



FO:MISC/94/7  
Working Paper

## NUTMEG AND DERIVATIVES

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 1994

## NUTMEG AND DERIVATIVES

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, September 1994

This document is a working paper. It documents information forming part of a larger study and informs interested persons about work in progress. It is available in limited numbers for comment and discussion.

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

	<u>Page</u>
PREFACE	iii
 <b><u>REPORT No. 1</u></b>	
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 Trimyrustin and Myristic Acid	20
9. Recommendations	23
Endnotes	25
 <b>TABLES</b>	
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 Trimyrustin	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

## **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

AAI%	Average Annual Percent Increase
FELDA	Malaysian Federal Land Development Authority
g	gram
GCNA	Grenada Cooperative Nutmeg Association
GC	Gas Chromatography
Inform	International News on Fats and Oils and Related Materials
kg	Kilogramme
MT	Metric Ton
\$	Dollars
US	United States
USDA	US Department of Agriculture

## TABLE OF CONTENTS

	<u>Page</u>
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
<b>TABLES</b>	
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

## **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<sup>1</sup>: Grenada's Nutmeg and Mace Production 1986-1993 (tons)

Year	Nutmeg	Mace
1986	2,229	212
1987	2,687	304
1988	2,712	331
1989	2,691	283
1990	2,717	271
1991	2,622	236
1992	2,595	163
1993	2,347	102

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<sup>2</sup>: Export Quantities of Nutmeg and Mace and Total Earnings for the Period 1986-1993**

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

**Table 3<sup>3</sup>: Prices Received by Grenada for its Nutmeg and Mace for the Period 1988-1993 (US\$)**

	1988	1989	1990	1991	1992	1993
Nutmeg/kg	3.35	3.22	2.49	1.26	0.88	0.57
No. 1 Mace/kg	7.43	7.38	6.22	2.62	2.60	2.53
No. 2 Mace/kg	4.83	4.08	3.24	1.43	1.26	0.81

### **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<sup>4</sup>: US Imports of Nutmeg for Consumption**

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

**Table 5<sup>5</sup>: US Imports of Mace for Consumption**

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

**Table 6<sup>6</sup>: US Imports of Nutmeg Oil for Consumption**

Country	Quantity (kg)	Value (thousand US\$)	Quantity (kg)	Value (thousand US\$)
	December 1992		January-December 1992	
World Total	3,720	32	191,952	1,998
France	---	---	1,459	19
India	---	---	7,899	88
Indonesia	3,000	29	178,204	1,789
Mexico	---	---	1,690	54
Spain	---	---	19	2
United Kingdom	720	3	2,601	47

Table 7<sup>7</sup>: EEC Imports of Nutmeg for Manufacture of Nutmeg Oil

Country	Quantity (kg)	Quantity (kg)
	January-December 1991	January-December 1992
World Total	58,928	33,528
Indonesia	30,480	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.<sup>8</sup>

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.<sup>9</sup> It was hinted that the excess stocks of nutmeg in Grenada were to be burned if additional markets were not found.<sup>10</sup>

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.<sup>11</sup>

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.<sup>12,13</sup>

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 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.<sup>14</sup> 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.<sup>15</sup> 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.<sup>16</sup>

### 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.<sup>17,18</sup> 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.<sup>19</sup>

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.<sup>20,21</sup> 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:

1. Sabinene	(50%)	5. d-Linalool	}	6%
or		6. d-Borneol		
2. Camphene	(50%)	7. i-Terpineol	}	4%
3. d-Pinene	20%	8. Geraniol		
4. Dipentene	8%	9. Myristicin	}	0.6%
		10. Safrole		
		11. Eugenol	}	2%
		12. iso Eugenol		

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	Eugenol
Methyl Iso-Eugenol	Myristicin
Methoxy Eugenol	Elemicin
Safrole	Iso-Eugenol
Iso-Elemicin	

### Terpenes

Alpha-Terpinene	Myrcene
Gamma-Terpinene	Terpinolene
Alpha-Pinene	Camphene
Beta-Pinene	Uinonene (Dipentene)
Alpha-Phellandrene	Sabinene
Beta-Phellandrene	Delta <sup>3</sup> -Carene
Alpha-Thujene	

### Monoterpene Alcohol

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

### Sesquiterpene

Caryophyllene

### Terpinic Esters

Geranyl Acetate	Linalyl Acetate
Bornyl acetate	

### Acids

Formic	Octanoic
Butyric	Acetic

### Aromatic hydrocarbons

P-Cymene	Toluene
----------	---------

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.<sup>22</sup> 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.<sup>23</sup>

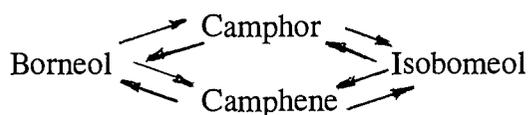
In addition to its use in cosmetic industries, nutmeg oil is prominently used in the pharmaceutical industry. Historically, nutmeg has been used as a form of medicine to treat many illnesses ranging from those affecting the nervous system to the digestive system.<sup>24</sup> Presently, the nutmeg oil 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.<sup>25</sup> 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.<sup>26</sup> 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.<sup>27</sup>

## 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.<sup>28</sup>



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.<sup>29,30,31</sup> Many of camphene derivatives are known pharmaceutical drugs, and camphene itself has been shown to prevent atheromatosis of the aorta in some animals.<sup>32</sup>

(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 atter 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.<sup>33</sup> However, the evidence is not very clear as to whether other compounds are involved since natural myristicin is more potent than synthetic myristicin.<sup>34</sup>

(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.

## 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

	<u>Page</u>
PREFACE	iii
 <b><u>REPORT No. 1</u></b>	
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 Trimyrustin and Myristic Acid	20
9. Recommendations	23
Endnotes	25
 <b>TABLES</b>	
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 Trimyrustin	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

## **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

AAI%	Average Annual Percent Increase
FELDA	Malaysian Federal Land Development Authority
g	gram
GCNA	Grenada Cooperative Nutmeg Association
GC	Gas Chromatography
Inform	International News on Fats and Oils and Related Materials
kg	Kilogramme
MT	Metric Ton
\$	Dollars
US	United States
USDA	US Department of Agriculture

## TABLE OF CONTENTS

	<u>Page</u>
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
<b>TABLES</b>	
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

## **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<sup>1</sup>: Grenada's Nutmeg and Mace Production 1986-1993 (tons)

Year	Nutmeg	Mace
1986	2,229	212
1987	2,687	304
1988	2,712	331
1989	2,691	283
1990	2,717	271
1991	2,622	236
1992	2,595	163
1993	2,347	102

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<sup>2</sup>: Export Quantities of Nutmeg and Mace and Total Earnings for the Period 1986-1993**

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

**Table 3<sup>3</sup>: Prices Received by Grenada for its Nutmeg and Mace for the Period 1988-1993 (US\$)**

	1988	1989	1990	1991	1992	1993
Nutmeg/kg	3.35	3.22	2.49	1.26	0.88	0.57
No. 1 Mace/kg	7.43	7.38	6.22	2.62	2.60	2.53
No. 2 Mace/kg	4.83	4.08	3.24	1.43	1.26	0.81

### **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<sup>4</sup>: US Imports of Nutmeg for Consumption**

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

**Table 5<sup>5</sup>: US Imports of Mace for Consumption**

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

**Table 6<sup>6</sup>: US Imports of Nutmeg Oil for Consumption**

Country	Quantity (kg)	Value (thousand US\$)	Quantity (kg)	Value (thousand US\$)
	December 1992		January-December 1992	
World Total	3,720	32	191,952	1,998
France	---	---	1,459	19
India	---	---	7,899	88
Indonesia	3,000	29	178,204	1,789
Mexico	---	---	1,690	54
Spain	---	---	19	2
United Kingdom	720	3	2,601	47

Table 7<sup>7</sup>: EEC Imports of Nutmeg for Manufacture of Nutmeg Oil

Country	Quantity (kg)	Quantity (kg)
	January-December 1991	January-December 1992
World Total	58,928	33,528
Indonesia	30,480	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.<sup>8</sup>

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.<sup>9</sup> It was hinted that the excess stocks of nutmeg in Grenada were to be burned if additional markets were not found.<sup>10</sup>

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.<sup>11</sup>

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.<sup>12,13</sup>

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 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.<sup>14</sup> 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.<sup>15</sup> 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.<sup>16</sup>

### 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.<sup>17,18</sup> 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.<sup>19</sup>

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.<sup>20,21</sup> 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:

1. Sabinene	(50%)	5. d-Linalool	}	6%
or		6. d-Borneol		
2. Camphene	(50%)	7. i-Terpineol	}	4%
3. d-Pinene	20%	8. Geraniol		
4. Dipentene	8%	9. Myristicin	}	0.6%
		10. Safrole		
		11. Eugenol	}	2%
		12. iso Eugenol		

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	Eugenol
Methyl Iso-Eugenol	Myristicin
Methoxy Eugenol	Elemicin
Safrole	Iso-Eugenol
Iso-Elemicin	

### Terpenes

Alpha-Terpinene	Myrcene
Gamma-Terpinene	Terpinolene
Alpha-Pinene	Camphene
Beta-Pinene	Uinonene (Dipentene)
Alpha-Phellandrene	Sabinene
Beta-Phellandrene	Delta <sup>3</sup> -Carene
Alpha-Thujene	

### Monoterpene Alcohol

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

### Sesquiterpene

Caryophyllene

### Terpinic Esters

Geranyl Acetate	Linalyl Acetate
Bornyl acetate	

### Acids

Formic	Octanoic
Butyric	Acetic

### Aromatic hydrocarbons

P-Cymene	Toluene
----------	---------

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.<sup>22</sup> 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.<sup>23</sup>

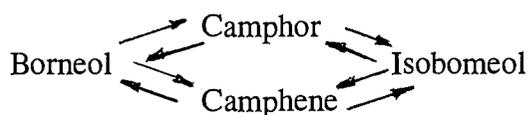
In addition to its use in cosmetic industries, nutmeg oil is prominently used in the pharmaceutical industry. Historically, nutmeg has been used as a form of medicine to treat many illnesses ranging from those affecting the nervous system to the digestive system.<sup>24</sup> Presently, the nutmeg oil 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.<sup>25</sup> 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.<sup>26</sup> 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.<sup>27</sup>

## 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.<sup>28</sup>



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.<sup>29,30,31</sup> Many of camphene derivatives are known pharmaceutical drugs, and camphene itself has been shown to prevent atheromatosis of the aorta in some animals.<sup>32</sup>

(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 atter 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.<sup>33</sup> However, the evidence is not very clear as to whether other compounds are involved since natural myristicin is more potent than synthetic myristicin.<sup>34</sup>

(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.

