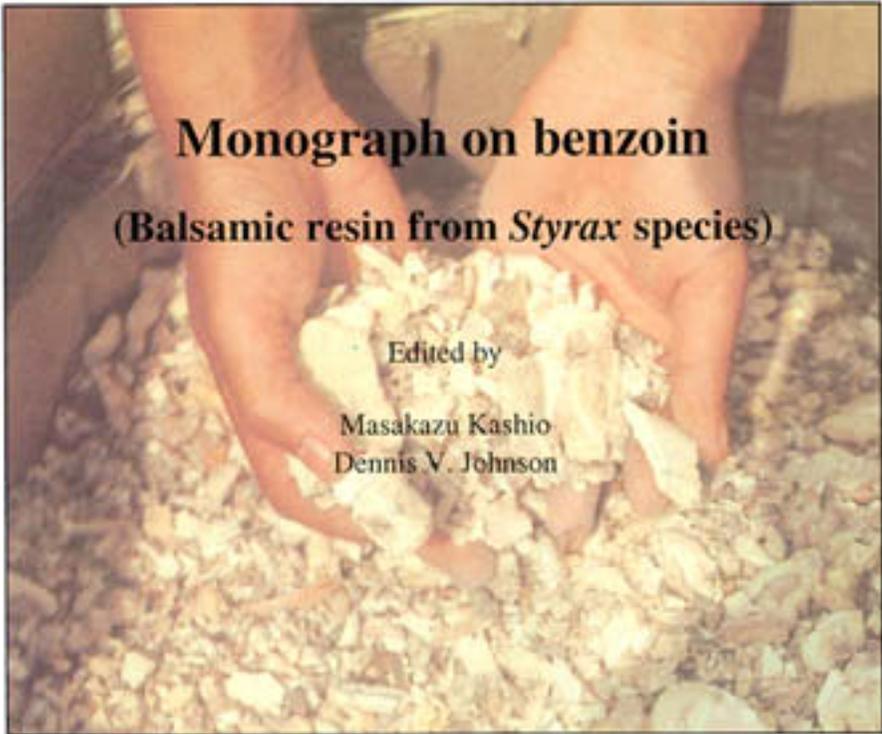




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A photograph showing a pair of hands holding a large quantity of light-colored, irregularly shaped pieces of benzoin resin. The resin pieces are piled up, and the hands are positioned above them, suggesting they are being presented or examined. The background is dark and out of focus.

Monograph on benzoin
(Balsamic resin from *Styrax* species)

Edited by

Masakazu Kashio
Dennis V. Johnson

Food and Agriculture Organization of the United Nations
Regional Office for Asia and the Pacific
Bangkok, Thailand
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©FAO 2001
ISBN 974-7946-16-5

Foreword

The Lao People's Democratic Republic (Lao PDR) is a land-locked, mountainous, and forest-rich country in continental Southeast Asia. The Lao forestry sector is one of the main export revenue earners, comprising 40 percent of total export value in 1996. The forest cover has, however, been reduced by excessive shifting cultivation, in which 1.8 million people are engaged. The pressure on forests is also increasing due to the growing demand for forest products in neighbouring countries such as Thailand and Viet Nam.

During 1989-1991, the Lao government with FAO assistance reviewed its forestry sector through the Tropical Forest Action Plan exercise and in 1992 the government adopted a new forestry policy, including the development of non-wood forest products (NWFPs).

In response to the government request, FAO formulated and implemented a project under the Technical Cooperation Programme, "Improved benzoin production (TCP/LAO/6611)", from 1996 to 1998. Lao or Siam benzoin, a balsamic resin derived from *Styrax tonkinensis*, is one of the traditional NWFPs that possesses potential for improvement to benefit rural people and enhance high-value, low-volume exports, highlighting the role of NWFPs in poverty alleviation and sustainable management of forests.

