NUTMEG AND DERIVATIVES

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1994
The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization (FAO) of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The opinion expressed in the document are those of the author(s) and do not necessarily reflect the opinion on the part of the FAO.
PREFACE

This document consists of two related reports: (i) Nutmeg Processing and Marketing in Grenada prepared by Dr. Dilon Daniel and (ii) Nutmeg, Mace and their By-Products: A Market Overview prepared by the Trade Information Service of the International Trade Centre UNCTAD/GATT.

These reports form part of the several studies on Non-Wood Forest Products (NWFP), commissioned by FAO. In the two reports, the authors have used different sources of relevant information. No attempt has been made to reconcile differences, if any, in the statistical information provided.

This document, along with other similar and related studies, will be used for preparing a substantial publication of wider coverage on NWFP.

Comments on the document (along with supporting materials as relevant) may kindly be sent to:

C. Chandrasekharan
Chief, Non-Wood Products and Energy Branch
Forest Products Division
FAO
Viale delle Terme di Caracalla
00100 Rome
Italy
TABLE OF CONTENTS

PREFACE

REPORT No. 1

List of Abbreviations
Executive Summary
1. Background Information and Trends Relating to the Growing, Management, Production, and Trade of Nutmeg/Nutmeg Products in Grenada
2. Relative Importance of Nutmeg in Providing Income, Employment and Export Earnings
3. Constraints/Problems Faced by Grenada in Nutmeg Production and Trade, and Proposed Solutions
4. Definition of Terms
5. Description of Components of Nutmeg
6. The Present Market Status of the Vegetable Fats and Oleochemical Industries
7. Market Analysis for Trimyristin and Myristic Acid
8. Recommendations

Endnotes

TABLES

Table 1: Grenada’s Nutmeg and Mace Production 1986-1993 (tons)
Table 2: Export Quantities of Nutmeg and Mace and Total Earnings for the Period 1986-1993
Table 3: Prices Received by Grenada for its Nutmeg and Mace for the Period 1988-1993 (US$)
Table 4: US Imports of Nutmeg for Consumption
Table 5: US Imports of Mace for Consumption
Table 6: US Imports of Nutmeg Oil for Consumption
Table 7: EEC Imports of Nutmeg for Manufacture of Nutmeg Oil
Table 8: Sources of Trimyristin
Table 9: World Production of Oils and Fats by Source (million metric tons) 15
Table 10: World Oil and Fat Production by Geographic Region (million metric tons) 16
Table 11: Prices of Major Raw Materials of Oleochemicals 16
Table 12: Relative Fatty Acid Composition 17
Table 13: World Fatty Acid Production, 1988-2000 (1,000 MT) 18
Table 14: Consumption of Natural Fatty Acids, 1987-1992 (1,000 MT) 18
Table 15: World Glycerine Production, Consumption and Capacity, 1988 (1,000 MT) 19
Table 16: World Production of Basic Natural Oleochemicals By-Product Group, 1988-2000 (1,000 MT) 19
Table 17: World Production of Basic Oleochemicals by Region, 1988-2000 (1,000 MT) 19
Table 18: Listed Catalogue Price for Trimyristin 21
Table 19: US Imports of Industrial Mono Fatty Acids from Coconut, Palm Kernel, and Palm Oil 22
Table 20: Myristic Acid into Ports of New York and New Jersey 22
Table 21: Prices of Four Major Fatty Acids 22

APPENDICES

Appendix 1: Structure and Physical Properties of Nutmeg Oil Components 29
Appendix 2: Manufacturers and Suppliers of Myristic Acid and Myristyl Alcohol 31
Appendix 3: Price Quote for a Gas Chromatograph Machine 33
Appendix 4: Companies Presently Selling Trimyristin as a Laboratory Reagent 37
Appendix 5: Companies Selling Oils and Fats Extraction Equipment 39
Appendix 6: Estimate for a Pilot Study to be Conducted at Texas A and M University and Price Quotation for Equipments Necessary for the Production of Trimyristin on a Commercial Scale, from Crown Iron Works 41

(vi)
REPORT No. 2

List of Abbreviations 50
List of ACP and LDCs 51

1. Nutmeg and Mace - World Overview 53
2. Nutmeg and Mace - European Union Overview 59
3. Nutmeg and Mace - USA 65
4. Nutmeg and Mace - Japan 69
5. Nutmeg and Mace - India 71
6. Derivatives of Nutmeg and Mace - Market Overview 75

TABLES

Table 1: Minimum Export Prices Agreed to by Indonesian and Grenadian Producers Under ‘Marketing Agreement’ in 1987 54
Table 2: MNS Prices for Nutmegs and Mace as on 29 April 1994 56
Table 3: Customs Tariffs in the EU for Imports of Nutmeg and Mace 60
Table 4: Customs Charges in USA for Imports of Nutmeg and Mace 66
Table 5: Main Suppliers of Nutmeg Oil to the US Market 76

APPENDICES

Appendix 1: Statistical Annexes 83
Appendix 2: List of Importers 97
REPORT No. 1

Nutmeg Processing and Marketing in Grenada

prepared by

Dilon Daniel
### LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAI%</td>
<td>Average Annual Percent Increase</td>
</tr>
<tr>
<td>FELDA</td>
<td>Malaysian Federal Land Development Authority</td>
</tr>
<tr>
<td>g</td>
<td>gram</td>
</tr>
<tr>
<td>GCNA</td>
<td>Grenada Cooperative Nutmeg Association</td>
</tr>
<tr>
<td>GC</td>
<td>Gas Chromatography</td>
</tr>
<tr>
<td>Inform</td>
<td>International News on Fats and Oils and Related Materials</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogramme</td>
</tr>
<tr>
<td>MT</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>$</td>
<td>Dollars</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>USDA</td>
<td>US Department of Agriculture</td>
</tr>
</tbody>
</table>

TABLE OF CONTENTS

Executive Summary

1. Background Information and Trends Relating to the Growing, Management, Production, and Trade of Nutmeg/Nutmeg Products in Grenada

2. Relative Importance of Nutmeg in Providing Income, Employment and Export Earnings

3. Constraints/Problems Faced by Grenada in Nutmeg Production and Trade, and Proposed Solutions

4. Definition of Terms

5. Description of Components of Nutmeg

6. The Present Market Status of the Vegetable Fats and Oleochemical Industries

7. Market Analysis for Trimyristin and Myristic Acid

8. Recommendations

Endnotes

TABLES

Table 1: Grenada’s Nutmeg and Mace Production 1986-1993 (tons)

Table 2: Export Quantities of Nutmeg and Mace and Total Earnings for the Period 1986-1993

Table 3: Prices Received by Grenada for its Nutmeg and Mace for the Period 1988-1993 (US$)

Table 4: US Imports of Nutmeg for Consumption

Table 5: US Imports of Mace for Consumption

Table 6: US Imports of Nutmeg Oil for Consumption

Table 7: EEC Imports of Nutmeg for Manufacture of Nutmeg Oil

Table 8: Sources of Trimyristin

Table 9: World Production of Oils and Fats by Source (million metric tons)
APPENDICES

Table 10: World Oil and Fat Production by Geographic Region (million metric tons) 16
Table 11: Prices of Major Raw Materials of Oleochemicals 16
Table 12: Relative Fatty Acid Composition 17
Table 13: World Fatty Acid Production, 1988-2000 (1,000 MT) 18
Table 14: Consumption of Natural Fatty Acids, 1987-1992 (1,000 MT) 18
Table 15: World Glycerine Production, Consumption and Capacity, 1988 (1,000 MT) 19
Table 16: World Production of Basic Natural Oleochemicals By-Product Group, 1988-2000 (1,000 MT) 19
Table 17: World Production of Basic Oleochemicals by Region, 1988-2000 (1,000 MT) 19
Table 18: Listed Catalogue Price for Trimiystin 21
Table 19: US Imports of Industrial Mono Fatty Acids from Coconut, Palm Kernel, and Palm Oil 22
Table 20: Myristic Acid into Ports of New York and New Jersey 22
Table 21: Prices of Four Major Fatty Acids 22

APPENDICES

Appendix 1: Structure and Physical Properties of Nutmeg Oil Components 29
Appendix 2: Manufacturers and Suppliers of Myristic Acid and Myristyl Alcohol 31
Appendix 3: Price Quote for a Gas Chromatograph Machine 33
Appendix 4: Companies Presently Selling Trimiystin as a Laboratory Reagent 37
Appendix 5: Companies Selling Oils and Fats Extraction Equipment 39
Appendix 6: Estimate for a Pilot Study to be Conducted at Texas A and M University and Price Quotation for Equipments Necessary for the Production of Trimiystin on a Commercial Scale, from Crown Iron Works 41

(xii)
EXECUTIVE SUMMARY

Questions Addressed

The feasibility of extracting individual components from nutmeg and marketing these components is reported in this document. Within this context, an analysis was conducted of the trend in nutmeg production and trade in Grenada along with the importance of this crop as a source of income to the populace. A thorough scientific investigation of the individual compounds found in nutmeg and the viability of extracting these compounds was also covered. Finally, an economic evaluation is discussed in terms of cost of production, marketing and revenue outlook of extracting these components, and recommendations are made based on the findings.

Summary of Findings

Nutmeg production continues to play a pivotal role as a source of income, employment and revenue for Grenada. However, the recent decline in the nutmeg trading price on the international market has seriously affected the economy of the country.

Upon examination of diversifying the uses of nutmeg, one of its components, trimyristin, was seen as a potential marketable product. Trimyristin is a fat, and it comprises approximately 40% by weight of the nutmeg seed. A by-product of trimyristin is myristic acid, and this carboxylic acid is used commercially in the soap and cosmetic industry.

Another possible marketable product is nutmeg oil. Nutmeg oil, which is the essential or volatile oil of nutmeg, is approximately 12% by weight of the nutmeg seed. A steam distillation plant is under construction in Grenada to obtain the nutmeg oil. However, once the nutmeg oil is removed by the steam distillation, if nothing is done with the remaining components of the nutmeg, then 88% of the nutmeg seed is discarded. Most importantly, the trimyristin which is a potentially marketable product, will be lost. Trimyristin can be sold as any other fat or oil to be used as a source for making fatty acids, fatty alcohols, or glycerol which are used for the soap, cosmetic and oleochemical industries. Moreover, the equipment used to extract trimyristin from nutmeg can also be used to extract other products such as coconut oil from copra. Thus, the marketing potential of trimyristin demands that a pilot study be conducted on its extraction from nutmeg to evaluate the possible commercial production of this fat.
NUTMEG PROCESSING AND MARKETING IN GRENADA

1. Background Information and Trends Relating to the Growing, Management, Production, and Trade of Nutmeg/Nutmeg Products in Grenada

Most of Grenada's nutmeg is grown inland in areas of higher altitude, greater than 100 meters above sea level. About three to five years after planting the nutmeg, the nutmeg tree (Myristica fragrans) begins to bear fruits which turn yellow in colour upon ripening. The yellow fruits split open to expose a shining dark brown nut that is surrounded by a bright red lace-like covering called mace. Inside of the dark brown nut is the light brown nutmeg seed.

Grenada produces over 23% of the world's nutmeg, which is second to Indonesia which produces 73% of the world's nutmeg. Nutmeg in Grenada is grown by both large and small farmers. Over the years, 1951-1993, 29% of the growers in Grenada had annual average deliveries of less than 100 pounds (or 45.41 kg). The seventy-six largest producers which comprise 0.5% of the nutmeg farming population contributed, on an annual average, deliveries in excess of 10,000 pounds (or 4,541 kg). As a group, they have been responsible for approximately 20% of Grenada's annual production in terms of volume. The structure of the industry as it relates to farm size, over time, has not changed in any significant manner.

Both nutmeg and mace are traded regionally and extra-regionally. Mace is removed from the nutmeg, washed and sun-dried for a few days until it becomes brittle. The mace is then sold to the receiving station for grading and packing. Nutmeg are dried, graded and bagged at the processing stations. Once the products have been packaged, they are ready for export.

Table 1: Grenada's Nutmeg and Mace Production 1986-1993 (tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Nutmeg</th>
<th>Mace</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>2,229</td>
<td>212</td>
</tr>
<tr>
<td>1987</td>
<td>2,687</td>
<td>304</td>
</tr>
<tr>
<td>1988</td>
<td>2,712</td>
<td>331</td>
</tr>
<tr>
<td>1989</td>
<td>2,691</td>
<td>283</td>
</tr>
<tr>
<td>1990</td>
<td>2,717</td>
<td>271</td>
</tr>
<tr>
<td>1991</td>
<td>2,622</td>
<td>236</td>
</tr>
<tr>
<td>1992</td>
<td>2,595</td>
<td>163</td>
</tr>
<tr>
<td>1993</td>
<td>2,347</td>
<td>102</td>
</tr>
</tbody>
</table>

Historically, the major markets for Grenada's nutmeg have been Holland, West Germany, United Kingdom, Belgium, Canada, Poland, Spain and Argentina. Although Holland provides Grenada with its largest single market of nutmeg exports, a significant amount of nutmeg reaching Holland is re-exported.

2. Relative Importance of Nutmeg in Providing Income, Employment and Export Earnings

The nutmeg industry is important as a provider of employment and income in Grenada. According to the Grenada Cooperative Nutmeg Association, about 7,000 to 10,000 small farmers are directly involved in the production of the crop. Conservative estimates claim that
not less than 35,000 persons in the farm household, or about one-third of Grenada's total population, depend directly on the nutmeg dollar. A further 500 persons find employment at the processing stations.

As seen in the tables below, over the last six financial years the export earnings derived from nutmeg have been on the decline. Export earnings have fallen from US $15,761,107 in 1988 to US $2,660,595 in 1993. During that same period farm income has declined both in absolute terms and as a share of export earnings. The Grenada Cooperative Nutmeg Association claims that whereas farm income was 83% of the 1988 export earnings, by the 1993 financial year the share had declined to 58%.

Some of the more important reasons for the decline in the performance of the industry are: decline in the world demand for raw nutmeg; the dismantling of the Grenada - Indonesia marketing arrangement; and, to a lesser extent, production expansion. Given the trends in the trade of nutmeg, the revival of the nutmeg industry would depend on the extent to which Grenada diversifies both the industry and the market.

Table 2: Export Quantities of Nutmeg and Mace and Total Earnings for the Period 1986-1993

<table>
<thead>
<tr>
<th>Year</th>
<th>Nutmeg (tons)</th>
<th>Mace (tons)</th>
<th>Total Export (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>3,362</td>
<td>217</td>
<td>7,690,957</td>
</tr>
<tr>
<td>1987</td>
<td>2,334</td>
<td>224</td>
<td>14,306,088</td>
</tr>
<tr>
<td>1988</td>
<td>2,230</td>
<td>256</td>
<td>15,761,107</td>
</tr>
<tr>
<td>1989</td>
<td>1,769</td>
<td>162</td>
<td>12,496,538</td>
</tr>
<tr>
<td>1990</td>
<td>1,900</td>
<td>173</td>
<td>10,912,888</td>
</tr>
<tr>
<td>1991</td>
<td>1,522</td>
<td>257</td>
<td>4,909,421</td>
</tr>
<tr>
<td>1992</td>
<td>1,577</td>
<td>201</td>
<td>3,620,911</td>
</tr>
<tr>
<td>1993</td>
<td>1,863</td>
<td>184</td>
<td>2,660,595</td>
</tr>
</tbody>
</table>

Table 3: Prices Received by Grenada for its Nutmeg and Mace for the Period 1988-1993 (US$)

<table>
<thead>
<tr>
<th>Year</th>
<th>Nutmeg/kg</th>
<th>No. 1 Mace/kg</th>
<th>No. 2 Mace/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>3.35</td>
<td>7.43</td>
<td>4.83</td>
</tr>
<tr>
<td>1989</td>
<td>3.22</td>
<td>7.38</td>
<td>4.08</td>
</tr>
<tr>
<td>1990</td>
<td>2.49</td>
<td>6.22</td>
<td>3.24</td>
</tr>
<tr>
<td>1991</td>
<td>1.26</td>
<td>2.62</td>
<td>1.43</td>
</tr>
<tr>
<td>1992</td>
<td>0.88</td>
<td>260</td>
<td>1.26</td>
</tr>
<tr>
<td>1993</td>
<td>0.57</td>
<td>2.53</td>
<td>0.81</td>
</tr>
</tbody>
</table>

3. **Constraints/Problems Faced by Grenada in Nutmeg Production and Trade, and Proposed Solutions**

Although Grenada continued to receive declining prices for its nutmeg and mace during the last five years, production of nutmeg during that period remained relatively constant. Therefore, the problem that the nutmeg industry faces lies in the nutmeg trade and not in its production.
The following information shows the market conditions for nutmeg and nutmeg products in the U.S. and European markets:

Table 4*: US Imports of Nutmeg for Consumption

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Total</td>
<td>135,206</td>
<td>196</td>
<td>1,685,231</td>
<td>2,358</td>
</tr>
<tr>
<td>Canada</td>
<td>---</td>
<td>---</td>
<td>1,077</td>
<td>3</td>
</tr>
<tr>
<td>Grenada</td>
<td>---</td>
<td>---</td>
<td>51,325</td>
<td>95</td>
</tr>
<tr>
<td>India</td>
<td>---</td>
<td>---</td>
<td>2,020</td>
<td>6</td>
</tr>
<tr>
<td>Indonesia</td>
<td>119,156</td>
<td>176</td>
<td>1,200,302</td>
<td>1,716</td>
</tr>
<tr>
<td>Italy</td>
<td>---</td>
<td>---</td>
<td>135</td>
<td>3</td>
</tr>
<tr>
<td>Madagascar</td>
<td>---</td>
<td>---</td>
<td>2,000</td>
<td>5</td>
</tr>
<tr>
<td>Netherlands</td>
<td>---</td>
<td>---</td>
<td>100,000</td>
<td>143</td>
</tr>
<tr>
<td>Singapore</td>
<td>16,050</td>
<td>20</td>
<td>323,600</td>
<td>381</td>
</tr>
<tr>
<td>St. Vincent and Grenadines</td>
<td>---</td>
<td>---</td>
<td>4,676</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 5*: US Imports of Mace for Consumption

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Total</td>
<td>18,965</td>
<td>23</td>
<td>219,949</td>
<td>456</td>
</tr>
<tr>
<td>Egypt</td>
<td>---</td>
<td>---</td>
<td>7,000</td>
<td>16</td>
</tr>
<tr>
<td>France</td>
<td>---</td>
<td>---</td>
<td>39</td>
<td>1</td>
</tr>
<tr>
<td>India</td>
<td>---</td>
<td>---</td>
<td>1,473</td>
<td>3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>10,120</td>
<td>17</td>
<td>145,394</td>
<td>305</td>
</tr>
<tr>
<td>Malaysia</td>
<td>---</td>
<td>---</td>
<td>425</td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>---</td>
<td>---</td>
<td>38,655</td>
<td>84</td>
</tr>
<tr>
<td>Peru</td>
<td>8,845</td>
<td>6</td>
<td>8,845</td>
<td>6</td>
</tr>
<tr>
<td>Singapore</td>
<td>---</td>
<td>---</td>
<td>18,118</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 6*: US Imports of Nutmeg Oil for Consumption

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Total</td>
<td>3,720</td>
<td>32</td>
<td>191,952</td>
<td>1,998</td>
</tr>
<tr>
<td>France</td>
<td>---</td>
<td>---</td>
<td>1,459</td>
<td>19</td>
</tr>
<tr>
<td>India</td>
<td>---</td>
<td>---</td>
<td>7,899</td>
<td>88</td>
</tr>
<tr>
<td>Indonesia</td>
<td>3,000</td>
<td>29</td>
<td>178,204</td>
<td>1,789</td>
</tr>
<tr>
<td>Mexico</td>
<td>---</td>
<td>---</td>
<td>1,690</td>
<td>54</td>
</tr>
<tr>
<td>Spain</td>
<td>---</td>
<td>---</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>720</td>
<td>3</td>
<td>2,601</td>
<td>47</td>
</tr>
</tbody>
</table>
Table 7: EEC Imports of Nutmeg for Manufacture of Nutmeg Oil

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (kg)</th>
<th>Quantity (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Total</td>
<td>58,928</td>
<td>33,528</td>
</tr>
<tr>
<td>Indonesia</td>
<td>30,480</td>
<td>5,080</td>
</tr>
<tr>
<td>Grenada</td>
<td>---</td>
<td>5,080</td>
</tr>
<tr>
<td>India</td>
<td>---</td>
<td>5,080</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>---</td>
<td>5,080</td>
</tr>
<tr>
<td>Intra-EEC</td>
<td>28,448</td>
<td>20,320</td>
</tr>
</tbody>
</table>

Note: Germany imported the largest quantity, 79% and 45% of EEC nutmeg imports for essential oil manufacture in 1991 and 1992, respectively. The second largest importer in 1991 was Ireland, 12%, and in 1992, the second largest importer was France, 24%.

The statistics in the tables above reveal that the US market is potentially the largest consumer market for nutmeg and related products, in particular nutmeg oil. Moreover, Grenada in 1992 exported to the US only 3% of the total 1.7 million kg of nutmeg exported to the US for consumption during this period while Indonesia exported 71.2%. In addition, of the 191,952 kg of nutmeg oil exported during 1992 to the US, Indonesia exported 92.8% while Grenada exported zero. This disparity of Grenada's portion in the US market becomes shockingly visible when taking into consideration that Grenada produces about 23% of the world’s nutmeg.8

In 1991, Grenada's Junior Agriculture Minister, Denis Noel reported that the prices of Grenada's nutmeg plummeted by more than 50% between 1990 and 1991. In 1992, Grenada's Agriculture Minister George Brizan said that the value of nutmeg and mace exports had slumped sharply from US $30 million total for both 1987 and 1988 to only US $8.5 million total for both 1991 and 1992. He also said that the price of nutmeg fell because of the end of the Indonesia-Grenada marketing agreement which had limited production to keep the nutmeg prices higher. Once the agreement ended in 1990, there was an oversupply of nutmeg and the prices drastically fell.9 It was hinted that the excess stocks of nutmeg in Grenada were to be burned if additional markets were not found.10

Because of the pathetic situation with the sales of nutmeg, the Grenada Cooperative Nutmeg Association (GCNA) was forced to sign an agreement in 1992 with J.H.B. International of Belgium to arrange through J.H.B.'s bankers, a financial package to make it possible for GCNA to continue operations of nutmeg, pay for the current nutmeg crop and increase its sale.11

From the above information, it is evident that Grenada faces a serious problem in marketing its nutmeg. It is conceivable that a more aggressive marketing strategy will give Grenada a bigger share, for example, of the US market. Recommendations to achieve this will be discussed under the recommendations section.

Although an increase in the market size of nutmeg would aid Grenada's present situation, it is doubtful that this alone would solve the problem completely since the prices of nutmeg have fallen to an all time low. One possible solution would be to diversify the uses of nutmeg. If
there is concurrently an increase in the supply of nutmeg by-products and a decrease in the supply of nutmeg, the price of nutmeg would have an elevating effect. Moreover, this would be a more profitable solution than simply burning the excess stocks of nutmeg.

The distillation plant to be constructed in Grenada to produce nutmeg oil is in line with finding alternative uses of nutmeg, in addition to only selling unprocessed nutmeg. This plant is estimated to cost EC $3 million (or US $1.11 million), and the expected capacity of production is approximately 32,000 kilograms of nutmeg oil. Since the estimated yield of this plant is 10% of the nutmeg, this steam distillation plant will consume 320,000 kilograms (or 315 tons) of nutmeg.\textsuperscript{12,13}

The production of nutmeg oil will aid in finding outlets for the excess nutmeg, which was created because of the depressed market. However, this will only consume a small percentage of Grenada’s potential output of nutmeg.

The remainder of this document will explore the possibility of obtaining other components of nutmeg that may be marketable, and thus, reduce Grenada’s dependence on selling only unprocessed nutmeg.

4. **Definition of Terms**

To aid in the understanding of the chemistry in this report, the following terms are defined:

**Organic compounds** - in general are compounds which contain carbon and hydrogen as the major elements

**Carboxylic acids** - are organic compounds which contain the functional group - COOH (Carboxy group)

**Fatty acids** - are long straight chain carboxylic acids which can be obtained from fats

**Alcohols** - are organic compounds that contain the functional group - OH (hydroxy group)

**Esters** - are derivatives of carboxylic acids and alcohols and contain the functional group - COOR

**Fats** - are naturally occurring esters of fatty acids and the alcohol glycerol (1,2,3-propanetriol). They are sometimes referred to as triglycerides

**Oils** - are fats that exist naturally as a liquid at or below room temperature

**Essential Oils** - are the water insoluble fractions obtained from plants or flowers via steam distillation. This fraction usually possess the characteristic odours identified with the plant or flower.

5. **Description of Components of Nutmeg**

The nutmeg seed is one of four components of the fruit obtained from the nutmeg tree, *Myristica fragans* Hoult (Myristicaceae). About 30-55% of the seed consists of oils and 45-60% consists of solid matter including cellulose materials. There are two types of oils: (1) The
"essential oil of nutmeg" also called the "volatile oil" accounts for 5-15% of the nutmeg seed and (2) the "fixed oil of nutmeg" sometimes called "nutmeg butter" or expressed oil of nutmeg accounts for 24-40% of the nutmeg seed. The relative percentages of the different components will vary depending on the geographical origin of the nutmeg. From this point on, "essential oil", "volatile oil", and "nutmeg oil" will be used interchangeably.

**Essential Oil**

Although the essential oil is present in lesser amounts than the fixed oil, the essential oil has received most of the investigative research efforts especially during the last twenty years. This is in accord with the fact that the essential oil contains the greater number of individual compounds or components, most of which are valuable in industries. Furthermore, the psychotropic effects of nutmeg as well as most of its other pharmacological properties have been attributed to the compounds found in the essential oil.

The essential oil is obtained from the nutmeg by steam distillation. It is a colourless or pale yellow liquid with a taste and odour of nutmeg. This oil is soluble in alcohol and insoluble in water and has a density, at 25°C of 0.859-0.924. Since it is light and air sensitive, it must be kept cool in a tightly closed container and protected from light.

**Components of the Essential Oil**

The first major successful analytical works to determine the constituents of nutmeg was performed by Frederick Power and Arthur Henry Salway from 1907 to 1908. They isolated and identified numerous compounds found in nutmeg. Around the 1960's, more compounds were identified by using modern techniques like gas-liquid chromatography.

The early articles on the chemistry of nutmeg, including the Merck Index, reported camphene and pinene as the major constituents of the essential oil. More recent articles show sabinene to be the major constituent of the essential oil. It is still questionable whether sabinene constitutes most of the essential oil because the latest Merck Index still shows camphene and pinene to be the major constituents of the essential oil.

From these analyses, a listing of the major components of the essential oil and their relative percentages is provided below. Note that either sabinene or camphene comprise about 50% of the essential oil:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sabinene</td>
<td>(50%)</td>
</tr>
<tr>
<td>or 2. Camphene</td>
<td>(50%)</td>
</tr>
<tr>
<td>3. d-Pinene</td>
<td>20%</td>
</tr>
<tr>
<td>4. Dipentene</td>
<td>8%</td>
</tr>
<tr>
<td>5. d-Linalool</td>
<td></td>
</tr>
<tr>
<td>6. d-Borneol</td>
<td></td>
</tr>
<tr>
<td>7. i-Terpineol</td>
<td></td>
</tr>
<tr>
<td>8. Geraniol</td>
<td></td>
</tr>
<tr>
<td>9. Myristicin</td>
<td></td>
</tr>
<tr>
<td>10. Safrole</td>
<td></td>
</tr>
<tr>
<td>11. Eugenol</td>
<td></td>
</tr>
<tr>
<td>12. iso Eugenol</td>
<td></td>
</tr>
</tbody>
</table>

In addition, a thorough listing of all the components that have been observed in the essential oil along with their classification based on type is given below:
Aromatic ethers
Methyl Eugenol
Methyl Iso-Eugenol
Methoxy Eugenol
Safrole
Iso-Elemicin
Methyl Eugenol
Methyl Iso-Eugenol
Methoxy Eugenol
Safrole
Iso-Elemicin

Terpenes
Alpha-Terpinene
Gamma-Terpinene
Alpha-Pinene
Beta-Pinene
Alpha-Phellandrene
Beta-Phellandrene
Alpha-Thujene
Myrcene
Terpinolene
Camphene
Uinonene (Dipentene)
Sabinene
Delta^3-Carene

Monoterpene Alcohol
Geraniol
Alpha-Terpineol
Citronellol
4-Terpineol
Beta-Terpineol
Linalool

Sesquiterpene
Caryophyllene

Terpinic Esters
Geranyl Acetate
Bornyl acetate
Linalyl Acetate

Acids
Formic
Butyric
Octanoic
Acetic

Aromatic hydrocarbons
P-Cymene
Toluene

The following compounds were identified only on the basis of retention times observed from gas chromatography.
Cumene
Camphor
Menthyl Isovalerate
Cyclamen Aldehyde
Menthone

The structures and physical properties of the major compounds in the essential oil is given in Appendix 1.
Uses of the Essential Oil

Because of its aroma, the essential oil has been used as a natural flavouring extract and as a perfume in the cosmetic industries. In particular, the oil has been used as a flavouring agent, replacing ground nutmeg in order to avoid leaving particles in foods and beverages. For example, it has been used to flavour baked goods, beverages, candies, meats and syrups.

The essential oil has found widespread use in the cosmetic industry when a spicy odour is required. For example, it has been employed as a flavour in dental creams in combination with peppermint, methyl salicylate and cloves.

In addition to its use in cosmetic industries, nutmeg oil is prominently used in the pharmaceutical industry. Historically, nutmeg has been used as a form of medicine to treat many illnesses ranging from those affecting the nervous system to the digestive system. Presently, the nutmeg oil is used by many pharmaceutical companies in their formulations of products to treat different illnesses. In 1992, Procter and Gamble launched a non-drowsy and alcohol-free Vicks cough syrup and the essential oil of nutmeg is a major ingredient. Robinson-Health Care in Britain in 1991 also marketed an impregnated tissue called Easy Breather Tissue which helps to clear congestion, and the essential oil of nutmeg was also an active ingredient. In that same year, Ramedica International Corp. marketed in the USA, a pain relieving ointment called Ramedica Herbal Wonder Balm, and nutmeg oil was again one of the active ingredients. This shows that the essential oil of nutmeg continues its historical importance as a major pharmaceutical ingredient.