Trimyristin	73.0%
Essential oil	12.5%
Unaponifiable constituents	8.5%
Oleic acid (as glyceride)	3.0%
Resinous materials	2.0%
Linolenic acid (as glyceride)	0.5%
Formic, acetate and cerotic acids	(very small amounts)

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:

Trimyristin	84.0%
Unaponifiable constituents	9.8%
Oleic acid (as glyceride)	3.5%
Resinous material	2.3%
Linolenic acid (as glyceride)	0.6%
Formic, acetic and cerotic acids	(very small amounts)

## 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.<sup>35</sup> In medicine, the fixed oil has been used externally for sprains and rheumatism.<sup>36</sup> 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:

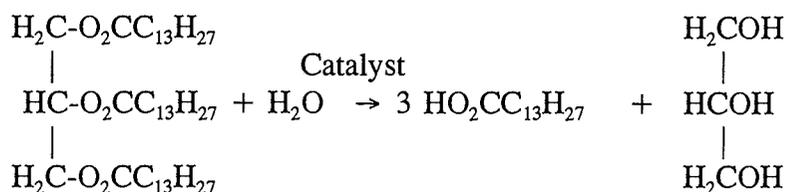
Since the essential oil was already dealt with under its own topic heading, no further discussion of essential oil will be covered under this section.

### 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 tritridecanoate. 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.<sup>46</sup>



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.<sup>47,48</sup> 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

this compound are highly marketable products, specifically myristic acid, myristyl alcohol and glycerol.

Trimyristin is a vegetable fat and can serve as a feedstock for the production of myristic acid, a saturated C<sub>14</sub> fatty acid. An evaluation of the economic viability of producing trimyristin as a raw material for the production of myristic acid and glycerol will warrant examination of the market conditions of the vegetable fat industry and other related industries such as the oleochemical industry.

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

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%.<sup>49</sup> 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.<sup>50</sup> 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)**

	1960	1970	1980	1990	2000
<u>Vegetable Oils</u>					
Coconut oil	2.1	2.2	3.0	3.0	3.3
Palm kernel oil	0.4	0.4	0.7	1.3	2.1
Palm oil	1.1	1.7	4.7	10.6	17.4
Soybean oil	4.0	6.1	14.4	16.9	23.2
Sunflower oil	1.2	3.8	5.6	8.0	9.9
Rapeseed/canola	1.1	1.9	3.4	8.1	10.7
Others	8.7	10.5	11.4	12.7	15.3
Subtotal	18.6	26.2	43.2	60.0	81.9
<u>Animal Fats</u>					
Tallow	3.6	4.4	6.1	6.8	7.7
Butter/lard	9.0	8.2	10.0	11.8	13.8
Subtotal	12.6	12.6	16.1	18.6	21.5
<u>Fish Oil</u>	0.9	1.3	1.2	1.4	1.6
<b>Grand Total</b>	<b>32.1</b>	<b>40.1</b>	<b>60.5</b>	<b>80.6</b>	<b>105.0</b>

**Table 10: World Oil and Fat Production by Geographic Region (million metric tons)**

	1960	1970	1980	1990	2000
North America	9.1	13.3	20.6	19.0	22.0
South America	1.6	2.2	5.0	6.5	9.7
Asia	7.5	8.4	13.5	24.4	39.3
Europe	6.2	7.5	9.8	17.0	19.0
USSR	3.1	5.2	5.3	6.0	8.0
All others	4.6	3.5	6.3	7.7	7.0
<b>Total</b>	<b>32.1</b>	<b>40.1</b>	<b>60.5</b>	<b>80.6</b>	<b>105.0</b>

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.<sup>51,52</sup>

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:<sup>53</sup>

**Table 11: Prices of Major Raw Materials of Oleochemicals**

Raw Material	Price US\$/Metric Ton November 1993
Palm Kernel	418
Palm Oil	407
Coconut oil	522
Tallow (inedible)	319

The relative fatty acid composition of these four major oils compared with the fixed oil of nutmeg is shown below<sup>4</sup>:

Table 12: Relative Fatty Acid Composition

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

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:

Raw Materials	Oleochemical Unit Operations	Basic Oleochemicals
<i>Natural</i> Tall Tallow Coconut Oil Palm Oil Palm Kernel Oil Soybean Oil Sunflower Oil Rapeseed Oil Canola Oil Other Veg. Oils	Splitting Distillation Fractionation Separation Hydrogenation Methylation Deionization	Fatty Acids FA Methyl Esters Fatty Alcohols Fatty Amines Glycerine
<i>Synthetic</i> Ethylene Propylene Olefins		

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

### 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.<sup>5</sup>

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

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

	1988	1995	2000	AAI%
North America	590	680	750	2.0
Western Europe	895	1,010	1,100	1.7
Asia	555	660	750	2.5
Other	190	225	260	2.6
Total <sup>a</sup>	2,230	2,575	2,860	2.1

<sup>a</sup> Does not include tall oil fatty acids or synthetic fatty acids

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

	1987	1992	AAI% 1987-1992
United States	737	842	2.7
Western Europe	904	986	1.5-2.0
Japan	245	310	4.8
Total	1,886	2,138	2.5

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

	Production	Consumption	Refining Capacity	
			Natural	Synthetic
North America	153	166	170	60
Western Europe	200	160	177	50
Asia/Pacific	150	137	189	40
Other	85	125	107	20
Total	588	588	643	170

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

	1988	1995	2000	AAI% 1988-2000
Natural fatty acids <sup>a</sup>	2,230.0	2,575.0	2,860.0	2.1
Fatty acid methyl esters <sup>b</sup>	110.0	175.0	232.0	6.4
Natural fatty alcohols <sup>c</sup>	364.0	581.0	627.0	4.6
Fatty amines <sup>d</sup>	371.0	491.2	581.7	3.8
Natural glycerine <sup>e</sup>	240.0	300.0	341.0	3.0
Total	3,315.1	4,122.2	4,461.7	2.8

<sup>a</sup> Does not include tall oil fatty acids

<sup>b</sup> Other than in production of fatty alcohols

<sup>c</sup> Overstated by undetermined amount used in fatty amines

<sup>d</sup> Does not include amines produced from olefins

<sup>e</sup> Does not include glycerine from soap production

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

	1988	1995	2000	AAI% 1988-2000
North America	831.5	1,022.2	1,144.3	2.7
Western Europe	1,274.4	1,464.3	1,593.8	1.9
Asia	751.2	1,070.6	1,252.6	4.3
Other	212.0	265.0	310.07	3.2
Total World Natural Glycerine	3,315.1	4,122.2	2,641.7	2.8

<sup>a</sup> 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), ie, 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.<sup>57</sup>

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.<sup>58</sup> 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.<sup>59,60</sup>

## 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 C<sub>14</sub> 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 C<sub>12</sub>-C<sub>14</sub> serve best as raw material for the soap, detergent and oleochemical.<sup>61</sup> 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 C<sub>12</sub>-C<sub>14</sub> fatty acids: coconut oil, palm kernel oil, nutmeg fixed oil and babassu oil.

Table 18: Listed Catalogue Price for Trimyrustin

Name	Location	Catalogue Prices		
Indofine Chemical Co. Inc.	New Jersey, USA	500 mg	\$ 45.00	
		1 g	\$ 68.00	
Macali Tesque, Inc.	Kyoto, Japan			
Extrasynthese S.A.	Genay, France			
Fluka	New York, USA	5 g	\$ 38.50	99% pure (GC)
		25 g	\$157.30	99% pure (GC)
		50 g	\$ 44.80	97% pure (GC)
Kodak	New York, USA			
Accurate Chemicals	New York, USA			
Sigma	Montana, USA	1 g	\$ 11.70	99% pure
		5 g	\$ 36.65	99% pure
		25 g	\$149.80	99% pure
		1 g	\$ 5.90	90+ % pure
		5 g	\$ 15.45	90+ % pure
		10 g	\$ 25.75	90+ % pure
		25 g	\$ 51.45	90+ % pure

Coconut, palm kernel and babassu oil are sometimes referred to as lauric oils. Lauric acid is a C<sub>12</sub> fatty acid and myristic acid is a C<sub>14</sub> 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.<sup>62</sup> Thus, fixed oil of nutmeg or trimyrustin as a precursor of C<sub>14</sub> fatty acid has a place in the soap, detergent and oleochemical industry if it can be produced at a reasonable price.

To estimate the present consumption of trimyrustin 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.<sup>63</sup> Assuming that half of this is for non-edible purposes, then 2.19 million metric tons of these oils are used industrially.<sup>64</sup> If 16% of these oils is trimyrustin, then about 0.35 million metric tons or 350 thousand metric tons of trimyrustin is consumed annually.

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.<sup>65</sup>

Most of this trimyrustin used is in the production of myristic acid and myristyl alcohol splitting this fat. Myristic acid and derivatives of this C<sub>14</sub> 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.<sup>66</sup> Lancaster marketed a new brand of cosmetic 'Le Futur' and myristyl lactate was an active ingredient in their lip colour formulation.<sup>67</sup> 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.<sup>68</sup> 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.<sup>69</sup>

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<sup>70</sup>**

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

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):<sup>71,72,73,74,75</sup>

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

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

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:<sup>76</sup>

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

Fatty Acid	Type	Price per kg
Myristic	Commercial pure bags, truckload	2.75
Lauric	Commercial pure bags, truckload	1.50
Tallow fatty acids	Technical non-returnable, carload	0.90
Oleic	Distilled, railroad tank cars	1.56

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.<sup>77</sup> 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 C<sub>14</sub> 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;
  - (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

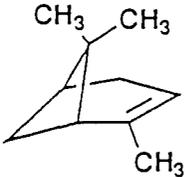
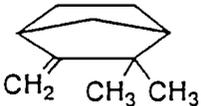
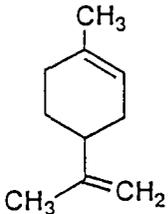
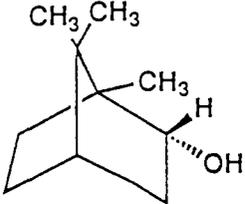
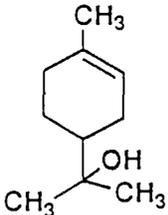
1. Grenada Cooperative Nutmeg Association, 7/12/93
2. Grenada Cooperative Nutmeg Association, 7/12/93
3. Grenada Cooperative Nutmeg Association, 7/12/93
4. Office of Trade and Economic Analysis, US Department of Commerce, International Trade Administration
5. Office of Trade and Economic Analysis, US Department of Commerce, International Trade Administration
6. Office of Trade and Economic Analysis, US Department of Commerce, International Trade Administration
7. Eurostat, Monthly EEC External Trade, period 91-52 and 92-52
8. Journal of Commerce, 1991, September, page 4
9. Caribbean-Update, 1993, March
10. Journal of Commerce, 1991, September, page 4
11. Caribbean-Update, 1993, March
12. Caribbean-Update, 1991, July, pages 16-17
13. Grenada Cooperative Nutmeg Association; Fax information, 11/2/93
14. Forrest, E. Janet and R. A. Heacock. "Nutmeg and Mace, the psychotropic spices from *Myristica fragrans*," Lloydia 35(4) 1972, 440-449.
15. Ibid.
16. The Merck Index, Eleventh Edition, 1989, 6749, Merck & Co Inc, NJ.
17. Power, Frederick B. and Arthur H. Salway, "The constituents of the essential oil of nutmeg," Chemical Society Journal, 1907, 91, 2037-2058.
18. Power, Frederick B. and Arthur H. Salway, "The constituents of the expressed oil of nutmeg," Journal of the Chemical Society, 1908, 83, 1653-1659.
19. Forest, E. Janet and R. A. Heacock. "Nutmeg and Mace, the psychotropic spices from *Myristica fragrans*," Lloydia 35 (4) 1972, 440-449.
20. Sarath-Kumara, Subaddarage J, Errol R. Janisz and Hearath M. Dharmadasa, J. Sci. Food Agric., 1985, 36, 93-100.
21. Flavours, Jan/Feb. 1976. p.29.