This TCP project undertook a series of studies and produced many valuable technical documents, but their distribution was limited. Thus, FAO felt it worthwhile to produce a comprehensive monograph of benzoin based on these documents in order to share the information in a wider arena.

My thanks are due to Dennis Johnson, who edited the original documents, and Masakazu Kashio, FAO Forest Resources Officer, who formulated and backstopped the project, and consolidated the scattered information into this monograph.

I hope that this publication will serve as a useful reference for resource managers and specialists seeking opportunities to improve the management of *Styrax* species and increase the effective production, processing, marketing and utilization of benzoin.

R.B. Singh
Assistant Director-General and
Regional Representative for
Asia and the Pacific

Acknowledgements

FAO would like to note with appreciation the work of Khongsak Pinyopusarerk, Project Team Leader and silviculture expert; Manfred Fischer, Associate Professional Officer of the project; John Coppen, marketing and processing consultant; Prachoen Sroithongkham, benzoin tapping consultant; and Masakazu Kashio, FAO Forest Resources Officer; as the authors of the original documents used in this publication.

FAO would also like to acknowledge the valuable contributions of the Lao counterparts in the Department of Forestry (DoF), Ministry of Agriculture and Forestry (MoAF), especially Sianouvong Savathvong, Chief, Luang Prabang Provincial Forestry Section. Kamphone Mounlamai, National Project Coordinator, Sommay Souligna, Field Manager, and many other DoF foresters who were assigned to the project, played key roles in the project implementation. The continuous support of Onechanh Boonnaphol, Chief of Provincial Agriculture and Forestry Office, Luang Prabang, MoAF, is much appreciated. Latsamy Vongsack (Mrs.), Director of the Food and Drug Quality Control Centre, and her staff were always cooperative in chemical analysis of benzoin.

A note of appreciation is due to other individuals who directly or indirectly supported this project. Boon Thong, former village headman, Sichanh, present village headman, and other villagers in Ban Kachet have been always very cooperative. In FAO, the strong support of Peer Hijmans, FAO Representative, Roger Eijkens, Forestry Officer in the FAO Office in Vientiane, and Masahiko Hori, FAO Project Operations Officer in Bangkok, is highly appreciated. Wanida Subansenee (Mrs.) and Yanyong Kangkarn of the Thai Royal Forest Department served as FAO consultants in benzoin tapping and processing. Renaud Costaz, a consultant for the European market, contributed to the project. Special thanks are given to Diederik Koning, Co-Director of the EU Micro Projects Luang Prabang Phase II, for his kind commitment to follow up the field trial work after the termination of the project.

Editorial notes

Original documents referred to:

Chapter 1 is derived from *Introductory Remarks for the National Workshop on Improved Benzoin Production*, 12-14 May 1998 in Luang Prabang, by M. Kashio with his additional writing, and the report *Gum Benzoin: Its Markets and Marketing and the Opportunities and Constraints to Their Improvement in Lao PDR*. July 1997, by J.J.W. Coppen.

Chapter 2 is derived from the above report by J.J.W. Coppen (July 1997).

Chapter 3 is derived from the report *Physical and Socio-Economic Conditions of Benzoin Production in Northern Laos*, 1997, by M. Fischer, and *Vientiane and Luang Prabang, Lao PDR, Back-to-office Report*, January 1994, by M. Kashio.

Chapter 4 is derived from the reports *Technical Cooperation Project: Improved Benzoin Production in Lao PDR. First Mission Report*, 1996, *Second, Third and Fourth Mission Reports*, 1997, and *Fifth Mission Report*, 1998, by K. Pinyopusarek.

Chapter 5 is derived from the report *Lao PDR Improved Benzoin Production, Monograph Report*, 1998, by P. Sroithongkham. This report was prepared to consolidate several benzoin tapping and processing consultant reports by W. Subansenee, Y. Kangkarn, and P. Sroithongkham himself.

Chapters 6, 7, 8 and 9 are derived from the report by J.J.W. Coppen (July 1997).