Discussion on Some of the Major Components of the Essential Oil

Most of the following information on components of the essential oil including the physical properties in Appendix I was taken from Merck Index, 11th edition and the CRC handbook of Physics and Chemistry.

(i) Sabinene - no information was available on the uses of sabinene

(ii) Camphene and its derivatives are widely used in numerous industrial processes and manufactures. A striking illustration of camphene’s industrial importance is shown in the scheme below: Camphene can be easily converted to these other compounds.

```
Camphene → Camphor → Isoborneol
```

Thus, camphene is used in the manufacture of camphor and its related compounds. Camphene and its chloro-derivative have strong antibacterial, antifungal, and insecticidal properties. Many of camphene derivatives are known pharmaceutical drugs, and camphene itself has been shown to prevent atheromatosis of the aorta in some animals.

(iii) d-Pinene accounts for 8-20% of the essential oil of nutmeg. This compound is used widely in industry. It is used in the manufacture of camphor (3/4 of US camphor is made from d-pinene), solvents, plasticizers, perfume bases and synthetic pine oil.

(iv) Dipentene is the dl-form of limonene or the inactive limonene. This terpene is used as a solvent and also a wetting and dispersing agent. It is also used in the manufacture of resins.
(v) d-Linalool is also called coriandrol and is used in perfumery substituting for bergamot oil or french lavender.

(vi) d-Borneol exists mostly as an acetate ester in nutmeg rather than the free alcohol. The acetate ester and other ester derivatives of borneol are used in the manufacturing industries. In addition, some free borneol, ie, the alcohol, is used in perfumery and incense making.

(vii) i- Terpineol is used as an antiseptic. It is also used in the making of perfumes and in soap manufacturing.

(viii) Geraniol is used mainly in perfumery because of its sweet rose aroma. Some of its esters such as butyrate is used for making artificial attar of rose.

(ix) Myristicin is the most studied individual compound found in nutmeg, especially its pharmacological properties. This compound is thought to be responsible for the hallucinogenic effect of nutmeg oil. However, the evidence is not very clear as to whether other compounds are involved since natural myristicin is more potent than synthetic myristicin.

(x) Safrole is used industrially in perfumery, and in the manufacturing of heliotropin and in the denaturing of fats in soap manufacture. Medically, it is used as an antiseptic.

(xi) Eugenol is used in the manufacture of vanillin, and in perfumery, instead of oil of cloves. Eugenol is also used as a dental analgesic.

(xii) iso-eugenol, like eugenol, is used in the manufacture of vanillin.

Fixed Oil of Nutmeg

Depending upon the method used to obtain the fixed oil of nutmeg from the seed, varying amounts of essential oil will be present in the fixed oil. There are two general ways in which the fixed oil of nutmeg is extracted from nutmeg. In the first process, the ground nutmeg is subjected to intense hydraulic pressure and heat. The other method employs a solvent, for example, diethyl ether. In this process, the ground nutmeg is reflux with diethyl ether, and after filtering off the solid residue, the diethyl ether is distilled off from the filtrate to leave behind the crude fixed oil. These two processes will result in the crude fixed oil containing substantial quantities of essential oil. The quantities of essential oil vary between 10-12%. If the essential oil is removed by steam distillation prior to extracting the crude fixed oil, then the fixed oil of nutmeg will contain only trace amounts of essential oil.

Unlike the liquid essential oil, the fixed oil is a semi-solid, reddish brown material with both the smell and taste of nutmeg. It melts at 45-51°C and has a density of 0.990-0.995. Like most oils, it is completely soluble in hot alcohol, however, sparingly soluble in cold alcohol. The fixed oil is freely soluble in ether and chloroform.

The fixed oil of nutmeg has not been subjected to as much investigative research as the essential oil. One possible reason is because of the small number of compounds that are present in the fixed oil.
This document consists of two related reports: (i) Nutmeg Processing and Marketing in Grenada prepared by Dr. Dilon Daniel and (ii) Nutmeg, Mace and their By-Products: A Market Overview prepared by the Trade Information Service of the International Trade Centre UNCTAD/GATT.

These reports form part of the several studies on Non-Wood Forest Products (NWFP), commissioned by FAO. In the two reports, the authors have used different sources of relevant information. No attempt has been made to reconcile differences, if any, in the statistical information provided.

This document, along with other similar and related studies, will be used for preparing a substantial publication of wider coverage on NWFP.

Comments on the document (along with supporting materials as relevant) may kindly be sent to:

C. Chandrasekharan
Chief, Non-Wood Products and Energy Branch
Forest Products Division
FAO
Viale delle Terme di Caracalla
00100 Rome
Italy
TABLE OF CONTENTS

PREFACE

REPORT No. 1

List of Abbreviations  x
Executive Summary  1

1. Background Information and Trends Relating to the Growing, Management, Production, and Trade of Nutmeg/Nutmeg Products in Grenada  2

2. Relative Importance of Nutmeg in Providing Income, Employment and Export Earnings  2

3. Constraints/Problems Faced by Grenada in Nutmeg Production and Trade, and Proposed Solutions  3

4. Definition of Terms  6

5. Description of Components of Nutmeg  6

7. The Present Market Status of the Vegetable Fats and Oleochemical Industries  15

8. Market Analysis for Trimyristin and Myristic Acid  20

9. Recommendations  23

Endnotes  25

TABLES

Table 1: Grenada’s Nutmeg and Mace Production 1986-1993 (tons) 2
Table 2: Export Quantities of Nutmeg and Mace and Total Earnings for the Period 1986-1993 3
Table 3: Prices Received by Grenada for its Nutmeg and Mace for the Period 1988-1993 (US$) 3
Table 4: US Imports of Nutmeg for Consumption 4
Table 5: US Imports of Mace for Consumption 4
Table 6: US Imports of Nutmeg Oil for Consumption 4
Table 7: EEC Imports of Nutmeg for Manufacture of Nutmeg Oil 5
Table 8: Sources of Trimyristin 12
Table 9: World Production of Oils and Fats by Source (million metric tons) 15
Table 10: World Oil and Fat Production by Geographic Region (million metric tons) 16
Table 11: Prices of Major Raw Materials of Oleochemicals 16
Table 12: Relative Fatty Acid Composition 17
Table 13: World Fatty Acid Production, 1988-2000 (1,000 MT) 18
Table 14: Consumption of Natural Fatty Acids, 1987-1992 (1,000 MT) 18
Table 15: World Glycerine Production, Consumption and Capacity, 1988 (1,000 MT) 19
Table 16: World Production of Basic Natural Oleochemicals By-Product Group, 1988-2000 (1,000 MT) 19
Table 17: World Production of Basic Oleochemicals by Region, 1988-2000 (1,000 MT) 19
Table 18: Listed Catalogue Price for Trimyristin 21
Table 19: US Imports of Industrial Mono Fatty Acids from Coconut, Palm Kernel, and Palm Oil 22
Table 20: Myristic Acid into Ports of New York and New Jersey 22
Table 21: Prices of Four Major Fatty Acids 22

APPENDICES

Appendix 1: Structure and Physical Properties of Nutmeg Oil Components 29
Appendix 2: Manufacturers and Suppliers of Myristic Acid and Myristyl Alcohol 31
Appendix 3: Price Quote for a Gas Chromatograph Machine 33
Appendix 4: Companies Presently Selling Trimyristin as a Laboratory Reagent 37
Appendix 5: Companies Selling Oils and Fats Extraction Equipment 39
Appendix 6: Estimate for a Pilot Study to be Conducted at Texas A and M University and Price Quotation for Equipments Necessary for the Production of Trimyristin on a Commercial Scale, from Crown Iron Works 41

(vi)
REPORT No. 2

List of Abbreviations 50
List of ACP and LDCs 51
1. Nutmeg and Mace - World Overview 53
2. Nutmeg and Mace - European Union Overview 59
3. Nutmeg and Mace - USA 65
4. Nutmeg and Mace - Japan 69
5. Nutmeg and Mace - India 71
6. Derivatives of Nutmeg and Mace - Market Overview 75

TABLES

Table 1: Minimum Export Prices Agreed to by Indonesian and Grenadian Producers Under ‘Marketing Agreement’ in 1987 54
Table 2: MNS Prices for Nutmegs and Mace as on 29 April 1994 56
Table 3: Customs Tariffs in the EU for Imports of Nutmeg and Mace 60
Table 4: Customs Charges in USA for Imports of Nutmeg and Mace 66
Table 5: Main Suppliers of Nutmeg Oil to the US Market 76

APPENDICES

Appendix 1: Statistical Annexes 83
Appendix 2: List of Importers 97
REPORT No. 1

Nutmeg Processing and Marketing in Grenada

prepared by

Dilon Daniel
**LIST OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAI%</td>
<td>Average Annual Percent Increase</td>
</tr>
<tr>
<td>FELDA</td>
<td>Malaysian Federal Land Development Authority</td>
</tr>
<tr>
<td>g</td>
<td>gram</td>
</tr>
<tr>
<td>GCNA</td>
<td>Grenada Cooperative Nutmeg Association</td>
</tr>
<tr>
<td>GC</td>
<td>Gas Chromatography</td>
</tr>
<tr>
<td>Inform</td>
<td>International News on Fats and Oils and Related Materials</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogramme</td>
</tr>
<tr>
<td>MT</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>$</td>
<td>Dollars</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>USDA</td>
<td>US Department of Agriculture</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS

Executive Summary

1. Background Information and Trends Relating to the Growing, Management, Production, and Trade of Nutmeg/Nutmeg Products in Grenada

2. Relative Importance of Nutmeg in Providing Income, Employment and Export Earnings

3. Constraints/Problems Faced by Grenada in Nutmeg Production and Trade, and Proposed Solutions

4. Definition of Terms

5. Description of Components of Nutmeg

7. The Present Market Status of the Vegetable Fats and Oleochemical Industries

8. Market Analysis for Trimyristin and Myristic Acid

9. Recommendations

Endnotes

TABLES

Table 1: Grenada's Nutmeg and Mace Production 1986-1993 (tons)

Table 2: Export Quantities of Nutmeg and Mace and Total Earnings for the Period 1986-1993

Table 3: Prices Received by Grenada for its Nutmeg and Mace for the Period 1988-1993 (US$)

Table 4: US Imports of Nutmeg for Consumption

Table 5: US Imports of Mace for Consumption

Table 6: US Imports of Nutmeg Oil for Consumption

Table 7: EEC Imports of Nutmeg for Manufacture of Nutmeg Oil

Table 8: Sources of Trimyristin

Table 9: World Production of Oils and Fats by Source (million metric tons)
Table 10: World Oil and Fat Production by Geographic Region (million metric tons) 16
Table 11: Prices of Major Raw Materials of Oleochemicals 16
Table 12: Relative Fatty Acid Composition 17
Table 13: World Fatty Acid Production, 1988-2000 (1,000 MT) 18
Table 14: Consumption of Natural Fatty Acids, 1987-1992 (1,000 MT) 18
Table 15: World Glycerine Production, Consumption and Capacity, 1988 (1,000 MT) 19
Table 16: World Production of Basic Natural Oleochemicals By-Product Group, 1988-2000 (1,000 MT) 19
Table 17: World Production of Basic Oleochemicals by Region, 1988-2000 (1,000 MT) 19
Table 18: Listed Catalogue Price for Trimyristin 21
Table 19: US Imports of Industrial Mono Fatty Acids from Coconut, Palm Kernel, and Palm Oil 22
Table 20: Myristic Acid into Ports of New York and New Jersey 22
Table 21: Prices of Four Major Fatty Acids 22

APPENDICES

Appendix 1: Structure and Physical Properties of Nutmeg Oil Components 29
Appendix 2: Manufacturers and Suppliers of Myristic Acid and Myristyl Alcohol 31
Appendix 3: Price Quote for a Gas Chromatograph Machine 33
Appendix 4: Companies Presently Selling Trimyristin as a Laboratory Reagent 37
Appendix 5: Companies Selling Oils and Fats Extraction Equipment 39
Appendix 6: Estimate for a Pilot Study to be Conducted at Texas A and M University and Price Quotation for Equipments Necessary for the Production of Trimyristin on a Commercial Scale, from Crown Iron Works 41

(xii)
EXECUTIVE SUMMARY

Questions Addressed

The feasibility of extracting individual components from nutmeg and marketing these components is reported in this document. Within this context, an analysis was conducted of the trend in nutmeg production and trade in Grenada along with the importance of this crop as a source of income to the populace. A thorough scientific investigation of the individual compounds found in nutmeg and the viability of extracting these compounds was also covered. Finally, an economic evaluation is discussed in terms of cost of production, marketing and revenue outlook of extracting these components, and recommendations are made based on the findings.

Summary of Findings

Nutmeg production continues to play a pivotal role as a source of income, employment and revenue for Grenada. However, the recent decline in the nutmeg trading price on the international market has seriously affected the economy of the country.

Upon examination of diversifying the uses of nutmeg, one of its components, trimyristin, was seen as a potential marketable product. Trimyristin is a fat, and it comprises approximately 40% by weight of the nutmeg seed. A by-product of trimyristin is myristic acid, and this carboxylic acid is used commercially in the soap and cosmetic industry.

Another possible marketable product is nutmeg oil. Nutmeg oil, which is the essential or volatile oil of nutmeg, is approximately 12% by weight of the nutmeg seed. A steam distillation plant is under construction in Grenada to obtain the nutmeg oil. However, once the nutmeg oil is removed by the steam distillation, if nothing is done with the remaining components of the nutmeg, then 88% of the nutmeg seed is discarded. Most importantly, the trimyristin which is a potentially marketable product, will be lost. Trimyristin can be sold as any other fat or oil to be used as a source for making fatty acids, fatty alcohols, or glycerol which are used for the soap, cosmetic and oleochemical industries. Moreover, the equipment used to extract trimyristin from nutmeg can also be used to extract other products such as coconut oil from copra. Thus, the marketing potential of trimyristin demands that a pilot study be conducted on its extraction from nutmeg to evaluate the possible commercial production of this fat.
NUTMEG PROCESSING AND MARKETING IN GRENADE

1. **Background Information and Trends Relating to the Growing, Management, Production, and Trade of Nutmeg/Nutmeg Products in Grenada**

Most of Grenada’s nutmeg is grown inland in areas of higher altitude, greater than 100 meters above sea level. About three to five years after planting the nutmeg, the nutmeg tree (*Myristica fragrans*) begins to bear fruits which turn yellow in colour upon ripening. The yellow fruits split open to expose a shining dark brown nut that is surrounded by a bright red lace-like covering called mace. Inside of the dark brown nut is the light brown nutmeg seed.

Grenada produces over 23% of the world’s nutmeg, which is second to Indonesia which produces 73% of the world’s nutmeg. Nutmeg in Grenada is grown by both large and small farmers. Over the years, 1951-1993, 29% of the growers in Grenada had annual average deliveries of less than 100 pounds (or 45.41 kg). The seventy-six largest producers which comprise 0.5% of the nutmeg farming population contributed, on an annual average, deliveries in excess of 10,000 pounds (or 4,541 kg). As a group, they have been responsible for approximately 20% of Grenada’s annual production in terms of volume. The structure of the industry as it relates to farm size, over time, has not changed in any significant manner.

Both nutmeg and mace are traded regionally and extra-regionally. Mace is removed from the nutmeg, washed and sun-dried for a few days until it becomes brittle. The mace is then sold to the receiving station for grading and packing. Nutmeg are dried, graded and bagged at the processing stations. Once the products have been packaged, they are ready for export.

**Table 1**: Grenada’s Nutmeg and Mace Production 1986-1993 (tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Nutmeg</th>
<th>Mace</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>2,229</td>
<td>212</td>
</tr>
<tr>
<td>1987</td>
<td>2,687</td>
<td>304</td>
</tr>
<tr>
<td>1988</td>
<td>2,712</td>
<td>331</td>
</tr>
<tr>
<td>1989</td>
<td>2,691</td>
<td>283</td>
</tr>
<tr>
<td>1990</td>
<td>2,717</td>
<td>271</td>
</tr>
<tr>
<td>1991</td>
<td>2,622</td>
<td>236</td>
</tr>
<tr>
<td>1992</td>
<td>2,595</td>
<td>163</td>
</tr>
<tr>
<td>1993</td>
<td>2,347</td>
<td>102</td>
</tr>
</tbody>
</table>

Historically, the major markets for Grenada’s nutmeg have been Holland, West Germany, United Kingdom, Belgium, Canada, Poland, Spain and Argentina. Although Holland provides Grenada with its largest single market of nutmeg exports, a significant amount of nutmeg reaching Holland is re-exported.

2. **Relative Importance of Nutmeg in Providing Income, Employment and Export Earnings**

The nutmeg industry is important as a provider of employment and income in Grenada. According to the Grenada Cooperative Nutmeg Association, about 7,000 to 10,000 small farmers are directly involved in the production of the crop. Conservative estimates claim that
not less than 35,000 persons in the farm household, or about one-third of Grenada’s total population, depend directly on the nutmeg dollar. A further 500 persons find employment at the processing stations.

As seen in the tables below, over the last six financial years the export earnings derived from nutmeg have been on the decline. Export earnings have fallen from US $15,761,107 in 1988 to US $2,660,595 in 1993. During that same period farm income has declined both in absolute terms and as a share of export earnings. The Grenada Cooperative Nutmeg Association claims that whereas farm income was 83% of the 1988 export earnings, by the 1993 financial year the share had declined to 58%.

Some of the more important reasons for the decline in the performance of the industry are: decline in the world demand for raw nutmeg; the dismantling of the Grenada - Indonesia marketing arrangement; and, to a lesser extent, production expansion. Given the trends in the trade of nutmeg, the revival of the nutmeg industry would depend on the extent to which Grenada diversifies both the industry and the market.

Table 2: Export Quantities of Nutmeg and Mace and Total Earnings for the Period 1986-1993

<table>
<thead>
<tr>
<th>Year</th>
<th>Nutmeg (tons)</th>
<th>Mace (tons)</th>
<th>Total Export (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>3,362</td>
<td>217</td>
<td>7,690,957</td>
</tr>
<tr>
<td>1987</td>
<td>2,334</td>
<td>224</td>
<td>14,306,088</td>
</tr>
<tr>
<td>1988</td>
<td>2,230</td>
<td>256</td>
<td>15,761,107</td>
</tr>
<tr>
<td>1989</td>
<td>1,769</td>
<td>162</td>
<td>12,496,538</td>
</tr>
<tr>
<td>1990</td>
<td>1,900</td>
<td>173</td>
<td>10,912,888</td>
</tr>
<tr>
<td>1991</td>
<td>1,522</td>
<td>257</td>
<td>4,909,421</td>
</tr>
<tr>
<td>1992</td>
<td>1,577</td>
<td>201</td>
<td>3,620,911</td>
</tr>
<tr>
<td>1993</td>
<td>1,863</td>
<td>184</td>
<td>2,660,595</td>
</tr>
</tbody>
</table>

Table 3: Prices Received by Grenada for its Nutmeg and Mace for the Period 1988-1993 (US$)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutmeg/kg</td>
<td>3.35</td>
<td>3.22</td>
<td>2.49</td>
<td>1.26</td>
<td>0.88</td>
<td>0.57</td>
</tr>
<tr>
<td>No. 1 Mace/kg</td>
<td>7.43</td>
<td>7.38</td>
<td>6.22</td>
<td>2.62</td>
<td>2.60</td>
<td>2.53</td>
</tr>
<tr>
<td>No. 2 Mace/kg</td>
<td>4.83</td>
<td>4.08</td>
<td>3.24</td>
<td>1.43</td>
<td>1.26</td>
<td>0.81</td>
</tr>
</tbody>
</table>

3. **Constraints/Problems Faced by Grenada in Nutmeg Production and Trade, and Proposed Solutions**

Although Grenada continued to receive declining prices for its nutmeg and mace during the last five years, production of nutmeg during that period remained relatively constant. Therefore, the problem that the nutmeg industry faces lies in the nutmeg trade and not in its production.
The following information shows the market conditions for nutmeg and nutmeg products in the U.S. and European markets:

Table 44: US Imports of Nutmeg for Consumption

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>December 1992</td>
<td>January-December 1992</td>
<td></td>
<td></td>
</tr>
<tr>
<td>World Total</td>
<td>135,206</td>
<td>196</td>
<td>1,685,231</td>
<td>2,358</td>
</tr>
<tr>
<td>Canada</td>
<td>---</td>
<td>---</td>
<td>1,077</td>
<td>3</td>
</tr>
<tr>
<td>Grenada</td>
<td>---</td>
<td>---</td>
<td>51,325</td>
<td>95</td>
</tr>
<tr>
<td>India</td>
<td>---</td>
<td>---</td>
<td>2,020</td>
<td>6</td>
</tr>
<tr>
<td>Indonesia</td>
<td>119,156</td>
<td>176</td>
<td>1,200,302</td>
<td>1,716</td>
</tr>
<tr>
<td>Italy</td>
<td>---</td>
<td>---</td>
<td>135</td>
<td>3</td>
</tr>
<tr>
<td>Madagascar</td>
<td>---</td>
<td>---</td>
<td>2,000</td>
<td>5</td>
</tr>
<tr>
<td>Netherlands</td>
<td>---</td>
<td>---</td>
<td>100,000</td>
<td>143</td>
</tr>
<tr>
<td>Singapore</td>
<td>16,050</td>
<td>20</td>
<td>323,600</td>
<td>381</td>
</tr>
<tr>
<td>St. Vincent and Grenadines</td>
<td>---</td>
<td>---</td>
<td>4,676</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 55: US Imports of Mace for Consumption

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>December 1992</td>
<td>January-December 1992</td>
<td></td>
<td></td>
</tr>
<tr>
<td>World Total</td>
<td>18,965</td>
<td>23</td>
<td>219,949</td>
<td>456</td>
</tr>
<tr>
<td>Egypt</td>
<td>---</td>
<td>---</td>
<td>7,000</td>
<td>16</td>
</tr>
<tr>
<td>France</td>
<td>---</td>
<td>---</td>
<td>39</td>
<td>1</td>
</tr>
<tr>
<td>India</td>
<td>---</td>
<td>---</td>
<td>1,473</td>
<td>3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>10,120</td>
<td>17</td>
<td>145,394</td>
<td>305</td>
</tr>
<tr>
<td>Malaysia</td>
<td>---</td>
<td>---</td>
<td>425</td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>---</td>
<td>---</td>
<td>38,655</td>
<td>84</td>
</tr>
<tr>
<td>Peru</td>
<td>8,845</td>
<td>6</td>
<td>8,845</td>
<td>6</td>
</tr>
<tr>
<td>Singapore</td>
<td>---</td>
<td>---</td>
<td>18,118</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 66: US Imports of Nutmeg Oil for Consumption

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
<th>Quantity (kg)</th>
<th>Value (thousand US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>December 1992</td>
<td>January-December 1992</td>
<td></td>
<td></td>
</tr>
<tr>
<td>World Total</td>
<td>3,720</td>
<td>32</td>
<td>191,952</td>
<td>1,998</td>
</tr>
<tr>
<td>France</td>
<td>---</td>
<td>---</td>
<td>1,459</td>
<td>19</td>
</tr>
<tr>
<td>India</td>
<td>---</td>
<td>---</td>
<td>7,899</td>
<td>88</td>
</tr>
<tr>
<td>Indonesia</td>
<td>3,000</td>
<td>29</td>
<td>178,204</td>
<td>1,789</td>
</tr>
<tr>
<td>Mexico</td>
<td>---</td>
<td>---</td>
<td>1,690</td>
<td>54</td>
</tr>
<tr>
<td>Spain</td>
<td>---</td>
<td>---</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>720</td>
<td>3</td>
<td>2,601</td>
<td>47</td>
</tr>
</tbody>
</table>
Intra-EEC 28,448 20,320
Indonesia --- 5,080
Grenada --- 5,080
India --- 5,080
Sri Lanka --- 5,080
Intra-EEC 28,448 20,320

Note: Germany imported the largest quantity, 79% and 45% of EEC nutmeg imports for essential oil manufacture in 1991 and 1992, respectively. The second largest importer in 1991 was Ireland, 12%, and in 1992, the second largest importer was France, 24%.

The statistics in the tables above reveal that the US market is potentially the largest consumer market for nutmeg and related products, in particular nutmeg oil. Moreover, Grenada in 1992 exported to the US only 3% of the total 1.7 million kg of nutmeg exported to the US for consumption during this period while Indonesia exported 71.2%. In addition, of the 191,952 kg of nutmeg oil exported during 1992 to the US, Indonesia exported 92.8% while Grenada exported zero. This disparity of Grenada’s portion in the US market becomes shockingly visible when taking into consideration that Grenada produces about 23% of the world’s nutmeg. 8

In 1991, Grenada’s Junior Agriculture Minister, Denis Noel reported that the prices of Grenada’s nutmeg plummeted by more than 50% between 1990 and 1991. In 1992, Grenada’s Agriculture Minister George Brizan said that the value of nutmeg and mace exports had slumped sharply from US $30 million total for both 1987 and 1988 to only US $8.5 million total for both 1991 and 1992. He also said that the price of nutmeg fell because of the end of the Indonesia-Grenada marketing agreement which had limited production to keep the nutmeg prices higher. Once the agreement ended in 1990, there was an oversupply of nutmeg and the prices drastically fell.9 It was hinted that the excess stocks of nutmeg in Grenada were to be burned if additional markets were not found.10

Because of the pathetic situation with the sales of nutmeg, the Grenada Cooperative Nutmeg Association (GCNA) was forced to sign an agreement in 1992 with J.H.B. International of Belgium to arrange through J.H.B.’s bankers, a financial package to make it possible for GCNA to continue operations of nutmeg, pay for the current nutmeg crop and increase its sale.11

From the above information, it is evident that Grenada faces a serious problem in marketing its nutmeg. It is conceivable that a more aggressive marketing strategy will give Grenada a bigger share, for example, of the US market. Recommendations to achieve this will be discussed under the recommendations section.

Although an increase in the market size of nutmeg would aid Grenada’s present situation, it is doubtful that this alone would solve the problem completely since the prices of nutmeg have fallen to an all time low. One possible solution would be to diversify the uses of nutmeg. If
there is concurrently an increase in the supply of nutmeg by-products and a decrease in the supply of nutmeg, the price of nutmeg would have an elevating effect. Moreover, this would be a more profitable solution than simply burning the excess stocks of nutmeg.

The distillation plant to be constructed in Grenada to produce nutmeg oil is in line with finding alternative uses of nutmeg, in addition to only selling unprocessed nutmeg. This plant is estimated to cost EC $3 million (or US $1.11 million), and the expected capacity of production is approximately 32,000 kilograms of nutmeg oil. Since the estimated yield of this plant is 10% of the nutmeg, this steam distillation plant will consume 320,000 kilograms (or 315 tons) of nutmeg.\textsuperscript{12,13}

The production of nutmeg oil will aid in finding outlets for the excess nutmeg, which was created because of the depressed market. However, this will only consume a small percentage of Grenada’s potential output of nutmeg.

The remainder of this document will explore the possibility of obtaining other components of nutmeg that may be marketable, and thus, reduce Grenada’s dependence on selling only unprocessed nutmeg.

4. \textbf{Definition of Terms}

To aid in the understanding of the chemistry in this report, the following terms are defined:

- **Organic compounds** - in general are compounds which contain carbon and hydrogen as the major elements
- **Carboxylic acids** - are organic compounds which contain the functional group \(-\text{COOH}\) (Carboxy group)
- **Fatty acids** - are long straight chain carboxylic acids which can be obtained from fats
- **Alcohols** - are organic compounds that contain the functional group \(-\text{OH}\) (hydroxy group)
- **Esters** - are derivatives of carboxylic acids and alcohols and contain the functional group \(-\text{COOR}\)
- **Fats** - are naturally occurring esters of fatty acids and the alcohol glycerol (1,2,3-propanetriol). They are sometimes referred to as triglycerides
- **Oils** - are fats that exist naturally as a liquid at or below room temperature
- **Essential Oils** - are the water insoluble fractions obtained from plants or flowers via steam distillation. This fraction usually possess the characteristic odours identified with the plant or flower.

5. \textbf{Description of Components of Nutmeg}

The nutmeg seed is one of four components of the fruit obtained from the nutmeg tree, \textit{Myristica fragans} Houtt (Myristicaceae). About 30-55\% of the seed consists of oils and 45-60\% consists of solid matter including cellulose materials. There are two types of oils: (1) The
"essential oil of nutmeg" also called the "volatile oil" accounts for 5-15% of the nutmeg seed and (2) the "fixed oil of nutmeg" sometimes called "nutmeg butter" or expressed oil of nutmeg accounts for 24-40% of the nutmeg seed.14 The relative percentages of the different components will vary depending on the geographical origin of the nutmeg. From this point on, "essential oil", "volatile oil", and "nutmeg oil" will be used interchangeably.

Essential Oil

Although the essential oil is present in lesser amounts than the fixed oil, the essential oil has received most of the investigative research efforts especially during the last twenty years. This is in accord with the fact that the essential oil contains the greater number of individual compounds or components, most of which are valuable in industries. Furthermore, the psychotropic effects of nutmeg as well as most of its other pharmacological properties have been attributed to the compounds found in the essential oil.

The essential oil is obtained from the nutmeg by steam distillation. It is a colourless or pale yellow liquid with a taste and odour of nutmeg.15 This oil is soluble in alcohol and insoluble in water and has a density, at 25°C of 0.859-0.924. Since it is light and air sensitive, it must be kept cool in a tightly closed container and protected from light.16

Components of the Essential Oil

The first major successful analytical works to determine the constituents of nutmeg was performed by Frederick Power and Arthur Henry Salway from 1907 to 1908.17,18 They isolated and identified numerous compounds found in nutmeg. Around the 1960's, more compounds were identified by using modern techniques like gas-liquid chromatography.19

The early articles on the chemistry of nutmeg, including the Merck Index, reported camphene and pinene as the major constituents of the essential oil. More recent articles show sabinene to be the major constituent of the essential oil.20,21 It is still questionable whether sabinene constitutes most of the essential oil because the latest Merck Index still shows camphene and pinene to be the major constituents of the essential oil.