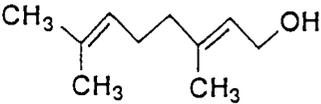
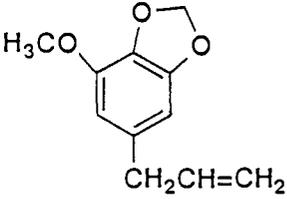
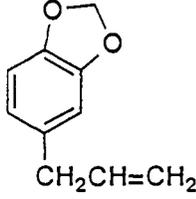
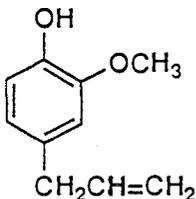
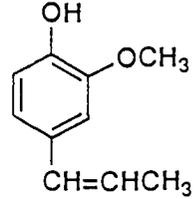
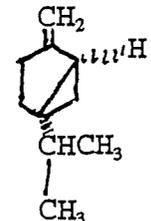
22. "A Consumers Dictionary of Cosmetic Ingredients" Ruth Winter. Crown Publishers, Inc. New York, 1989, 215.
23. "Poucher's Perfumes Cosmetics and Soaps: The Raw Material of Perfumery." Vol 1, ninth edition W.A. Poucher edited and revised by A. J. Jouchai Chapman and Hall, 1991.
24. Weil, Andrew T. "Nutmeg as a narcotic," Econ Botany, 1965, 19 (3), 194-217.
25. Product Alert, June 3, 1992.
26. Chemist and Druggist, 1991, November 2, Page 744.
27. Product-Alert, September 2, 1991.
28. Chemical Abstract 36: 759<sup>2</sup> (1942)
29. Chemical Abstract 49: 11091f (1955)
30. Chemical Abstract 69: 104131j (1968)
31. Chemical Abstract 58: 14638h (1963)
32. Chemical Abstract 55: 17909f (1961)
33. Kalbhen, Dieter A. "Nutmeg as a narcotic, A contribution to the chemistry and pharmacology of nutmeg," Angew. Chem. Int. Ed Engl, 1971, 10(b) 370-374
34. Weil, Andrew T. "Nutmeg as a narcotic," Econ Botany, 1965, 19 (3), 194-217 and Kalbhen, Dieter A "Nutmeg as a narcotic, A contribution to the chemistry and pharmacology of nutmeg," Angew. Chem. Int. Ed. Engl, 1971, 10(b) 370-374
35. The Merck Index
36. Weil, Andrew T. "Nutmeg as a narcotic," Econ Botany, 1965, 19(3), 194-217.
37. "Summary of Trade and Tariff Information - Fatty Acids of Animal or Vegetable Origin", United States International Trade Commission, 1981, pg 4.
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.
39. Clifford, A. J.; L. M. Smith; R. K. Crevelling; C. L. Hamblin; C. K. Clifford, "Effects of Dietary Triglycerides on Serum and Liver Lipids and Sterol Excretion of Rats" Journal of Nutrition, 1986, 116(6), 944-956.
40. Fox, P. L.; P. E. DiCorleto. "Fish Oil Inhibit Endothelial Cell Production of Platelet-derived Growth Factor-like Protein" Science, 1988, 241 (4864), 453-456.
41. Chem Abstract, 73: 129752h (1970)
42. Chem Abstract 75<sup>18-22</sup>:121348b (1971) also 56:P11734f(1962)

43. Organic chemistry laboratory experiments 1976, Organic chemistry faculty SUNY - Binghamton
44. Modern Experimental Organic Chemistry, Roberts, Royston M.; John C. Gilbert; Lynn B. Rodewald and Alan S. Wingrove, 4th ed. Philadelphia: Saunders College Pub. 1985.
45. Fatty Acids in Industry: Processes, Properties, Derivatives and Applications edited by Robert W. Johnson and Earle Fritz. Marcel Dekker, Inc New York, 1989 page 23.
46. Fatty acids and their industrial applications, edited by Scott E. Pattison. Marcel Dekker, Inc, New York 1968, page 25.
47. Chem Mark Rep Vol: 237(8) 1990 p. 22
48. Office of Trade and Economic Analysis, US Department of Commerce, International Trade Administration
49. International News on Fats, Oils and Related Materials, (Inform) 1990, 1(12), 1034
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
54. Summary of Trade and Tariff Information. Fatty acids of animal and vegetable origin. U.S. International Trade Commission. 1981
55. Chemical Marketing Reporter, 1992, October 5
56. Inform, 1990, 1(12), 1034
57. Inform, 1991, 2(12), 1062
58. Supplement to Summary of Trade and Tariff Information on fatty acids of animal or vegetable origin, page 5, TS US Items 490.10-490.26 US International Trade Commission, 1982, and Summary of Trade and Tariff Information. Fatty acids of animal and vegetable origin. US International Trade Commission, 1981 pg 27.
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

66. Manufacturing-Chemist, 1993, May, 43
67. Cosmetics and Toiletries - Manufacturers and Suppliers, 1991, November, 9
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
77. Summary of Trade and Tariff Information. Fatty acids of Animal and Vegetable Origin. US International Trade Commission, 1981.

Structure and Physical Properties of Nutmeg Oil Components

NAME	STRUCTURE	B.P./M.P. °C	DENSITY
d-Pinene		b <sub>760</sub> 155-156	0.8591
Camphene		m.p. 52	d <sup>50</sup> 0.8486
Dipentene		b <sub>763</sub> 175.5-176.5	0.8402
d-Linalool	$(\text{CH}_3)_2\text{C}=\text{CH}(\text{CH}_2)_2\text{C}(\text{CH}_3)\begin{matrix} \text{OH} \\   \\ \text{CH}=\text{CH}_2 \end{matrix}$	b <sub>760</sub> 198-200	0.8733
d-Borneol		b <sub>760</sub> 212	1.011
i-Terpinol		b <sub>731</sub> 206-207	0.9338

NAME	STRUCTURE	B.P./M.P. °C	DENSITY
Geraniol		b <sub>751</sub> 229-230	0.8894
Myristicin		b <sub>15</sub> 149.5	1.1437
Safrole		b <sub>760</sub> 232-234	1.096
Eugenol		b <sub>760</sub> 225	1.0664
iso-Eugenol		b <sub>760</sub> 266	1.080
Sabinene		b <sub>760</sub> 163	0.8468

**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

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

Quantum Chemical Corp; Emery Div.  
11501-T Northlake Dr.  
Cincinnati, OH 45249  
Tel: 513-530-7300  
Fax: 513-530-7443

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

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

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

Henkel Corp, Emery Group  
11501 Northlank Dr.  
Cincinnati, OH 45249  
Tel: 513-530-7300  
Fax: 513-530-7581

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

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

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

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

Witco Corp. Humko Chemical Div.  
P.O. Box 125  
Memphis, TN 38101  
Tel: 901-684-7000  
Fax: 901-761-1851

Mitsui and Co. (USA) Inc  
200 Park Ave.  
New York, NY 10166  
Tel: 212-878-4000

Robeco Chemicals, Inc.  
99 Park Ave.  
New York, NY 10016  
Tel: 212-986-6410  
Fax: 212-986-6419

Ruger Chemical Co. Inc.  
83 Cordier St.  
Irvington, NJ 07111  
Tel: 201-926-0331  
Fax: 201-926-4921

AKZO Chemical Div.  
300 S. Riverside Plaza  
Chicago, IL 60606  
Tel: 312-906-7500  
Fax: 312-906-7680

Berje Chemical Products, Inc.  
5 Lawrence St.  
Bloomfield, NJ 07003  
Tel: 201-748-8980  
Fax: 201-680-9618

Filo Chemical Inc.  
50 Broadway  
New York, NY 10004  
Tel: 212-514-9330  
Fax: 212-514-9085

### Myristyl Alcohol

Ethyl Corp. Marketing Communications  
451 Florida St.  
Baton Rouge, LA 70801  
Tel: 504-388-7040  
Fax: 504-388-7686

R.W. Greeff and Co. Inc  
777 W. Putnam Ave.  
Greenwich, CT 06830  
Tel: 203-532-2900  
Fax: 203-532-2980

Henkel Corp, Emery Group, Cospha/CD  
Div.  
M. Michel and Co, Inc.  
90 Broad St.  
New York, NY 10004  
Tel: 212-344-3878  
Fax: 212-344-3880

Spectrum Chemical Mfg. Corp.  
14422 S. San Pedro St.  
Gardena, CA 90248-9985  
Tel: 310-516-8000  
Fax: 310-516-7512

Vista Chemical Co.  
900 Threadneedle  
P.O. Box 19029  
Houston, TX 77224  
Tel: 713-588-3000

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

Quotation No: 9580/1

Page No: 1

Issue Date: 12/13/93

Destination: GRE

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

From: Jeffrey Borins  
 Irvine, CA 92718

Phone: 714-458-7262

Itm	Qty	Part-No	Description	Unit Price	Total Price
---	---	-----	-----	-----	-----
1	1	N611-9001	AUTOSYSTEM GAS CHROMATOGRAPH for 220 V, 50/60 Hz. operation.	630.00	630.00
2	1	N611-0002	<p>AutoSystem Gas Chromatograph. A microprocessor-controlled gas chromatograph system - GC fully controlled from instrument keyboard. Features include:</p> <ul style="list-style-type: none"> <li>- Four-step, three-ramp temperature programming to 450 degrees C (oven maximum software controlled).</li> <li>- 35-key color-coded keyboard entry of all instrument parameters.</li> <li>- Two-line x 20 character vacuum fluorescence display.</li> <li>- Five method setup, storage, copy, and generate.</li> <li>- Comprehensive hardware and software thermal protection.</li> <li>- Continuous diagnostic monitoring of all instrument functions.</li> <li>- Up to two simultaneous analog outputs for integrator or recorder.</li> <li>- Digital electronic pressure readout with capillary injectors.</li> <li>- Up to 32 programmable timed events.</li> <li>- RS-232C Printer port for hardcopy of methods, instrument configuration and run log.</li> <li>- External computer communications allows full instrument control plus two simultaneous channels of raw data.</li> <li>- Dual-channel background correction.</li> </ul>	8,040.00	8,040.00

**PERKIN ELMER**

**QUOTATION**

Quotation No: 9580/1

Page No: 2

<u>Itm</u>	<u>Qty</u>	<u>Part-No</u>	<u>Description</u>	<u>Unit Price</u>	<u>Total Price</u>
3	1	N611-1030	Channel A - Single capillary column injector with pressure regulator & split vent controls, digital column head pressure readout, and automatic control of split vent solenoid valve.	1,800.00	1,800.00
4	1	N611-2010	Channel A - Single flame-ionization detector with amplifier & needle valve control of air & H2 combustion gases.	2,120.00	2,120.00
5	1	0332-8000	INSTALLATION KIT	400.00	400.00
6	1	N541-0301	MODEL 1022 GC+ SING CHANNL INT	3,050.00	3,050.00
7	1	N541-0041	S/W KIT 1020 LC PLUS V7.50 -NT	275.00	275.00

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

continued...