Chapter 10 is derived mainly from *The Proceedings of the National Workshop on Improved Benzoin Production*, 12-14 May 1998 in Luang Prabang, edited by M. Fischer and K. Pinyopusarek, with some inputs from the report by J.J.W. Coppen (July 1997).

Use of the terms *Siam benzoin* and *Lao benzoin*:

Siam benzoin and Lao benzoin refer to the same product from *Styrax tonkinensis*. The former name is used almost universally outside Lao PDR when it is necessary to distinguish benzoin of Lao origin from that produced in Indonesia (Sumatra benzoin). The name originates from the previous importance of Thailand (old name Siam) as an international exit point for

benzoin. The latter name is used for the benzoin specifically produced in Lao PDR. Both terms are used in this publication.

Spellings for the names of provinces:

There are many different spellings of the names of provinces even in officially released government documents. To be consistent in their uses in this publication, the following spellings have been adopted. The spellings in the parentheses show other spellings often seen.

- Luang Prabang (Luangprabang, Luangphrabang)
- Phong Saly (Phongsaly, Phongsali)
- Houaphan (Houaphanh, Houa Phan, Houa Phang)
- Oudomxay (Oudomxai, Oudomsai)
- Xieng Khuang (Xiengkhuang, Xiang Kwang)
- Luang Namtha (Luangnamtha)

Abbreviations

ADI	Acceptable daily intake (an indicator of food safety)
C & F	Cost and freight (import prices)
CIF	Cost, insurance and freight (import prices)
DAFO	District Agriculture and Forestry Office
ECU	European currency unit
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FOB	Free on board (export prices)
GDP	Gross domestic product
HS	Harmonised System
IUCN	International Union for Conservation of Nature and Natural Resources
JECFA	Joint FAO/WHO Expert Committee on Food Additives
NWFP	Non-wood forest product(s)
PAFO	Provincial Agriculture and Forestry Office
ppm	Parts per million
SITC	Standard International Trade Classification
TCP	Technical Cooperation Programme
UAE	United Arab Emirates
WHO	World Health Organization