From these analyses, a listing of the major components of the essential oil and their relative percentages is provided below. Note that either sabinene or camphene comprise about 50% of the essential oil:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sabinene or Camphene</td>
<td>50%</td>
</tr>
<tr>
<td>2. Camphene</td>
<td>50%</td>
</tr>
<tr>
<td>3. d-Pinene</td>
<td>20%</td>
</tr>
<tr>
<td>4. Dipentene</td>
<td>8%</td>
</tr>
<tr>
<td>5. d-Linalool</td>
<td></td>
</tr>
<tr>
<td>6. d-Borneol</td>
<td></td>
</tr>
<tr>
<td>7. i-Terpineol</td>
<td></td>
</tr>
<tr>
<td>8. Geraniol</td>
<td></td>
</tr>
<tr>
<td>9. Myristicin</td>
<td></td>
</tr>
<tr>
<td>10. Safrole</td>
<td></td>
</tr>
<tr>
<td>11. Eugenol</td>
<td></td>
</tr>
<tr>
<td>12. iso Eugenol</td>
<td></td>
</tr>
</tbody>
</table>

In addition, a thorough listing of all the components that have been observed in the essential oil along with their classification based on type is given below:
<table>
<thead>
<tr>
<th>Aromatic ethers</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl Eugenol</td>
<td>Eugenol</td>
<td></td>
</tr>
<tr>
<td>Methyl Iso-Eugenol</td>
<td>Myristicin</td>
<td></td>
</tr>
<tr>
<td>Methoxy Eugenol</td>
<td>Elemicin</td>
<td></td>
</tr>
<tr>
<td>Safrole</td>
<td>Iso-Eugenol</td>
<td></td>
</tr>
<tr>
<td>Iso-Elemicin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terpenes</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha-Terpinene</td>
<td>Myrcene</td>
<td></td>
</tr>
<tr>
<td>Gamma-Terpinene</td>
<td>Terpinolene</td>
<td></td>
</tr>
<tr>
<td>Alpha-Pinene</td>
<td>Camphene</td>
<td></td>
</tr>
<tr>
<td>Beta-Pinene</td>
<td>Unonene (Dipentene)</td>
<td></td>
</tr>
<tr>
<td>Alpha-Phellandrene</td>
<td>Sabinene</td>
<td></td>
</tr>
<tr>
<td>Beta-Phellandrene</td>
<td>Delta²-Carene</td>
<td></td>
</tr>
<tr>
<td>Alpha-Thujene</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Monoterpene Alcohol</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Geraniol</td>
<td>4-Terpineol</td>
<td></td>
</tr>
<tr>
<td>Alpha-Terpineol</td>
<td>Beta-Terpineol</td>
<td></td>
</tr>
<tr>
<td>Citronellol</td>
<td>Linalool</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sesquiterpene</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Caryophyllene</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terpinic Esters</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Geranyl Acetate</td>
<td>Linalyl Acetate</td>
<td></td>
</tr>
<tr>
<td>Bornyl acetate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acids</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Formic</td>
<td>Octanoic</td>
<td></td>
</tr>
<tr>
<td>Butyric</td>
<td>Acetic</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aromatic hydrocarbons</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Cymene</td>
<td>Toluene</td>
<td></td>
</tr>
</tbody>
</table>

The following compounds were identified only on the basis of retention times observed from gas chromatography.

| Cumene                          | Cyclamen Aldehyde|                |
| Camphor                         | Menthone        |                |
| Menthyl Isovalerate             |                |                |

The structures and physical properties of the major compounds in the essential oil is given in Appendix 1.
Uses of the Essential Oil

Because of its aroma, the essential oil has been used as a natural flavouring extract and as a perfume in the cosmetic industries. In particular, the oil has been used as a flavouring agent, replacing ground nutmeg in order to avoid leaving particles in foods and beverages. For example, it has been used to flavour baked goods, beverages, candies, meats and syrups.

The essential oil has found widespread use in the cosmetic industry when a spicy odour is required. For example, it has been employed as a flavour in dental creams in combination with peppermint, methyl salicylate and cloves.

In addition to its use in cosmetic industries, nutmeg oil is prominently used in the pharmaceutical industry. Historically, nutmeg has been used as a form of medicine to treat many illnesses ranging from those affecting the nervous system to the digestive system. Presently, the nutmeg oil is used by many pharmaceutical companies in their formulations of products to treat different illnesses. In 1992, Procter and Gamble launched a non-drowsy and alcohol-free Vicks cough syrup and the essential oil of nutmeg is a major ingredient. In that same year, Ramedica International Corp. marketed in the USA, a pain relieving ointment called Ramedica Herbal Wonder Balm, and nutmeg oil was again one of the active ingredients. This shows that the essential oil of nutmeg continues its historical importance as a major pharmaceutical ingredient.

Discussion on Some of the Major Components of the Essential Oil

Most of the following information on components of the essential oil including the physical properties in Appendix I was taken from Merck Index, 11th edition and the CRC handbook of Physics and Chemistry.

(i) Sabinene - no information was available on the uses of sabinene

(ii) Camphene and its derivatives are widely used in numerous industrial processes and manufactures. A striking illustration of camphene's industrial importance is shown in the scheme below: Camphene can be easily converted to these other compounds.

\[
\text{Borneol} \leftrightarrow \text{Camphor} \leftrightarrow \text{Isoborneol}
\]

Thus, camphene is used in the manufacture of camphor and its related compounds. Camphene and its chloro-derivative have strong antibacterial, antifungal, and insecticidal properties. Many of camphene derivatives are known pharmaceutical drugs, and camphene itself has been shown to prevent atheromatosis of the aorta in some animals.

(iii) d-Pinene accounts for 8-20% of the essential oil of nutmeg. This compound is used widely in industry. It is used in the manufacture of camphor (3/4 of US camphor is made from d-pinene), solvents, plasticizers, perfume bases and synthetic pine oil.

(iv) Dipentene is the dl-form of limonene or the inactive limonene. This terpene is used as a solvent and also a wetting and dispersing agent. It is also used in the manufacture of resins.
(v) d-Linalool is also called coriandrol and is used in perfumery substituting for bergamot oil or french lavender.

(vi) d-Borneol exists mostly as an acetate ester in nutmeg rather than the free alcohol. The acetate ester and other ester derivatives of borneol are used in the manufacturing industries. In addition, some free borneol, ie, the alcohol, is used in perfumery and incense making.

(vii) i- Terpineol is used as an antiseptic. It is also used in the making of perfumes and in soap manufacturing.

(viii) Geraniol is used mainly in perfumery because of its sweet rose aroma. Some of its esters such as butyrate is used for making artificial attar of rose.

(ix) Myristicin is the most studied individual compound found in nutmeg, especially its pharmacological properties. This compound is thought to be responsible for the hallucinogenic effect of nutmeg oil.\textsuperscript{33} However, the evidence is not very clear as to whether other compounds are involved since natural myristicin is more potent than synthetic myristicin.\textsuperscript{34}

(x) Safrole is used industrially in perfumery, and in the manufacturing of heliotropin and in the denaturing of fats in soap manufacture. Medically, it is used as an antiseptic.

(xi) Eugenol is used in the manufacture of vanillin, and in perfumery, instead of oil of cloves. Eugenol is also used as a dental analgesic.

(xii) iso-eugenol, like eugenol, is used in the manufacture of vanillin.

**Fixed Oil of Nutmeg**

Depending upon the method used to obtain the fixed oil of nutmeg from the seed, varying amounts of essential oil will be present in the fixed oil. There are two general ways in which the fixed oil of nutmeg is extracted from nutmeg. In the first process, the ground nutmeg is subjected to intense hydraulic pressure and heat. The other method employs a solvent, for example, diethyl ether. In this process, the ground nutmeg is reflux with diethyl ether, and after filtering off the solid residue, the diethyl ether is distilled off from the filtrate to leave behind the crude fixed oil. These two processes will result in the crude fixed oil containing substantial quantities of essential oil. The quantities of essential oil vary between 10-12\%. If the essential oil is removed by steam distillation prior to extracting the crude fixed oil, then the fixed oil of nutmeg will contain only trace amounts of essential oil.

Unlike the liquid essential oil, the fixed oil is a semi-solid, reddish brown material with both the smell and taste of nutmeg. It melts at 45-51°C and has a density of 0.990-0.995. Like most oils, it is completely soluble in hot alcohol, however, sparingly soluble in cold alcohol. The fixed oil is freely soluble in ether and chloroform.

The fixed oil of nutmeg has not been subjected to as much investigative research as the essential oil. One possible reason is because of the small number of compounds that are present in the fixed oil.
Components of the Fixed Oil

Power and Salways' analysis of the fixed oil which was obtained from nutmeg without prior removal of the essential oil gave the following components and their relative abundance in the fixed oil.

<table>
<thead>
<tr>
<th>Component</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimyristin</td>
<td>73.0%</td>
</tr>
<tr>
<td>Essential oil</td>
<td>12.5%</td>
</tr>
<tr>
<td>Unsaponifiable constituents</td>
<td>8.5%</td>
</tr>
<tr>
<td>Oleic acid (as glyceride)</td>
<td>3.0%</td>
</tr>
<tr>
<td>Resinous materials</td>
<td>2.0%</td>
</tr>
<tr>
<td>Linolenic acid (as glyceride)</td>
<td>0.5%</td>
</tr>
<tr>
<td>Formic, acetate and cerotic acids</td>
<td>(very small amounts)</td>
</tr>
</tbody>
</table>

In this extraction procedure, the essential oil was not removed prior to extracting the fixed oil and thus, the essential oil appears as a component in the fixed oil. If the fixed oil was obtained after initial removal of the essential oil, the relative component ratios would be as shown below:

<table>
<thead>
<tr>
<th>Component</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimyristin</td>
<td>84.0%</td>
</tr>
<tr>
<td>Unsaponifiable constituents</td>
<td>9.8%</td>
</tr>
<tr>
<td>Oleic acid (as glyceride)</td>
<td>3.5%</td>
</tr>
<tr>
<td>Resinous material</td>
<td>2.3%</td>
</tr>
<tr>
<td>Linolenic acid (as glyceride)</td>
<td>0.6%</td>
</tr>
<tr>
<td>Formic, acetate and cerotic acids</td>
<td>(very small amounts)</td>
</tr>
</tbody>
</table>

Uses of the Fixed Oil

The fixed oils that contain a substantial amount of essential oil have the same odour as nutmeg. Therefore, these fixed oils have been used in perfumes. In medicine, the fixed oil has been used externally for sprains and rheumatism. As a whole, the fixed oil finds very little commercial use; however, components of the fixed oils and derivatives of some of those compounds find extensive commercial uses.

Discussion on the Individual Components of the Fixed Oil

Essential Oil:

Since the essential oil was already dealt with under its own topic heading, no further discussion of essential oil will be covered under this section.

Trimyristin:

Trimyristin accounts for over three quarters of the fixed oil of nutmeg. Because the essential oil was considered as a component of the fixed oil, trimyristin is about 75% of the total oil (fixed and volatile) extracted from nutmeg. This implies that nutmeg is made up of approximately 40% trimyristin.

Other names used for trimyristin are (i) glycerol trimyristate and (ii) glycerol tritetradecanoate. It is a white to yellowish grey solid with a melting point between 56-57 °C.
the catalyst used, and at times an alkaline catalyst like zinc oxide, calcium hydroxide or magnesium hydroxide can be used.\textsuperscript{46}

\[
\begin{align*}
H_2C-O_2CC_{13}H_{27} & \quad \text{Catalyst} \quad H_2COH \\
HC-O_2CC_{13}H_{27} + H_2O & \rightarrow 3 H_2OCC_{13}H_{27} + HCOH \\
H_2C-O_2CC_{13}H_{27} & \quad H_2COH
\end{align*}
\]

Because of the high pressure and temperature required, this hydrolysis technique is used predominantly in industry.

A Laboratory Preparation of Myristic Acid from Trimyristin

**Equipment:** One 500 ml round bottom flask; a mechanical stirrer or magnetic stirrer; a steam bath or heating mantel; one 500 ml erlenmeyer flask; steam-jacketed funnel; a graduated cylinder

**Procedure:** Pure trimyristin (25g, 0.935 mole) is placed into a 500 ml round bottom flask followed by the addition of 50 ml of a 2.5 M solution of sodium hydroxide. This mixture is heated at 100 °C with the heat source for 2 hours with constant stirring. At this time, the solution should appear clear indicating that saponification is completed. The solution is then poured into a 500 ml erlenmeyer flask containing 150 ml solution of 20% hydrochloric acid. The crude myristic acid should form a separate phase and appear clear. If this layer is not clear, the mixture is heated until the oily layer is transparent. This mixture is then allowed to cool and the crude myristic acid solidifies. The myristic acid can be collected by filtering through a steam-jacketed funnel.

**Conclusion from Chemical Composition Analysis of Nutmeg**

(No in-depth review of the essential oil as a potential marketable commodity will be further discussed since a construction project of a steam distillation plant is in progress in Grenada.)

As seen from the discussion on the chemical composition of nutmeg, the most abundant individual compound in nutmeg is trimyristin. Trimyristin, a triglyceride (fat) is approximately 75% by weight of the total fixed and essential oils of nutmeg and 40% by weight of the nutmeg seed. The relative abundance of trimyristin in nutmeg makes it a potentially desirable target for isolation.

At present, the price of the essential oil on the US market is $14/kg and the market size seems to be good. In 1989, nutmeg oil imports to the US were approximately 115,000 kg, and in 1992 nutmeg oil imports were about 192,000 kg valued at about 2 million US dollars.\textsuperscript{47,48} Recognizing the favourable market trends and prices of nutmeg oil, it would not be advisable to attempt to isolate any individual compounds from nutmeg oil. Nevertheless, one must keep in mind the possibility of extracting compounds from the nutmeg oil in case nutmeg oil faces any severe marketing problems in the near future.

Trimyristin is a favourable potential compound to isolate from nutmeg. In addition to being the most abundant compound in nutmeg, six times that of the essential oil, derivatives of
An oleochemical is any chemical that has been derived from fats and oils. In general, there are two types of feedstock (raw materials) for the oleochemical industries: (1) when the feedstock raw material used is a natural fat then the oleochemical produced is known as "natural" oleochemical and (2) when the raw material is from petroleum then the oleochemical produced is known as "synthetic" oleochemical or petrochemical. The focus here will be on the "natural" oleochemicals and reference will be made to show the competition of the "synthetic" oleochemicals.

Between 1960 and 1990, the world production of fats increased annually at an average 3.7%. Kaufman (Vice-president for Oleochemicals for Henkel's Emery Group in Ohio) in a keynote address to the world conference on oleochemicals in 1990 said that the world production of fats and oils increased between 1960 and 1990 from 32.1 million metric tons to 80.6 million metric tons. Furthermore, the average annual growth rate to the year 2000 is expected to be about 2.8% with total production reaching 105 million metric tons. The figures are shown in the table below:

Table 9: World Production of Oils and Fats by Source (million metric tons)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable Oils</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coconut oil</td>
<td>2.1</td>
<td>2.2</td>
<td>3.0</td>
<td>3.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Palm kernel oil</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
<td>1.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Palm oil</td>
<td>1.1</td>
<td>1.7</td>
<td>4.7</td>
<td>10.6</td>
<td>17.4</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>4.0</td>
<td>6.1</td>
<td>14.4</td>
<td>16.9</td>
<td>23.2</td>
</tr>
<tr>
<td>Sunflower oil</td>
<td>1.2</td>
<td>3.8</td>
<td>5.6</td>
<td>8.0</td>
<td>9.9</td>
</tr>
<tr>
<td>Rapeseed/canola</td>
<td>1.1</td>
<td>1.9</td>
<td>3.4</td>
<td>8.1</td>
<td>10.7</td>
</tr>
<tr>
<td>Others</td>
<td>8.7</td>
<td>10.5</td>
<td>11.4</td>
<td>12.7</td>
<td>15.3</td>
</tr>
<tr>
<td>Subtotal</td>
<td>18.6</td>
<td>26.2</td>
<td>43.2</td>
<td>60.0</td>
<td>81.9</td>
</tr>
<tr>
<td>Animal Fats</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tallow</td>
<td>3.6</td>
<td>4.4</td>
<td>6.1</td>
<td>6.8</td>
<td>7.7</td>
</tr>
<tr>
<td>Butter/lard</td>
<td>9.0</td>
<td>8.2</td>
<td>10.0</td>
<td>11.8</td>
<td>13.8</td>
</tr>
<tr>
<td>Subtotal</td>
<td>12.6</td>
<td>12.6</td>
<td>16.1</td>
<td>18.6</td>
<td>21.5</td>
</tr>
<tr>
<td>Fish Oil</td>
<td>0.9</td>
<td>1.3</td>
<td>1.2</td>
<td>1.4</td>
<td>1.6</td>
</tr>
<tr>
<td>Grand Total</td>
<td>32.1</td>
<td>40.1</td>
<td>60.5</td>
<td>80.6</td>
<td>105.0</td>
</tr>
</tbody>
</table>
The figures in the tables above show that although North America was the world's leading producer of fats and oils up to 1980, within the next ten years they were bypassed by the Asian countries. In particular, the increase in palm oil production in Asia was responsible for this change in position. This increase in fats and oils production in Asia occurs simultaneously with the development of the oleochemical industries in the region, especially in Malaysia.

In 1990, over 20% of the worldwide production of fats and oils were used in non-edible products related industries. Tallow, coconut oil, palm oil and palm kernel oil are the major raw materials for oleochemicals, and in 1990 they accounted for 36% of all the world's fats and oils produced. It is expected that in the year 2000, they will account for over 42% of the total world production of fats and oils.\textsuperscript{51,52}

The prices for the four major raw materials for the oleochemical market as given in the Chemical Marketing Reporter for November 1993 are shown in the table below:\textsuperscript{53}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|}
\hline
Raw Material & Price US$/Metric Ton November 1993 \\
\hline
Palm Kernel & 418 \\
Palm Oil & 407 \\
Coconut oil & 522 \\
Tallow (inedible) & 319 \\
\hline
\end{tabular}
\caption{Prices of Major Raw Materials of Oleochemicals}
\end{table}
The relative fatty acid composition of these four major oils compared with the fixed oil of nutmeg is shown below:

Table 12: Relative Fatty Acid Composition

<table>
<thead>
<tr>
<th>Fatty Acid</th>
<th>Coconut Oil</th>
<th>Palm Kernel Oil</th>
<th>Palm Oil</th>
<th>Tallow (Beef)</th>
<th>Fixed Oil of Nutmeg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lauric</td>
<td>48.0</td>
<td>49.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myristic</td>
<td>17.5</td>
<td>14.1</td>
<td>1.0</td>
<td>3.0</td>
<td>95.0</td>
</tr>
<tr>
<td>Palmitic</td>
<td>8.8</td>
<td>8.8</td>
<td>42.5</td>
<td>29.0</td>
<td></td>
</tr>
<tr>
<td>Caprylic</td>
<td>8.0</td>
<td>2.5</td>
<td></td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>Oleic</td>
<td>6.0</td>
<td>18.5</td>
<td>43.0</td>
<td>46.5</td>
<td></td>
</tr>
<tr>
<td>Capric</td>
<td>7.0</td>
<td>7.0</td>
<td></td>
<td></td>
<td>18.5</td>
</tr>
<tr>
<td>Stearic</td>
<td>2.0</td>
<td>1.3</td>
<td>4.0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Linoleic</td>
<td>2.5</td>
<td>0.7</td>
<td>9.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linolenic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
</tbody>
</table>

The fatty acid comparison as shown in the table above reveals that coconut oil and palm kernel oil can be used interchangeably in the oleochemical industries because of their similarities. A very similar situation exists between palm oil and tallow. It also shows that the fixed oil of nutmeg has a relatively high proportion of myristic acid. This makes the fixed oil of nutmeg advantageous as a source of myristic acid since the extraction and purification processes would be less tedious due to the high proportion of myristic acid and low proportion of other components.

To show how these fats are used in the oleochemical industries, a flowchart taken from International News on Fats and Oils and Related Materials (Inform), Vol. 1(12) 1990 is provided below:
Oleochemicals

In 1990, the world demand for oleochemicals was about 4.4 million metric tons with 50% of this representing market for fatty acids and 20% for fatty alcohols. \(^5\)

The following tables taken from Inform show the present market for fatty acids and other oleochemicals. \(^6\) (MT means metric tons, and AAI% means average annual percent increase.)

<table>
<thead>
<tr>
<th>Derivative Operations</th>
<th>Oleochemical Derivates</th>
<th>End-use Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amidation</td>
<td>Fatty Amides</td>
<td>Building Auxiliaries</td>
</tr>
<tr>
<td>Chlorination</td>
<td>Dimer and Trimer Acids</td>
<td>Candles</td>
</tr>
<tr>
<td>Dimerization</td>
<td>Epoxidized Oils and Esters</td>
<td>Cleaning Agents</td>
</tr>
<tr>
<td>Epoxidation</td>
<td>Ethoxylates</td>
<td>Cosmetics</td>
</tr>
<tr>
<td>Ethoxylation</td>
<td>Fatty Acid Sulphates</td>
<td>Detergents</td>
</tr>
<tr>
<td>Quaternization</td>
<td>Fatty Acid Sulphonates</td>
<td>Fixe Extinguishing Agents</td>
</tr>
<tr>
<td>Sulfation</td>
<td>Fatty Esters</td>
<td>Flotation</td>
</tr>
<tr>
<td>Sulfonation</td>
<td>Soaps and Salts</td>
<td>Food Emulsifiers Insecticides</td>
</tr>
<tr>
<td>Transesterification</td>
<td></td>
<td>Leather</td>
</tr>
<tr>
<td>Esterification</td>
<td></td>
<td>Lubricants</td>
</tr>
<tr>
<td>Saponification</td>
<td></td>
<td>Paints</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pesticides</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pharmaceuticals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plastics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rubber</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soaps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Textile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tires</td>
</tr>
</tbody>
</table>

Oleochemicals

In 1990, the world demand for oleochemicals was about 4.4 million metric tons with 50% of this representing market for fatty acids and 20% for fatty alcohols. \(^5\)

The following tables taken from Inform show the present market for fatty acids and other oleochemicals. \(^6\) (MT means metric tons, and AAI% means average annual percent increase.)

Table 13: World Fatty Acid Production, 1988-2000 (1,000 MT)

<table>
<thead>
<tr>
<th>Region</th>
<th>1988</th>
<th>1995</th>
<th>2000</th>
<th>AAI%</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>590</td>
<td>680</td>
<td>750</td>
<td>2.0</td>
</tr>
<tr>
<td>Western Europe</td>
<td>895</td>
<td>1,010</td>
<td>1,100</td>
<td>1.7</td>
</tr>
<tr>
<td>Asia</td>
<td>555</td>
<td>660</td>
<td>750</td>
<td>2.5</td>
</tr>
<tr>
<td>Other</td>
<td>190</td>
<td>225</td>
<td>260</td>
<td>2.6</td>
</tr>
<tr>
<td>Total(^a)</td>
<td>2,230</td>
<td>2,575</td>
<td>2,860</td>
<td>2.1</td>
</tr>
</tbody>
</table>

\(^a\) Does not include tall oil fatty acids or synthetic fatty acids

Table 14: Consumption of Natural Fatty Acids, 1987-1992 (1,000 MT)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>737</td>
<td>842</td>
<td>2.7</td>
</tr>
<tr>
<td>Western Europe</td>
<td>904</td>
<td>986</td>
<td>1.5-2.0</td>
</tr>
<tr>
<td>Japan</td>
<td>245</td>
<td>310</td>
<td>4.8</td>
</tr>
<tr>
<td>Total</td>
<td>1,886</td>
<td>2,138</td>
<td>2.5</td>
</tr>
</tbody>
</table>
to the year 1995. It is believed that further increases in the use of oleochemicals over petrochemicals for fatty alcohol production will occur as new facilities are built to produce more fatty alcohols from oleochemicals. This increased capacity is expected to occur predominantly in southeast Asia.

The competition of synthetic versus natural feedstock for the surfactant industry exists primarily with the production of surfactant alcohols (fatty alcohols). At present, vegetable oil accounts for 40% of fatty alcohols produced in the world and this is expected to rise to 52% by 1995. It is believed that further increases in the use of oleochemicals over petrochemicals for fatty alcohol production will occur as new facilities are built to produce more fatty alcohols from oleochemicals. This increased capacity is expected to occur predominantly in southeast Asia.

The data in the tables above shows that there has been a steady increase in demand for oleochemicals and that industry will probably grow steadily at an average annual increase of 3% up to the year 2000. The largest growth in terms of production of basic oleochemicals is expected to occur in Asia. It should be reminded that the figures given above are for oleochemicals produced from natural sources and does not include the production of synthetic oleochemicals (petrochemicals), i.e., oleochemicals whose raw material sources are petroleum-based products.

The competition of synthetic versus natural feedstock for the surfactant industry exists primarily with the production of surfactant alcohols (fatty alcohols). At present, vegetable oil accounts for 40% of fatty alcohols produced in the world and this is expected to rise to 52% by 1995. It is believed that further increases in the use of oleochemicals over petrochemicals for fatty alcohol production will occur as new facilities are built to produce more fatty alcohols from oleochemicals. This increased capacity is expected to occur predominantly in southeast Asia.

Table 15: World Glycerine Production, Consumption and Capacity, 1988 (1,000 MT)

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>Consumption</th>
<th>Refining Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Natural</td>
</tr>
<tr>
<td>North America</td>
<td>153</td>
<td>166</td>
<td>170</td>
</tr>
<tr>
<td>Western Europe</td>
<td>200</td>
<td>160</td>
<td>177</td>
</tr>
<tr>
<td>Asia/Pacific</td>
<td>150</td>
<td>137</td>
<td>189</td>
</tr>
<tr>
<td>Other</td>
<td>85</td>
<td>125</td>
<td>107</td>
</tr>
<tr>
<td>Total</td>
<td>588</td>
<td>588</td>
<td>643</td>
</tr>
</tbody>
</table>

Table 16: World Production of Basic Natural Oleochemicals By-Product Group, 1988-2000 (1,000 MT)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural fatty acids\a</td>
<td>2,230.0</td>
<td>2,575.0</td>
<td>2,860.0</td>
<td>2.1</td>
</tr>
<tr>
<td>Fatty acid methyl esters\b</td>
<td>110.0</td>
<td>175.0</td>
<td>232.0</td>
<td>6.4</td>
</tr>
<tr>
<td>Natural fatty alcohols\c</td>
<td>364.0</td>
<td>581.0</td>
<td>627.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Fatty amines\d</td>
<td>371.0</td>
<td>491.2</td>
<td>581.7</td>
<td>3.8</td>
</tr>
<tr>
<td>Natural glycerine\e</td>
<td>240.0</td>
<td>300.0</td>
<td>341.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Total</td>
<td>3,315.1</td>
<td>4,122.2</td>
<td>4,461.7</td>
<td>2.8</td>
</tr>
</tbody>
</table>

\a Does not include tall oil fatty acids
\b Other than in production of fatty alcohols
\c Overstated by undetermined amount used in fatty amines
\d Does not include amines produced from olefins
\e Does not include glycerine from soap production

Table 17: World Production of Basic Oleochemicals by Region, 1988-2000 (1,000 MT)\a

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>831.5</td>
<td>1,022.2</td>
<td>1,144.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Western Europe</td>
<td>1,274.4</td>
<td>1,464.3</td>
<td>1,593.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Asia</td>
<td>751.2</td>
<td>1,070.6</td>
<td>1,252.6</td>
<td>4.3</td>
</tr>
<tr>
<td>Other</td>
<td>212.0</td>
<td>265.0</td>
<td>310.07</td>
<td>3.2</td>
</tr>
<tr>
<td>Total World Natural Glycerine</td>
<td>3,315.1</td>
<td>4,122.2</td>
<td>2,641.7</td>
<td>2.8</td>
</tr>
</tbody>
</table>

\a Conditions that were given in the footnote of the previous table apply here also.

The data in the tables above shows that there has been a steady increase in demand for oleochemicals and that industry will probably grow steadily at an average annual increase of 3% up to the year 2000. The largest growth in terms of production of basic oleochemicals is expected to occur in Asia. It should be reminded that the figures given above are for oleochemicals produced from natural sources and does not include the production of synthetic oleochemicals (petrochemicals), i.e., oleochemicals whose raw material sources are petroleum-based products.
Malaysia is a prime example of growth with the oleochemical industry. The first fatty acid plant was built in Malaysia in 1979 producing over 30 thousand metric tons annually. Later in 1981, two other plants were opened with combined capacity of about 62 thousand metric tons. There were six oleochemical plants in Malaysia in 1990 with total annual capacity of 250 thousand metric tons.

The Industrial Master Plan (IMP), an industrial development program in Malaysia, calls for an increase to 750 thousand metric tons by 1995. In 1993, the US Department of Agriculture (USDA) estimated Malaysia’s oleochemical capacity at 600 thousand metric tons. This has been accomplished by several joint venture projects between Malaysian companies and foreign companies. For example, Procter and Gamble joined with Felda Mills Corporation, a subsidiary of the Malaysian Federal Land Development Authority (Felda) to build a $50 million natural fatty alcohol and glycerine plant production which began in 1992 and the capacity is 60 thousand metric tons annually. In this venture, Procter and Gamble has 50% ownership and will use its propriety natural alcohol technology. Felda will supply palm kernel oil as feedstock.

8. **Market Analysis for Trimyristin and Myristic Acid**

Nutmeg fixed oil if obtained from nutmeg after initial removal from the nutmeg oil (essential oil) will contain up to 84% trimyristin. Trimyristin is a fat which is made up of a C₁₄ fatty acid, which is myristic acid, and glycerol. There are three major other natural sources of trimyristin: coconut oil (17.5%); palm kernel oil (14.1%) and babassu oil (19.9%).

The two most prominent fats (triglycerides) found in coconut oil and palm kernel oil are glyceryl trilaurate and trimyristin (glyceryl trimyristate). Together these fats account for 65.5% and 63.7% of all fats found in coconut oil and palm kernel oil, respectively. However, these fats are never isolated and sold individually because it would be tedious to separate them from the six additional fats present in these oils. What is done in the oleochemical industry with these oils is that all the fats in these oils are split by a single hydrolysis process into their different fatty acids and glycerol. The crude fatty acids are then fractionally distilled to produce the individual fatty acids which are then sold.