**PERKIN ELMER**

# QUOTATION

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 Borins

## TERMS AND CONDITIONS OF SALES

### 1. Delivery Dates

a. All delivery and shipment dates indicated on the face hereof are approximate and subject to Seller's availability schedule. Seller will make reasonable efforts to meet the delivery dates quoted. However, Seller will not be liable for its failure to meet the quoted delivery dates or for any delay in performance hereunder due to unforeseen circumstances or shortages, due to causes beyond its control, or due to its voluntary or mandatory compliance with any governmental act, regulation, or request. By reason of such circumstances, Seller's supplies of the equipment covered hereby are limited. Seller shall have the right to prorate the available supply among its customers in such manner as it, in its sole discretion, determines.

b. All orders are priced and acknowledged on the basis of an estimated shipment date within ninety (90) days of the date of order acknowledgement to the stated destination. Should Buyer request a change in the estimated shipment date or otherwise cause delay in delivery beyond ninety (90) days from the date of order acknowledgement or request that the goods be shipped outside the country of original delivery, the prices established by such acknowledgement shall no longer apply, and Seller's list prices in effect on the actual date of shipment shall be used in determining the price to be paid.

**2. Packing and Loss or Damage in Transit.** Equipment will be packed for shipment in a manner suitable to the method of shipment specified by Buyer, or to the method selected by Seller in the absence of instructions. Unless otherwise indicated on the face hereof, all sales hereunder are f.o.b. shipping point, and all risk of loss or damage to equipment in transit is upon Buyer. Payment will be made in accordance with Paragraph 5 below.

**3. Payment Due For Partial Deliveries.** Seller may, in its sole discretion, deliver any portion of the equipment or supplies ordered, regardless of utility to Buyer in the absence of the undelivered portion, and all such partial deliveries shall be accepted and paid for in accordance with the terms of Paragraphs 4 and 5 below. Likewise, completion of any installation services shall not be a condition to Buyer's obligation to remit payment. The making of a partial delivery that, to any extent, is not in accordance with the contract of sale shall not affect the Buyer's obligation hereunder to remit payment.

**4. Inspection, Acceptance and Return of Goods.** Buyer shall inspect the equipment immediately after arrival and shall within five (5) days of its arrival give written notice to the Seller of any claim for shortage or that the equipment does not conform with the terms of the contract of sale. If the Buyer shall fail to give such notice, the equipment shall be deemed accepted and to conform with the terms of the contract of sale and the Buyer shall be bound to pay for the equipment in accordance with the terms of Paragraph 5 below. Return of goods, defective or otherwise, will not be accepted by Seller unless they are shipped f.o.b. destination, freight prepaid, and with prior written authorization by Seller. When return of nonconforming goods has been accepted, conforming shipment may be made in accordance with Paragraph 1 above and Paragraph 8 below without further liability on Seller's part. Buyer will be liable for restocking charges in the event equipment is returned to the Seller which is not defective and is in accordance with the terms of the contract of sale.

**5. Payment and Credit Terms.** Unless otherwise indicated on the face hereof, Buyer agrees to remit payment in full to the address provided on the face of Seller's invoice for all shipments, including shipments of any portion of the equipment ordered, upon receipt of invoice. This obligation shall not be contingent upon the completion of any installation services included in the purchase price. No cash discounts will be granted. Account balances not paid in accordance with this agreement, are subject to the maximum prevailing legal interest rate calculated from date of delinquency. In the event Seller finds it necessary to refer this matter to an attorney or an agent for collection of delinquent accounts, Buyer shall pay all costs of collection including reasonable attorney's fees. Buyer agrees that Seller shall retain a security interest in the equipment sold hereunder to secure any portion of the price not paid on delivery and will, on request, execute a security agreement in such form as is required by Seller, which, at Seller's option, may be filed with appropriate local and state authorities. Seller reserves the right to change the credit terms provided herein when, in Seller's opinion, the financial condition or previous payment record of Buyer so warrants. Should Buyer become delinquent in the payment of any sum due hereunder, Seller will not be obligated to continue performance.

**6. Taxes.** Buyer is responsible for the ultimate payment of all taxes which may be assessed or levied on or on account of materials sold hereunder to the Buyer whether termed a gross receipts tax, use tax, property tax, sales tax or otherwise. Where Buyer claims that this transaction is not subject to any such tax, that Buyer is exempt, or that Seller is not required to collect such tax, Buyer agrees to provide Seller with any documentation necessary to support such a claim and to allow Seller to document its decision not to collect such tax(es). Prices are subject to change to reflect changes in any Federal or state laws taxing raw or processed materials or governing working hours or compensation of labor.

**7. Installation and Site Preparation.** 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 in Seller's most current price list. For equipment requiring installation by Seller's service personnel, it is the responsibility of the Buyer to prepare the site environmentally and provide the required services: power, water, drain, air, bottled gases, permits, licenses, approvals, etc., as well as whatever is required to uncrate and move the equipment to its location. Failure to do so will result in a service charge by Seller to cover the lost time of its service personnel. Because Seller's service personnel may be required to enter upon Buyer's premises for the purpose of providing service to the equipment sold hereunder, Buyer hereby undertakes to maintain its premises in a safe condition and to comply with all applicable laws, statutes and regulations governing workplace health and safety. Seller's sales and service personnel are not authorized to enter into any indemnity or hold harmless agreements on behalf of Seller. Seller will not, in any event, indemnify, defend or hold Buyer harmless from any liability that it may incur to Seller's sales and service personnel.

### 8. Limited Warranty

a. **Basic Warranty.** Except as otherwise provided herein, Seller warrants to Buyer that the equipment sold hereunder is, at the time of shipment to Buyer from Seller, free from defects in material and workmanship. As Buyer's sole and exclusive remedy under this warranty, Seller agrees either to repair or replace, at Seller's sole option, any part or parts of such equipment which, under proper and normal conditions of use, prove(s) to be defective within ninety (90) days from the date of shipment to Buyer (except when a different warranty period is specified in Seller's current applicable price list, in which event the specified period shall control). Buyer shall promptly notify Seller of any such defect. Any realignment, readjustment, recleaning or recalibration, provided they do not relate to a proven defect in material or workmanship, shall be performed only at Seller's then current rates for service.

b. **Exclusions and Limitations.** (i) It is recognized that some parts by their nature may not function the full warranty period. Therefore, excluded from the foregoing warranty are chromatography columns, filaments, energy sources, lamps, power amplifier tubes, graphite tubes, sample cells holders, burner and furnace chambers, nebulizers, and other similar parts referenced in the applicable operating manual.

(ii) The foregoing warranty excludes certain equipment or accessories which are identified on applicable price lists, quotations, order acknowledgements, special promotional materials, or on the face hereof, for which this limited warranty may be further limited. Included within this category are items produced by third party manufacturers (as to which Seller passes to Buyer the warranty it has been provided by the manufacturer) and items which are sold at specially reduced prices with reduced warranty protection (in some such cases, extended warranty protection may be available at an increased price).

(iii) This warranty does not cover loss, damage, or defects resulting from: transportation to the Buyer's facility, improper or inadequate maintenance by Buyer; Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the equipment, or improper site preparation and maintenance.

(iv) No warranty is made with respect to used equipment, which will be so marked on the face hereof and, unless otherwise indicated on the face hereof, shall be sold as is.

(v) The basic warranty period, as set forth in subsection A above, is limited to ninety (90) days from date of shipment to Buyer with respect to data processing equipment, including data storage devices, processors, printer terminals, communication interfaces, tape drives and similar devices.

c. **Place of Service.** Except when otherwise provided in Seller's current applicable price list, Seller shall use its best efforts to perform all warranty services hereunder at the Buyer's facility, as soon as reasonably practicable after notification by the Buyer of a possible defect provided however that Seller reserves the right to require that the Buyer return the equipment to Seller's production facility, transportation charges prepaid, when necessary to provide proper warranty service.

d. **Refund of Purchase Price.** In lieu of the foregoing, Seller may at any time and in its sole discretion, to discharge its warranty by accepting the return of such equipment and refunding any portion of the purchase price paid by Buyer.

e. **Software and Firmware Products.** This sole and exclusive warranty applicable to software and firmware products provided by Seller for use with a processor shall be as follows: Seller warrants that such software and firmware will conform to Seller's program manuals current at the time of shipment to Buyer when properly installed on that processor. Seller does not warrant that the operation of the processor or software or firmware will be uninterrupted or error-free.

**NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. SELLER EXPRESSLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

**9. EXCLUSIVE REMEDIES. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. SELLER SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR OTHER LEGAL THEORY ARISING OUT OF THE SALE, INSTALLATION, SERVICE OR USE OF ITS EQUIPMENT. SELLER NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE, INSTALLATION, SERVICE OR USE OF ITS EQUIPMENT.**

**10. Patent Indemnity.** Seller agrees to defend, at its own expense, any suit or legal proceeding which may be brought against Buyer alleging infringement by Buyer of any patent of the United States, by Buyer's use of the equipment sold hereunder for its intended purposes, provided that Buyer shall give Seller prompt written notice of any claim, threat or institution of suit or legal proceeding, and provided that Seller shall then have the sole right to control and conduct the defense and/or settlement of such claim, threat, suit or legal proceeding, either in the name of Seller or Buyer or both, and Buyer shall, at Seller's request and expense, provide relevant information and reasonable cooperation. Seller shall pay all final judgments and all costs and attorney's fees assessed against Buyer in any such suit or legal proceeding, provided Buyer has complied with the conditions hereof with respect to prompt notice and cooperation in connection with such suit or legal proceeding and given exclusive control thereof to Seller, but Seller shall not be liable for any attorney's fees or other legal expenses incurred by Buyer without the prior written consent of Seller. Seller shall also have the right, at its own expense, to replace the equipment claimed to infringe with equally satisfactory non-infringing equipment, modify said equipment so that it becomes non-infringing, or remove such equipment and refund the purchase price thereof.

The foregoing indemnity fully defines Seller's obligations for patent infringement; such obligations to defend and make payment shall specifically not apply to:

(i) an infringement claim resulting from additions or changes made to the equipment made by Buyer or any third party or from use in combination with other equipment; or

(ii) an infringement claim which is settled without the consent of Seller; or

(iii) an infringement claim which results from compliance by Seller with specifications furnished by Buyer.

The total amount of Seller's obligations and liability under this Section shall not exceed the price paid by Buyer to Seller for the equipment held to infringe, and in no event will Seller be held accountable for consequential damages under this indemnity, such as, for example, loss of business profits or goodwill. With respect to goods manufactured in whole or part to Buyer's specifications, the Buyer will protect and indemnify Seller against all claims for damages or profits arising from infringement of patents, designs, copyrights or trademarks.