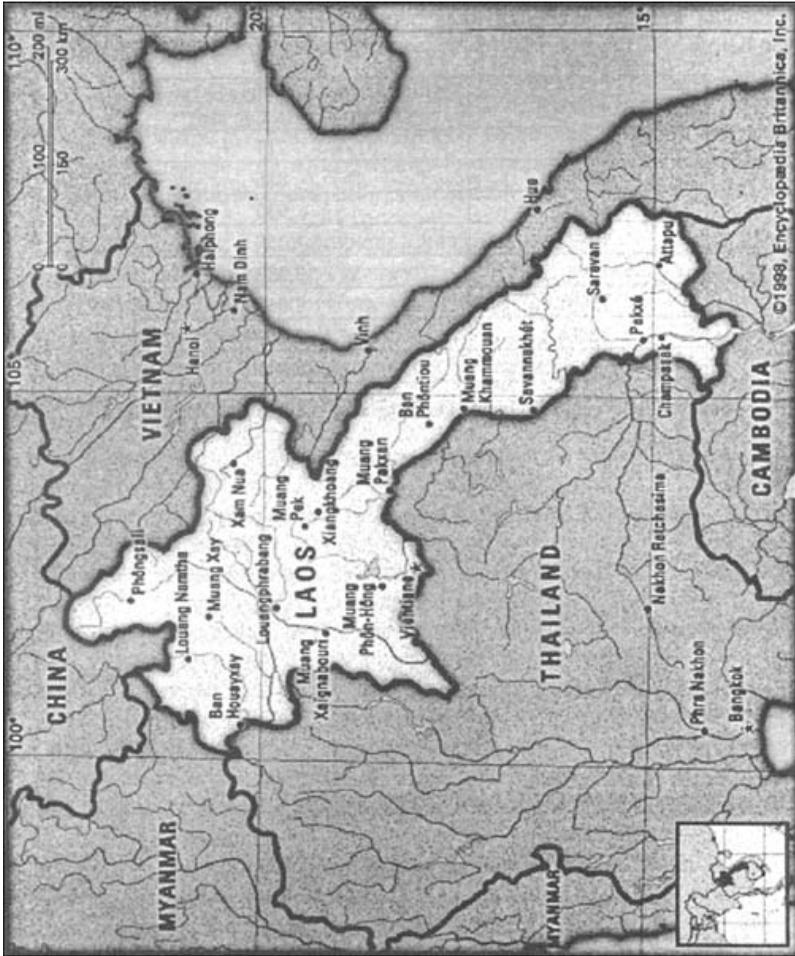
Exchange rates

The annual average exchange rates between US dollar and Lao kip are given below.

Year	Annual average exchange rates (1 US dollar to Lao kip)
1994	717
1995	816
1996	935
1997	1,257
1998	3,282
1999	7,067
2000	7,809
2001 (Jan. – Oct.)	8,843

Source: the Foreign Exchange Department of the Lao National Bank.

Map of Lao PDR



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Chapter 1. Introduction

1.1 General background

The Lao People's Democratic Republic (Lao PDR) is a land-locked country with an economy that is overwhelmingly agrarian in character. Approximately 85% of the 4.3 million people live in rural areas with agriculture as their main occupation and about 65% of GDP is derived from agriculture and forestry. About 300,000 families (1.8 million people) are engaged in shifting cultivation, a practice that seeks to meet family subsistence needs and provide some cash income. Shifting cultivation brings with it, however, certain serious environmental and social problems.

Lao PDR is the major producer of Siam or Lao benzoin, a balsamic resin obtained from the *yan* tree (*Styrax tonkinensis*), which is native to Southeast Asia. Annual production of Siam benzoin, one of the two types of commercially produced benzoin, is around 50 tonnes. In some years Lao PDR is the sole producer of benzoin, although Viet Nam is believed to intermittently produce much smaller amounts.

The second type of commercial benzoin, Sumatra benzoin, is derived from two other *Styrax* species: *S. benzoin* and *S. paralleloneurum*, both also Southeast Asian trees. Indonesia, specifically north Sumatra, is the only producer of Sumatra benzoin. The scale of production of the two types of benzoin is very different. Annual production of Sumatra benzoin is of the order of 1,000 tonnes. This production figure for Sumatra benzoin is based on Indonesian export data. It is important to note that some of this benzoin contains damar, which is used in the manufacture of benzoin block. The actual figure for genuine benzoin could be as low as half this, i.e. about 500 tonnes.

Benzoin is used chiefly for incense purposes and in the flavouring, fragrance and pharmaceutical industries. The higher quality Siam benzoin is used mainly in the manufacture of fine fragrances.

Production of benzoin in Lao PDR is centered in the mountainous, northern provinces of Luang Prabang, Phong Saly, Houaphan, and Oudomxay, where *Styrax tonkinensis* trees are managed within the shifting cultivation cycle. The shifting cultivators in Luang Prabang, Phong Saly and Oudomxay provinces extract the resin from trees during the dry season. Luang Prabang is the chief province for benzoin production; there are some 3,000 ha of styrax forests above 700 m elevation in two districts of the province.

Benzoin production, integrated into the shifting cultivation cycle, forms an agroforestry system combined with upland rice cultivation. For example, the villagers of Ban Kachet in Nam Bak district of Luang Prabang province apply a rotation of 11 years, producing upland rice in the first year and benzoin during the following 10-year fallow period. This type of land use can maintain forest ecosystems and offers an excellent rehabilitation method for degraded forests damaged by shifting cultivation. In other villages, however, a shorter rotation period of 5-7 years is applied. Under this regime soil degradation has been inferred from a decline in rice yields.