Presently, the main use of trimyristin is for research and development. In a survey taken of some chemical companies asking them about the quantity of trimyristin they sell, most reported that the amount sold is small and only as a laboratory reagent. The name, location of the company and the price listed in their catalogues are given in Table 18:

It is not clear whether these companies are extracting the trimyristin from natural sources or producing the trimyristin synthetically. Trimyristin can be produced synthetically by esterifying myristic acid with glycerol, i.e., the reverse process of splitting. The myristic acid can be obtained from the distillate of fatty acids from either coconut oil or palm kernel oil. Thus, there is a small potential market for the sale of relatively pure trimyristin.

One can estimate this sale at present to be about one or two kilograms per year. It is conceivable that the high cost at which trimyristin is being sold presently limits its availability/accessibility to other potential buyers.

The choice of fats and oils used directly in the manufacturing of soap and indirectly for oleochemicals depends on their relative proportions of individual fatty acids. Fats and oils containing fatty acids of chain length between C₁₂-C₁₄ serve best as raw material for the soap, detergent and oleochemicals. The two fatty acids occurring in natural fats and oils of this chain length are lauric and myristic acid. There are therefore only four natural sources for C₁₂-C₁₄ fatty acids: coconut oil, palm kernel oil, nutmeg fixed oil and babassu oil.
To estimate the present consumption of trimyristin as a fat source, it is necessary to make some assumptions. The world production of coconut oil and palm kernel oil are 2.85 and 1.53 million metric tons, respectively. Together, the total production of these two oils is 4.38 million metric tons. Assuming that half of this is for non-edible purposes, then 2.19 million metric tons of these oils are used industrially. If 16% of these oils is trimyristin, then about 0.35 million metric tons or 350 thousand metric tons of trimyristin is consumed annually.

Coconut, palm kernel and babassu oil are sometimes referred to as lauric oils. Lauric acid is a C12 fatty acid and myristic acid is a C14 fatty acid. "Lauric oils produce the best surfactant molecules due to their 12-carbon and 14-carbon chain lengths, which provide good performance properties for detergency," according to Bill Knodel, Manager of Chemicals for Procter and Gamble Co. Thus, fixed oil of nutmeg or trimyristin as a precursor of C14 fatty acid has a place in the soap, detergent and oleochemical industry if it can be produced at a reasonable price.

Myristic acid supply is extremely tight in the European market causing prices there to rise strongly. A producer says the US market is firm with strong demand, but prices have not surged.

Most of this trimyristin used is in the production of myristic acid and myristyl alcohol splitting this fat. Myristic acid and derivatives of this C14 fatty acid play very crucial roles in the cosmetic industry. In May 1993, a Bristol-Myers Squibb’s patent application for novel anti-perspirant agents described esters of myristyl alcohol as important ingredients which reduces the skin/clothes whitening effect. Lancaster marketed a new brand of cosmetic ‘Le Futur’ and myristyl lactate was an active ingredient in their lip colour formulation. Dr. Pearl Grimes, an associate professor of dermatology at the King Drew Medical Centre reported that isopropyl myristate and myristyl lactate are active ingredients found in cosmetics frequently purchased by the blacks. Moreover, black women spend over US $600 million annually on cosmetics in the US. Unichem North America of Chicago marketed Estol 1509 as an emollient for the skin care and cosmetic industry with the isopropanol derivative of myristic acid as an active ingredient.

### Table 18: Listed Catalogue Price for Trimyristin

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Catalogue Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indofine Chemical Co. Inc.</td>
<td>New Jersey, USA</td>
<td>500 mg $ 45.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 g $ 68.00</td>
</tr>
<tr>
<td>Macali Tesque, Inc.</td>
<td>Kyoto, Japan</td>
<td></td>
</tr>
<tr>
<td>Extrasynthese S.A.</td>
<td>Genay, France</td>
<td>5 g $ 38.50 99% pure (GC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 g $157.30 99% pure (GC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 g $ 44.80 97% pure (GC)</td>
</tr>
<tr>
<td>Fluka</td>
<td>New York, USA</td>
<td>1 g $ 11.70 99% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 g $ 36.65 99% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 g $149.80 99% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 g $ 5.90 90+% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 g $ 15.45 90+% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 g $ 25.75 90+% pure</td>
</tr>
<tr>
<td>Kodak</td>
<td>New York, USA</td>
<td></td>
</tr>
<tr>
<td>Accurate Chemicals</td>
<td>New York, USA</td>
<td></td>
</tr>
<tr>
<td>Sigma</td>
<td>Montana, USA</td>
<td>1 g $ 11.70 99% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 g $ 36.65 99% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 g $149.80 99% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 g $ 5.90 90+% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 g $ 15.45 90+% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 g $ 25.75 90+% pure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 g $ 51.45 90+% pure</td>
</tr>
</tbody>
</table>
Although there are no worldwide statistics given for the production or consumption of myristic acid and myristic alcohol, the following table shows the commercial sale of fatty acid imported to the US.

Table 19: **US Imports of Industrial Mono Fatty Acids from Coconut, Palm Kernel, and Palm Oil**

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (kg)</th>
<th>Value (thousand $)</th>
<th>Quantity (kg)</th>
<th>Value (thousand $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 1992</td>
<td>January-December 1992</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>World Total</td>
<td>1,856,347</td>
<td>782</td>
<td>27,415,771</td>
<td>13,435</td>
</tr>
<tr>
<td>Canada</td>
<td>202,652</td>
<td>146</td>
<td>581,908</td>
<td>430</td>
</tr>
<tr>
<td>Germany, West</td>
<td>758</td>
<td>6</td>
<td>7,038</td>
<td>98</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1,486,253</td>
<td>376</td>
<td>4,366,016</td>
<td>2,068</td>
</tr>
<tr>
<td>Japan</td>
<td>--</td>
<td>--</td>
<td>63,442</td>
<td>157</td>
</tr>
<tr>
<td>Malaysia</td>
<td>91,254</td>
<td>137</td>
<td>15,735,727</td>
<td>5,257</td>
</tr>
<tr>
<td>Netherlands</td>
<td>17,920</td>
<td>27</td>
<td>86,149</td>
<td>157</td>
</tr>
<tr>
<td>Philippines</td>
<td>57,510</td>
<td>71</td>
<td>6,258,914</td>
<td>5,080</td>
</tr>
<tr>
<td>Thailand</td>
<td>--</td>
<td>--</td>
<td>246,577</td>
<td></td>
</tr>
</tbody>
</table>

The quantity of myristic acid landing in ports of New York and New Jersey during June-September of 1993 is given below (taken from Chemical Marketing Reporter).

Table 20: **Myristic Acid into Ports of New York and New Jersey**

<table>
<thead>
<tr>
<th>Consignee</th>
<th>Net weight (kg)</th>
<th>Port of Origin</th>
<th>Date of Arrival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interflow</td>
<td>19,540</td>
<td>Singapore</td>
<td>27 June</td>
</tr>
<tr>
<td>ITCM</td>
<td>47,479</td>
<td>Kaohsiung</td>
<td>9 August</td>
</tr>
<tr>
<td>Artek</td>
<td>20,589</td>
<td>Singapore</td>
<td>27 August</td>
</tr>
<tr>
<td>Interflow</td>
<td>19,260</td>
<td>Pt Kelang</td>
<td>7 September</td>
</tr>
<tr>
<td>Tormont</td>
<td>22,898</td>
<td>Algeciras</td>
<td>13 September</td>
</tr>
</tbody>
</table>

It is important to note that the above table is only for myristic acid imported into the U.S. through ports in New York and New Jersey. Much more myristic acid is expected to be imported on the pacific coast because of its proximity to the south-east Asian producing countries.

The prices of four major fatty acids listed in Chemical Marketing Reporter in November are given in the table below.

Table 21: **Prices of Four Major Fatty Acids**

<table>
<thead>
<tr>
<th>Fatty Acid</th>
<th>Type</th>
<th>Price per kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myristic</td>
<td>Commercial pure bags, truckload</td>
<td>2.75</td>
</tr>
<tr>
<td>Lauric</td>
<td>Commercial pure bags, truckload</td>
<td>1.50</td>
</tr>
<tr>
<td>Tallow fatty acids</td>
<td>Technical non-returnable, carload</td>
<td>0.90</td>
</tr>
<tr>
<td>Oleic</td>
<td>Distilled, railroad tank cars</td>
<td>1.56</td>
</tr>
</tbody>
</table>

If one used the estimate that 350 thousand metric tons of trimyristin is consumed indirectly through the use of coconut and palm kernel oil, and if 20% of all fats and oils are used to produce
raw materials for the oleochemical industry, then 70 thousand metric tons of trimyristin is used to
produce myristic acid and other raw materials for the oleochemical industries. Myristic acid is 71%
and glycerol is 29% by weight of trimyristin. Thus, the approximate amount of myristic acid and
myristyl alcohol from trimyristin estimated to be produced annually is about 50 thousand metric
tons.

It has been stated that a major rule of thumb for pricing fatty acids is that it is twice the cost
of the raw material. Thus, since myristic acid is sold commercially at US $2.75 per kilogram, then
one would assume that the crude trimyristin can be sold at US $1.40 per kilogram. This, therefore,
implies that there is a potential world market for trimyristin of 70 thousand metric tons annually
to be used in the production of myristic acid and other raw material for the oleochemical
industry. The estimated value of this market can be about $140 million US dollars.

9. **Recommendations**

The following recommendations are made based on the analysis given throughout the body of
this report.

(a) The Grenada Cooperative Nutmeg Association (GCNA) needs to increase its share in the sale
of nutmeg and mace in the US market. At present, the GCNA holds a 3% share of the US
market nutmeg sales and 0% in mace sales. A more intensive marketing strategy must be
put into operation to achieve this increase.

One suggestion is to have a marketing representative located in the Grenadian Mission in
New York whose sole purpose is to liaison with all the nutmeg and mace brokers in the US.
The representative should send these brokers information on the quality and prices of
Grenada’s nutmeg and mace. The brokers should be informed about how they can purchase
nutmeg from Grenada. The marketing representative should keep abreast of the nutmeg and
mace prices on the US market and inform the GCNA on a monthly basis of the US prices
of nutmeg and mace. In addition, the representative should follow the market trends and
update the GCNA on such trends.

A time limit should be given to this representative to achieve a certain percentage increase
in sales of Grenada’s nutmeg and mace to the U.S. The GCNA must be given a monthly
report on the quantity of Grenadian nutmeg and mace that has been sold in the US.

(b) The marketing representative mentioned in (1) should play a similar role in the marketing
of nutmeg oil from Grenada in the US.

(c) Because there is a large potential market for trimyristin as a raw material for the soap and
oleochemical industries, the GCNA should begin looking further into isolating this material
from nutmeg and marketing this material. The isolation of trimyristin should preferably be
done from the remains of nutmeg after the nutmeg oil has been removed by steam
distillation.

Note that the GCNA intends to use "defective" nutmeg as raw material for the steam
distillation project. (Defective nutmeg is nutmeg that does not float when placed in water.
It is termed defective because it is not as dense as the "sound" nutmeg that sinks when
placed in water). It is believed that newer (or younger in age) defective nutmeg would have
almost the same proportion of trimyristin as sound nutmeg. A laboratory evaluation of the
yield of trimyristin from defective nutmeg after steam distillation of the nutmeg oil will have
to be undertaken by the Produce Chemist Laboratory. This evaluation should examine the
percentage of trimyristin that can be extracted from defective nutmeg of different ages (older
versus newer nutmeg) and the quantity of solvent needed for extraction. It is strongly recommended that this study be done prior to a pilot study of the trimyristin extraction process because no full evaluation has been conducted on the "defective" nutmeg. This report and other previous evaluations have only focused on "sound" nutmeg.

In short, it will be economical to extract both nutmeg oil through steam distillation and the trimyristin from the remains after steam distillation because the same batch of nutmeg would be used to yield these two marketable by-products. Moreover, the equipment that would be used for extracting the trimyristin from nutmeg can also be used to extract coconut oil from copra. This would allow the equipment to have multi-purpose uses, and would save in having to purchase additional equipment to extract the coconut oil as well as other vegetable oils.

(d) In considering extracting trimyristin from nutmeg on a large scale, the GCNA should first look into a possible joint venture with a large company that already produces myristic acid and other oleochemicals. The GCNA should propose to this company the possibility of Grenada supplying them with trimyristin as a source of C14 myristic acid and myristyl alcohol. It should be stated that the advantage of using trimyristin over coconut oil or palm kernel oil is that you eliminate the distillation process of purifying the fatty acid since GCNA can produce trimyristin with greater than 90% purity. In Appendix 2, a list of prospective companies that would possibly use trimyristin to produce myristic acid and myristyl alcohol is given.

(e) The GCNA should immediately begin the isolation of trimyristin on a laboratory scale and send out samples to these different companies shown in Appendix 2. In addition, samples greater than 90% pure should be sent to companies that sell trimyristin for research and development purposes. This would require access to a gas chromatography (GC) machine to quote the purity of trimyristin. A GC would also be needed to test the purity of the nutmeg oil and any products sold. A price quote for a GC machine from Perkin Elmer is listed in Appendix 3. Appendix 4 contains a list of companies that offer trimyristin for sale as a laboratory reagent for research and development.

(f) A pilot study must be conducted to examine the following conditions on a commercial scale: (a) the quantity of trimyristin that can be obtained on a commercial scale from the remains of the "defective" nutmeg after steam distillation; (b) the quantity of trimyristin that can be obtained from pure nutmeg, sound or defective; (c) the possible use of one equipment to allow the extraction of oils from other sources such as coconut oil from copra; (d) the optimum conditions of solvent to nutmeg ratio and the best yield possible; and (e) the cost of producing trimyristin commercially under the optimum conditions and equipment recommended. A list of prospective companies that sell equipment for the extraction of fats and those who may also undertake a pilot study is available in Appendix 5.

The capacity of the equipment recommended to be used for the extraction of trimyristin on a commercial scale is capable of consuming about 320,000 kilograms of nutmeg per year. This was based on the quantity of nutmeg that would be consumed in the production of nutmeg oil and the expected remains of nutmeg after the nutmeg oil has been removed. This would imply that the plant should produce 96,000 kilograms of crude trimyristin per year if the yield is approximately 30% by weight. At an estimated price of US $1.00 per kilogram of trimyristin, the annual sales can conceivably be US $96,000.00.

An estimate for a pilot study to be conducted at Texas A and M University along with a description of equipments necessary for the production of trimyristin on a commercial scale and a price quote provided by Crown Iron Works is given in Appendix 6.
Endnotes

1. Grenada Cooperative Nutmeg Association, 7/12/93
2. Grenada Cooperative Nutmeg Association, 7/12/93
3. Grenada Cooperative Nutmeg Association, 7/12/93
7. Eurostat, Monthly EEC External Trade, period 91-52 and 92-52
13. Grenada Cooperative Nutmeg Association; Fax information, 11/2/93
15. Ibid.


31. Chemical Abstract 58: 14638h (1963)


35. The Merck Index


38. Ozilgen, S; C. Simoneau; J.B. German; M.J. McCarthy; D. S. Reid, "Crystallization Kinetics of Emulsified Triglycerides" Journal of the Science of Food and Agriculture, 1993 61(1); 101-108.


43. Organic chemistry laboratory experiments 1976, Organic chemistry faculty SUNY - Binghamton


50. Inform, 1990, 1(12), 1034

51. Inform, 1996, 1(12), 1034

52. Inform, 1993, 4(2), 174

53. Chemical Marketing Reporter, 1993, November 1, V224


55. Chemical Marketing Reporter, 1992, October 5

56. Inform, 1990, 1(12), 1034

57. Inform, 1991, 2(12), 1062


59. Inform 1990, 1(9) 774

60. Inform 1993, 4(2) 175

61. Inform 1991, 2(12) 1062

62. Inform 1992, 3(10) 1080

63. Inform 1992, 3(10) 1080

64. Inform 1993, 4(2) 174

65. Chem Mark Rep 1991, 240 (17), 10

27
68. Dermatology-Times, 1991, November, 76
69. Soap, Cosmet Chem Spec 1991, 67(10), 91
70. Office of Trade and Economic Analysis, US Department of Commerce, International Trade Administration
71. Chem Mark Rep, 1993, 244, August 16
72. Chem Mark Rep, 1993, 244, September 27
73. Chem Mark Rep, 1993, 244, October 18
74. Chem Mark Rep, 1993, 244, October 25
75. Chem Mark Rep, 1993, 244, November 1
76. Chem Mark Rep, 1993, 244, November 1
Appendix 1

Structure and Physical Properties of Nutmeg Oil Components

<table>
<thead>
<tr>
<th>NAME</th>
<th>STRUCTURE</th>
<th>B.P./M.P. °C</th>
<th>DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>d-Pinene</td>
<td><img src="image" alt="d-Pinene Structure" /></td>
<td>b$_{760}$ 155-156</td>
<td>0.8591</td>
</tr>
<tr>
<td>Camphene</td>
<td><img src="image" alt="Camphene Structure" /></td>
<td>m.p. 52</td>
<td>d$_{50}$ 0.8486</td>
</tr>
<tr>
<td>Dipentene</td>
<td><img src="image" alt="Dipentene Structure" /></td>
<td>b$_{763}$ 175.5-176.5</td>
<td>0.8402</td>
</tr>
<tr>
<td>d-Linalool</td>
<td>(CH$_3$)$_2$C=CH(CH$_2$)$_2$C(CH$_3$)</td>
<td>b$_{760}$ 198-200</td>
<td>0.8733</td>
</tr>
<tr>
<td>d-Borneol</td>
<td><img src="image" alt="d-Borneol Structure" /></td>
<td>b$_{760}$ 212</td>
<td>1.011</td>
</tr>
<tr>
<td>i-Terpinol</td>
<td><img src="image" alt="i-Terpinol Structure" /></td>
<td>b$_{731}$ 206-207</td>
<td>0.9338</td>
</tr>
<tr>
<td>NAME</td>
<td>STRUCTURE</td>
<td>B.P./M.P. °C</td>
<td>DENSITY</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------</td>
<td>--------------</td>
<td>----------</td>
</tr>
<tr>
<td>Geraniol</td>
<td><img src="image" alt="Structure of Geraniol" /></td>
<td>$b_{751}$ 229-230</td>
<td>0.8894</td>
</tr>
<tr>
<td>Myristicin</td>
<td><img src="image" alt="Structure of Myristicin" /></td>
<td>$b_{15}$ 149.5</td>
<td>1.1437</td>
</tr>
<tr>
<td>Safrole</td>
<td><img src="image" alt="Structure of Safrole" /></td>
<td>$b_{760}$ 232-234</td>
<td>1.096</td>
</tr>
<tr>
<td>Eugenol</td>
<td><img src="image" alt="Structure of Eugenol" /></td>
<td>$b_{760}$ 225</td>
<td>1.0664</td>
</tr>
<tr>
<td>iso-Eugenol</td>
<td><img src="image" alt="Structure of iso-Eugenol" /></td>
<td>$b_{760}$ 266</td>
<td>1.080</td>
</tr>
<tr>
<td>Sabinene</td>
<td><img src="image" alt="Structure of Sabinene" /></td>
<td>$b_{760}$ 163</td>
<td>0.8468</td>
</tr>
</tbody>
</table>
Appendix 2

Manufacturers and Suppliers of Myristic Acid and Myristyl Alcohol

**Myristic Acid**

Procter and Gamble Co.
1 Procter and Gamble Plaza
Cincinnati, OH 45202
Tel: 513-983-1100
Fax: 513-983-4500

or Procter and Gamble Co.
Industrial Chem. Div.
P.O. Box 599
Cincinnati, OH 45201
Tel: 513-983-5607

Alnor Oil Co. Inc.
70 East Sunrise Highway Suite 418
Valley Stream, NY 11581
Tel: 516-561-6146
Fax: 516-561-6123

Humko Chemical Div.
WITCO Corp.
755 Crossover Lane
Memphis, TN 38117
Tel: 901-684-7000
Fax: 901-682-6531

ACME Hardesty Co.
626 Benjamin Fox Pavillion
P.O. Box 707
Jenkintown, PA 19046-0831
Tel: 215-885-3610
Fax: 215-886-2309

Witco Corp.
520 Madison Ave.
Continental Illinois Bank Bldg.
New York, NY 10022-4236
Tel: 212-605-3800
Fax: 212-605-3660

Unichemia North America
4650 S. Racine Avenue
Chicago, IL 60609
Tel: 312-376-9000
Fax: 312-376-0095

Quantum Chemical Corp; Emery Div.
11501-T Northlake Dr.
Cincinnati, OH 45249
Tel: 513-530-7300
Fax: 513-530-7581

Penta Manufacturing Co.
P.O. Box 1448
Fairfield, NJ 07007
Tel: 201-740-2300
Fax: 201-740-1839

or Quantum Chemical Corp.
99-T Park Ave.
New York, NY 10016
Tel: 212-949-5000

Spectrum Chemical Mfg. Corp.
14422 S. San Pedro St.
Gardena, CA 90348-9985
Tel: 310-516-8000
Fax: 310-516-7512

Ashland Chemical Inc.
Sub. of Ashland Oil Inc.
Industrial Chemicals and Solvent Div.
P.O. Box 2219
Columbus, OH 43216
Tel: 614-889-3333
Fax: 614-889-3465

Universal Preservachem, Inc.
297 N. 7th St.
Brooklyn, NY 11211
Tel: 718-782-7429
Fax: 718-782-8109

31
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Address</th>
<th>City, State  ZIP Code</th>
<th>Phone</th>
<th>Fax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witco Corp. Humko Chemical Div.</td>
<td>P.O. Box 125</td>
<td>Memphis, TN 38101</td>
<td>901-684-7000</td>
<td>901-761-1851</td>
</tr>
<tr>
<td>Mitsui and Co. (USA) Inc</td>
<td>200 Park Ave.</td>
<td>New York, NY 10166</td>
<td>212-878-4000</td>
<td>212-986-6419</td>
</tr>
<tr>
<td>Robeco Chemicals, Inc.</td>
<td>99 Park Ave.</td>
<td>New York, NY 10016</td>
<td>212-986-6410</td>
<td>212-986-6419</td>
</tr>
<tr>
<td>Ruger Chemical Co. Inc.</td>
<td>83 Cordier St.</td>
<td>Irvington, NJ 07111</td>
<td>201-926-0331</td>
<td>201-926-4921</td>
</tr>
<tr>
<td>AKZO Chemical Div.</td>
<td>300 S. Riverside Plaza</td>
<td>Chicago, IL 60606</td>
<td>312-906-7500</td>
<td>312-906-7680</td>
</tr>
<tr>
<td>Berje Chemical Products, Inc.</td>
<td>5 Lawrence St.</td>
<td>Bloomfield, NJ 07003</td>
<td>201-748-8980</td>
<td>201-680-9618</td>
</tr>
<tr>
<td>Filo Chemical Inc.</td>
<td>50 Broadway</td>
<td>New York, NY 10004</td>
<td>212-514-9330</td>
<td>212-514-9085</td>
</tr>
<tr>
<td>Myristyl Alcohol</td>
<td>Ethyl Corp. Marketing Communications</td>
<td>451 Florida St.</td>
<td>504-388-7040</td>
<td>504-388-7686</td>
</tr>
<tr>
<td>Spectrum Chemical Mfg. Corp.</td>
<td>14422 S. San Pedro St.</td>
<td>Gardena, CA 90248-9985</td>
<td>310-516-8000</td>
<td>310-516-7512</td>
</tr>
<tr>
<td>Vista Chemical Co.</td>
<td>900 Threadneedle</td>
<td>Houston, TX 77224</td>
<td>713-588-3000</td>
<td>713-588-3000</td>
</tr>
</tbody>
</table>
Price Quote for a Gas Chromatograph Machine

**PERKIN ELMER**

**QUOTATION**

To: DILON DANIEL  
CHEMISTRY DEPARTMENT  
UNIVERSITY OF CALIFORNIA  
RIVERSIDE, CA 92521  
FAX: (909) 787-4713

From: Jeffrey Borins  
Phone: 714-458-7262  
Irvine, CA 92718

Destination: GRE

Your Ref: YDJB87  
Our Ref: 601-1/TE/1/BOR/SDM

<table>
<thead>
<tr>
<th>Itm Qty</th>
<th>Part-No</th>
<th>Description</th>
<th>Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N611-9001</td>
<td>AUTOSYSTEM GAS CHROMATOGRAPH for 220 V, 50/60 Hz. operation.</td>
<td>630.00</td>
<td>630.00</td>
</tr>
</tbody>
</table>
| 2       | N611-0002| AutoSystem Gas Chromatograph. A microprocessor-controlled gas chromato-
|         |          | graph system - GC fully controlled from instrument keyboard. Features include:
|         |          | - Four-step, three-ramp temperature pro-
|         |          | gamming to 450 degrees C (oven maximum software controlled).
|         |          | - 35-key color-coded keyboard entry of all instrument parameters.
|         |          | - Two-line x 20 character vacuum fluores-
|         |          | cence display.
|         |          | - Five method setup, storage, copy, and generate.
|         |          | - Comprehensive hardware and software thermal protection.
|         |          | - Continuous diagnostic monitoring of all instrument functions.
|         |          | - Up to two simultaneous analog outputs for integrator or recorder.
|         |          | - Digital electronic pressure readout with capillary injectors.
|         |          | - Up to 32 programmable timed events.
|         |          | - RS-232C Printer port for hardcopy of methods, instrument configuration and run log.
|         |          | - External computer communications allows full instrument control plus two simultaneous channels of raw data.
<p>|         |          | - Dual-channel background correction.                         | 8,040.00| 8,040.00 |</p>
<table>
<thead>
<tr>
<th>Itm</th>
<th>Qty</th>
<th>Part-No</th>
<th>Description</th>
<th>Unit Price</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>N611-1030</td>
<td>Channel A - Single capillary column injector with pressure regulator &amp; split vent controls, digital column head pressure readout, and automatic control of split vent solenoid valve.</td>
<td>1,800.00</td>
<td>1,800.00</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>N611-2010</td>
<td>Channel A - Single flame-ionization detector with amplifier &amp; needle valve control of air &amp; H2 combustion gases.</td>
<td>2,120.00</td>
<td>2,120.00</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0332-8000</td>
<td>INSTALLATION KIT</td>
<td>400.00</td>
<td>400.00</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>N541-0301</td>
<td>MODEL 1022 GC+ SING CHANNEL INT</td>
<td>3,050.00</td>
<td>3,050.00</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>N541-0041</td>
<td>S/W KIT 1020 LC PLUS V7.50 -NT</td>
<td>275.00</td>
<td>275.00</td>
</tr>
</tbody>
</table>

PRICE INCLUDES INSTALLATION AND A ONE (1) YEAR WARRANTY.

FOB Norwalk, CT

16,315.00

Quotation Validity: JANUARY 12, 1994

Estimated Delivery: 4-5 Weeks ARO

Terms: Orders subject to credit
Quotation No: 9580/1
Page No: 3

Approval. Payment due upon receipt of invoice.

Terms and conditions of sales, enclosed

PLEASE ADD APPLICABLE SALES TAX AND SHIPPING COSTS.

Jeffrey Burins
1. Delivery Dates
   a. All delivery and shipment dates indicated on the face hereof are approximate and are subject to change at Buyer's option in the event that Seller's resources are overextended or Buyer's demand for delivery is increased. Seller reserves the right to make delivery in two or more lots.
   b. Seller shall not be liable for its failure to meet the delivery or performance dates indicated on the face hereof, which may be changed without notice, in event that Seller, due to unforeseen circumstances, or shortages, or delays, due to causes beyond its control, or due to any cause which in Seller's opinion may delay delivery or performace of the equipment.
   c. In the event that Buyer shall request or decret by reason of such circumstances, Seller's supplies of the equipment cannot be delivered at the time of delivery or performance dates indicated on the face hereof, Seller's obligation shall be limited to the total and the Buyer shall be entitled to have the items shipped to Buyer at Seller's expense, if applicable, and in accordance with the provisions of this agreement.

2. Acceptance and Return of Good
   a. All equipment delivered to Buyer shall be accepted or refused by Buyer within five (5) days after receipt, after which time Buyer shall be deemed to have accepted the equipment.
   b. All equipment so accepted shall remain the property of Seller, and Buyer shall store same in a safe and proper condition until sold as is.
   c. All claims for non-conformity or damage in transit shall be filed with the carrier of transit.
   d. All claims for shortage of shipment shall be filed within ten (10) days of receipt by Buyer.
   e. All claims for damaged or defective equipment shall be reported to Seller within five (5) days of receipt.
   f. All claims for non-conformity or damage in transit shall be filed with the carrier of transit.
   g. All claims for shortage of shipment shall be filed within ten (10) days of receipt by Buyer.
   h. All claims for damaged or defective equipment shall be reported to Seller within five (5) days of receipt.

3. Payment and Credit Terms
   a. Payment for the equipment and services shall be made upon receipt of invoice by Buyer.
   b. Unless otherwise indicated on the face hereof, Buyer shall pay three percent (3%) of the purchase price to be paid as a down payment upon acceptance of the equipment by Buyer, with the balance due and payable in ninety (90) days from the date of delivery or performance.
   c. If Buyer fails to make any payment when due,Seller may assess interest at the rate of one and one-half percent (1 1/2%) per month on the amount overdue on the date of delivere or performance.
   d. Seller reserves the right to change the terms of credit at any time, with or without notice.

4. Inspection, Acceptance and Return of Goods
   a. Buyer shall inspect all services and equipment at delivery, and shall give written notice to Seller of any material defects or non-conformity within five (5) days after delivery.
   b. If Buyer fails to give notice of any material defects or non-conformity within five (5) days after delivery, Buyer shall be deemed to have accepted the equipment.
   c. Seller shall not be liable for any defects or non-conformity of the equipment which are not discovered by Buyer during the inspection period.

5. Payment and Credit Terms, Unless otherwise indicated on the face hereof, Buyer agrees to pay the price of the equipment and services in accordance with the terms and conditions of this agreement, including interest at the rate of one and one-half percent (1 1/2%) per month on the amount overdue on the date of delivery or performance.

6. Taxes
   a. Tax of any kind will be paid by Buyer or Seller as provided by law.
   b. Any taxes imposed upon Seller as a result of the sale, furnishing, or installation shall be paid by Buyer.

