Avenue New York NY 10011	Processors/manufacturers
Givaudan Corporation 100 Delawanna Avenue Clifton NJ 07014	Processors/compounders
Haarmann and Reimer Corporation PO Box 175 Springfield NJ 07081	Processors/compounders
D. W. Hutchinson and Co. 700 South Columbus Avenue Mount Vernon NY 10550	Dealer
International Flavours and Fragrances (US) 600 State Highway 36 Hazlet NJ 07730	Processors/compounders
Ivolin Enterprises 500 Fifth Avenue Suite 4330 New York NY 10036	Dealer
Kalsec Inc. PO Box 511 Kalamazoo MI 49005	Flavour house
Lautier Aromatiques 5 Pearl Court Allendale NJ 07401	Processors/importers
Lever Brothers Co. 390 Park Avenue New York NY 10022	End-users

Ludwig Mueller Co. Inc. 2 Park Avenue New York NY 10016	Brokers
J. Manheimer Inc. 47–22 Pearson Place Long Island City NY 11101	Dealer
Naarden International USA Inc. 43–23 37th Avenue Long Island City NY 11101	Processors/compounders
Norda Inc. 140 Route 10 East Hanover NJ 07936	Processors/compounders
Polak's Frutal Works Inc. Middletown NY 10940	Processors/compounders
Polarome International Inc. 22 Ericsson Place New York	Dealer
SCM Organic Chemicals Clark Road PO Box 389 Jacksonville FL 32201	Manufacturers of synthetic perfumery and flavouring materials
E. L. Scott and Co. Inc. 1 World Trade Centre Suite 2347 New York NY 10048	Agents
George Uhe Co. Inc. 76 Ninth Avenue New York NY 10011	Broker
Ungerer and Company 4 Bridgewater Lane PO Box U Lincoln Park NJ 07035	Processors/manufacturers
Union Camp Corporation PO Box 60369 Jacksonville FL 32205	Manufacturers of aromatic products
The John D. Walsh Co. 65 Glen Avenue Glen Rock NJ 07452	Broker

Takasago USA Inc. Volvo Drive Rockleigh NJ 07647	Processors/manufacturers
A. M. Todd Company Kalamazoo MI 49005	Dealer

THE UNITED KINGDOM

Bush Boake Allen Ltd Blackhorse Lane London E17 5QP	Processors/compounders
H. E. Daniel Ltd Longfield Road Tunbridge Wells Kent	Dealers/processors/compounders
Dragoco (GB) Ltd Lady Lane Industrial Estate Hadleigh Ipswich Suffolk IP7 6AX	Processors/dealers
T.M. Duche and Sons (UK) Ltd Berisford House 50 Mark Lane London EC3R 7QS	Dealers/merchants
S. Figgis and Co. Ltd 53 Aldgate High Street London EC3N 1LU	Brokers
Fuerst Day Lawson Ltd 1 Leadenhall Street London EC3V 1JH	Dealers
Lionel Hitchen (Essential Oils) Ltd 50 Albert Road North Reigate Surrey	Processors/compounders
International Flavours and Fragrances (GB) Ltd Crown Road Southbury Road Enfield Middlesex EN1 1TX	Processors/compounders
Pauls and Whites International Albert Road North Reigate Surrey	Manufacturers of flavouring essences
P. P. F. International Dock Road South Bromborough Port The Wirral Merseyside	End-users flavour and feedstuff manufacturers

Proprietary Perfumes and Flavours International Ashford Kent	Processors/compounders
R. Sarant and Co. Ltd Priestley Road Basingstoke Hants RG24 9PU	Dealers/compounders
R. C. Treatt and Co. Ltd Northern Way Bury St Edmunds Suffolk	Dealers
Ungerer and Co. Ltd Flint Road Letchworth Hertfordshire SG6 1HJ	Compounders
A. E. Wells and Co. (Produce) Ltd 500 Old Kent Road London SE1 5AH	Dealers
Zimmermann Hobbs Ltd Dawson Road Bletchley Milton Keynes Bucks MK1 1JR	Compounders

FRANCE

Adrian SA 15 rue de Cassis 13008 Marseille	Dealers
Benard et Honnorat SA BP 67 06332 Grasse	Processors/compounders
Madame Boyer 62 rue Lafayette 75009 Paris	Brokers
Pierre Chauvet SA 83770 Seillans	Essence manufacturers
Les Fils et Petits-Fils de Maurice Duclos 8 Place Vendôme 75001 Paris	Brokers
Lautier Fils 06 Grasse	Processors/compounders
V. Mane Fils 06620 Bar-sur-Loup	Processors/compounders
Naarden International (France) SA 06 Grasse	Processors/compounders

Syndicat National des Fabricants de Produits Aromatiques ('Prodarom') 7 rue Gazan 06 Grasse	Trade association
P. Robertet et Co. Avenue Sidi-Brahim 06333 Grasse	Processors/compounders
Roure Bertrand Dupont SA 27 av Pierre-Sémard 06130 Grasse	Processors/compounders
Schmoller et Bompard Chemin de la Madeleine 06331 Grasse	Processors/compounders

THE FEDERAL REPUBLIC OF GERMANY

Cornehls und Bosse bei den Mühren 91 2000 Hamburg 11	Broker
Dragoco GmbH D–3450 Holzminden	Processors/compounders
Hermann Düllberg Alsterdorferstrasse 19 D–2000 Hamburg	Essential oil manufacturers
Frey und Lau Behringstrasse 116 D–2000 Hamburg 50	Essential oil manufacturers
Haarmann und Reimer GmbH D–3450 Holzminden	Processors/compounders
Paul Kaders GmbH Postfach 11 12 80 2000 Hamburg 11	Dealers
C. Melchers and Co. 48a Steindamm D–2820 Bremen 77	Dealers
Worlee–Drogen Bellevue 7–8 2000 Hamburg 60	Dealers

THE NETHERLANDS

International Flavours and Fragrances (Nederland) bv Zevenheuvelenweg 60 5048 AN Tilburg	Processors/compounders
Maschmeijer Aromatics PO Box 4170 Omval 81 1009 AD Amsterdam	Processors/compounders

Mirandolle, Voute and Co bv Maasstraat 12a—14a 3016 DC Rotterdam	Dealers/agents
Naarden International PO Box 2 1400 CA Naarden—Bussum	Processors/compounders
Polak's Frutal Works Nijverheidsweg Zuid 7 Amersfoort	Processors/compounders
A. Valenkamp bv Prins Hendrikkade 152 1011 AW Amsterdam	Broker

SWITZERLAND

Jules Chiquet SA Dreispitzstrasse 11 Bau 181 4142 Basle	Dealer
Firmenich SA CH—1211 Geneva 8	Processors/compounders
Givaudan SA CH—1214 Vernier-Geneva	Processors/compounders
Puressence Zürich Blümlisalpstrasse 3 8033 Zürich	Dealer

Printed in the UK for HMSO Dd8304895 4/83 (213)