Although benzoin production in Lao PDR is relatively small, at least in comparison with that in Indonesia, it provides a welcome source of cash income to the people who collect it. Benzoin also makes a small contribution to the national economy through foreign exchange earnings.

1.2 FAO technical assistance through a project

A brief introduction to the background of the project is appropriate. As forestry specialists are well aware, the tropical forests of the Asia-Pacific Region are being threatened by a continuous process of degradation and deforestation. Lao PDR is one of the countries that has been affected by this process through the 1980s and 1990s.

In October 1989, the Lao government drew international attention to major problems in its forestry sector — a serious environmental crisis

and further impoverishment of rural communities and people living around or inside the forests, in particular in watershed areas affected by intensive practices of shifting cultivation.

In response to a request by the Lao government, FAO reviewed the forestry sector through a Tropical Forestry Action Plan (TFAP) exercise during 1989-1991. A set of recommendations was submitted to the government, along with several forestry project proposals. Many donors began to formulate projects based on these proposals. The government also requested FAO to formulate forestry projects, in particular in the field of watershed management and non-wood forest products (NWFPs).

Recognition by the Lao government that problems of shifting cultivation needed to be addressed, and that promotion of non-wood forest products could contribute to finding a solution, highlighted the benefits that would derive from improved benzoin production.

This recognition facilitated the commencement of project formulation work in July 1992. An FAO review of the country's NWFP resources concluded that the improvement of benzoin cultivation, processing and marketing should be one of the top priority subjects. Following the preparation of a draft project proposal on benzoin, a second mission was carried out in January 1994, in close collaboration with the Department of Forestry (DoF). The mission studied benzoin production systems combined with shifting cultivation practices in the field, and identified a suitable project site at the village of Ban Kachet in Nam Bak. The site was chosen because soil degradation, related to declining upland rice yields, was being experienced — and there was easy access to the village by road.

After the addition of information collected in the field, the project document was finalized by DoF with support from FAO in March 1994. The project identified two key issues: 1) how to provide effective alternative income sources to shifting cultivators; and 2) how to reduce the negative impacts of shifting cultivation. The project also identified

the need for a broad rural development concept to improve benzoin production, processing and marketing.

Thus, a project funded by the FAO Technical Cooperation Programme (TCP), “*Improved Benzoin Production (TCP/LAO/6611)*,” was initiated and operated from July 1996 to June 1998. The following were three objectives of the project:

1. to introduce better and innovative techniques of: a) cultivation and harvesting (either through natural regeneration or plantation cultivation); and b) extraction, processing and purification of benzoin resin (technical aspects);
2. to develop the domestic trade of benzoin resin, and develop international marketing strategies and mechanisms (institutional aspects); and
3. to promote agroforestry and rural development through a benzoin utilization programme in the country (socio-economic and environmental aspects).

The project achieved many things in pursuit of these objectives. However, much work still remains in the hands of Lao government officials, including DoF foresters, as well as villagers, benzoin traders, researchers, and other NWFP-related project staff to meet challenges of the future.

1.3 Major activities and outputs

The project implemented many activities during its 2-year implementation period. These ranged from the improvement of silvicultural treatments, tapping methods, and agroforestry trials, to a socio-economic survey, benzoin market studies, study tours and chemical analysis of benzoin samples. These were all new activities that had not been conducted

before. There have been some interesting results from these activities, and more are expected from the on-going follow-up and future activities.

A variety of technical advances, including those relating to silvicultural treatments, tapping methods, genetic improvement work, selection of high yield elite trees, healthy and resistant characters against pests and diseases, seedling propagation in nurseries, and socio-economic and benzoin marketing survey results, were presented at a workshop held in May 1998, and publicized in its proceedings in July 1998. A number of recommendations were also made at the workshop and these are detailed in Chapter 10 of this monograph.