7. Installation and Site Preparation
   a. Installation services are included in the purchase price of the equipment sold hereunder only if expressly so stated on the face of Seller's quotation or sales contract.
   b. For equipment requiring installation, Seller shall provide all necessary labor and materials, including but not limited to: excavation, grading, concrete, electrical, plumbing, and painting.
   c. Installation services are subject to the terms and conditions herein and shall be performed in accordance with the installation specifications provided by Seller.

8. Limited Warranty
   a. Basic Warranty. Except as otherwise provided herein, Seller warrants to Buyer that the equipment delivered to Buyer hereunder shall be free from defects in material and workmanship for a period of ninety (90) days from the date of delivery to Buyer.
   b. If Buyer discovers any defects in the equipment during the warranty period, Seller shall promptly repair or replace the equipment at Seller's option.
   c. In the event that Seller fails to repair or replace the equipment within a reasonable time, Buyer may have the defect repaired or replaced by another contractor, and Buyer shall be entitled to recover the reasonable cost of such repairs or replacements.

9. Exclusion of Liability
   a. Seller is not liable for any loss or damage resulting from fire, flood, storm, or other acts of God.
   b. Seller is not liable for any loss or damage resulting from the use or misuse of the equipment.
   c. Seller is not liable for any loss or damage resulting from the failure to use proper installation procedures.
   d. Seller is not liable for any loss or damage resulting from the failure to operate the equipment properly.

10. Non-waiver
   a. No waiver by Buyer of any provision of this agreement shall be deemed to be a waiver of any other provision hereof, or of the same or similar provision at any time.
   b. No waiver by Buyer of any provision of this agreement shall be deemed to be a waiver of any other provision hereof, or of the same or similar provision at any time.
   c. No waiver by Buyer of any provision of this agreement shall be deemed to be a waiver of any other provision hereof, or of the same or similar provision at any time.
   d. No waiver by Buyer of any provision of this agreement shall be deemed to be a waiver of any other provision hereof, or of the same or similar provision at any time.

11. Governing Law
   a. This agreement shall be governed by and construed in accordance with the laws of the State of Connecticut.
   b. Any dispute arising out of or relating to this agreement shall be resolved exclusively in the State of Connecticut's courts.
   c. This agreement shall be governed by and construed in accordance with the laws of the State of Connecticut.
   d. Any dispute arising out of or relating to this agreement shall be resolved exclusively in the State of Connecticut's courts.

12. Arbitration
   a. Any dispute arising out of or relating to this agreement shall be resolved exclusively in the State of Connecticut's courts.
   b. Any dispute arising out of or relating to this agreement shall be resolved exclusively in the State of Connecticut's courts.
   c. Any dispute arising out of or relating to this agreement shall be resolved exclusively in the State of Connecticut's courts.
   d. Any dispute arising out of or relating to this agreement shall be resolved exclusively in the State of Connecticut's courts.

13. Governing Law
   a. This agreement shall be governed by and construed in accordance with the laws of the State of New York.
   b. This agreement shall be governed by and construed in accordance with the laws of the State of New York.
   c. This agreement shall be governed by and construed in accordance with the laws of the State of New York.
   d. This agreement shall be governed by and construed in accordance with the laws of the State of New York.

14. Miscellaneous
   a. This agreement shall be governed by and construed in accordance with the laws of the State of New York.
   b. This agreement shall be governed by and construed in accordance with the laws of the State of New York.
   c. This agreement shall be governed by and construed in accordance with the laws of the State of New York.
   d. This agreement shall be governed by and construed in accordance with the laws of the State of New York.
Companies Presently Selling Trimyristin as a Laboratory Reagent

Accurate Chemical & Scientific Corp. Tel: 800-526 3593
300 Shames Drive
Westbury, NY 11590
Tel: 800-645-6264

or Accurate Chemical & Scientific Corp.
614 Pennsylvania Ave.
San Diego, CA 92103
Tel: 800-255-9378

Fluka Chemie Ac
Industriestrasse 25
CH-9470 Buchs Switzerland
085 6 9511

or Fluka Chemical Corp.
980 South Second Street
RonkonKoma, NY 11779
Tel: 516-467-0980
Tel: 516-467-0663

Kodak Laboratory Chemicals
Eastman Kodak Company
Building 701, 343 State Street
Rochester, NY 14652-3512
Tel: 800-225-5352

Pfaltz & Bauer, Inc.
Division of Aceto Chemical Co.
172 E. Aurora Street
Waterbury, CT 06708
Tel: 203-574-0075
Tel: 800-225-5172
Fax: 203-574-3181

Indofine Chemical Company, Inc
P.O. Box 473
Somerville, NJ 08876
Tel: 980-534-6522
Fax: 980-534-5789

Pharmacia Biotech Inc.
800 Centennial Ave.
Piscataway, NJ 08854
Tel: 908-457-8000
ACME Synthetic Chemicals
308, Veer Savarkar Marg
Bombay, 400028
India
Tel: 465127, 452706

Interchin S.A.
213, Avenue Kennedy
B.P. 15
F-03103 Montlucon
France
Tel: 70 03 88 55
Fax: 70 03 82 60

Larodan Fine Chemicals AB
Limhamnsgardens Alle 9
S-21616 Malmo
Sweden
Tel: 46 40 164155
Fax: 46 40 155498

Potential Large-Scale Buyers of Trimyristin

Geo Pfau’s Sons Company Inc.
P.O. Box 7
Jeffersonville, IN 47131
Tel: 800-PFAUOIL
Fax: 812-283-0765

Welch, Holme and Clark Co, Inc.
7 Avenue L
Newark, NJ 07105
Tel: 201-465-1200
Fax: 201-465-7332

Arista Industries Inc.
1082 Post Road
Darien, CT 06820
Tel: 800-ALL OILS
Tel: 203-655-0881
Fax: 203-656-0328
Appendix 5

Companies Selling Oils and Fats Extraction Equipment

Crown Iron Works
Winster and Sanger Division
P.O. Box 1364
Minneapolis, MN 55440-1365
Tel: 612-639-8900
Fax: 612-639-8051

Otto H. York, Co Inc
42 Intervale Road
P.O. Box 3100
Parsippany, NJ 07054-0918
Tel: 201-299-9200
Tel: 800-524-1543
Fax: 201-299-9401

The French Oil Mill Machinery Company
P.O. Box 920
Piqua, OH 45356
Tel: 513-773-3420
Fax: 513-77303424

Extraction De Smet.
Prins Boudewijulaan 265
B-2520 Edegem
Antwerp Belgium
Tel: 32/3/4494240
Fax: 32/3/4494204

Masiero Industrial S.A.
Jeu, Sao Paulo, 17200
P.O. Box 218
Brazil
Tel: Jau 55146,22 2773
Sao Paulo 55112853862

Ballestra Group
via S. Fautoli
21/17-20138 Milano
Italy
Tel: (02)50831
Fax: 02 5066003

Construzioni Meccaniche Bernardini
C.M.B. Spa
via dei Castelli Romani, 2L
00040 Pomezia (Rome) Italy
Tel: (06) 9120251-2-3
Fax: (06) 9106762

EMI Corporation
3166 Des Plaines Avenue
Des Plaines, IL 60018
Tel: 708-827-3164
Fax: 708-803-8394
An Estimate for a Pilot Study to be Conducted at Texas A and M University and Price Quotation for Equipments Necessary for the Production of Trimyristin on a Commercial Scale, from Crown Iron Works

Estimated Costs, Two Days Testing, at Texas A & M University
Nutmeg Extraction

<table>
<thead>
<tr>
<th>ITEM</th>
<th>AMOUNT</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility/Equipment</td>
<td>Day 1</td>
<td>$2,000.00*</td>
</tr>
<tr>
<td>Facility/Equipment</td>
<td>Day 2</td>
<td>$2,000.00*</td>
</tr>
<tr>
<td>Set-up</td>
<td>½ Day</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Clean-up</td>
<td>½ Day</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Crown Iron Works</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airfare</td>
<td></td>
<td>$900.00</td>
</tr>
<tr>
<td>Room/meals</td>
<td></td>
<td>$190.00</td>
</tr>
<tr>
<td>Solids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipping</td>
<td></td>
<td>?</td>
</tr>
<tr>
<td>Disposal</td>
<td></td>
<td>?</td>
</tr>
<tr>
<td>Solvent (diethyl ether)</td>
<td></td>
<td>negligible</td>
</tr>
<tr>
<td>Fresh Feed</td>
<td></td>
<td>?</td>
</tr>
<tr>
<td>Disposal</td>
<td></td>
<td>?</td>
</tr>
<tr>
<td>Analytical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check with local labs in College Station, TX</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Costs that need to be paid to Crown a minimum of 1 week in advance of the tests. Remaining costs to be paid within 30 days of billing.
We are pleased to quote:

1. Two (2) rotary valves (RVs), stacked to form a vapor barrier, for feeding the solid material into the extractor. A slight vacuum will be drawn from the space between the units to remove any solvent vapors that may escape the extractor. Units are carbon steel and come complete with drives and motors.

2. One (1) Crown, Series 2143B, Model IV Extractor. Extractor is completely piped, and includes powerpack. Six (6) Hydraulic drives will be furnished. Two (2) flowmeters will be furnished for fresh solvent and full miscella.

3. One (1) solvent preheater. A shell and tube type heat exchanger is provided for heating solvent before it enters the extractor. Vessel has stainless steel tubes and is designed for 150 PSI steam.

4. One (1) hydroclone for clarifying miscella.

5. One (1) rotary valve (RV) for feeding the solid material from the extractor to the Down Draft Desolventizer (DDD) conveyor. The RV is used to provide a pressure barrier between the two units. The RV is carbon steel and comes complete with a drive and motor.

6. One (1) DDD conveyor. Special conveyor for carrying spent material from extractor to DDD. Unit is complete with drive, less motor. Conveyor screw and housing is carbon steel.

7. One (1) Down Draft Desolventizer for desolventizing of spent Material. Unit evaporates solvent from material by conveying it over a series of steam chests. The unit is constructed of carbon steel.

8. One (1) Evaporator for removing solvent from miscella leaving the hydroclone. This is a shell and tube type, steam heated, heat exchanger. An entrainment separator mounts on top. Shell and dome are carbon steel. Tubes are 304 stainless steel. Vapors go from dome to condenser and miscella flows by gravity to oil stripper. Vessel operates under partial vacuum.

9. One (1) Luwa scrape surface heat exchanger. The viscous miscella from the evaporator is sprayed onto the steam heated interior wall of the vessel. The fats are continuously scraped from the vessel wall when the remaining solvent has been evaporated.

10. One (1) Evaporator Condenser for condensing solvent vapors from evaporator and Luwa. Vessel is a shell and tube type with 304 stainless steel tubes. Shell, end caps and tube sheets are carbon steel. Vapors pass on shell side and chilled water goes through tubes.
11. One (1) Slurry Pump for removing the final product, solid nutmeg fats, from the Luwa.

12. One (1) DDD Condenser for condensing solvent vapors. The shell, end caps and tube sheets are carbon steel. Tubes are 304 stainless steel. Vapors pass on shell side and chilled water through tubes.

13. One (1) refrigeration unit for chilling the cooling water, used by the condensers, to below the solvent's boiling point.

14. One (1) vacuum pump used to increase the efficiency of the Evaporator Condenser.

15. One (1) Vent Condenser is provided for further condensing vent gases before they enter the solvent air separator system. Vessel is shell and tube type with 304 stainless steel tubes. Tube sheets are carbon steel. Vapors pass on shell side and chilled water through tubes.

16. One (1) solvent-air separator system. A mineral oil absorption system (MOS) is provided for removing solvent from air before it is discharged to the atmosphere. The system includes an absorption column packed with saddles, a steam jacketed, stripping column, mineral oil cooler with stainless steel tubes and centrifugal type cold oil pump with explosion proof coupling and base. A flowmeter for controlling flow of mineral oil is provided. An ejector for providing partial vacuum is provided for the system. All piping, valves, regulators and traps for water, oil and steam are provided by others.

17. One (1) decanter and solvent work tank. A steel tank for decanting water from solvent and providing working storage for solvent is provided. Tank is horizontal with divider for separation. A recycle pump is furnished for pumping any water from working side to decanter side. The tank is vented to condenser.

18. All thermometers, manometers and pressure gauges necessary for the proper operation of the above equipment are provided. No other instrumentation is required or provided. Wiring is NOT included.

18. Forty-five (45) days of field engineering will be supplied to assist in erection, inspection, operator training, and start-up service. Additional field engineering can be provided upon request. The per diem charge is $550 US dollars/day plus all travel and living expenses.
NOT INCLUDED:

1. Wiring, conduit, starters or push button stations for motors.
2. Solvent, oil or material storage.
3. Insulation.
4. Building structures or foundations.
5. Equipment for preparation of material prior to extractor.
6. Conveying of material to extractor or from desolventizer.
7. Erection labor or tools.
8. Final paint for equipment.
9. Structural, electrical or civil engineering.

PRICES & TERMS

PRICE: $335,700 FOB Manufacturer

DELIVERY: Six (6) to seven (7) months

TERMS: 25% down payment, balance due upon shipment.

TAXES: The price herein quoted does not include any applicable city, county, state or federal sales tax or import duty. Any tax or duty levied on this sale is to be borne by the purchaser. Purchaser to furnish supplier with tax exempt certificate if applicable.

SAFETY:

The equipment to be furnished under this quotation will be designed and fabricated to the industrial standards for solvent extraction systems. When properly installed, no modification of the Crown Solvent Extraction equipment should be necessary to comply with the Occupational Safety and Health Standards Act as contained in Part 1910, including Change 12, dated April 5, 1976.

It is the customer's responsibility to see that he or his agents install the equipment properly so as to be in compliance with all applicable laws and regulations. We request that the customer comply with National Fire Protection Association Standard #36, including reasonable and practical upgrades of existing systems or procedures. All safety requirements should be
coordinated with the customers insurance company and other Authorities Having Jurisdiction as defined in the Standard.

FORCE MAJEURE AND DELAY:

Crown Iron Works Company shall not be responsible for loss of workage arising from delays caused by inability to procure required materials, strikes, lockouts, acts of God or other causes beyond the seller’s control. In case of such delay, the seller shall have an extension of time for performance equal to the delay caused thereby.

GUARANTEES ON EQUIPMENT NOT MANUFACTURED BY CROWN:

Crown Iron Works Company is responsible for items supplied, but not manufactured by them only to the extent of the original manufacturer’s warranty.

GUARANTEES ON EQUIPMENT MANUFACTURED BY CROWN:

Warranty shall be one year from start-up of equipment. Equipment shall be warranted against defects in workmanship and material when operated under normal use and service. New parts will be furnished to replace such defective parts free of charge f.o.b. point of manufacture. The purchaser shall give immediate notice of such defective parts and return them to seller, if requested by seller.

Crown reserves the right to add to, modify, delete or change equipment if we feel such changes are advantageous to the operation of the plant. Customer shall be notified of any such changes.

PRICE VALIDITY:

This quotation is firm for a period of sixty (60) days, after which time the price is subject to change.

Best regards,

Kevin D. Gilbert
Product Manager - Sales
REPORT No. 2

Nutmeg, Mace and their By-Products
a Market Overview

prepared by

Trade Information Service
Division of Product and Market Development
International Trade Centre UNCTAD/GATT
TABLE OF CONTENTS

List of Abbreviations ........................................... 50
List of ACP and LDCs ............................................. 51
1. Nutmeg and Mace - World Overview ....................... 53
2. Nutmeg and Mace - European Union Overview ............ 59
3. Nutmeg and Mace - USA ....................................... 65
4. Nutmeg and Mace - Japan ..................................... 69
5. Nutmeg and Mace - India ..................................... 71
6. Derivatives of Nutmeg and Mace - Market Overview ...... 75

TABLES

Table 1: Minimum Export Prices Agreed to by Indonesian and Grenadian Producers Under ‘Marketing Agreement’ in 1987 54
Table 2: MNS Prices for Nutmegs and Mace as on 29 April 1994 56
Table 3: Customs Tariffs in the EU for Imports of Nutmeg and Mace 60
Table 4: Customs Charges in USA for Imports of Nutmeg and Mace 66
Table 5: Main Suppliers of Nutmeg Oil to the US Market 76

APPENDICES

Appendix 1: Statistical Annex ................................ 83
Appendix 2: List of Importers .................................. 97
LIST OF ABBREVIATIONS

ITC  International Trade Centre UNCTAD/GATT
FAO  United Nations Food and Agriculture Organization
ACP  African, Caribbean and Pacific
LDC  Least Developed Country (or less developed developing country)
ISO  International Organization for Standardization
EU   European Union
EUROSTAT Statistical Office of the European Communities, Luxembourg
ASPIN Asosiasi Pala Indonesia
GCNA Grenada Cooperative Nutmeg Association
USDA United States Department of Agriculture
FDA  United States Food and Drug Administration
FEMA Flavor and Extract Manufacturers Association of the United States
JETRO Japan External Trade Organization
MNS  ITC's Market News Service - provides price information to subscribers on a regular basis.

MFN  Most Favoured Nation
GSP  Generalized System of Preferences

BS   British Standards
NF   Norme Française (French standards)
ASTA American Spice Trade Association
BIS  Bureau of Indian Standards

FOB  Free on Board
CIF  Cost, Insurance, Freight
C&F  Cost & Freight
VAT  Value-added tax

SUNS Sound unsorted nutmegs
GUNS Grenada unsorted nutmegs
BWP  Broken, wormy and punky
ABCD Indonesian trading term indicating an assortment of sizes of high quality whole nutmegs.

BIA/ETEZ Code letters designating volatile oil-content
BSL/AZWI Code letters designating volatile oil-content

FAQ  Fair average quality

Product description - trade classification systems used:

HS   Harmonized System (harmonised commodity description and coding system of the Customs Cooperation Council)
SITC Standard International Trade Classification; SITC(3) is the third revision of the classification system.
CN   Combined Nomenclature - 8-digit classification system of the European Union which is based on the 6-digit Harmonized System plus 2 digits.
HSTUSA Harmonized System Tariff USA - 10-digit classification system of the United States which is based on the 6-digit Harmonized System plus 4 digits.
### List of African, Caribbean and Pacific States (ACP)

<table>
<thead>
<tr>
<th>Angola</th>
<th>Gambia</th>
<th>Saint Kitts and Nevis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigua and Barbuda</td>
<td>Ghana</td>
<td>Saint Lucia</td>
</tr>
<tr>
<td>Bahamas</td>
<td>Grenada</td>
<td>Saint Vincent</td>
</tr>
<tr>
<td>Barbados</td>
<td>Guinea</td>
<td>Sao Tomé and Principe</td>
</tr>
<tr>
<td>Belize</td>
<td>Guinea-Bissau</td>
<td>Senegal</td>
</tr>
<tr>
<td>Benin</td>
<td>Guyana</td>
<td>Seychelles</td>
</tr>
<tr>
<td>Botswana</td>
<td>Haiti</td>
<td>Sierra Leone</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>Jamaica</td>
<td>Solomon Islands</td>
</tr>
<tr>
<td>Burundi</td>
<td>Kenya</td>
<td>Somalia</td>
</tr>
<tr>
<td>Cameroon</td>
<td>Kiribati</td>
<td>Sudan</td>
</tr>
<tr>
<td>Cape Verde</td>
<td>Lesotho</td>
<td>Suriname</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>Liberia</td>
<td>Swaziland</td>
</tr>
<tr>
<td>Chad</td>
<td>Madagascar</td>
<td>Tanzania UR</td>
</tr>
<tr>
<td>Comoros</td>
<td>Malawi</td>
<td>Togo</td>
</tr>
<tr>
<td>Congo</td>
<td>Mali</td>
<td>Tonga</td>
</tr>
<tr>
<td>Côte d'Ivoire</td>
<td>Mauritania</td>
<td>Trinidad and Tobago</td>
</tr>
<tr>
<td>Djibouti</td>
<td>Mauritius</td>
<td>Tuvalu</td>
</tr>
<tr>
<td>Dominica</td>
<td>Mozambique</td>
<td>Uganda</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>Namibia</td>
<td>Vanuatu</td>
</tr>
<tr>
<td>Equatorial Guinea</td>
<td>Niger</td>
<td>Western Samoa</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Nigeria</td>
<td>Zaire</td>
</tr>
<tr>
<td>Fiji</td>
<td>Papua New Guinea</td>
<td>Zambia</td>
</tr>
<tr>
<td>Gabon</td>
<td>Rwanda</td>
<td>Zimbabwe</td>
</tr>
</tbody>
</table>

### List of Less Developed Developing Countries (LDCs)

| Afghanistan | Guinea | Rwanda |
| Bangladesh | Guinea Bissau | Sao Tomé and Principe |
| Benin | Haiti | Sierra Leone |
| Bhutan | Kiribati | Solomon Islands |
| Botswana | Lao PDR | Somalia |
| Burkina Faso | Lesotho | Sudan |
| Burundi | Liberia | Tanzania |
| Cambodia | Madagascar | Togo |
| Cape Verde | Malawi | Tuvalu |
| Central African Republic | Maldives | Uganda |
| Chad | Mali | Vanuatu |
| Comoros | Mauritania | Yemen |
| Djibouti | Mozambique | Zambia |
| Equatorial Guinea | Myanmar | Zaire |
| Ethiopia | Nepal | |
| Gambia | Niger | |

51
1. NUTMEG AND MACE - WORLD OVERVIEW

Product Description

The nutmeg tree, *Myristica fragrans*, is indigenous to the Moluccas in Indonesia but has been successfully grown in other Asian countries and in the Caribbean, namely Grenada. A range of commercial products derive from the nutmeg tree of which the spices - nutmeg and mace - are the most commonly known and widely traded; other products are their essential oils, extracted oleoresins and nutmeg butter. Other nutmeg tree species include the *M. argentea* which produces ‘Papuan’ nutmegs from Irian Jaya and Papua New Guinea, and *M. malabarica* which produces ‘Bombay’ nutmegs from India; both are used as adulterants of *M. fragrans* products. This report focuses on world trade in the spices which are classified under the following codes:

- HS 0908.10 Nutmeg
- HS 0908.20 Mace
- SITC(3) 075.25 Nutmeg, mace and cardamoms

The spices in their ground form are mainly used in the food processing industry, principally in the seasoning of meat products; they are also used in soups, sauces, baked goods and spice mixes such as curry powder in Japan. Both spices have similar taste qualities; mace is more popular because of its light orange colour in light coloured foods. Nutmeg, in general, tends to be sweeter and more delicate. These products are also used in the perfumery and pharmaceutical industries. A possible, future use for nutmeg is as a natural control for insects that infest stored cereal grains.

Production and Trade

World production of nutmegs is estimated to average between 10,000 and 12,000 tons per year with annual world demand estimated at 9,000 tons; production of mace is estimated at 1,500 to 2,000 tons. Indonesia and Grenada dominate production and exports of both products with a world market share of 75% and 20% respectively. Other producers include India, Malaysia, Papua New Guinea and Sri Lanka, and other Caribbean islands such as St. Vincent. The principal import markets are the European Community, the United States, Japan and India (see statistical annex for import data). Singapore and the Netherlands are major re-exporters.

The East Indian islands of Siauw, Sangihe, Ternate, Ambon, Banda and Papua (Irian Jaya) produce nutmegs which are highly aromatic. Grenada produces the West Indian variety which is milder in flavor and lighter in colour. International trade in nutmegs is either of the East Indian variety or the West Indian variety, with a negligible quantity of wild ‘Bombay’ nutmegs imported by the United States.

Market Profile

International trade in spices as a whole, valued at an estimated US$ 1.5 billion for a volume of 400,000 tons, has experienced substantial growth in demand over the last two decades, particularly for major spices such as pepper.
Demand for nutmeg and mace grew in the 1970s but has been relatively stable despite a significant decline in prices due to oversupply (production and stocks\(^1\)) from the two main producers, Indonesia and Grenada in the 1980s. Prices are crucial for the decision to plant, and since the spices come from a tree and are harvested 7-9 years after plantation with the tree reaching its peak after 20 years, investment in this sector is a long term venture.

In 1986, the world price for higher grades of nutmeg was approximately US$ 1,000 per ton which did not ensure adequate returns to exporters. This led to a decision by Grenada and Indonesia to negotiate a marketing arrangement. In 1987, a ‘Marketing Agreement’ was concluded between the Indonesian producers group, Asosiasi Pala Indonesia or ASPIN formed in 1985, and the Grenada Cooperative Nutmeg Association (GCNA) with the objectives of controlling export volumes of nutmeg and mace to ensure price stability and of setting minimum price levels. Under the agreement creating the cartel, Indonesian and Grenadian producers agreed to the following minimum export prices:

Table 1: Minimum Export Prices Agreed to by Indonesian and Grenadian Producers Under ‘Marketing Agreement’ in 1987

<table>
<thead>
<tr>
<th></th>
<th>US$/ton</th>
<th>Indonesia</th>
<th>Grenada</th>
</tr>
</thead>
<tbody>
<tr>
<td>High quality nutmeg</td>
<td>6,800 - 7,000</td>
<td>6,650</td>
<td></td>
</tr>
<tr>
<td>Low quality nutmeg</td>
<td>1,000 - 1,200</td>
<td>5,575</td>
<td></td>
</tr>
<tr>
<td>High quality mace</td>
<td>13,500</td>
<td>11,750</td>
<td></td>
</tr>
<tr>
<td>Low quality mace</td>
<td>6,000</td>
<td>5,750</td>
<td></td>
</tr>
</tbody>
</table>

Source: Financial Times, 19 June 1992

Prices and revenues increased for both countries but in 1989, the cartel collapsed as Indonesian producers began selling below the minimum price levels, followed by the Grenadians. Despite efforts to reestablish the cartel, the subsequent economic liberalization of the Indonesian economy in 1990 effectively ended the Agreement.

In 1992, efforts were made by Grenada to recreate the cartel given the low world prices commanded by nutmeg and mace; it should be noted that Grenada earns up to 40% of its total foreign exchange earnings from exports of nutmeg and mace and it is therefore in the country’s interests to keep prices high. An important feature of these negotiations was the attempt to eliminate intermediaries or commodity brokers from the market\(^2\). As a result of negotiations

---

\(^1\) Both Indonesia and Grenada usually keep one year’s supply in stock; however, low prices led to stockpiling and the subsequent agreement to destroy an estimated 300 tons each of low quality nutmeg. In 1993, Indonesia and Grenada reportedly held 5,000 tons and 4,000 tons in stock respectively.

\(^2\) In April 1992, the Indonesian state trading company, Berdikari, and the Dutch company, Catz International, formed a joint venture (BerCatz BV) to buy Indonesian nutmeg and mace and trade it on international markets. According to their own estimates, BerCatz controls almost all the nutmeg and mace exported from Indonesia. Marketing agents for Grenada are JHB International in Belgium.
in May 1993, both Indonesia and Grenada agreed to destroy a percentage of their stocks in an effort to bolster world prices which rose by up to 40% following the announcement.

In 1994, Grenada’s nutmeg and mace output are expected to be below average due to bad weather; average annual production is between 2,700 tons and 3,000 tons of nutmeg and 275 tons of mace. Forecasts for 1994 are at 2,000 - 2,200 tons of nutmeg and 120 tons of mace. Forecasts for Indonesia were not available.

Prices

ITC’s Market News Service (MNS) issues weekly prices on a subscription basis for twenty-one spices, spice seeds and herbs, covering: USA, Japan, Hong Kong, Singapore, and selected European and Middle Eastern markets. Extracts of MNS prices for nutmeg and mace on 29 April 1994 are given in Table 2.

Quality Standards

Nutmegs and mace are classified by origin (East or West Indian) and by grade.

(a) Nutmegs

Whole nutmegs are grouped under three broad quality classifications:

- **Sound**: nutmegs which are mainly used for grinding and to a lesser extent for oleoresin extraction;
- **Substandard**: nutmegs which are used for grinding, oleoresin extraction and essential oil distillation
- **Distilling**: poor quality nutmegs used for essential oil distillation.

**Indonesia**

High quality or **sound** whole nutmegs are traded in grades which refer to their size in numbers of nutmegs per pound: 80s, 110s and 130s (110 to 287 nuts per kg), or ‘ABCD’ which is an assortment of various sizes.

**Substandard** nutmegs are traded as ‘sound, shrivelled’ which in general have a higher volatile oil content than mature sound nutmegs and are used for grinding, oleoresin extraction and oil distillation; and ‘BWP’ (broken, wormy and punky) which are mainly used for grinding as volatile oil content generally does not exceed 8%.

**Distilling** grades of nutmegs are of poorer quality: ‘BIA’ or ‘ETEZ’ with a volatile oil content of 8% to 10%; and ‘BSL’ or ‘AZWI’ which has less shell material and a volatile oil content of 12% to 13%.

**Grenada**

**Sound** nutmegs are sold as sound unassorted which corresponds to the Indonesian grade ‘ABCD’. In Grenada, determining whether a nutmeg is of sound quality is carried out by a water test where nutmegs are placed in a basket partly submerged in water: sound nutmegs sink whereas the unsound float.
Substandard nutmegs are classified as 'floats', and as 'defectives', the latter is similar to the Indonesian BWP grade but considered of higher quality.

Distilling grades of nutmegs are primarily exported to the USA and consist of 'floats'.