**11. MODIFICATION OF TERMS — THIS DOCUMENT IS NOT AN OFFER TO SELL. ALL ORDERS SUBMITTED IN RESPONSE TO SELLER'S QUOTATION ARE SUBJECT TO ACCEPTANCE OR REJECTION AT SELLER'S MAIN OFFICE IN NORWALK, CONNECTICUT. SELLER'S ACCEPTANCE OF ANY ORDER IS EXPRESSLY SUBJECT TO BUYER'S ASSENT TO EACH AND ALL OF THE TERMS AND CONDITIONS SET FORTH IN SELLER'S ACKNOWLEDGMENT AND BUYER'S ASSENT TO THESE TERMS AND CONDITIONS SHALL BE CONCLUSIVELY PRESUMED FROM BUYER'S RECEIPT OF SELLER'S ACKNOWLEDGMENT WITHOUT PROMPT WRITTEN OBJECTION THERETO OR FROM BUYER'S ACCEPTANCE OF ALL OR ANY PART OF THE GOODS OR SERVICES ORDERED. NO ADDITION TO OR MODIFICATION OF SAID TERMS AND CONDITIONS SHALL BE BINDING UPON SELLER UNLESS SPECIFICALLY AGREED TO BY SELLER IN WRITING. IF BUYER'S PURCHASE ORDER OR OTHER CORRESPONDENCE CONTAINS TERMS OR CONDITIONS CONTRARY TO OR IN ADDITION TO THE TERMS AND CONDITIONS CONTAINED IN SELLER'S ACKNOWLEDGMENT, ACCEPTANCE OF ANY ORDER BY SELLER SHALL NOT BE CONSTRUED AS ASSENT TO SUCH CONTRARY OR ADDITIONAL TERMS AND CONDITIONS OR CONSTITUTE A WAIVER BY SELLER OF ANY OF THE TERMS AND CONDITIONS CONTAINED IN SELLER'S ACKNOWLEDGMENT. ANY REFERENCE TO BUYER'S PURCHASE ORDER NOTED ON SELLER'S ACKNOWLEDGMENT SHALL NOT AFFECT OR LIMIT THE APPLICABILITY OF THE TERMS AND CONDITIONS CONTAINED THERETO.**

**12. AUTHORITY TO EXPORT. ALL ORDERS ACCEPTED FOR EXPORT (AND/OR RE-EXPORT) ARE SUBJECT TO: 1) ISSUANCE OF AN EXPORT (RE-EXPORT) LICENSE BY THE UNITED STATES GOVERNMENT, AND 2) THE BUYER PROVIDING SELLER WITH ALL DOCUMENTATION NECESSARY FOR SHIPMENT TO THE DESTINATION COUNTRY.**

### 13. Software Licenses and Copyrighted Material

a. Perkin-Elmer provides certain software products by license only. The terms of the license are available from Perkin-Elmer and are accepted by Buyer on delivery of the licensed software.

b. Unless otherwise specified, Seller's copyrighted material (software, firmware and printed documentation) may not be copied except for archive purposes, to replace a defective copy, or for program error verification by Buyer.

### 14. Miscellaneous

a. **Applicable Laws.** This contract shall be construed in accordance with the laws of the State of New York, U.S.A.

b. **Confidential Data and Information.** If, in connection with the sale, purchase, use, or maintenance of the equipment, Seller is requested, required or deems it advisable to furnish data or information which, in its sole discretion, seems proprietary, confidential or both, Seller shall not, in any event, submit or be required to furnish such data or information unless and until Buyer enters into an agreement concerning the handling, use, copying, retention and return of such information; the form of which agreement is available to Buyer on request. Seller does not agree to accept any proprietary or confidential information of Buyer in the absence of such a written agreement signed by an authorized representative of Seller.

c. **Assignment.** Any attempt by Buyer to assign, transfer or delegate any of the rights, duties, warranties, or obligations herein shall be null and void.

d. **Non-waiver.** Seller's failure to exercise any of its rights shall not constitute or be deemed a waiver or forfeiture of such rights.

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

Extrasynthese S.A.  
Zone Industrielle Lyon Nord  
B.P. 62  
69730 Genay  
France  
Tel: 78.98.20.34  
Fax: 78.98.19.45

Nacali Tesque, Inc.  
Nijyo Karasuma  
Nakagyo-Ku  
Kyoto 604  
Japan  
Tel: 81-75-271-5631  
Fax: 81-75-371-5543

ICN Biomedicals Inc.  
K&K Rare & Fine Chemicals  
P.O. Box 5023  
Costa Mesa, CA 92626  
Tel: 800-854-0530  
Fax: 741-557-4872

Research Plus Inc.  
P.O. Box 324  
Bayonne, NJ 07002  
Tel: 201-823-3592  
Tel: 800-341-2296  
Fax: 201-823-9590

Biosynth International  
P.O. Box 541  
Skokie, IL 60077  
Tel: 708-574-5160  
Fax: 708-674-8885

Fisher Scientific Company  
711 Forbes Ave.  
Pittsburgh, PA 15219  
Tel: 412-562-8300

Serdary Research Laboratories Inc.  
1643 Kathryn Drive  
London, Ontario N6G 2R7  
Canada  
Tel: 519-434-4419  
Fax: 519-434-4419

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

Carl Roth Chbh & Co. Chemische Fabrik  
Schoemperienstrabe 1-5  
Postfach 211162  
D-7500 Karlsruhe 21  
West Germany (BRD)  
Tel: 0721 56060  
Fax: 0721 560649

Potential Large-Scale Buyers of Trimyrustin

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

**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

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

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

EMI Corporation  
3166 Des Plaines Avenue  
Des Plaines, IL 60018  
Tel: 708-827-3164  
Fax: 708-803-8394

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



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 Trimvristin on a  
Commercial Scale, from Crown Iron Works



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

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

\*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.
3. Solvent, oil or material storage.
4. Insulation.
5. Building structures or foundations.
6. Equipment for preparation of material prior to extractor.
7. Conveying of material to extractor or from desolventizer.
8. Erection labor or tools.
9. Final paint for equipment.
10. 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



Quotation #C93-281

Page 4

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:**

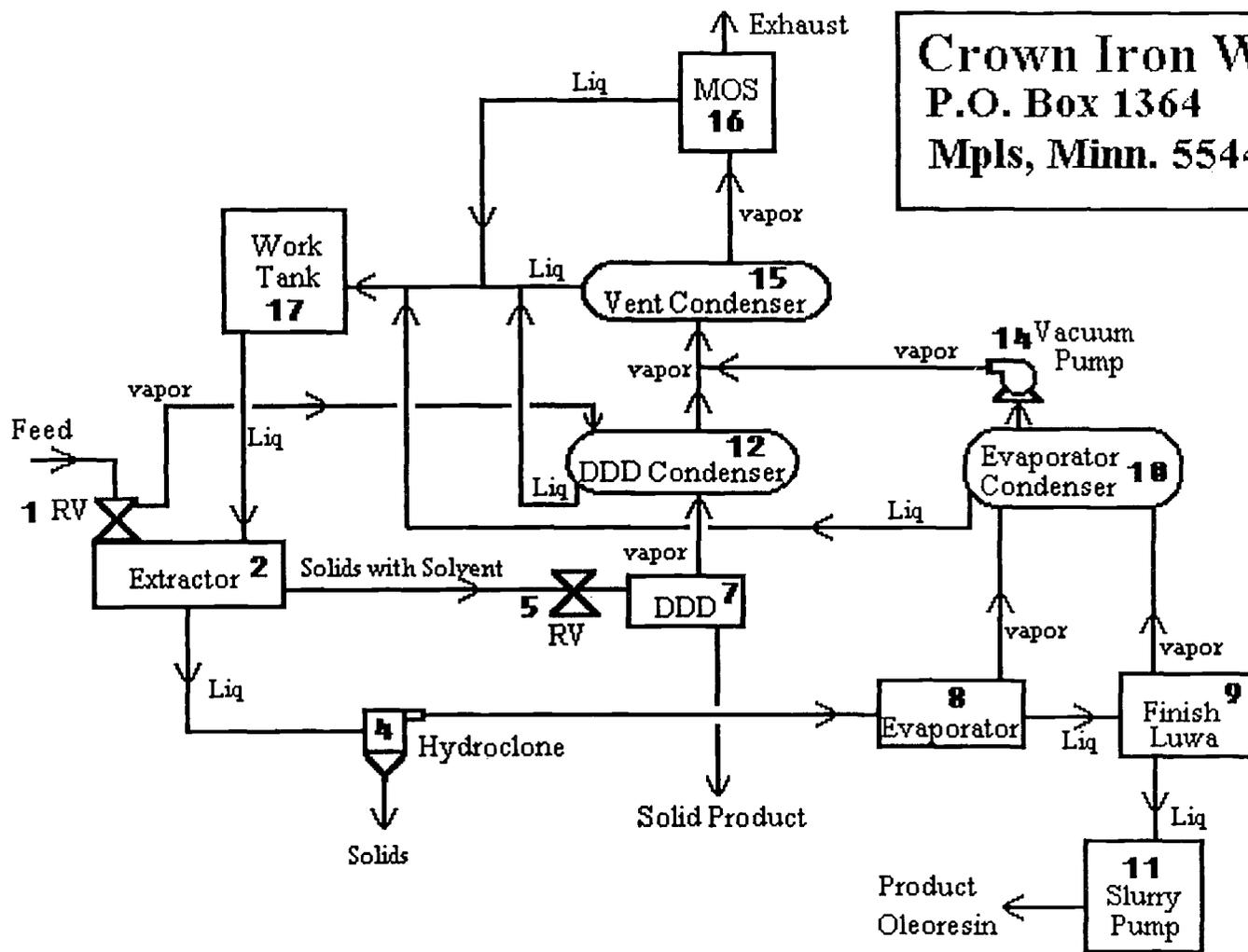
This quotation is firm for a period of sixty (60) days, after which time the price is subject to change.

Best regards,

Kevin D. Gilbert

Product Manager - Sales

**Crown Iron Works, Co.**  
**P.O. Box 1364**  
**Mpls, Minn. 55440**



## 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

	<u>Page</u>
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
 <b>TABLES</b>	
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
 <b>APPENDICES</b>	
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)

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

List of Less Developed Developing Countries (LDCs)

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



# NUTMEG, MACE AND THEIR BY-PRODUCTS

## 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 Siau, 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<sup>1/</sup>) 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**

US\$/ton	Indonesia	Grenada
High quality nutmeg	6,800 - 7,000	6,650
Low quality nutmeg	1,000 - 1,200	5,575
High quality mace	13,500	11,750
Low quality mace	6,000	5,750
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<sup>2/</sup>. As a result of negotiations

<sup>1/</sup> 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.