Two subjects meriting special attention are processing and marketing of benzoin – the most crucial factors in determining the future of Lao benzoin and how much it can contribute to improving the economic situation of Lao villagers. Experts contracted to the project conducted a series of studies on the benzoin markets in Lao PDR, Indonesia, Singapore and France. Benzoin samples have been analyzed at the Food and Drug Quality Control Centre in Vientiane to facilitate improvement of tapping methods, grading systems and quality control. Results of these studies are incorporated into this publication. Project study tours to Viet Nam, Singapore and Indonesia provided vital information to the participants. Unfortunately, the project period of 2 years was not long enough to fully achieve the initially targeted objectives. However, the Lao government is keen to follow up the project activities.

Outputs from the project are mostly in the form of English-language documents. Some of them have been translated into Laotian for the benefit of the Lao people. In principle, the documents are government property, although the government has placed them in the public domain. In reality, however, it is not easy for non-governmental people to obtain copies. There is, however, recognition of the importance of sharing the information generated and the experience gained by the project. This is the reason for this publication, *Monograph on Benzoin*.

The project has opened a new horizon for Lao benzoin and shown what can be done and should be done in the future. It is hoped that this publication will enable anyone concerned and/or interested to assess new opportunities and continue efforts to achieve the final project goals. By attaining greater appreciation in the international market, benzoin production in Lao PDR can provide a good opportunity for off-farm employment and an income source for rural communities. It will not be an easy task, but this should not deter efforts to develop benzoin resources and process benzoin resin for new and expanding markets.

Both FAO and the Lao government have ranked NWFP development as a top priority in conjunction with rural development for environmentally sound, economically viable, and socially acceptable forest resources management and utilization.

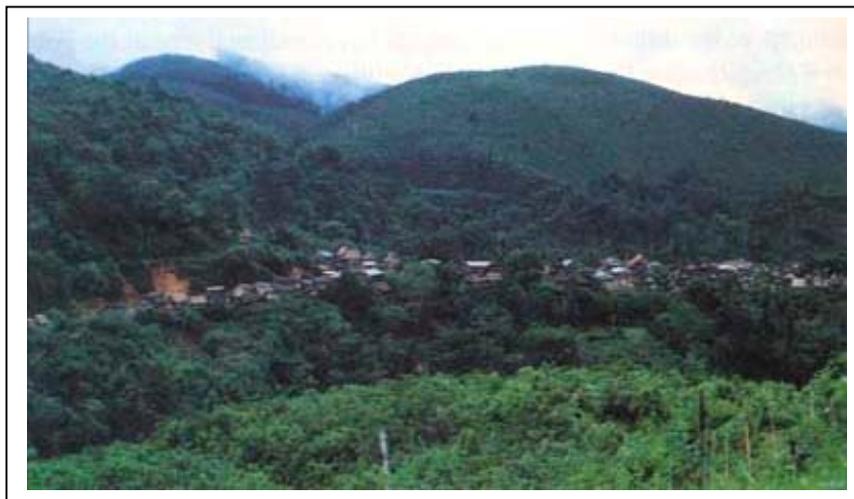


Photo 1.1 The project village, Ban Kachet.

Chapter 2. Description of gum benzoin

2.1 Terminology

Apart from the distinction already made between Siam benzoin and Sumatra benzoin, there are two English terms used to describe the resinous product from styrax trees: *benzoin* (or *gum benzoin*, although use of the word *gum* is strictly incorrect since benzoin is not a water-soluble polysaccharide) and *gum benjamin*. The latter term is used as the description in Singapore's trade statistics and is the designation employed by many Singaporean traders. Since Singapore is the major international trading centre for benzoin, the term *gum benjamin* is often used elsewhere in trade.

In common usage in Indonesia benzoin is known as *kemenyan*. In Indonesian trade statistics, however, benzoin is misleadingly called *frankincense*, a term usually applied to the resinous exudate from *Boswellia* spp. of Arabia and Africa. It is possible that this use of the term *frankincense* derives from benzoin of Indonesian origin that was traded by the Arabs, who regarded it as a form of frankincense, at least 700 years ago.