Table 2: MNS Prices for Nutmegs and Mace as on 29 April 1994

<table>
<thead>
<tr>
<th>Origin / Destination</th>
<th>Nutmegs - Grade</th>
<th>US$/ton CIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grenada / main European port</td>
<td>SUNS</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>GUNS</td>
<td>1,800</td>
</tr>
<tr>
<td></td>
<td>80's</td>
<td>3,200</td>
</tr>
<tr>
<td></td>
<td>60/65's</td>
<td>3,350</td>
</tr>
<tr>
<td></td>
<td>110's</td>
<td>2,950</td>
</tr>
<tr>
<td>Indonesia / Netherlands</td>
<td>BWP</td>
<td>1,425</td>
</tr>
<tr>
<td></td>
<td>BWP spot</td>
<td>1,385 (June-July)</td>
</tr>
<tr>
<td></td>
<td>Shrivels</td>
<td>1,825 (June-July)</td>
</tr>
<tr>
<td></td>
<td>ABCD spot</td>
<td>1,700 (June-July)</td>
</tr>
<tr>
<td>Indonesia / Germany</td>
<td>Shrivels</td>
<td>1,600 (June-July)</td>
</tr>
<tr>
<td></td>
<td>ABCD</td>
<td>1,700 (June-July)</td>
</tr>
<tr>
<td></td>
<td>BWP</td>
<td>1,675 (June-July)</td>
</tr>
<tr>
<td>Indonesia / United Kingdom</td>
<td>SUNS</td>
<td>1,875 (June-July)</td>
</tr>
<tr>
<td>Papua New Guinea / Netherlands</td>
<td>BWP</td>
<td>1,425</td>
</tr>
<tr>
<td></td>
<td>ABCD</td>
<td>1,950</td>
</tr>
<tr>
<td>West Indies / USA</td>
<td>Whole spot</td>
<td>2,205</td>
</tr>
<tr>
<td>East Indies / USA</td>
<td>Whole spot</td>
<td>1,765 (September)</td>
</tr>
<tr>
<td>Indonesia / Japan</td>
<td>110's spot</td>
<td>2,100</td>
</tr>
<tr>
<td></td>
<td>110's</td>
<td>2,500 (June-July)</td>
</tr>
<tr>
<td>Indonesia / Saudi Arabia</td>
<td>FAQ</td>
<td>1,600</td>
</tr>
<tr>
<td>Sri Lanka / Bahrain</td>
<td>110's</td>
<td>1,170</td>
</tr>
<tr>
<td>Sri Lanka / Kuwait</td>
<td>110's FAQ</td>
<td>1,035</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Origin / Destination</th>
<th>Mace - Grade</th>
<th>US$/ton CIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grenada / main European port</td>
<td>Mace 1</td>
<td>8,500 (August)</td>
</tr>
<tr>
<td></td>
<td>Mace 3</td>
<td>1,600</td>
</tr>
<tr>
<td>Indonesia / Netherlands</td>
<td>Broken 2</td>
<td>3,000 (June-July)</td>
</tr>
<tr>
<td></td>
<td>Whole</td>
<td>3,100 (June-July)</td>
</tr>
<tr>
<td>Siauw / USA</td>
<td>Siftings 2</td>
<td>2,645</td>
</tr>
</tbody>
</table>

(b) Mace

The same applies to mace which is classified as *whole pale mace, No1 broken mace, selected, unassorted or siftings* (Indonesia), and as *whole, broken blades or siftings* (Grenada).

However, the standards are not well defined and the preference for a specific quality depends a lot on the preference and experience of the buyer.

The international standards applicable for trade in spices of nutmeg and mace are *ISO 6577:1990 (Nutmeg, whole or broken, and mace, whole or in pieces - Specifications)*.

Distribution Channels

In principle, the distribution channels for nutmeg and mace are the same as for other spices which, since the 1980's, have seen a shift towards direct sales to end-users by producers; this has also led to a reduced role of major trading/entrepôt centres such as Singapore in the case of nutmeg and mace.

The distribution network is naturally influenced by the monopoly Indonesia and Grenada have on the nutmeg and mace trade and their efforts to decrease the role of intermediaries. The establishment of the Grenada Cooperative Nutmeg Association in 1947 had already significantly decreased the role of Grenadian dealers in the distribution chain. This was further intensified with the subsequent appointment by GCNA of JHB International as their marketing agents; and with the creation of ASPIN and the joint venture between the Indonesian state trading company, Berdikari, and the Dutch company, Catz International, to form BerCatz BV which markets virtually all Indonesian exports of nutmeg and mace.

Packaging

Nutmegs are usually packed in double-layered linen, jute, sisal or woven polythene bags. If other packing is used, care must be taken to avoid materials which might lead to 'sweating' and the development of mould. Spices must be thoroughly dried before shipment. They can then be transported in containers in conventional vessels. Packaging should be such that maximum weight loss is 10%, *(e.g. 20 kg declared weight should be at least 18 kg upon arrival at port)*.

Environmental regulations regarding packaging will be of increasing importance. A source of information on this is Duales System Deutschland GmbH (see Useful addresses).

Useful addresses

<table>
<thead>
<tr>
<th>Tariff information</th>
<th>Environmental packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Worldtariff Ltd</strong></td>
<td>Duales System Deutschland GmbH</td>
</tr>
<tr>
<td>220 Montgomery St., Suite # 432</td>
<td>Abteilung Vergabe &quot;Grüner Punkt&quot;</td>
</tr>
<tr>
<td>San Francisco, CA 94104-3410, USA</td>
<td>Postfach 1324</td>
</tr>
<tr>
<td>Tel: (415) 391 7501</td>
<td>Rochusstraße 2-6</td>
</tr>
<tr>
<td>Fax: (415) 391 7537</td>
<td>D-W-5300 Bonn 1</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
</tr>
<tr>
<td><strong>International Customs Tariff Bureau</strong></td>
<td>Tel: (228) 97 920</td>
</tr>
<tr>
<td>38, rue de l'association</td>
<td>Fax: (228) 979 2198</td>
</tr>
<tr>
<td>1000 Brussels, Belgium</td>
<td></td>
</tr>
</tbody>
</table>
2. NUTMEG AND MACE - EUROPEAN UNION OVERVIEW

Product Description

<table>
<thead>
<tr>
<th>CN Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0908.10-10</td>
<td>Nutmegs for industrial manufacture of essential oils or resinoids</td>
</tr>
<tr>
<td>0908.10-90</td>
<td>Crushed or ground nutmeg</td>
</tr>
<tr>
<td>0908.20-10</td>
<td>Mace, excluding crushed or ground</td>
</tr>
<tr>
<td>0908.20-90</td>
<td>Crushed or ground mace</td>
</tr>
</tbody>
</table>

Imports of Nutmeg and Mace (aggregates in metric tons)

Source: EUROSTAT

The major importers within the European Union (EU) are:

- Nutmegs imported for industrial use: Germany, France, United Kingdom, Denmark;
- Crushed or ground nutmeg: Netherlands, Germany;
- Mace, excluding crushed or ground: Germany, Netherlands, Belgium-Luxembourg;
- Crushed or ground mace: Netherlands, Belgium-Luxembourg, United Kingdom, France.

Details are provided in the statistical annex.

Market Profile

The EU is the largest import market for nutmeg and mace. However, demand for nutmegs is not very price-sensitive and the falling prices have not led to increased imports. This is due to the fact that demand in traditional end-use sectors has not grown.

In general, importers prefer whole nutmegs and mace of the East Indian variety. However, because of historical reasons, the West Indian varieties have held a strong position...
in the United Kingdom. Much of the imports to the Netherlands are re-exported, partly to the United States but mostly within the European Union.

**Market Access**

Imports of nutmeg and mace are subject to the following customs tariffs in the EU:

**Table 3: Customs Tariffs in the EU for Imports of Nutmeg and Mace**

<table>
<thead>
<tr>
<th>Tariff heading</th>
<th>Duty - MFN rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0908.10-10</td>
<td>Free</td>
</tr>
<tr>
<td>0908.10-90</td>
<td>5%</td>
</tr>
<tr>
<td>0908.20-10</td>
<td>Free</td>
</tr>
<tr>
<td>0908.20-90</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: Worldtariff Ltd

Imports from less developed developing countries (LDCs) are exempt from customs duties.

The following value-added tax (VAT) rates are levied on imports of food products:

- Belgium: 6.0%
- Denmark: 25.0%
- France: 5.5%
- Germany: 7.0%
- Greece: 18.0%
- Italy: 9.0%
- Luxembourg: 3.0%
- Netherlands: 17.5%
- Spain: Zero-rated
- UK: Zero-rated
- Ireland: Zero-rated

(Rates for Portugal were not available.)

High quality is of prime importance for importers of nutmeg and mace. Separate national standards have been issued to obtain the desired level of quality:

- Netherlands: *Spices Decree*
- United Kingdom: *BS 7087:14*
- France: *NF V32-125*

However, most European traders prefer the *ASTA (American Spice Trade Association) Cleanliness Specifications* which are regarded as stricter than other national standards. The most common complaints on imports of nutmeg concerns aflatoxin in the Netherlands and in Germany, and salmonella in the United Kingdom. Recently, much attention has been given to the irradiation of spices. Although no regulations exist, customers prefer non-irradiated spices. Likewise, the use of environmentally friendly methods for cultivating the spices is becoming a niche market.
Distribution Channels

Main dealers are located in Rotterdam, Amsterdam, London and Hamburg. Dealers in the Netherlands are to a large extent processors and re-exporters to the United States and within the European Union.

For retail trade of nutmeg in the Netherlands, the whole nutmeg must be limed, i.e. coated with chalk; this is almost entirely carried out by importers.

Packaging

Recommended packaging is described under World Overview. For labelling in the EU market, the following requirements need to be fulfilled:

- name of the product
- any care conditions
- country of origin
- instructions for use
- name of the manufacturer or distributor
- special storage conditions
- metric requirements

It is advisable to write labels in at least two official languages of the European Union.

Commercial Practices

Initial contacts are usually made by fax or telex. Samples of the spice are sent and, subsequent to acceptance, an agreement between buyer and seller can be settled using a standard contract. In the Netherlands the contract is issued by the Dutch Spice Association, and in the United Kingdom the contract terms are settled by the International General Produce Association. Whether traded on an FOB or CIF basis is subject to negotiation.

Sales Promotion

Marketing missions and promotional materials are the most common means of promotion. In addition, advertisements can be placed in specialised magazines such as "Perfumer & Flavorist", "Meat Industry" and "Foodnews". Trade fairs of interest are Slavakto, Horecava and FIE in the Netherlands, Anuga in Germany, and SIAL in France (see Useful addresses).

Market Prospects

The prospects for the trade of nutmeg and mace in the EU are not promising for new suppliers from countries other than Indonesia and Grenada. An increase in the use of oleoresins does not seem likely because of the relatively conservative attitude of the European food processing industry. The British industry differs on this point which could lead to a rise in the consumption in the United Kingdom.
Useful addresses

1. Associations

Spice Trade & Seasoning Manufacturers Association
6 Catherine Street
London WC2B 5JJ
United Kingdom
Tel: (071) 836 2460
Tel: (071) 836 0580

Nederlandse Zuidvruchten vereniging
Bezuidenhoutseweg 82
822594 AX Den Haag
Netherlands
Tel: (70) 383 3011
Fax: (70) 347 5253

Syndicat National des Triturateurs-Conditionneurs de Poivres et Epices
8, rue d’Isly
75008 Paris
France
Tel: (1) 45 22 28 15
Fax: (1) 43 87 85 40

2. Standards

International Organization for Standardization (ISO)
1, rue de Varembé
1211 Geneva 10
Switzerland
Tel: (022) 749 0111
Fax: (022) 733 3430

Codex Alimentarius Commission
Via delle Terme di Caracalla
00100 Rome
Italy
Tel: (6) 57 971
Fax: (6) 5797 3152

3. Import Promotion Offices (assist exporters in developing countries)

DeCTA
Bank House
Sutton Court Road
Sutton, Surrey SM1 4SP
United Kingdom
Tel: (081) 643 3311
Fax: (081) 643 8030

Pro-Trade/GTZ GmbH
Dag Hammarskjöldsweg 1-5
6236 Eschborn
Germany
Tel: (6196) 790
Fax:(6196) 797 414

Promex-PMA
10, Avenue d’Iéna
75016 Paris
France
Tel: (1) 40 73 30 67
Fax: (1) 40 73 39 69

CBI
P.O. Box 30009
3001 DA Rotterdam
Netherlands
Tel: (010) 201 3434
Fax: (010) 411 4081
4. **Trade fairs**

**Netherlands**

Slavakto *(meat industry)*
The Royal Netherlands Industries Fairs
Jaarbeursplein
P.O. Box 8500
3505 RM Utrecht
Tel: (30) 955 911
Fax: (30) 940 379

FIE *(Unground products for foodstuff industry)*
Expoconsult Maarsen
Industrieweg 54
P.O. Box 200
2600 AE Maarsen
Tel: (3465) 73 777
Fax: (3465) 73 811

**Germany**

Anuga - Central Marketing
Gesellschaft de Deutschen Agrar Wirtschaft
Koblenzerstrasse 148
5300 Bonn-bad Godesberg
Tel: (228) 8470
Fax: (228) 847202

**France**

SIAL - Salon International de l'Alimentation
39, rue de la Bien Naissance
75008 Paris
Tel: (1) 42 89 46 87
Fax: (1) 42 89 46 94

**Germany**

Horecava *(catering industry)*
RAI gebouw
Europaplein 8
1078 GZ Amsterdam
The Netherlands
Tel: (20) 549 1212
Fax: (20) 4644 6910

**France**
Product Description

HSTUSA 0908.10-0000  Nutmegs
HSTUSA 0908.20-2000  Mace, ‘bombay’ or wild, ground
HSTUSA 0908.20-4000  Mace nes

Imports of Nutmeg and Mace (aggregates in metric tons)

Market Profile

The USA is the largest individual market for whole nutmegs. Importers of the United States prefer the East Indian variety of deep-brown, aromatic nutmegs and orange-red mace in their whole form. Indonesia has traditionally been the principal supplier of nutmegs and mace to the US market, accounting on average for 65% of total US imports of nutmegs per year in terms of volume. It is also the main supplier of mace. (See statistical annex for details.) Following talks between ASPIN and GCNA in 1993, Indonesia has agreed to allow Grenada greater access to the US market. The outcome, however, depends on the processors’ reaction on the US side and the Grenadian producers’ ability to satisfy market requirements.

The US food and beverage industry is one of the largest in the world with a correspondingly high consumption of spices and their oleoresins and essential oils. One of the uses of nutmeg oil is in the manufacture of soft drinks, specifically Coca-Cola. The US food and drink market is also one of the most highly developed in terms of innovation in flavourings, fast foods and the ethnic foods sector.
Market Access

Imports of nutmeg and mace are subject to the following customs charges:

Table 4: Customs Charges in USA for Imports of Nutmeg and Mace

<table>
<thead>
<tr>
<th>Tariff heading</th>
<th>MFN</th>
<th>GSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0908.10-0000 Nutmegs</td>
<td>Free</td>
<td>Free</td>
</tr>
<tr>
<td>0908.20-2000 Mace, ‘Bombay’ or wild, ground</td>
<td>16.5¢/kg *</td>
<td>Free</td>
</tr>
<tr>
<td>0908.20-4000 Mace nes</td>
<td>Free</td>
<td>Free</td>
</tr>
</tbody>
</table>

Source: Worldtariff Ltd
* The MFN rate was lowered to 12.4¢ per kg (31 December 1993).

Other charges include a Merchandise Processing Fee (0.19% of FOB value) and a Harbour Maintenance Fee (0.125% of FOB value). In addition, general sale and use taxes are levied at the state level (rates differ from state to state).

The American Spice Trade Association issues ASTA Cleanliness Specifications which set the quality requirements necessary to enter the US market. The major complaints on the part of US importers has been the presence of insect fragments in shipments of nutmegs. As in the EU, non-irradiated spices are preferred.

Distribution Channels

The main brokers and dealers in spices are located in New York; the main ports of entry are New York, Baltimore, Los Angeles and San Francisco.

Up to the 1980s, the traditional distribution chain for spices was from exporter to importer via a US agent. At the national level the distribution channel was:

Importer → broker → grinder/processor → (i) wholesaler, (ii) retailer, (iii) food processor.

Since then, direct purchase from source has reduced the number of intermediaries in the chain.

Exporters should note that official ASTA contracts are used. US dealers prefer C&F quotations, in general.

Market Prospects

Consumer trends for health foods, ethnic cuisine and fast foods, in addition to the need for constant innovation in the food industry, all indicate that consumption of spices and spice oleoresins, in general, will continue to grow. This is reflected in the fact that the food industry and institutional outlets consume up to 65% of imported spices as opposed to 40% a decade ago.
This implies a growing ‘prepared foods’ market and increased demand from the restaurant and catering sector. Therefore any growth in these two sectors will have a direct influence on imports of spices, and to a lesser extent of nutmegs and mace.

Useful addresses

American Spice Trade Association (ASTA) Inc.
580 Sylvan Avenue
P.O. Box 1267
Englewood Cliffs, NJ 07632
Tel: (201) 568-2163
Fax: (201) 568-7318

United States Department of Agriculture (USDA)
Agricultural Marketing Service
Washington, D.C. 20250
Tel: (202) 720-4276
Fax: (202) 720-8477

Flavour and Extract Manufacturers Association of the United States
1620 I St., NW, Suite 925
Washington D.C. 20006
Tel: (202) 293-5800
Fax: (202) 463-8998
4. NUTMEG AND MACE - JAPAN

Product Description

JHS 0908.10-100  Nutmeg put up in containers for retail sale
JHS 0908.10-210  Nutmeg, neither crushed or ground, not put up in containers for retail sale
JHS 0908.10-220  Nutmeg, crushed or ground, not put up in containers for retail sale
JHS 0908.20-210  Mace, neither crushed or ground, not put up in containers for retail sale
JHS 0908.20-220  Mace, crushed or ground, not put up in containers for retail sale

Imports of Nutmeg and Mace (aggregates in metric tons)

Main suppliers

Japan's major supplier of nutmegs and mace is Indonesia, accounting on average for 93% of total imports. Other suppliers include Malaysia, India and Singapore. See statistical annex for details.

Source: Japan Exports & Imports, Commodity by Country, Japan Tariff Association

Market Profile

The Japanese import market for spices is the largest in the Asia-Pacific region; but per capita consumption is lower than in Europe or in the United States. However, with the tremendous growth in popularity of spicy foods, specifically Indian, consumption is expected to increase. Nutmegs and mace are used in the manufacture of curry powder.

The main end-user is the food processing industry. Nutmegs and mace and their oleoresins and essential oils are used in the preparation of meat products, soups, sauces and baked goods. An interesting feature of the Japanese market is the growth in the 'instant' and fast food sectors.

For spices in general, imports have increased over the last ten years, mainly for use in the food processing industry, but a non-traditional spice such as nutmeg has not benefited from this trend. Whole mace, on the other hand, has been imported in increasing quantities, partly due to its greater use in the manufacture of curry powder.

Market Access

Whole nutmegs and mace are imported free of charge into Japan. Products put up in containers for retail sale are subject to a tariff of 4.2%.

The Quarantine System and Plant Protection Law and the Food Sanitation Act set the quality standards for nutmeg and mace. The main complaint concerning imported nutmegs has
been the aflatoxin content. Spices may not be irradiated nor is it permissible use ethylene oxide gas to disinfect spices.

**Distribution Channels**

Importers supply food processors, grinders/processors and essential oil and oleoresin manufacturers. These in turn supply the different end-use sectors such as curry manufacturers.

**Packaging and Labelling**

The Japanese customer is very demanding regarding packaging, particularly concerning environmental protection. Lettering size is prescribed for labels which must include:

- name of the product
- name and address of the manufacturer or seller
- net contents
- date of manufacture

**Market Prospects**

The Japanese market is a promising one for spices given the changing lifestyles. More women are working in Japan today which increases the need for 'instant' and 'oven to table' type meals. Greater demand for non-traditional spices such as nutmeg and mace is probable in the food and drink sector with the consumer trend towards French, Italian and Indian cuisine.

To increase household consumption, "user-friendly" spices, spice mixes and attractive retail packaging are necessary. Exporters should coordinate with Japanese distributors and retailers in this area. Furthermore, a growing interest for international foods, trade liberalisation and a stronger yen could have favourable implications for imports of nutmegs and mace.

**Useful addresses**

All Nippon Spice Association  
Boeki Bldg., 4F  
123 Higashi-machi  
Chuo-ku  
Kobe 651-01  
Tel: (078) 321 8431  
Fax: (078) 321 8460

Japan External Trade Organization (JETRO)  
2-5, Toranomon 2-chome  
Minato-ku  
Tokyo 105  
Tel: (03) 3582 5173  
Fax: (03) 3585 5027
5. NUTMEG AND MACE - INDIA

The fiscal year in India extends from April to March. Data for March 1991 to April 1992 are reported as "1991" in the figure below.

**Imports of Nutmeg and Mace** (aggregates in metric tons)

![Graph showing imports of Nutmeg and Mace]

Source: Statistics of the Foreign Trade of India by Country. For details, see statistical annex.

**Main Suppliers**

The principal suppliers to the Indian market for nutmegs and mace are Indonesia, Singapore and Sri Lanka; over the years their relative positions have changed.

**Market Profile**

India's domestic production of nutmegs is insufficient to meet local demand and is therefore supplemented by imports. East Indian nutmegs and mace are traditionally preferred because of geographic proximity and their particular flavouring qualities which are more suitable for Indian foods.

**Market Access**

The recent trade liberalization reforms in India have to a great extent reduced customs duties and virtually eliminated non-ad valorem charges on imports. Nevertheless, duties remain high - imports of nutmegs and mace are subject to an ad valorem tax of 65%. However, preferences are accorded on an item by item basis, specifically for industries which are of particular importance such as food and beverages.
Shipments of nutmegs and mace should be accompanied by a general sanitary certificate. The Bureau of Indian Standards (BIS) can provide details on specifications for the Indian market (see Useful addresses); minimum standards comply with those issued by ISO.

**Distribution Channels**

As India is one of the major producers and exporters of spices in general, exporters and food processors usually act as importers when local production is insufficient to meet domestic demand.

Exporters are advised to appoint agents either on an exclusive or non-exclusive basis to handle all matters dealing with the marketing, including sales promotion, and distribution of goods within the country. The major market centres are Bombay, Calcutta, Madras and New Delhi.

**Packaging and Labelling**

India's principal ports are located in the central and southern parts of country. Packaging should therefore take into account climatic conditions and protect the goods from dampness, heat, exposure to sun and rain, insects, fungus and mold. Labelling should be in English and a minimum lettering size of 2 millimetres should be used for the country of origin. Labels should indicate:

- country/place of production or the name and address of the manufacturer,
- whether the goods were partly or wholly produced/processed in more than one country.
- the names of both countries where the goods were produced in one country and the packaging made in another.

In addition, there are standards in effect for marking and labelling related to weights and measures for imports packaged for retail sale.

**Commercial Practices**

Indian importers are required to obtain a Code Number, issued by the Regional Licensing Authority, Chief Controller of Imports & Exports. Import licenses are issued on a CIF basis, issued in duplicates and valid for a period of 18 to 24 months. Payment should be made in the form of a letter of credit, payable in favour of the supplier against presentation of shipping documents through the importer’s bank.

**Market Prospects**

The Indian market is considered to be one of the top ten emerging markets in the world and as such presents very positive prospects for imports in general. This combined with a growing middle class, estimated at 200 million people with a substantial purchasing power, and a corresponding demand growth in the food and drink sector, should all positively affect demand for spices in general. In addition, the food processing industry has been declared a priority domestic economic sector.
Useful addresses

Bureau of Indian Standards (BIS)
9, Bahadur Shah Zafar Marg
NEW DELHI 110 002
Tel: (11) 331 0131
Tlx: 031-65870
Fax: (11) 331 4062

Ministry of Commerce
Udyog Bhawan
Maulana Azad Road
NEW DELHI 110 001
Tel: (11) 301 1938

Indian Trade Promotion Organization
(ITPO)
Pragati Bhawan
Pragati Maidan
Lal Bahadur Shastri Marg
NEW DELHI 110 001
Tel: (11) 332 8239
Fax: (11) 331 8142
6. DERIVATIVES OF NUTMEG AND MACE - MARKET OVERVIEW

**Product Description**

1. **Essential oils**

   The dry kernel (seed), nutmeg, typically contains between 8% and 15% of essential oil obtained by steam distillation. The chief constituents of the aromatic oil are terpenes, mainly sabinene and β-pinene but the important fragrance and flavour constituents or aromatic ethers, which are found in the small oxygenated portion, are *myristicin* which can be produced synthetically, safrole, elemicin and iso-elemicin.

   Nutmeg oil is a colourless, pale yellow or pale green liquid with an odour and taste of the spice. The market makes a distinction between the East Indian, West Indian and Sri Lankan nutmeg oil where the East Indian oil is regarded to be the superior in flavour and odour. A further difference is their degree of solubility in alcohol (1 in 3 for the East Indian and 1 in 4 for the West Indian; unknown for Sri Lankan). Nutmeg oil is mainly used in flavourings, especially for soft drinks (colas in general, such as Coca-Cola) and meat products. It is used in cosmetics and toiletries because of its aromatic properties, especially in men’s fragrances, as well as in the manufacture of pharmaceuticals (such as *Vicks VapoRub*) and in flavouring tobacco.

   Mace oil possesses almost identical physiochemical and organoleptic properties as nutmeg oil. For mace oil the same distinction is made between the East and West Indian varieties. Mace oil is also used in perfumes and flavourings.

2. **Spice oleoresins**

   Nutmeg oleoresins, obtained by solvent extraction from the dried spice of nutmeg, are used in colourings and flavourings in the food industry. The extracted spice oleoresin is a direct competitor of the dry spice.

3. **Nutmeg butter**

   Nutmegs contain between 25% and 40% of fixed oil which can be obtained by expression. The nutmeg butter obtained is a highly aromatic, orange-coloured fat. It is composed of 70% to 85% of trimyristin and other material including *myristicin*. Poor quality nutmegs are used for nutmeg butter production.

4. **Others**

   Both nutmeg and mace contain the active ingredient *myristicin* which is a narcotic; it is the major constituent in mace. Myristicin, whether or not derived from nutmeg, is also found in crop-control insecticides and in flavourings used in tobacco products. East Indian oils have a higher concentration of myristicin (up to 13.5%) than West Indian oils (below 1%). This combined with a higher safrole content is probably responsible for the stronger nutmeg flavour in the East Indian variety. Myristicin can be synthesized from pine oil.

   *Myristic acid* or *tetradecanoic acid*, a C<sub>14</sub> fatty acid, is the predominant fatty acid of the nutmeg family, comprising between 70% and 90% of the glycerides of nutmeg butter (*Myristica fragrans*) and is obtained by fractional distillation. It is an oily, white crystalline solid, soluble
in alcohol and ether. It is an intermediate in the preparation of myristyl alcohol, myristoyl chloride and related compounds.

Myristic acid is commercially available as a fractionally distilled product of 90% purity. It is used in the preparation of soaps, liquid detergents, shampoos, shaving creams, perfumes; in the production of plastics; in compounding rubber, paints and greases; in the synthesis of ester for flavours and perfumes; and as a component of food-grade additives.

Trimyristin is a triglyceride of myristic acid, and is a white to yellowish-gray solid.

**Principal Import Markets**

The main importer of nutmeg oil is the United States, accounting for around 50% of total global imports, followed by the United Kingdom with approximately 10%.

Indonesia dominates the US market as the main supplier of nutmeg oil as shown in the table below.

| Table 5: Main Suppliers of Nutmeg Oil to the US Market |
|----------------|----------------|----------------|----------------|----------------|----------------|
| Total | 1,685 | 105.8 | 1,333 | 132.6 | 2,077 | 192.0 | 935.6 | 109.5 |
| Indonesia | 1,452 | 96.7 | 1,275 | 128.3 | 1,861 | 178.2 | 832.8 | 101.8 |
| France | 75 | 4.0 | 0 | 0 | 19 | 1.5 | 66.2 | 6.2 |
| Mexico | 0 | 0 | 3 | 0.6 | 57 | 1.7 | 14.0 | 0.4 |
| UK | 15 | 0 | 0 | 0 | 48 | 2.7 | 13.9 | 0.9 |
| India | 2 | 0 | 24 | 1.1 | 89 | 7.9 | 0 | 0 |

Source: US Department of Commerce, Bureau of the Census

(a) 1993 values are FOB country of origin; 1990-1992 values are CIF.

In the European Union, import data for nutmeg and mace oil are not available; however, data on nutmegs imported for the industrial manufacture of essential oils and resinoids are given in the statistical annex. Traded volumes of mace oil are very small. The main importer is the United States, which accounts for approximately 75% of total global imports. In the EU market, Germany is the major importing country.

**Market Characteristics**

Nutmeg and mace oils and oleoresins used to be almost exclusively produced in importing countries, where end-users required higher quality and stricter control during production. However, Indonesia is now the main world supplier of nutmeg and mace oil, with
over a 90% share of the US market. Other suppliers are Sri Lanka and Grenada. The supply of West Indian oil, however, is considered to be more irregular than that of the East Indian oil.

While the main end-user of the spice oleoresins is the food industry, recent trends may revive the fragrance sector, particularly the use of essential oils in aromatherapy and the "home fragrances" market niche. In a 1987 study (Warren et al.), it was reported that the main constituents of nutmeg and mace, myristicin, elemicin and iso-elemicin, when presented in aroma form acted as stress relievers. In Japan, many companies are diffusing aromas through air ventilation systems to improve the work environment as well as the quality of air. The same principle is now available for the home in different forms, such as scented candles, potpourris, atomizers, and other aroma products. According to a recent report, the US market for home fragrancing is valued at US$ 500 million (Chemical Marketing Reporter, May 16 1994).

According to trade sources, apparent consumption of all natural fatty acids, including tall oil fatty acids, in the USA is an estimated 1.8 million pounds per year, of which approximately 12 million pounds of myristic and lauric acid. In Western Europe, apparent consumption is expected to reach 840 thousand metric tons in 1995. Japanese apparent consumption is estimated at over 300 thousand tons per year.

Nutmeg butter as a source for myristic acid is not widely used and information was not available from major processors of the fatty acid. The main sources for commercial myristic acid and of C8-C14 fatty acids in general, are coconut oil and palm kernel oil which contain approximately 18% of myristic acid. The percentage used of these oils in the production of myristic acid is not known, but approximately 50% of the 4.3 million metric tons produced of both oils is used for the production of lauric acid which has similar chemical properties and industrial applications as myristic acid, according to trade sources. It is a bulk chemical and in ample supply, particularly from Malaysia (palm kernel oil) and the Philippines (coconut oil) where the main US and European producers of fatty acids have plants or joint venture agreements. Malaysia is the principal source for Japanese imports of fatty acids.

**Market Access**

Imports of nutmeg and mace oil into the European Union are exempt from customs duties when originating in ACP or less developed developing countries (LDCs). Within the EU, a value-added tax (VAT) rate is applied to imports; this rate varies from country to country. Imports of nutmeg and mace oil from all origins into the United States are exempt from customs duties. The same applies to Japan for essential oils originating in developing countries; however, a list of authorized import volumes is issued annually. In the case of the European Union and Japan, shipments must be accompanied by a certificate of origin. For the European Union, they should also be shipped direct from the country of origin.