<sup>2/</sup> 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

Origin / Destination	Nutmegs - Grade	US\$/ton CIF
Grenada / main European port	SUNS	2,000
	GUNS	1,800
	80's	3,200
	60/65's	3,350
	110's	2,950
Indonesia / Netherlands	BWP	1,425
	BWP spot	1,385 (June-July)
	Shrivels	1,825 (June-July)
	ABCD spot	1,700 (June-July)
Indonesia / Germany	Shrivels	1,600 (June-July)
	ABCD	1,700 (June-July)
	BWP	1,675 (June-July)
Indonesia / United Kingdom	SUNS	1,875 (June-July)
Papua New Guinea / Netherlands	BWP	1,425
	ABCD	1,950
West Indies / USA	Whole spot	2,205
East Indies / USA	Whole spot	1,765 (September)
Indonesia / Japan	110's spot	2,100
	110's	2,500 (June-July)
Indonesia / Saudi Arabia	FAQ	1,600
Sri Lanka / Bahrain	110's	1,170
Sri Lanka / Kuwait	110's FAQ	1,035
Origin / Destination	Mace - Grade	US\$/ton CIF
Grenada / main European port	Mace 1	8,500 (August)
	Mace 3	1,600
Indonesia / Netherlands	Broken 2	3,000 (June-July)
	Whole	3,100 (June-July)
Siau / USA	Siftings 2 spot	2,645
Source: Market News Service, "Spice World", N° 21/94, 8 June 1994		

(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**

**Tariff information**

Worldtariff Ltd  
220 Montgomery St., Suite # 432  
San Francisco, CA 94104-3410, USA  
Tel: (415) 391 7501  
Fax: (415) 391 7537

International Customs Tariff Bureau  
38, rue de l'association  
1000 Brussels, Belgium

**Environmental packaging**

Duales System Deutschland GmbH  
Abteilung Vergabe "Grüner Punkt"  
Postfach 1324  
Rochusstraße 2-6  
D-W-5300 Bonn 1  
Germany

Tel: (228) 97 920  
Fax: (228) 979 2198

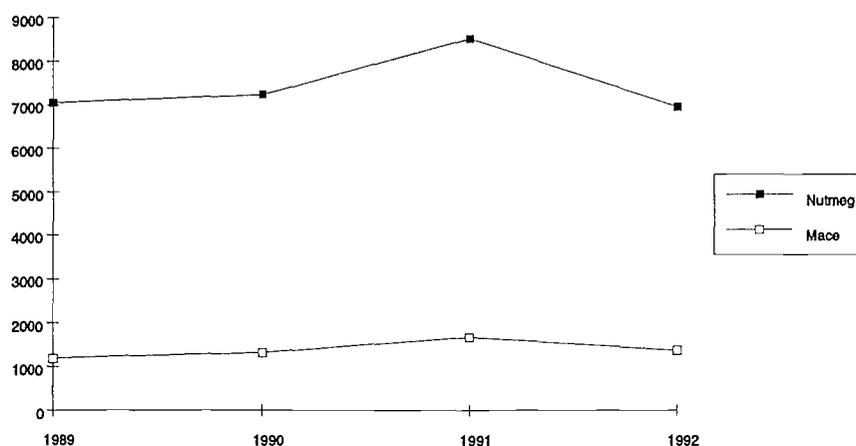


## 2. NUTMEG AND MACE - EUROPEAN UNION OVERVIEW

### Product Description

CN 0908.10-10	Nutmegs for industrial manufacture of essential oils or resinoids
CN 0908.10-90	Crushed or ground nutmeg
CN 0908.20-10	Mace, excluding crushed or ground
CN 0908.20-90	Crushed or ground mace

### 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**

Tariff heading	Duty - MFN rate
0908.10-10	Free
0908.10-90	5%
0908.20-10	Free
0908.20-90	4%
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%	Italy	9.0%
Denmark	25.0%	Luxembourg	3.0%
France	5.5%	Netherlands	17.5%
Germany	7.0%	Spain	Zero-rated
Greece	18.0%	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:	<i>Spices Decree</i>
United Kingdom:	<i>BS 7087:14</i>
France:	<i>NF V32-125</i>

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

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

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

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

Waren-Verein der Hamburger Börse  
Plan 5  
2000 Hamburg 1  
Germany  
Tel: (040) 326 414  
Fax: (040) 322 639

### 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

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

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

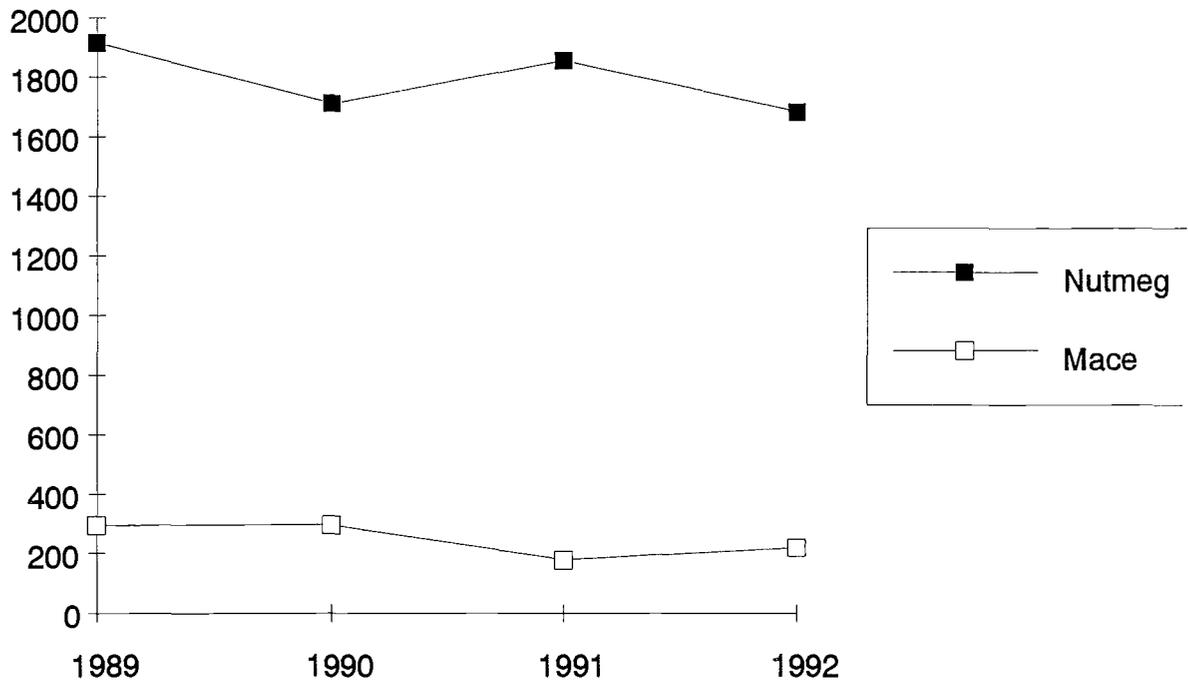


### 3. NUTMEG AND MACE - USA

#### 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

Tariff heading	MFN	GSP
0908.10-0000 Nutmegs	Free	Free
0908.20-2000 Mace, 'Bombay' or wild, ground	16.5¢/kg *	Free
0908.20-4000 Mace nes	Free	Free

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

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

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

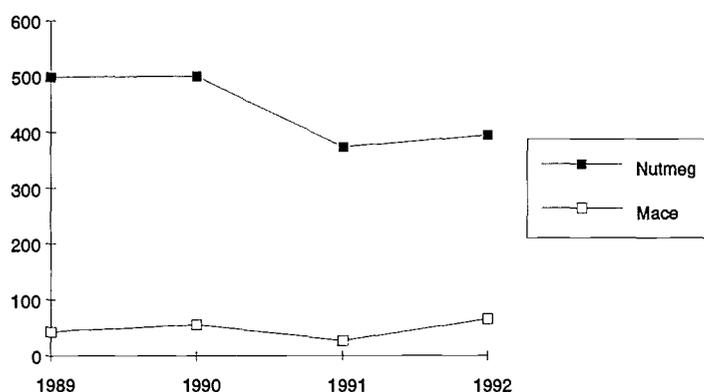


#### 4. NUTMEG AND MACE - JAPAN

##### 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                            | - net contents        |
| - name and address of the manufacturer or seller | - 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, Toranomom 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)



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  $\beta$ -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  $C_{14}$  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**

V: US\$ '000 Q: Metric tons	1990		1991		1992		1993 (a)	
	V	Q	V	Q	V	Q	V	Q
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 C<sub>8</sub>-C<sub>14</sub> 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:

EU	7.1% (MFN rate)
USA	Free (GSP scheme)
Japan	Free (GSP scheme)

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

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

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

## 4. Japan

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

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

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

## 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 Minorities  
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



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 Nutmeg, 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

V: ECU '000  
Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL EC	244	71	154	31	192	64	58	35	39	33
FR GERMANY	163	31	98	20	81	22	46	26	24	15
FRANCE	10	24	14	3	22	14	0	0	8	8
UNITED KINGDOM	21	6	0	0	4	2	4	6	3	5
DENMARK	31	7	1	0	6	6	0	0	3	5
SPAIN	2	0	0	0	28	7	0	0	1	0
BELGIUM-LUXEMBOURG	7	1	2	1	6	2	1	1	0	0
NETHERLANDS	0	0	14	3	11	5	0	0	0	0
ITALY	5	1	0	0	31	5	0	0	0	0
IRELAND	0	0	0	0	0	0	7	2	0	0
GREECE	3	1	25	4	3	1	0	0	0	0
PORTUGAL	2	0	0	0	0	0	0	0	0	0

84

European Community: Exports of nutmeg for industrial manufacture  
of essential oils or resinoids, excluding crushed or ground nutmeg  
CN 0908.10-10

V: ECU '000  
Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL EC	224	36	100	22	237	63	208	110	65	22
FR GERMANY	84	15	6	1	100	25	114	78	28	5
SPAIN	8	0	6	1	9	1	9	1	12	1
NETHERLANDS	70	13	14	3	0	0	23	12	10	5
BELGIUM-LUXEMBOURG	62	8	53	12	22	3	11	2	6	3
UNITED KINGDOM	0	0	0	0	102	33	51	17	5	6
FRANCE	0	0	2	0	0	0	0	0	4	2
ITALY	0	0	16	5	4	1	0	0	0	0
PORTUGAL	0	0	3	0	0	0	0	0	0	0

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

European Community: Suppliers of nutmeg for industrial manufacture  
of essential oils or resinoids, excluding crushed or ground nutmeg  
CN 0908.10-10

V: ECU '000  
Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
W O R L D	244	71	154	31	192	64	58	35	39	33
EXTRA-EC TRADE	203	42	106	21	118	47	30	15	23	20
INTRA-EC TRADE	42	29	48	10	74	17	28	20	17	13
NETHERLANDS	12	2	20	5	46	8	17	12	16	13
GRENADA	67	12	27	5	36	7	0	0	10	5
INDONESIA	125	26	65	13	61	31	30	15	6	5
INDIA	0	0	0	0	20	9	0	0	3	5
SRI LANKA	11	4	0	0	0	0	0	0	3	5
BELGIUM-LUXEMBOURG	5	1	24	4	0	0	0	0	1	0
FRANCE	1	0	3	0	3	1	0	0	0	0
FR GERMANY	15	3	0	0	8	3	4	6	0	0
ITALY	0	0	0	0	0	0	0	0	0	0
UNITED KINGDOM	0	0	2	1	17	5	7	2	0	0
SPAIN	9	24	0	0	0	0	0	0	0	0