ISO and BS standards applicable to nutmeg and mace oils are:

- ISO 7355 - 1985 Nutmeg and Sassafras Oil
- BS 2999/37 : 1971 East Indian Nutmeg Oil
- BS 2999/38 : 1971 West Indian Nutmeg Oil
- ISO 4734 - 1981 Mace Oil

EU regulations on essential oils set limits on the types of end uses in which each essential oil can be used. The relatively restrictive EU rules and, in particular, the listing of prohibited ingredients render market access more difficult for new suppliers.
The Japanese Food Sanitation Law regulates essential oils used in the food and beverages industries. Details can be obtained from JETRO (see Nutmeg and Mace: Japan).

In the case of aroma chemicals, the United States issues a list of flavour substances that are classified as "Generally Recognized as Safe (GRAS)". This list is compiled by the Flavour Extracts Manufacturers Association (FEMA) and is acknowledged by the US Food and Drug Administration (FDA).

Lists of permitted and prohibited ingredients are also issued for cosmetics and toiletries.

Tariffs on imports of myristic acid are as follows:

<table>
<thead>
<tr>
<th>Country</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>7.1% (MFN rate)</td>
</tr>
<tr>
<td>USA</td>
<td>Free (GSP scheme)</td>
</tr>
<tr>
<td>Japan</td>
<td>Free (GSP scheme)</td>
</tr>
</tbody>
</table>

A certificate of origin is required to benefit from preferential tariff regimes.

**Prices**

Supplies of nutmeg and mace oils are directly dependent on the availability of the raw materials for processing. Given the current supply situation for nutmegs, supplies of the oils are low. In 1988 spot prices in the United States for East Indian nutmeg oil, which generally is less expensive than West Indian oil, were reported at around US$ 32/kg. In 1991 corresponding prices were at US$ 11/kg. Since then prices have showed a small increase and in 1993 spot prices were quoted at US$ 13.5/kg. Current spot prices for Indonesian distilled nutmeg oil in drums range from US$ 6 to US$ 6.50 per pound (Chemical Marketing Reporter, June 6 1994).

Prices for myristic acid were quoted at US$ 1.15 and US$ 1.23 per pound (truckload) from the same source.

**Packaging**

Low volume oils such as nutmeg and mace can be shipped in drums with capacities ranging between 25 litres and 100 litres. Exporters should ensure that drums used for the storage and transportation of the essential oils are:

- impermeable to minimize loss through evaporation or oxidation,
- thoroughly cleaned to remove all traces of impurities which could alter the olfactory and taste characteristics of the oils,
- correctly sealed and have adequate air space between the surface of the oil and the top of the container.

During storage and transportation, the oils should be protected from light and stored at a temperature not exceeding 25°C.

Myristic acid is packed in bags.
Market Prospects

The flavourings sector is a growth market despite increasing regulation on food additives and permitted ingredients.

Given the current low prices for nutmegs in particular for low quality nutmegs used for essential oil distillation, supply of nutmeg and mace oil is limited as farmers switch over to more profitable crops. This has resulted in firmer prices for both nutmeg and mace oils but direct supply is unlikely to increase substantially in 1994. Stocks held of these oils will probably keep the market stable in the immediate to short term.

Myristicin has received negative publicity recently with findings that the consumption of cola drinks caused genetic material to be damaged in the liver of mice. Studies would be necessary to determine whether human health could be affected by the presence of myristicin in food and drink products, even though it is unlikely.

According to available data, US imports of all natural fatty acids are limited as the US is a major producer.

Consumption of fatty acids in general is in decline in the European Union. This is attributed to the loss of markets in Eastern Europe, and changes in the use of fatty acids in industrial applications, specifically the detergent sector. This decline is expected to continue in the short term. No specific information was available concerning myristic acid or lauric acid.

The Japanese market for fatty acids has been increasing since the mid-1980s, importing over 12 thousand metric tons of myristic, lauric and capric acid in 1992, up from an estimated 1,000 metric tons in 1983.

There could, therefore, be a potential market for myristic acid from nutmeg butter given the wide industrial applications of the fatty acid. However, with the monopoly Indonesia and Grenada have on nutmeg production for spices and, to a lesser extent, for essential oils, it would seem that little research or investment has gone into exploring other commercial uses for nutmegs despite the fact that poor quality or rejected nutmegs are used for the production of nutmeg butter. It should be noted that the major producers of myristic acid and derivatives are multinational enterprises with production facilities for coconut and palm kernel oil in South East Asia, such as Akzo Chemicals (Netherlands), Rhône-Poulenc (France), Procter & Gamble (USA), Witco Corporation (USA) and Unichema (Unilever Group).

Useful addresses

1. International organizations

International Federation of Essential Oils and Aroma Trades (IFEAT)
16/16 Dufferin Street
London EC1Y 8PD
United Kingdom
Tel: (071) 253 9421
Fax: (071) 250 0965

International Organization of the Flavour Industry (IOFI)
8, rue Charles-Humbert
1205 Geneva
Switzerland
Tel: (022) 321 3548
Fax: (022) 781 1860
(Also the seat of the International Fragrance Association - IFRA)
2. European Union
Office of Consumer Protection
10, rue Guimard
1040 Brussels
Belgium

Cosmetic, Toiletry & Perfumery Association
35 Dover Street
London W1X 3RA
United Kingdom
Tel: (071) 491 8891
Fax: (071) 493 8061

Industry Association for Personal Care and Laundry Products
Industrieverband für Körperpflege und Waschmittel (IKW)
Karlstrasse 21
6000 Frankfurt/Main 1
Germany
Tel: (069) 255 6323
Tlx: 414299 vcif d

European Association of Fatty Acid Producers
Association européenne des Producteurs d'acides gras (APAG)
250, avenue Louise
Bte. 111
1050 Brussels
Belgium
Tel: (2) 648 8290
Fax: (2) 640 1981

3. USA
Flavour Extracts Manufacturers Association (FEMA)
Suite 700
900 17th Street NW
Washington, DC 20006

Food & Drug Administration (FDA)
200 C Street SW
Washington, DC 20204
(Catalog of Information Materials for the Food & Cosmetics Industries)

Essential Oil Association of USA Inc (EOA)
60 East 42nd Street
New York, NY 10017

4. Japan
The Japanese Standards of Cosmetic Ingredients
Yakuji Nippo Ltd
1-11 Kanda Izumicho
Chiyoda-ku
Tokyo 101

Japan Perfumery & Flavoring Association
Nitta Building
8-2-1 Ginza, Chuo-ku
Tokyo 102

Japan Flavor & Fragrance Manufacturers Association
Nomura Building
14-14 Nibonbashi
Kodenmacho, Chuo-ku
Tokyo 103
Price information

The Public Ledger
12-13 Clerkenwell Green
London EC1R 0DP
United Kingdom
Tel: (071) 490 1969
Fax: (071) 490 0859
Weekly average prices for essential oils, i.a., in UK and major European markets

Chemical Marketing Reporter
80 Broad Street
New York, NY 10004-2203
USA
Tel: (212) 248 4177
Fax: (212) 248 4903
Weekly average prices for essential oils and myristic acid in the USA

The following brokers/agents, among others, provide price and market information to their clients:

Beacon Ltd
70 Florall Avenue
Murray Hill, NJ 07974-1511
USA
Tel: (908) 464 5800
Fax: (908) 464 0002

George Uhe Co. Inc.
12 Route 17 N
Paramus, NJ 07653
USA
Tel: (201) 843 4000
Fax: (201) 843 7517

Fuerst Day Lawson Limited
St. Clare House
30-33 Minories
London EC3N 1LN
United Kingdom
Tel: (071) 488 0777
Fax: (071) 488 9927

John Kelly’s Limited
Prescot House
Prescot Street
London E1 8BB
United Kingdom
Tel: (071) 481 2110
Fax: (071) 480 5030
Appendix 1

STATISTICAL ANNEXES

European Community: Imports of Nutmeg for Industrial Manufacture of Essential Oils or Resinoids, Excluding Crushed or Ground Nutmeg

European Community: Exports of Nutmeg for Industrial Manufacture of Essential Oils or Resinoids, Excluding Crushed or Ground Nutmeg

European Community: Suppliers of Nutmeg for Industrial Manufacture of Essential Oils or Resinoids, Excluding Crushed or Ground Nutmeg

European Community: Imports of Crushed or Ground Nutmeg

European Community: Exports of Crushed or Ground Nutmeg

European Community: Suppliers of Crushed or Ground Nutmeg

European Community: Imports of Mace, excluding Crushed or Ground

European Community: Exports of Mace, excluding Crushed or Ground

European Community: Suppliers of Mace, excluding Crushed or Ground

European Community: Imports of Crushed or Ground Mace

European Community: Exports of Crushed or Ground Mace

European Community: Suppliers of Crushed or Ground Mace

European Community: Imports of Nutmeg and Mace, January-October 1993

European Community: Non-EC Suppliers of Nutmeg and Mace, January-October 1993

USA: Imports of Nutmegs

USA: Imports of Mace, nes

India: Imports of Nutmeg

India: Imports of Mace

Japan: Imports of Nutmeg Put Up in Containers for Retail Sale

Japan: Imports of Nutmeg, neither Crushed nor Ground, not Put Up in Containers for Retail Sale

Japan: Imports of Mace, Crushed or Ground, not Put Up in Containers for Retail Sale

Japan: Imports of Mace, neither Crushed nor Ground, not Put Up in Containers for Retail Sale

Japan: Imports of Mace, Crushed or Ground, not Put Up in Containers for Retail Sale
### European Community: Imports of nutmeg for industrial manufacture

of essential oils or resinoids, excluding crushed or ground nutmeg

CN 0908.10-10

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>V: ECU '000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q: Metric tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL EC</td>
<td>244</td>
<td>71</td>
<td>154</td>
<td>31</td>
<td>192</td>
</tr>
<tr>
<td>FR GERMANY</td>
<td>163</td>
<td>31</td>
<td>98</td>
<td>20</td>
<td>81</td>
</tr>
<tr>
<td>FRANCE</td>
<td>10</td>
<td>24</td>
<td>14</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>21</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>DENMARK</td>
<td>31</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>SPAIN</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>ITALY</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>31</td>
<td>5</td>
</tr>
<tr>
<td>IRELAND</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>GREECE</td>
<td>3</td>
<td>1</td>
<td>25</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


Source: Statistical Office of the European Communities, Luxembourg, CD-ROM Supplement 1-1993

### European Community: Exports of nutmeg for industrial manufacture

of essential oils or resinoids, excluding crushed or ground nutmeg

CN 0908.10-10

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>V: ECU '000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q: Metric tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL EC</td>
<td>224</td>
<td>36</td>
<td>100</td>
<td>22</td>
<td>237</td>
</tr>
<tr>
<td>FR GERMANY</td>
<td>84</td>
<td>15</td>
<td>6</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>SPAIN</td>
<td>8</td>
<td>0</td>
<td>6</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>70</td>
<td>13</td>
<td>14</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td>62</td>
<td>8</td>
<td>53</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>102</td>
</tr>
<tr>
<td>FRANCE</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ITALY</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


Source: Statistical Office of the European Communities, Luxembourg, CD-ROM Supplement 1-1993
European Community: Suppliers of nutmeg for industrial manufacture of essential oils or resinoids, excluding crushed or ground nutmeg CN 0908.10-10

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WORLD</td>
<td>244</td>
<td>71</td>
<td>154</td>
<td>31</td>
<td>192</td>
<td>64</td>
<td>58</td>
<td>35</td>
<td>39</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>EXTRA-EC TRADE</td>
<td>203</td>
<td>42</td>
<td>106</td>
<td>21</td>
<td>118</td>
<td>47</td>
<td>30</td>
<td>15</td>
<td>23</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>INTRA-EC TRADE</td>
<td>42</td>
<td>29</td>
<td>48</td>
<td>10</td>
<td>74</td>
<td>17</td>
<td>28</td>
<td>20</td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>12</td>
<td>2</td>
<td>20</td>
<td>5</td>
<td>46</td>
<td>8</td>
<td>17</td>
<td>12</td>
<td>16</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>GRENADA</td>
<td>67</td>
<td>12</td>
<td>27</td>
<td>5</td>
<td>36</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>INDONESIA</td>
<td>125</td>
<td>26</td>
<td>65</td>
<td>13</td>
<td>61</td>
<td>31</td>
<td>30</td>
<td>15</td>
<td>6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>INDIA</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>SRI LANKA</td>
<td>11</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td>5</td>
<td>1</td>
<td>24</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FRANCE</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FR GERMANY</td>
<td>15</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>ITALY</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>17</td>
<td>5</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>SPAIN</td>
<td>9</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Source: Statistical Office of the European Communities, Luxembourg, CD/ROM Supplement 1-1993
### European Community: Imports of crushed or ground nutmeg

**CN 0908.10-90**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL EC</td>
<td>29,749</td>
<td>33,282</td>
<td>19,582</td>
<td>13,078</td>
<td>8,497</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>11,262</td>
<td>12,450</td>
<td>2,683</td>
<td>5,325</td>
<td>3,723</td>
</tr>
<tr>
<td>FR GERMANY</td>
<td>7,455</td>
<td>7,848</td>
<td>5,786</td>
<td>3,779</td>
<td>2,179</td>
</tr>
<tr>
<td>FRANCE</td>
<td>2,874</td>
<td>4,735</td>
<td>1,076</td>
<td>773</td>
<td>708</td>
</tr>
<tr>
<td>ITALY</td>
<td>1,701</td>
<td>1,789</td>
<td>322</td>
<td>653</td>
<td>296</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>1,805</td>
<td>1,852</td>
<td>469</td>
<td>655</td>
<td>377</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td>2,867</td>
<td>2,659</td>
<td>598</td>
<td>659</td>
<td>246</td>
</tr>
<tr>
<td>SPAIN</td>
<td>1,215</td>
<td>1,177</td>
<td>203</td>
<td>671</td>
<td>215</td>
</tr>
<tr>
<td>GREECE</td>
<td>132</td>
<td>356</td>
<td>61</td>
<td>181</td>
<td>48</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>186</td>
<td>135</td>
<td>23</td>
<td>163</td>
<td>62</td>
</tr>
<tr>
<td>DENMARK</td>
<td>163</td>
<td>184</td>
<td>43</td>
<td>163</td>
<td>19</td>
</tr>
<tr>
<td>IRELAND</td>
<td>89</td>
<td>97</td>
<td>32</td>
<td>38</td>
<td>8</td>
</tr>
</tbody>
</table>

**Source:** Statistical Office of the European Communities, Luxembourg, CD-ROM Supplement 1-1993

### European Community: Exports of crushed or ground nutmeg

**CN 0908.10-90**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL EC</td>
<td>15,773</td>
<td>16,763</td>
<td>9,376</td>
<td>6,622</td>
<td>3,189</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>10,334</td>
<td>12,024</td>
<td>6,594</td>
<td>5,018</td>
<td>2,564</td>
</tr>
<tr>
<td>FR GERMANY</td>
<td>1,106</td>
<td>977</td>
<td>1,008</td>
<td>258</td>
<td>575</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td>1,807</td>
<td>1,101</td>
<td>550</td>
<td>397</td>
<td>256</td>
</tr>
<tr>
<td>FRANCE</td>
<td>2,020</td>
<td>2,170</td>
<td>399</td>
<td>181</td>
<td>96</td>
</tr>
<tr>
<td>SPAIN</td>
<td>81</td>
<td>124</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>221</td>
<td>236</td>
<td>33</td>
<td>41</td>
<td>38</td>
</tr>
<tr>
<td>ITALY</td>
<td>132</td>
<td>113</td>
<td>14</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>GREECE</td>
<td>5</td>
<td>9</td>
<td>1</td>
<td>29</td>
<td>3</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>66</td>
<td>93</td>
<td>18</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>DENMARK</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>IRELAND</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Statistical Office of the European Communities, Luxembourg, CD-ROM Supplement 1-1993
| Source: Statistical Office of the European Communities, Luxembourg, CD-ROM Supplement 1-1993 |

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>V: ECU '000</strong></td>
<td><strong>Q: Metric tons</strong></td>
<td><strong>V</strong></td>
<td><strong>Q</strong></td>
<td><strong>V</strong></td>
<td><strong>Q</strong></td>
</tr>
<tr>
<td><strong>WORLD</strong></td>
<td>29,749</td>
<td>6,092</td>
<td>33,282</td>
<td>7,019</td>
<td>19,582</td>
</tr>
<tr>
<td><strong>EXTRA-EC TRADE</strong></td>
<td>22,936</td>
<td>4,783</td>
<td>26,662</td>
<td>5,721</td>
<td>14,428</td>
</tr>
<tr>
<td><strong>INTRA-EC TRADE</strong></td>
<td>6,810</td>
<td>1,311</td>
<td>6,623</td>
<td>1,298</td>
<td>5,155</td>
</tr>
<tr>
<td><strong>INDONESIA</strong></td>
<td>14,998</td>
<td>3,183</td>
<td>18,660</td>
<td>3,963</td>
<td>9,799</td>
</tr>
<tr>
<td><strong>GRENADA</strong></td>
<td>6,001</td>
<td>1,148</td>
<td>3,939</td>
<td>743</td>
<td>2,263</td>
</tr>
<tr>
<td><strong>NETHERLANDS</strong></td>
<td>3,715</td>
<td>731</td>
<td>4,079</td>
<td>764</td>
<td>3,027</td>
</tr>
<tr>
<td><strong>BELGIUM-LUXEMBOURG</strong></td>
<td>1,300</td>
<td>271</td>
<td>833</td>
<td>185</td>
<td>509</td>
</tr>
<tr>
<td><strong>FRANCE</strong></td>
<td>819</td>
<td>159</td>
<td>1,120</td>
<td>242</td>
<td>1,073</td>
</tr>
<tr>
<td><strong>ST VINCENT</strong></td>
<td>319</td>
<td>62</td>
<td>203</td>
<td>41</td>
<td>206</td>
</tr>
<tr>
<td><strong>SINGAPORE</strong></td>
<td>218</td>
<td>47</td>
<td>578</td>
<td>120</td>
<td>419</td>
</tr>
<tr>
<td><strong>ITALY</strong></td>
<td>35</td>
<td>5</td>
<td>44</td>
<td>6</td>
<td>41</td>
</tr>
<tr>
<td><strong>SRI LANKA</strong></td>
<td>178</td>
<td>52</td>
<td>423</td>
<td>205</td>
<td>63</td>
</tr>
<tr>
<td><strong>UNITED KINGDOM</strong></td>
<td>106</td>
<td>21</td>
<td>135</td>
<td>41</td>
<td>197</td>
</tr>
<tr>
<td><strong>MALAYSIA</strong></td>
<td>627</td>
<td>144</td>
<td>2,403</td>
<td>525</td>
<td>1,375</td>
</tr>
<tr>
<td><strong>INDIA</strong></td>
<td>132</td>
<td>52</td>
<td>225</td>
<td>77</td>
<td>85</td>
</tr>
<tr>
<td><strong>TRINIDAD &amp; TOBAGO</strong></td>
<td>84</td>
<td>17</td>
<td>94</td>
<td>19</td>
<td>102</td>
</tr>
<tr>
<td><strong>USA</strong></td>
<td>187</td>
<td>35</td>
<td>65</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td><strong>SPAIN</strong></td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td><strong>ALBANIA</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>CHINA</strong></td>
<td>47</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>SWITZERLAND</strong></td>
<td>13</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>PAPUA NEW GUINEA</strong></td>
<td>79</td>
<td>18</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td><strong>MADAGASCAR</strong></td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>2</td>
<td>78</td>
</tr>
<tr>
<td><strong>IRELAND</strong></td>
<td>21</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
European Community: Exports of mace, excluding crushed or ground
CN 0908.20-10

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: Metric tons</td>
<td>V</td>
<td>Q</td>
<td>V</td>
<td>Q</td>
<td>V</td>
</tr>
<tr>
<td>TOTAL EC</td>
<td>10,308</td>
<td>1,043</td>
<td>10,243</td>
<td>1,098</td>
<td>5,326</td>
</tr>
<tr>
<td>FR GERMANY</td>
<td>4,215</td>
<td>416</td>
<td>3,670</td>
<td>382</td>
<td>1,815</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>3,055</td>
<td>320</td>
<td>3,291</td>
<td>348</td>
<td>2,440</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td>1,197</td>
<td>118</td>
<td>1,288</td>
<td>135</td>
<td>122</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>977</td>
<td>103</td>
<td>784</td>
<td>79</td>
<td>420</td>
</tr>
<tr>
<td>FRANCE</td>
<td>192</td>
<td>21</td>
<td>734</td>
<td>108</td>
<td>334</td>
</tr>
<tr>
<td>DENMARK</td>
<td>270</td>
<td>27</td>
<td>95</td>
<td>10</td>
<td>71</td>
</tr>
<tr>
<td>ITALY</td>
<td>301</td>
<td>28</td>
<td>296</td>
<td>27</td>
<td>83</td>
</tr>
<tr>
<td>SPAIN</td>
<td>95</td>
<td>9</td>
<td>84</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td>GREECE</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>IRELAND</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

European Community: Imports of mace, excluding crushed or ground
CN 0908.20-10

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: Metric tons</td>
<td>V</td>
<td>Q</td>
<td>V</td>
<td>Q</td>
<td>V</td>
</tr>
<tr>
<td>TOTAL EC</td>
<td>10,308</td>
<td>1,043</td>
<td>10,243</td>
<td>1,098</td>
<td>5,326</td>
</tr>
<tr>
<td>FR GERMANY</td>
<td>4,215</td>
<td>416</td>
<td>3,670</td>
<td>382</td>
<td>1,815</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>3,055</td>
<td>320</td>
<td>3,291</td>
<td>348</td>
<td>2,440</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td>1,197</td>
<td>118</td>
<td>1,288</td>
<td>135</td>
<td>122</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>977</td>
<td>103</td>
<td>784</td>
<td>79</td>
<td>420</td>
</tr>
<tr>
<td>FRANCE</td>
<td>192</td>
<td>21</td>
<td>734</td>
<td>108</td>
<td>334</td>
</tr>
<tr>
<td>DENMARK</td>
<td>270</td>
<td>27</td>
<td>95</td>
<td>10</td>
<td>71</td>
</tr>
<tr>
<td>ITALY</td>
<td>301</td>
<td>28</td>
<td>296</td>
<td>27</td>
<td>83</td>
</tr>
<tr>
<td>SPAIN</td>
<td>95</td>
<td>9</td>
<td>84</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td>GREECE</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>IRELAND</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Ireland, Denmark and Greece declared no export for the period 1988-1992.

Source: Statistical Office of the European Communities, Luxembourg, CD/ROM Supplement 1-1993
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WORLD</strong></td>
<td>10,308</td>
<td>1,043</td>
<td>10,243</td>
<td>1,098</td>
<td>5,326</td>
<td>1,111</td>
<td>3,694</td>
<td>1,476</td>
<td>2,784</td>
<td>1,231</td>
</tr>
<tr>
<td><strong>EXTRA-EC TRADE</strong></td>
<td>9,366</td>
<td>937</td>
<td>9,411</td>
<td>986</td>
<td>4,806</td>
<td>991</td>
<td>3,385</td>
<td>1,347</td>
<td>2,617</td>
<td>1,146</td>
</tr>
<tr>
<td><strong>INTRA-EC TRADE</strong></td>
<td>941</td>
<td>107</td>
<td>832</td>
<td>112</td>
<td>522</td>
<td>121</td>
<td>308</td>
<td>131</td>
<td>169</td>
<td>85</td>
</tr>
<tr>
<td><strong>INDONESIA</strong></td>
<td>6,402</td>
<td>643</td>
<td>6,129</td>
<td>674</td>
<td>3,311</td>
<td>690</td>
<td>2,274</td>
<td>993</td>
<td>1,827</td>
<td>851</td>
</tr>
<tr>
<td><strong>GRENADA</strong></td>
<td>2,104</td>
<td>200</td>
<td>1,761</td>
<td>148</td>
<td>807</td>
<td>134</td>
<td>717</td>
<td>199</td>
<td>612</td>
<td>178</td>
</tr>
<tr>
<td><strong>NETHERLANDS</strong></td>
<td>608</td>
<td>59</td>
<td>577</td>
<td>61</td>
<td>329</td>
<td>87</td>
<td>216</td>
<td>93</td>
<td>119</td>
<td>66</td>
</tr>
<tr>
<td><strong>SINGAPORE</strong></td>
<td>344</td>
<td>36</td>
<td>884</td>
<td>93</td>
<td>469</td>
<td>120</td>
<td>225</td>
<td>81</td>
<td>73</td>
<td>49</td>
</tr>
<tr>
<td><strong>FR GERMANY</strong></td>
<td>106</td>
<td>10</td>
<td>165</td>
<td>17</td>
<td>98</td>
<td>14</td>
<td>48</td>
<td>25</td>
<td>36</td>
<td>15</td>
</tr>
<tr>
<td><strong>SRI LANKA</strong></td>
<td>28</td>
<td>2</td>
<td>18</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>35</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td><strong>PAPUA NEW GUINEA</strong></td>
<td>26</td>
<td>7</td>
<td>135</td>
<td>15</td>
<td>40</td>
<td>17</td>
<td>43</td>
<td>27</td>
<td>33</td>
<td>25</td>
</tr>
<tr>
<td><strong>MALAYSIA</strong></td>
<td>148</td>
<td>20</td>
<td>328</td>
<td>36</td>
<td>42</td>
<td>10</td>
<td>32</td>
<td>21</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td><strong>BELGIUM-LUXEMBOURG</strong></td>
<td>144</td>
<td>14</td>
<td>58</td>
<td>7</td>
<td>78</td>
<td>18</td>
<td>25</td>
<td>12</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td><strong>ST VINCENT</strong></td>
<td>66</td>
<td>8</td>
<td>92</td>
<td>10</td>
<td>46</td>
<td>5</td>
<td>13</td>
<td>4</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td><strong>COSTA RICA</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td><strong>UNITED KINGDOM</strong></td>
<td>25</td>
<td>6</td>
<td>17</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>18</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>FRANCE</strong></td>
<td>13</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>INDIA</strong></td>
<td>27</td>
<td>6</td>
<td>39</td>
<td>7</td>
<td>53</td>
<td>9</td>
<td>9</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Statistical Office of the European Communities, Luxembourg, CD-ROM Supplement 1-1993
European Community: Imports of crushed or ground mace
CN 0908.20-90

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL EC</td>
<td></td>
<td>1,055</td>
<td>112</td>
<td>802</td>
<td>96</td>
<td>993</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td></td>
<td>399</td>
<td>36</td>
<td>190</td>
<td>20</td>
<td>237</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td></td>
<td>171</td>
<td>15</td>
<td>158</td>
<td>19</td>
<td>150</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td></td>
<td>2</td>
<td>0</td>
<td>73</td>
<td>8</td>
<td>294</td>
</tr>
<tr>
<td>FRANCE</td>
<td></td>
<td>133</td>
<td>14</td>
<td>67</td>
<td>8</td>
<td>68</td>
</tr>
<tr>
<td>FR GERMANY</td>
<td></td>
<td>142</td>
<td>15</td>
<td>143</td>
<td>17</td>
<td>134</td>
</tr>
<tr>
<td>DENMARK</td>
<td></td>
<td>43</td>
<td>5</td>
<td>17</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>ITALY</td>
<td></td>
<td>81</td>
<td>13</td>
<td>104</td>
<td>18</td>
<td>53</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td></td>
<td>21</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>IRELAND</td>
<td></td>
<td>44</td>
<td>8</td>
<td>33</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>SPAIN</td>
<td></td>
<td>5</td>
<td>1</td>
<td>14</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>GREECE</td>
<td></td>
<td>14</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

European Community: Exports of crushed or ground mace
CN 0908.20-90

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL EC</td>
<td></td>
<td>1,107</td>
<td>107</td>
<td>978</td>
<td>107</td>
<td>972</td>
</tr>
<tr>
<td>FR GERMANY</td>
<td></td>
<td>244</td>
<td>20</td>
<td>281</td>
<td>27</td>
<td>261</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td></td>
<td>211</td>
<td>21</td>
<td>312</td>
<td>29</td>
<td>275</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td></td>
<td>536</td>
<td>52</td>
<td>245</td>
<td>27</td>
<td>291</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td></td>
<td>36</td>
<td>7</td>
<td>42</td>
<td>13</td>
<td>36</td>
</tr>
<tr>
<td>FRANCE</td>
<td></td>
<td>67</td>
<td>6</td>
<td>67</td>
<td>8</td>
<td>93</td>
</tr>
<tr>
<td>ITALY</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DENMARK</td>
<td></td>
<td>10</td>
<td>1</td>
<td>22</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>IRELAND</td>
<td></td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SPAIN</td>
<td></td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


Source: Statistical Office of the European Communities, Luxembourg, CD-ROM Supplement 1-1993
### European Community: Suppliers of crushed or ground mace

**CN 0908.20-90**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>V: ECU '000</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Q: Metric tons</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WORLD</strong></td>
<td>1,055</td>
<td>112</td>
<td>802</td>
<td>96</td>
<td>993</td>
</tr>
<tr>
<td>INTRA-EC TRADE</td>
<td>886</td>
<td>93</td>
<td>626</td>
<td>75</td>
<td>652</td>
</tr>
<tr>
<td>EXTRA-EC TRADE</td>
<td>168</td>
<td>17</td>
<td>174</td>
<td>22</td>
<td>343</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>176</td>
<td>13</td>
<td>223</td>
<td>20</td>
<td>281</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td>551</td>
<td>60</td>
<td>247</td>
<td>33</td>
<td>273</td>
</tr>
<tr>
<td>SWITZERLAND</td>
<td>9</td>
<td>0</td>
<td>19</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>FRANCE</td>
<td>1</td>
<td>0</td>
<td>9</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>INDONESIA</td>
<td>138</td>
<td>14</td>
<td>72</td>
<td>8</td>
<td>53</td>
</tr>
<tr>
<td>GRENADA</td>
<td>15</td>
<td>1</td>
<td>49</td>
<td>6</td>
<td>258</td>
</tr>
<tr>
<td>FR GERMANY</td>
<td>65</td>
<td>8</td>
<td>80</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>ITALY</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>91</td>
<td>13</td>
<td>57</td>
<td>1</td>
<td>41</td>
</tr>
<tr>
<td>INDIA</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>SPAIN</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>USA</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>SRI LANKA</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Source:** Statistical Office of the European Communities, Luxembourg, CD-ROM Supplement 1-1993
### European Community: Imports of nutmeg & mace, January-October 1993

#### V: ECU '000

#### Q: Metric tons

### 1) Extra-EC trade

<table>
<thead>
<tr>
<th>Country/Group</th>
<th>0908.10-10 V</th>
<th>0908.10-90 Q</th>
<th>0908.20-10 V</th>
<th>0908.20-90 Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL EC</td>
<td>68</td>
<td>63</td>
<td>4,510</td>
<td>4,414</td>
</tr>
<tr>
<td>BELGIUM-LUXEMBOURG</td>
<td>0</td>
<td>0</td>
<td>230</td>
<td>281</td>
</tr>
<tr>
<td>GERMANY</td>
<td>4</td>
<td>4</td>
<td>1,222</td>
<td>993</td>
</tr>
<tr>
<td>IRELAND</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DENMARK</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>GREECE</td>
<td>0</td>
<td>0</td>
<td>71</td>
<td>54</td>
</tr>
</tbody>
</table>

### 2) Intra+Extra-EC trade

<table>
<thead>
<tr>
<th>Country/Group</th>
<th>0908.10-10 V</th>
<th>0908.10-90 Q</th>
<th>0908.20-10 V</th>
<th>0908.20-90 Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRANCE</td>
<td>17</td>
<td>3</td>
<td>207</td>
<td>123</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>0</td>
<td>0</td>
<td>2,424</td>
<td>2,438</td>
</tr>
<tr>
<td>ITALY</td>
<td>7</td>
<td>4</td>
<td>529</td>
<td>310</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>118</td>
<td>91</td>
<td>362</td>
<td>332</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>2</td>
<td>1</td>
<td>49</td>
<td>27</td>
</tr>
<tr>
<td>SPAIN</td>
<td>2</td>
<td>2</td>
<td>255</td>
<td>144</td>
</tr>
</tbody>
</table>

**NOTE:** As of 1 January 1993 with the creation of the Single Market, a new statistical procedure (INTRASTAT) was introduced to collect statistical data on trade flows between member countries of the European Union. The compilation of 1993 annual time series has thus been delayed. However, data on trade with non-EC partners is available for the period January-October 1993 for the following countries/groups: Belgium-Luxembourg, Germany, Ireland, Denmark, and Greece; data on trade with EC and non-EC partners is available for the following countries: France, Netherlands, Italy, Portugal, United Kingdom and Spain for the same period.

**Source:** Statistical Office of the European Communities, Luxembourg CD-ROM 5-1994
<table>
<thead>
<tr>
<th>Country</th>
<th>Nutmeg</th>
<th>Mace</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRENADA</td>
<td>57</td>
<td>52</td>
</tr>
<tr>
<td>TRINIDAD &amp; TOBAGO</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>SRI LANKA</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>INDIA</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>INDONESIA</td>
<td>2,840</td>
<td>2,879</td>
</tr>
<tr>
<td>GRENADA</td>
<td>1,349</td>
<td>1,170</td>
</tr>
<tr>
<td>SINGAPORE</td>
<td>223</td>
<td>290</td>
</tr>
<tr>
<td>SRI LANKA</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>USA</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>COMOROS</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>ST VINCENT</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>POLAND</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>SWITZERLAND</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>SLOVENIA</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ISRAEL</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>INDONESIA</td>
<td>1,229</td>
<td>660</td>
</tr>
<tr>
<td>GRENADA</td>
<td>326</td>
<td>124</td>
</tr>
<tr>
<td>SINGAPORE</td>
<td>43</td>
<td>27</td>
</tr>
<tr>
<td>PAPUA NEW GUINEA</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>ST VINCENT</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>SRI LANKA</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>COMOROS</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>INDIA</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>INDONESIA</td>
<td>61</td>
<td>27</td>
</tr>
<tr>
<td>SWITZERLAND</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>GRENADA</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>USA</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>TURKEY</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Statistical Office of the European Communities, Luxembourg, CD/ROM 5-1994
### USA: Imports of Nutmegs

**HSTUSA 0908.10-0000**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>5330</td>
<td>1711</td>
<td>3237</td>
<td>1858</td>
<td>2518</td>
<td>1685</td>
<td>2446</td>
<td>1846</td>
</tr>
<tr>
<td>Indonesia</td>
<td>3757</td>
<td>1076</td>
<td>2292</td>
<td>1285</td>
<td>1828</td>
<td>1200</td>
<td>1557</td>
<td>1149</td>
</tr>
<tr>
<td>Singapore</td>
<td>954</td>
<td>490</td>
<td>614</td>
<td>425</td>
<td>418</td>
<td>324</td>
<td>596</td>
<td>471</td>
</tr>
<tr>
<td>Grenada</td>
<td>338</td>
<td>61</td>
<td>140</td>
<td>29</td>
<td>99</td>
<td>56</td>
<td>137</td>
<td>106</td>
</tr>
<tr>
<td>India</td>
<td>96</td>
<td>26</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>2</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Madagascar</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Germany</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Canada</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>France</td>
<td>120</td>
<td>27</td>
<td>30</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Netherlands</td>
<td>53</td>
<td>26</td>
<td>140</td>
<td>93</td>
<td>149</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(a) 1993 customs value; 1990-1992 CIF.

### USA: Imports of Mace, Nes

**HSTUSA 0908.20-4000**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>1735</td>
<td>296</td>
<td>462</td>
<td>179</td>
<td>505</td>
<td>220</td>
<td>351</td>
<td>226</td>
</tr>
<tr>
<td>Indonesia</td>
<td>925</td>
<td>139</td>
<td>409</td>
<td>159</td>
<td>334</td>
<td>145</td>
<td>321</td>
<td>212</td>
</tr>
<tr>
<td>Singapore</td>
<td>472</td>
<td>117</td>
<td>37</td>
<td>16</td>
<td>41</td>
<td>18</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Germany</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>196</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Netherlands</td>
<td>98</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>97</td>
<td>39</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Egypt</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Peru</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>India</td>
<td>21</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>France</td>
<td>21</td>
<td>5</td>
<td>8</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(a) 1993 customs value; 1990-1992 CIF.
### India: Imports of Nutmeg

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V</td>
<td>Q</td>
<td>V</td>
<td>Q</td>
</tr>
<tr>
<td>TOTAL</td>
<td>9,997</td>
<td>132</td>
<td>16,336</td>
<td>206</td>
</tr>
<tr>
<td>Singapore</td>
<td>2,597</td>
<td>45</td>
<td>4,292</td>
<td>104</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2,742</td>
<td>73</td>
<td>7,128</td>
<td>163</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>2,003</td>
<td>35</td>
<td>1,703</td>
<td>55</td>
</tr>
</tbody>
</table>

### India: Imports of Mace

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V</td>
<td>Q</td>
<td>V</td>
<td>Q</td>
</tr>
<tr>
<td>TOTAL</td>
<td>7,441</td>
<td>153</td>
<td>13,123</td>
<td>323</td>
</tr>
<tr>
<td>Singapore</td>
<td>2,697</td>
<td>45</td>
<td>4,292</td>
<td>104</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2,742</td>
<td>73</td>
<td>7,128</td>
<td>163</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>2,003</td>
<td>35</td>
<td>1,703</td>
<td>55</td>
</tr>
</tbody>
</table>

Source: Statistics of the Foreign Trade of India by countries, Ministry of Commerce
**Japan: Imports of nutmeg put up in containers for retail sale (0908.10-100)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,144</td>
<td>491</td>
</tr>
<tr>
<td>V: Yen '000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q: Kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Japan: Imports of nutmeg, neither crushed nor ground, not put up in containers for retail sale (0908.10-210)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>331,441</td>
<td>369,368</td>
<td>445,121</td>
<td>491,749</td>
<td>348,045</td>
</tr>
<tr>
<td>Indonesia</td>
<td>324,387</td>
<td>361,368</td>
<td>444,641</td>
<td>490,751</td>
<td>346,471</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0</td>
<td>0</td>
<td>480</td>
<td>998</td>
<td>1,574</td>
</tr>
<tr>
<td>India</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Singapore</td>
<td>7,054</td>
<td>8,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Japan: Imports of nutmeg, crushed or ground, not put up in containers for retail sale (0908.10-220)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>0</td>
<td>9,720</td>
<td>7,266</td>
<td>2,007</td>
<td>1,520</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0</td>
<td>0</td>
<td>4,262</td>
<td>3,200</td>
<td>0</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0</td>
<td>0</td>
<td>5,458</td>
<td>4,066</td>
<td>2,007</td>
</tr>
</tbody>
</table>

**Japan: Imports of mace, neither crushed nor ground, not put up in containers for retail sale (0908.20-210)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>44,630</td>
<td>27,326</td>
<td>69,443</td>
<td>43,227</td>
<td>55,504</td>
</tr>
<tr>
<td>Indonesia</td>
<td>43,026</td>
<td>26,326</td>
<td>69,443</td>
<td>43,227</td>
<td>38,679</td>
</tr>
<tr>
<td>Singapore</td>
<td>1,504</td>
<td>1,000</td>
<td>0</td>
<td>0</td>
<td>3,714</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>0</td>
<td>0</td>
<td>13,111</td>
<td>15,020</td>
<td>0</td>
</tr>
<tr>
<td>India</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>202</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>793</td>
</tr>
</tbody>
</table>

**Japan: Imports of mace, crushed or ground, not put up in containers for retail sale (0908.20-220)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,286</td>
<td>2,995</td>
</tr>
</tbody>
</table>

Source: Japan Exports & Imports, Commodity by Country, Japan Tariff Association
LIST OF IMPORTERS

United Kingdom
France
Germany
the Netherlands
Belgium
Spain
USA
Japan
India
List of importers of spices
(non-exhaustive)

United Kingdom
F.R. BENSON & PARTNERS LTD
CROSSROADS HOUSE
165 THE PARADE
WATFORD, HERTS WD1 1 NJ
Tel: (0923) 240560
Fax: (0923) 240569
Tlx: 22677

V. BERG & SONS LTD
112 UNION STREET
LONDON SE10
Tel: (071) 928 9000
Fax: (071) 928 0920
Tlx: 887949

BRITISH PEPPER & SPICE CO. LTD
RHOSILI ROAD BRACKMILLS
OLD NORTHAMPTON, NORTHANTS NN4
Tel: (0604) 66461
Tlx: 312472

BUCKLEY AROMATICS LTD
22, HIGH STREET
ALTON, HAMPSHIRE GU34 1BN
Tel: (0420) 541307
Tlx: 858004 HRMCS G

BUSH BOAKE ALLEN LTD
BLACKHORSE LANE
LONDON E17 5QP
Tel: (081) 531 4211
Fax: (081) 527 2360
Tlx: 897809

CARBUTT & CO. (1928) LTD
WILSHIRE ROAD
DAIRYCOATES TRADING ESTATE
HULL, HUMBERSIDE HU4 6PQ
Tel: (0482) 561151
Tlx: 597582 CARBUT G

AB TRADING LTD
MERIDIAN HOUSE
ROYAL HILL
LONDON SE10
Tel: (081) 305 2226
Fax: (081) 305 1782
Tlx: 9312131304 AB G

ATHOLFORCE LTD
426 ALEXANDRA AVENUE
HARROW, MIDDX HA2 9TW
Tel: (01) 8681228

ATLANTIC OCEAN FOOD
PRODUCTS LTD
SUITE 114, PREMIER HOUSE
10 GREYCOAT PLACE
LONDON SW1P 1BB
Tel: (071) 222 4344
Tlx: 9413609

AVAGO LTD
3 ALEXANDRIA ROAD
WEST EALING
LONDON W13 9NG
Tel: (081) 8404016
Tlx: 936203 AVAGO G

B. E. INTERNATIONAL FOODS LTD
GRAFTON HOUSE
STOCKINGSWATER ROAD
ENSFIELD MIDDX EM3 7JZ
Tel: (01) 804 8788
Fax: (01) 8041006

List of importers of spices
(non-exhaustive)
BENDER AND CASSEL
BLACKHORSE ROAD
LETCRTHORW, HERTS SG6 1HL
Tel: (0462) 686971
Fax: (0462) 670214

CHAMBER & KNIGHT LTD
THAMES HOUSE
18 PARK STREET
LONDON SE1 9DL
Tel: (071) 357 7821
Fax: (071) 378 8582
Tlx: 885334

CHOITHRAM & SONS (STORES) LTD
CHOITHRAM HOUSE,
LANCELOT ROAD
WEMBLEY, MIDDX HA0 2BG
Tel: (01) 903 8311
Fax: (01) 903 6982
Tlx: 924784

COLES TRADITIONAL BAKERY LTD
STATION APPROACH, LONDON ROAD
CHESTERFORD
SAFFRON WALDEN, ESSEX CB10 1PG
Tel: (0799) 31053

COTSWOLD COMMODITIES LTD
ORIEL HOUSE
52 COOMBER ROAD
NEW MALDEN, SURREY KT3 4QW
Tel: (081) 942 3262
Fax: (081) 942 6330
Tlx: 295808-9 NUTETC G

DALOON FOODS UK LTD
BRUNEL DRIVE, NORTHERN ROAD,
INDUSTRIAL ESTATE
NEWARK, NOTTS NG24 2EG
Tel: (0636) 701000
Fax: (0636) 72581
Tlx: 377775

JAMES DALTON (SEASONING & SPICES) LTD
PENNINE RANGE MILLS
CAMWEL ROAD, STARBECK
HARROGATE, HG1 4PY
Tel: (0423) 885 255
Fax: (0423) 880 611

DHIKSHANA ENTERPRISE LTD
27, BLASHFOLD,
ADELAIDE ROAD
LONDON NW3 3RX
Tel: (071) 586 6951

EVANS GRAY & HOOD CO LTD
EAST CROSS CENTRE WATERDEN
STRATFORD
LONDON E15 2MN
Tel: (081) 986 3202
Tlx: 927694

FELTON WORLDWIDE LTD
BILTON ROAD
BLETCHLEY, MILTON KEYNES
MK1 1HP
Tel: (0908) 270270
Fax: (0908) 270271
Tlx: 825533

FOOKS & FRENCH LTD
19 EARL ST
LONDON EC2A 2AL
Tel: (081) 3379295
Tlx: 885334 ENERGY G

GROCERS SUPPLY LTD
34 ASHFORD COURT
ASHFORD ROAD
LONDON NW2 6BW
Tel: (081) 2080755
Fax: (081) 4526212
Tlx: 938047 GRSPLY G
INDO-MEDITERRANEAN COMMODITIES LTD
MAYCRETE HOUSE
BRENTFORD, MIDDX TW8 9JQ
Tel: (01) 568 6561
Fax: (01) 847 2093

R M JONES FOODS LTD
THREXTON INDUSTRIAL ESTATE
THREXTON ROAD
WATTON, NORFOLK IP25 6BR
Tel: (0953) 882991
Fax: (0603) 861362
Tlx: 975569 SPEED G

JOHN KELLY'S (LONDON) LTD
PRECOT HOUSE, PRESCOT STREET
LONDON E1N 8BB
Tel: (071) 481 2110
Fax: (071) 480 5030
Tlx: 884659 ERGON G

TRUSTIN-KERWOOD LTD
CHASE ROAD NORTHERN WAY
BURY ST. EDMUNDS
SUFFOLK IP32 6NT
Tel: (0284) 66265
Tlx: 81117 TRUSTIN G

KIRBY COMMODITY PACKERS AND SUPPLIERS
PARK LANE
ABRAM, WIGAN WN2 5XJ
Tel: (0942) 861316
Fax: (0942) 864668
Tlx: 67368

THE LIONMARK GROUP
ASTMOOR
RUNCORN, CHESHIRE WA7 1PE
Tel: (0928) 565221
Fax: (0928) 561172
Tlx: 628343 LIONMH G

MCCORMICK STANGE
ROSSMORE ROAD
ELLESMERE PORT,
SOUTH WIRRAL WA7 3DA
Tel: (051) 355 5011
Fax: (051) 356 0469
Tlx: 628351

GERARD MCDONALD CO., LTD
1, ST. ANDREW'S HILL
LONDON EC4V 5H8
Tel: (071) 236 3695
Fax: (071) 236 3695
Tlx: 8812098 GERMAC G

MIDLAND HERBS & SPICES LTD
1A FORMANS TRADING ESTATE
PENTOS DRIVE SPARKHILL
BIRMINGHAM B11 3TA
Tel: (021) 778 5771
Fax: (021) 777 1348
Tlx: 335540

B. RAMBHAI & COMPANY
SPICE HOUSE
15A, WILLOWS LANE
BOLTON, LANCS BL3 4AA
Tel: (0204) 62113

J. H. RAYNER (MINCING LANE) LTD
BERISFORD WING
1 PRESCOTT STREET
LONDON E1 8AY
Tel: (071) 481 9144
Fax: (071) 488 4352
Tlx: 883461 RAYMAR G

SIBER HEGNER LTD
MACKENZIE HOUSE, 221-241
BECKENHAM ROAD
SELBY, KENT BR3 4UF
Tel: (01) 659 2345
Fax: (01) 659 1292
Tlx: 946651SIBER G
UNION MERCHANTS OVERSEAS LTD
ST CLARE HOUSE
30-33 MINORIES
LONDON EC3N 1LN
Tel: (071) 488 0777
Fax: (071) 488 9927
Tlx: 8814769

France
DARAS S.A. (GEORGES S.)
14, RUE FORTIA
BP 1878
13222 MARSEILLE CEDEX 01
Tel: (91) 549168
Fax: (91) 556236

SAINTE LUCIE SA
53, RUE CORBIER THIEBAUT
60270 GOUVIEUX
Tel: (44) 585757
Fax: (44) 580649

ALFRED L. WOLFF (FRANCE)
15, RUE DE L'ARSENAL
75004 PARIS
Tel: (1) 4272 9231
Fax: (1) 4272 1199

BALDACCI JACQUES SARL
RUE J A FRESNEL
ZA LARNOUZETTE
11000 CARCASSONNE
Tel: (68) 472400
Fax: (68) 476287

CHRISTIAN GAYMARD
AGENT COMMERCIAL
10, Bd GENERAL DE GAULLE
BP 44
06530 PEYMEINADE
Tel: (93) 663785
Tlx: 470028

COYNE OLIVIER
21, RUE DU REV. PERE CORENTIN
BP 43
92270 BOIS-COLOMBES
Tel: 42426844
Tlx: 620113 EMARDIN

ETS DUCROS ET FILS
ZI LE TERRADOU
B.P. 142
84200 CARPENTRAS
Tel: (90) 671425
Tlx: 431184 F

EUROBROKER SA
12, RUE DE L'ISLY
75008 PARIS
Tel: (1) 42949394
Fax: (1) 43872774
Tlx: 648658 EUBKR

STE S. MIZRAKI & CIE
BP 14
13351 MARSEILLE CEDEX 5
Tel: (91) 476288
Tlx: 440 950 SOLY

TRADIMPEX
11/13 RUE GUSTAVE EIFFEL
ZI SAINT NICOLAS
BP 23
94510 LA QUEUE EN BRIE
Tel: (1) 4593 0232
Tlx: (042) 262210

Germany
HENRY LAMOTTE-BREMEN
POSTFACH 103849
28038 BREMEN
Tel: (0421) 547 060
Fax: (0421) 547 0699

LEO SAVELSBERG
POSTFACH 1380
52410 JÜRICH
Tel: (02461) 52045
Fax: (02461) 58 856
UNIVERSAL TRADING GMBH
SPALDINGSTR. 210
2000 HAMBURG 1
Tel: (040) 234744
Fax: (040) 234754
Tlx: 216576 UNIT D

CORNEHLS & BOSSE GMBH
KAISER-WILHELM-STR.115
2000 HAMBURG 36
Tel: (040) 351345
Fax: (040) 346347
Tlx: 212342

J VON ENGELBRECHTEN GMBH
BALLINDAMM 9
2000 HAMBURG 1
Tel: (040) 331747-49
Fax: (040) 338914
Tlx: 2161914

KRONE LEBENSMITTEL-IMPORT UND
HANDELSGESELLSCHAFT
MESSBERGHOF PUMPEN 17
2000 HAMBURG 1
Tel: (040) 330608
Tlx: 13725

ORBIS IMPORT EXPORT
HANDELS GMBH
DEICHSTR. 11
POSTFACH 110889
2000 HAMBURG 11
Tel: (040) 362577
Fax: (040) 363637
Tlx: 216164 ORB

ALBERT PANZER
KASPAR OHM WEG 8
2000 HAMBURG 65
Tel: (040) 5367678
Tlx: 2162131

WALThER PAUSEN GMBH
VIRCHOWSTR. 15
2000 HAMBURG 50
Tel: (040) 38021705
Fax: (040) 38021760

PETERSEN & PAULSEN GMBH
MARIENTHALERSTR. 20
2000 HAMBURG 26
Tel: (040) 254015
Fax: (040) 254017
Tlx: 212388

RUNKEL & FRISCHEN GMBH
HANS BREDOw STR. 36
2800 BREMEN 44
Tel: (0421) 486950
Tlx: 244125 UBENA D

H. GITAB MBH
AM WALL 73
2800 BREMEN 1
Tel: (0421) 14386
Fax: (0421) 18735
Tlx: 245558 HGTAB D

JOH. GOTTFRIED SCHUTTE & CO
BORNSTR 16/17
2800 BREMEN 1
Tel: (0421) 30420
Fax: (0421) 3042285

SOFRAL IMPORT EXPORT MBH
UPPER BORG 65
2800 BREMEN 33
Tel: (0421) 270393
Fax: (0421) 486 9511

Netherlands

EERSTE EURO GRAAN BV
BORNHOLMSTRAAT 4
9723 AX GRONINGEN
Tel: (050) 133344
Fax: (050) 146304

DAARNHOVER & CO’S
HANDELSMJ. BV
HARENGRAcht 223-225
1016 BG AMSTERDAM
Tel: (020) 624 4113
Fax: (020) 626 0977
<table>
<thead>
<tr>
<th>Company</th>
<th>Address 1</th>
<th>Address 2</th>
<th>Phone 1</th>
<th>Phone 2</th>
<th>Fax 1</th>
<th>Fax 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATZ INTERNATIONAL BV</td>
<td>SLAAK 22</td>
<td>30111 TA</td>
<td>Tel: (010) 411 3440</td>
<td>Fax: (010) 404 5406</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KARSTEN STADSKANAAL BV</td>
<td>TRANSISTORweg 3</td>
<td>9503 GT</td>
<td>Tel: (05990) 21000</td>
<td>Fax: (05990) 21744</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALANHERI PRODUKTEN BV</td>
<td>MOLENEIND 2</td>
<td>4260 AC</td>
<td>Tel: (04165) 2582</td>
<td>Tlx: 30462130468</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BARIMPEX BV</td>
<td>VAN BOSHUIZENSTRAAT 537</td>
<td>1082 AV</td>
<td>Tel: (020) 646 4521</td>
<td>Fax: (020) 642 1935</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUTTNER EN CO, G.</td>
<td>DE KORF 54</td>
<td>P. O. BOX</td>
<td>Tel: (01807) 50055</td>
<td>Tlx: 50432</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIJK INTERNATIONAL BV</td>
<td>ADMIRALITEITSKADE 60</td>
<td>PO BOX 698</td>
<td>Tel: (010) 453 1122</td>
<td>Fax: (010)453 0709</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EHMEX BV</td>
<td>UTRECTSEweg 115</td>
<td>6871 RENKUM</td>
<td>Tel: (0837) 318373</td>
<td>Tlx: 45365 VADA NL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUIJBREGTS' SPECERIJEN</td>
<td>HELMOND BV</td>
<td>ACHTERDIJK 15-16</td>
<td>Tel: (04920) 41415</td>
<td>Fax: (04920) 50540</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INTER SPECIAL</td>
<td>MIDDlEWEG 3</td>
<td>PO BOX 40</td>
<td>Tel: (080) 582838</td>
<td>Fax: (080) 585580</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KILSDONK, HANS VAN</td>
<td>ROZENSTRAAT 5</td>
<td>3353 VH PAPENDRECHT</td>
<td>Tel: (078) 150770</td>
<td>Tlx: 20512</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KNOOP, BV V/H K. VD</td>
<td>RUBENSLAAN 20</td>
<td>3136 SCHIEDAM</td>
<td>Tel: (010) 474 6715</td>
<td>Tlx: 23257</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUCULLUS, BV</td>
<td>LIJNBAAN 4-5</td>
<td>POSTBUS 100</td>
<td>Tel: (071) 416153</td>
<td>Fax: (071) 415655</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAN-PRODUCTEN BV</td>
<td>VAN VOLLENHOVENSTRAAT 3</td>
<td>POSTBUS 253</td>
<td>Tel: (010) 436 1877</td>
<td>Fax: (010) 436 2108</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;C NEDERLAND BV</td>
<td>POSTBUS 14</td>
<td>3740 AA BAARN</td>
<td>Tel: (02154) 28911</td>
<td>Fax: (02154) 21136</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Belgium

INTERNATIONAL SPICE AND FOOD IMPORT (ISFI) SPRL
PARC INDUSTRIEL DE LA VALLÉE DU HAIN
1420 BRAINE L'ALLEND
Tel: (02) 384 6077
Fax: (02) 384 5147
Tlx: 64904

HARTO INTERNATIONAL NV
VLAAMSE KAAI 11
2000 ANTWERPEN
Tel: (03) 216 2910
Fax: (03) 238 4646
Tlx: 31495 / 31649

NIL SA NV
QUAI DES USINES 155 B9
1210 BRUSSELS
Tel: (02) 216 3526
Fax: (02) 216 2948

NOORDAM NV
INDUSTRIESTRAAT 9
2500 LIER
Tel: (03) 480 9523
Fax: (03) 489 9478

INDIA SPECERIJEN BV B A
WIJNGAARDSTRAAT 1
2390 MALLE
Tel: (03) 311 5448
Fax: (03) 311 7311

SPECICO NV
GROENESTRAAT 330
8930 MENEN
Tel: (056) 518595
Tlx: 86417
J VAN ASCH NV
SINT-ROCHUSSTRAAT 142-144
2100 ANTWERPEN
Tel: (03) 321 6255
Tlx: 25224

Spain

ANGEL JOBAL, SA
C. PRINCESA 38
APARTADO POSTAL 08003
BARCELONA
Tel: (03) 197802
Tlx: 93377

MATENCIO LOPEZ SA
CAMINO VIEJO DE
MONTEAGUDO NO. 38
APARTADO POSTAL 4051
MURCIA
Tel: (968) 232325
Tlx: 235390
USA

SCHIFF FOOD PRODUCTS CO., INC.
190 BERRY ST.
BROOKLYN, NY 11211
Tel: (718) 782 4353
Fax: (718) 782 4731

WICKS TRADING (NUTMEG & MACE)
9005 NILES CENTER RD.
SKOKIE, IL 60076-1513
Tel: (708) 677 6839

ABCO LABORATORIES, INC.
2377 STANWELL DR.
CONCORD, CA 94520
Tel: (510) 685 1212
Fax: (510) 682 7241

ACCURATE INGREDIENTS CO., INC.
160 EILEEN WAY
SYOSSET, NY 11791
Tel: (516) 496 2500
Fax: (516) 496 2516

ALLIED EXPORT, INC.
11436 CRONHILL DR.
OWINGS MILLS, MD 21117
Tel: (410) 365 1212
Fax: (410) 362 7241

MCCORMICK & CO., INC.
11350 MCCORMICK RD.
HUNT VALLEY, MD 21031
Tel: (410) 771 7301
Fax: (410) 771 7462

Baltimore Spice, Inc.
9740 REISTERSTOWN RD.
Garrison, MD 21055
Tel: (410) 363 1700
Fax: (410) 363 6619

MAX VAN PELS, INC.
111 N. CENTRAL AVE.
HARTSDALE, NY 10530
Tel: (914) 761 3390
Fax: (914) 761 3288

Crescent Foods, Inc.
21612 88TH AVE., S.
KENT, WA 98031
Tel: (206) 395 9400
Fax: (206) 395 4396

Gel Spice Co., Inc.
48 HOOK RD.
BAYONNE, NJ 07002
Tel: (201) 339 0700
Fax: (201) 339 0072

INGREDIENT RESOURCES, INC.
160 EILEEN WAY
SYOSSET, NY 11791
Tel: (516) 496 2500
Fax: (516) 496 2516

INGREDIENT RESOURCES, INC.
160 EILEEN WAY
SYOSSET, NY 11791
Tel: (516) 496 2500
Fax: (516) 496 2516

Mincing Trading Corp.
582 FERRY ST.
NEWARK, NJ 07105
Tel: (201) 465 0066
Fax: (201) 465 6755

SAUER CO., C. F.
2000 W. BROAD ST.
RICHMOND, VA 23220
Tel: (804) 359 5786
Fax: (804) 358 4396

Seven Brothers Trading, Inc.
1470 S. VALLEY VISTA DR., STE. 250
DIAMOND BAR, CA 91765
Tel: (909) 396 8888
Fax: (909) 396 8383

Franklin Trading Co., Inc.
990 FRANKLIN AVE.
GARDEN CITY, NY 11530
Tel: (516) 294 6520
Fax: (516) 294 6307
Japan

ASHOKA CO., LTD
3-17, MIZUKI 5-CHOME
DAZAIFU CITY, 818-01
Tel: (092) 923 5822
Fax: (092) 923 5823

HINO PHARMACEUTICAL CO., LTD
3-15, DOSHMACHI 2-CHOME
CHUO-KU, OSAKA 541
Tel: (06) 231 5847
Fax: (06) 231 7309

SAN-AI TRADING CORP
174-2 IKESHITA OBATA
MORIYAMA-KU, NAGOYA 463
Tel: (052) 791 1888
Fax: (052) 791 1889

India

BAJAJ BROTHERS PRIVATE LTD
ROUND BUILDING KALBADEVI RD
BOMBAY 400 002
Tel: (22) 312 881
Cable: PRITPAL

INDO COTTAGE IMPORT & EXPORT
STATION RD
MORADABAD 244 011
Fax: (22) 262 2003

MS EXPORTS PVT LTD
113 LILY MAKER CHAMBERS NO2
BOMBAY 400 021
Tel: (22) 202 0644
Tlx: 011-4677 MJAY

UNION SPICE FOODS CO. LTD
10-14, KUZUHARA 1-CHOME
KOKORAM-KU, KITAKUYSHU 800-02
Tel: (093) 471 8747
Fax: (093) 471 8747