85

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

V: ECU '000

Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL EC	29,749	6,092	33,282	7,019	19,582	7,181	13,078	8,497	9,031	6,940
NETHERLANDS	11,262	2,466	12,450	2,683	7,553	2,869	5,325	3,723	3,279	3,094
FR GERMANY	7,455	1,399	7,848	1,509	5,786	1,984	3,779	2,179	2,901	1,872
FRANCE	2,874	663	4,735	1,076	1,475	695	773	708	649	605
ITALY	1,701	301	1,789	322	1,166	322	653	296	598	318
UNITED KINGDOM	1,805	327	1,852	469	1,272	429	655	377	505	318
BELGIUM-LUXEMBOURG	2,867	623	2,659	598	1,157	509	1,060	865	426	381
SPAIN	1,215	210	1,177	203	671	215	535	238	403	224
GREECE	132	21	356	61	181	48	143	54	125	61
PORTUGAL	186	33	135	23	120	35	77	30	85	43
DENMARK	163	31	184	43	163	62	47	19	56	24
IRELAND	89	18	97	32	38	13	31	8	4	0

European Community: Exports of crushed or ground nutmeg  
CN 0908.10-90

V: ECU '000

Q: Metric tons

98

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL EC	15,773	2,995	16,763	3,053	9,376	2,918	6,622	3,189	4,762	2,968
NETHERLANDS	10,334	1,981	12,024	2,174	6,594	2,195	5,018	2,564	3,443	2,364
FR GERMANY	1,106	196	977	177	1,008	258	575	217	611	240
BELGIUM-LUXEMBOURG	1,807	375	1,017	227	550	194	397	256	308	254
FRANCE	2,020	362	2,170	399	688	181	210	79	107	41
SPAIN	81	7	124	10	110	9	122	8	102	8
UNITED KINGDOM	221	41	236	33	226	41	164	38	94	26
ITALY	132	20	113	14	122	22	96	21	90	33
GREECE	0	0	0	0	0	0	5	1	3	1
PORTUGAL	5	1	9	1	11	1	29	3	3	0
DENMARK	66	11	93	18	67	17	6	2	1	1
IRELAND	1	1	0	0	0	0	0	0	0	0

European Community: Suppliers of crushed or ground nutmeg  
CN 0908.10-90

V: ECU '000

Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
W O R L D	29,749	6,092	33,282	7,019	19,582	7,181	13,078	8,497	9,031	6,940
EXTRA-EC TRADE	22,936	4,783	26,662	5,721	14,428	5,608	10,123	7,044	6,566	5,457
INTRA-EC TRADE	6,810	1,311	6,623	1,298	5,155	1,573	2,955	1,454	2,465	1,483
INDONESIA	14,998	3,183	18,660	3,963	9,799	3,943	7,340	5,474	4,602	4,168
GRENADA	6,001	1,148	3,939	743	2,263	768	2,140	1,149	1,623	1,094
NETHERLANDS	3,715	731	4,079	764	3,027	974	1,804	949	1,616	1,042
BELGIUM-LUXEMBOURG	1,300	271	833	185	509	197	317	205	294	247
FR GERMANY	819	159	1,120	242	1,073	302	496	237	263	130
FRANCE	804	117	406	63	286	41	190	29	175	32
ST VINCENT	319	62	203	41	206	54	66	32	79	38
SINGAPORE	218	47	578	120	419	174	75	76	79	75
ITALY	35	5	44	6	41	8	41	12	65	18
SRI LANKA	178	52	423	205	63	45	34	23	48	23
UNITED KINGDOM	106	21	135	41	197	45	98	25	39	7
MALAYSIA	627	144	2,403	525	1,375	533	187	129	39	25
INDIA	132	52	225	77	85	42	119	60	26	12
TRINIDAD & TOBAGO	84	17	94	19	102	30	43	23	20	9
USA	187	35	65	14	16	1	29	7	16	1
SPAIN	8	1	1	0	16	3	8	1	14	7
ALBANIA	0	0	0	0	0	0	0	0	11	1
CHINA	47	10	1	1	0	0	30	50	8	0
SWITZERLAND	13	3	3	1	2	1	18	6	5	2
PAPUA NEW GUINEA	79	18	4	1	5	1	0	0	5	5
MADAGASCAR	0	0	12	2	78	14	26	7	1	2
IRELAND	21	6	0	0	0	0	0	0	0	0

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

V: ECU '000

Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL EC	10,308	1,043	10,243	1,098	5,326	1,111	3,694	1,476	2,784	1,231
FR GERMANY	4,215	416	3,670	382	1,815	394	1,546	650	1,200	544
NETHERLANDS	3,055	320	3,291	348	2,448	443	1,523	524	1,151	448
BELGIUM-LUXEMBOURG	1,197	118	1,288	135	122	56	265	130	201	117
UNITED KINGDOM	977	103	784	79	420	93	185	75	130	57
FRANCE	192	21	734	108	334	79	52	35	30	21
DENMARK	270	27	95	10	71	15	43	20	29	14
ITALY	301	28	296	27	83	22	52	27	26	18
SPAIN	95	9	84	9	33	9	28	15	15	12
GREECE	2	0	0	0	0	0	0	0	2	0
IRELAND	4	1	0	0	0	0	0	0	0	0
PORTUGAL	0	0	1	0	0	0	0	0	0	0

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

V: ECU '000

Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL EC	1,582	154	1,344	137	1,008	210	474	194	279	115
NETHERLANDS	1,033	96	824	83	716	154	362	153	220	96
ITALY	17	2	21	2	9	1	1	0	29	12
FR GERMANY	152	14	234	23	73	12	60	19	18	3
BELGIUM-LUXEMBOURG	180	18	69	9	122	24	41	18	9	4
SPAIN	0	0	0	0	0	0	0	0	3	0
FRANCE	169	17	172	16	47	11	3	1	0	0
UNITED KINGDOM	27	6	21	4	34	7	7	3	0	0
DENMARK	4	1	3	0	7	1	0	0	0	0

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

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

V: ECU '000

Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
W O R L D	10,308	1,043	10,243	1,098	5,326	1,111	3,694	1,476	2,784	1,231
EXTRA-EC TRADE	9,366	937	9,411	986	4,806	991	3,385	1,347	2,617	1,146
INTRA-EC TRADE	941	107	832	112	522	121	308	131	169	85
INDONESIA	6,402	643	6,129	674	3,311	690	2,274	993	1,827	851
GRENADA	2,104	200	1,761	148	807	134	717	199	612	178
NETHERLANDS	608	59	577	61	329	87	216	93	119	66
SINGAPORE	344	36	884	93	469	120	225	81	73	49
FR GERMANY	106	10	165	17	98	14	48	25	36	15
SRI LANKA	28	2	18	3	6	1	0	0	35	22
PAPUA NEW GUINEA	26	7	135	15	40	17	43	27	33	25
MALAYSIA	148	20	328	36	42	10	32	21	24	15
BELGIUM-LUXEMBOURG	144	14	58	7	78	18	25	12	7	3
ST VINCENT	66	8	92	10	46	5	13	4	6	1
COSTA RICA	0	0	0	0	0	0	0	0	4	1
UNITED KINGDOM	25	6	17	3	6	1	18	1	3	0
FRANCE	13	1	6	1	0	0	0	0	2	0
INDIA	27	6	39	7	53	9	9	2	2	1

68

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

V: ECU '000  
Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL EC	1,055	112	802	96	993	204	522	190	357	143
NETHERLANDS	399	36	190	20	237	41	109	32	82	29
BELGIUM-LUXEMBOURG	171	15	158	19	150	24	186	76	75	25
UNITED KINGDOM	2	0	73	8	294	47	56	24	52	30
FRANCE	133	14	67	8	68	19	38	18	50	29
FR GERMANY	142	15	143	17	134	45	59	20	37	8
DENMARK	43	5	17	2	22	4	22	4	28	10
ITALY	81	13	104	18	53	19	13	5	25	11
PORTUGAL	21	2	3	0	5	0	10	1	6	1
IRELAND	44	8	33	3	26	4	13	2	1	0
SPAIN	5	1	14	1	4	1	2	1	1	0
GREECE	14	3	0	0	0	0	14	7	0	0

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

06 V: ECU '000  
Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL EC	1,107	107	978	107	972	180	626	202	478	185
FR GERMANY	244	20	281	27	261	36	206	49	173	40
NETHERLANDS	211	21	312	29	275	60	251	95	152	55
BELGIUM-LUXEMBOURG	536	52	245	27	291	54	130	43	121	48
UNITED KINGDOM	36	7	42	13	36	8	30	12	13	3
FRANCE	67	6	67	8	93	15	6	2	10	37
ITALY	0	0	0	0	0	0	0	0	5	1
DENMARK	10	1	22	2	3	0	0	0	4	1
IRELAND	0	0	9	1	13	7	0	0	0	0
PORTUGAL	1	0	0	0	0	0	0	0	0	0
SPAIN	2	0	0	0	0	0	3	1	0	0

Greece declared no exports for the period 1988-1992.

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

V: ECU '000

Q: Metric tons

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
W O R L D	1,055	112	802	96	993	204	522	190	357	143
INTRA-EC TRADE	886	93	626	75	652	140	452	160	271	106
EXTRA-EC TRADE	168	17	174	22	343	64	69	30	86	36
NETHERLANDS	176	13	223	20	281	70	248	102	111	41
BELGIUM-LUXEMBOURG	551	60	247	33	273	53	118	37	101	41
SWITZERLAND	9	0	19	1	0	0	7	1	38	16
FRANCE	1	0	9	2	18	3	25	4	25	9
INDONESIA	138	14	72	8	53	13	15	7	23	7
GRENADA	15	1	49	6	258	43	34	16	16	13
FR GERMANY	65	8	80	10	36	5	19	7	15	5
ITALY	0	0	0	0	0	0	9	1	9	5
UNITED KINGDOM	91	13	57	9	41	9	30	9	9	4
INDIA	0	0	0	0	2	2	3	0	6	0
SPAIN	1	0	0	0	0	0	4	1	3	0
USA	3	1	2	0	6	3	3	0	2	0
SRI LANKA	0	0	10	2	0	0	0	0	1	0

16

European Community: Imports of nutmeg & mace, January-October 1993

V: ECU '000

Q: Metric tons

1) Extra-EC trade	0908.10-10		0908.10-90		0908.20-10		0908.20-90	
	V	Q	V	Q	V	Q	V	Q
TOTAL EC	68	63	4,510	4,414	1,641	836	86	37
BELGIUM-LUXEMBOURG	0	0	230	281	59	33	6	5
GERMANY	4	4	1,222	993	608	359	16	3
IRELAND	0	0	0	0	0	0	0	0
DENMARK	0	0	21	17	3	2	0	0
GREECE	0	0	71	54	0	0	0	0

2) Intra+Extra-EC trade	0908.10-10		0908.10-90		0908.20-10		0908.20-90	
	V	Q	V	Q	V	Q	V	Q
FRANCE	17	3	207	123	11	6	50	32
NETHERLANDS	0	0	2,424	2,438	866	369	90	31
ITALY	7	4	529	310	20	17	0	0
UNITED KINGDOM	118	91	362	332	87	60	39	19
PORTUGAL	2	1	49	27	0	0	1	0
SPAIN	2	2	255	144	0	0	1	0

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

European Community: non-EC suppliers of nutmeg and mace  
for the period January-October 1993

V: ECU '000  
Q: Metric tons

0908.10-10	V	Q
EXTRA-EC	68	63
GRENADA	57	52
TRINIDAD & TOBAGO	6	8
SRI LANKA	2	4
INDIA	1	0

0908.10-90	V	Q
EXTRA-EC	4,510	4,414
INDONESIA	2,840	2,879
GRENADA	1,349	1,170
SINGAPORE	223	290
SRI LANKA	25	40
USA	23	4
INDIA	21	10
COMOROS	12	8
ST VINCENT	7	5
POLAND	6	5
SWITZERLAND	4	2
SLOVENIA	1	0
ISRAEL	1	0

0908.20-10	V	Q
EXTRA-EC	1,641	836
INDONESIA	1,229	660
GRENADA	326	124
SINGAPORE	43	27
PAPUA NEW GUINEA	16	12
ST VINCENT	11	3
SRI LANKA	9	6
COMOROS	4	1
INDIA	3	0

0908.20-90	V	Q
EXTRA-EC	86	37
INDONESIA	61	27
SWITZERLAND	12	2
GRENADA	10	7
USA	2	0
TURKEY	1	0

Source: Statistical Office of the European Communities,  
Luxembourg, CD-ROM 5-1994

USA: Imports of nutmegs  
HSTUSA 0908.10-0000

V: US\$ '000 Q: Metric tons	1990		1991		1992		1993 (a)	
	V	Q	V	Q	V	Q	V	Q
TOTAL	5,330	1,711	3,237	1,858	2,518	1,685	2,446	1,846
Indonesia	3,757	1,076	2,292	1,285	1,828	1,200	1,557	1,149
Singapore	954	490	614	425	418	324	596	471
Grenada	338	61	140	29	99	56	137	106
India	96	26	0	0	7	2	16	15
Madagascar	0	0	0	0	6	2	14	10
Germany	0	0	0	0	0	0	13	9
Canada	0	0	0	0	3	1	9	5
France	120	27	30	17	0	0	2	0
Netherlands	53	26	140	93	149	100	0	0

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

USA: Imports of mace, nes  
HSTUSA 0908.20-4000

V: US\$ '000 Q: Metric tons	1990		1991		1992		1993 (a)	
	V	Q	V	Q	V	Q	V	Q
TOTAL	1,735	296	462	179	505	220	351	226
Indonesia	925	139	409	159	334	145	321	212
Singapore	472	117	37	16	41	18	16	9
Germany	0	0	0	0	0	0	8	4
United Kingdom	196	20	0	0	0	0	2	0
Netherlands	98	10	0	0	97	39	0	0
Egypt	0	0	0	0	20	7	0	0
Peru	0	0	0	0	7	9	0	0
India	21	5	1	1	3	1	0	0
France	21	5	8	3	2	0	0	0

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

India: Imports of nutmeg

Q: Metric tons	1989/90		1990/91		1991/92		1992/93	
	V	Q	V	Q	V	Q	V	Q
TOTAL	7,441	153	13,123	323	1,500	62	2,732	104
Singapore	2,697	45	4,292	104	858	30	1,405	45
Indonesia	2,742	73	7,128	163	220	6	820	29
Sri Lanka	2,003	35	1,703	55	421	26	507	31

India: Imports of mace

	1989/90		1990/91		1991/92		1992/93	
	V	Q	V	Q	V	Q	V	Q
TOTAL	9,997	132	16,336	206	1,711	30	2,081	51
Indonesia	6,140	77	14,586	182	0	0	590	17
Singapore	3,329	46	1,684	24	1,711	30	768	21
Sri Lanka	527	9	66	1	0	0	723	13

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)

V: Yen '000  
Q: Kg

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
USA	0	0	0	0	1,144	491	462	201	1,307	685

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

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL	331,441	369,368	445,121	491,749	348,045	499,525	134,692	373,771	135,236	393,406
Indonesia	324,387	361,368	444,641	490,751	346,471	496,525	118,747	333,776	125,993	362,765
Malaysia	0	0	480	998	1,574	3,000	0	0	6,427	20,641
India	0	0	0	0	0	0	0	0	2,816	10,000
Singapore	7,054	8,000	0	0	0	0	14,367	36,100	0	0
Hong Kong	0	0	0	0	0	0	1,578	3,895	0	0

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

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL	0	0	9,720	7,266	2,007	1,520	0	0	652	1,200
Malaysia	0	0	4,262	3,200	0	0	0	0	652	1,200
Indonesia	0	0	5,458	4,066	2,007	1,520	0	0	0	0

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

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
TOTAL	44,630	27,326	69,443	43,227	55,504	52,590	9,636	23,533	21,960	64,618
Indonesia	43,026	26,326	69,443	43,227	38,679	34,546	7,941	19,476	20,270	59,522
Singapore	1,604	1,000	0	0	3,714	3,024	699	1,500	0	0
Papua New Guinea	0	0	0	0	13,111	15,020	0	0	0	0
India	0	0	0	0	0	0	203	40	448	1,000
Malaysia	0	0	0	0	0	0	793	2,517	1,242	4,096

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

	1988		1989		1990		1991		1992	
	V	Q	V	Q	V	Q	V	Q	V	Q
Indonesia	0	0	0	0	1,286	2,995	1,075	2,986	396	900

LIST OF IMPORTERS

United Kingdom

France

Germany

the Netherlands

Belgium

Spain

USA

Japan

India

**List of importers of spices**  
(non-exhaustive)

**United Kingdom**

HP Foods Limited  
Abbey Street  
MARKET HARBOROUGH  
LEICESTERSHIRE  
Tel : (858) 64771  
Tlx: 34350

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

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 FE1 0NL  
Tel: (071) 928 9000  
Fax: (071) 928 0920  
Tlx: 887949

BRITISH PEPPER & SPICE CO. LTD  
RHOSILI ROAD BRACKMILLS  
OLD NORTHAMPTON, NORTS 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

BENDER AND CASSEL  
BLACKHORSE ROAD  
LETCHWORTH, 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 COOMBEROAD  
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  
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 CÉDEX 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

BALDACC 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: 2165576 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 HG TAB 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  
HANDELSMIJ. BV  
HARENGRACHT 223-225  
1016 BG AMSTERDAM  
Tel: (020) 624 4113  
Fax: (020) 626 0977

CATZ INTERNATIONAL BV  
BLAAK 22  
30111 TA ROTTERDAM  
Tel: (010) 411 3440  
Fax: (010) 404 5406

KARSTEN STADSKANAAL BV  
TRANSISTORWEG 3  
9503 GT STADSKANAAL  
Tel: (05990) 21000  
Fax: (05990) 21744

ALANHERI PRODUKTEN BV  
MOLENEIND 2  
PO BOX 107  
4260 AC MEEUWEN  
Tel: (04165) 2582  
Tlx: 30462/30468

BARIMPEX BV  
VAN BOSHUIZENSTRAAT 537  
1082 AV AMSTERDAM  
Tel: (020) 646 4521  
Fax: (020) 642 1935

BUTTNER EN CO, G.  
DE KORF 54  
P. O. BOX 100  
2920 AC KRIMPEN A/D IJSSEL  
Tel: (01807) 50055  
Fax: (01807) 50432

DIJK INTERNATIONAL BV  
ADMIRALITEITSKADE 60  
PO BOX 698  
3000 AR ROTTERDAM  
Tel: (010) 453 1122  
Fax: (010)453 0709

EHMEX BV  
UTRECTSEWEG 115  
6871 RENKUM  
Tel: (0837) 318373  
Tlx: 45365 VADA NL

HUIJBREGTS' SPECERIJEN  
HELMOND BV  
ACHTERDIJK 15-16  
PO BOX 165  
5705 CB HELMOND  
Tel: (04920) 41415  
Fax: (04920) 50540

INTER SPECIAL  
MIDDELWEG 3  
PO BOX 40  
MOOK- MOLENHOEK  
Tel: (080) 582838  
Fax: (080) 585580

KILSDONK, HANS VAN  
ROZENSTRAAT 5  
3353 VH PAPENDRECHT  
Tel: (078) 150770  
Tlx: 20512

KNOOP, BV V/H K. VD  
RUBENSLAAN 20  
3136 SCHIEDAM  
Tel: (010) 474 6715  
Tlx: 23257

LUCULLUS, BV  
LIJNBAAAN 4-5  
POSTBUS 100  
2350 AC LEIDERDORP  
Tel: (071) 416153  
Fax: (071) 415655

MAN-PRODUCTEN BV  
VAN VOLLENHOVENSTRAAT 3  
POSTBUS 253  
3000 AG ROTTERDAM  
Tel: (010) 436 1877  
Fax: (010) 436 2108  
Tlx: 21197/ 21116

R&C NEDERLAND BV  
POSTBUS 14  
3740 AA BAARN  
Tel: (02154) 28911  
Fax: (02154) 21136  
Tlx: 43940 RECON NL

SILLEVOLDT BV, C.M. VAN  
KETELWEG 34  
POSTBUS 34  
3353 VH PAPENDRECHT  
Tel: (078) 151755  
Tlx: 29252

VERSTEGEN INTL BV  
GIESSENWEG 62  
POSTBUS 11190  
3004 ED ROTTERDAM  
Tel: (010) 437 8587  
Tlx: 23008 PICOL NL

WOLDIJK GRONINGEN BV  
WESTERKADE 18  
POSTBUS 54  
9700 AB GRONINGEN  
Tel: (050) 133344  
Tlx: 53100 WLDYK NL

#### Belgium

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

BLEUZE NV  
STATIONSSTRAAT 23  
(GROOT-BIJGAARDEN)  
1702 DILBEEK  
Tel: (02) 466 1500  
Fax: (02) 466 0037  
Tlx: 25233

CALDIC-FOOD NV  
TERIOCHTWEG 1  
2620 HEMIKSEM  
Tel: (03) 887 9001  
Fax: (03) 887 9020  
Tlx: 31681

EUROSAN INTER PRODUCTION NV  
PAPENBOSKANT 85 (WOLVERTEM)  
1861 MEISE  
Tel: (052) 300988  
Tlx: 24617

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

HONIG FOODS (BELGIUM) NV  
LEUVENSESTEENWEG 605  
1930 ZAVENTEM  
Tel: (02) 759 4838  
Fax: (02) 759 2212  
Tlx: 61365

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  
(WESTMALLE)  
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) 363 0066  
Fax: (410) 363 0735

BALTIMORE SPICE, INC.  
9740 REISTERSTOWN RD.  
Garrison, MD 21055  
Tel: (410) 363 1700  
Fax: (410) 363 6619

CRESCENT FOODS, INC.  
21612 88TH AVE., S.  
KENT, WA 98031  
Tel: (206) 395 9400

FRANKLIN TRADING CO., INC.  
990 FRANKLIN AVE.  
GARDEN CITY, NY 11530  
Tel: (516) 294 6520  
Fax: (516) 294 6307

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

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

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

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

## 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

ATAKA PRODUCE CO., LTD  
3-1- MINAMI AOYAMA  
MINATO-KU, TOKYO 105  
Tel: (03) 478 9128  
Tlx: 22568

MORII TRADING CO., LTD  
MORII BLDG. (*SPICES*)  
4-10, AWAJIMACHI, 1-CHOME  
CHUO-KU, OSAKA 541  
Tel: (06) 222 3774  
Tlx: 522 2002 EMORII J

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

## 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