In Malaysia, benzoin is called *kemenyan* or *kemayan*. Malaysian trade statistics use the term *gum benjamin*. In Thailand it is known as *kamyan* or *kumyan* and in Lao PDR it is called *kam nhan*, *nyan* or *yan*.

2.2 Appearance

Benzoin appears in international trade in several forms. Most Siam benzoin exported from Lao PDR is in the form in which it is collected from the tree, after it has been cleaned and graded. It consists of hard, usually cream-coloured/pale orange pieces, which if broken reveal a milky white colour. The benzoin is quite pale in colour when freshly

collected but darkens gradually during storage to a sandy-orange colour. During handling and transport from its collection to the point of export, larger pieces are inevitably broken down to smaller ones and a significant proportion of dust and siftings is produced. Some benzoin which finds its way to Bangkok through Thai traders living near the border with Lao PDR, and which is used in the preparation of traditional medicines (but also occasionally exported), is formed in larger, dark brown lumps with a glassy appearance.

Sumatra benzoin similar in appearance to the Siam benzoin described above is traded (often known as *almonds*), and with the same sort of grades, but there are also substantial quantities of darker, dirtier, lower grade material. Even more common is a semi-processed form of block benzoin which generally contains pieces of damar embedded in a matrix of low grade benzoin. The use of damar is an important feature of the production of block benzoin and accounts for the large differences in volume between exports of benzoin from Indonesia to Singapore (the major initial destination) and subsequent exports of benzoin out of Singapore. Occasionally, pure benzoin almonds are used in the production of block benzoin, instead of damar.

2.3 Chemistry

The chemical compositions of the two types of benzoin account for their sensory characteristics and determine the uses to which they are put. There are both similarities and differences in composition and this means that although they are both used for flavour and fragrance purposes, they often go into different parts of the markets. Both contain mixtures of organic acids and esters, along with numerous other – mostly minor – components, and both can be described as *balsamic* in odor. However, in Siam benzoin the chief constituents are benzoic acid and its esters (such as coniferyl benzoate, benzyl benzoate and cinnamyl benzoate), while in Sumatra benzoin the major constituents are cinnamic acid and

its esters (such as coniferyl cinnamate and cinnamyl cinnamate). Vanillin is present in both types of benzoin and gives rise to its familiar vanilla odor (most readily detected in the Siam type).

Using samples of benzoin obtained from regional fieldwork, qualitative analyses were carried out at the laboratories of the Royal Forest Department, Bangkok. The results illustrate the similarities in composition of the two types of benzoin, but by separating and detecting the cinnamates in the Sumatra type it was also possible to distinguish them. The results are discussed in more detail later (Chapter 8, section 8.1.3 and **Appendix 2**). They also confirm the presence of damar in some of the semi-processed block forms of benzoin.

2.4 Plant sources

Benzoin comes from tree species of the genus *Styrax* in the family Styracaceae. *Styrax* contains about 130 species of trees and shrubs occurring in tropical to temperate climates. Three centres of distribution are described: southeastern Asia, southeastern North America to South America, and a single species in the Mediterranean.

Siam benzoin is obtained from *S. tonkinensis* (Pierre) Craib ex Hartwiss. Sumatra benzoin is collected from two species: *S. benzoin* Dryand. and *S. paralleloneurum* Perkins (sometimes spelled *paralleloneurus*). The latter two species are cultivated for benzoin production in different parts of Indonesia and are said to produce benzoin of different qualities; the two types are not separately identified in trade however.

Two varieties of *S. benzoin* occur in Peninsular Malaysia, var. *benzoin* and var. *hiliferum* Steenis. Neither is tapped for benzoin on a commercial scale. In China, *S. tonkinensis*, *S. hypoglauca* Perk. and *S. cascarifolia* are tapped but the products, though used domestically, are not believed to enter world trade.

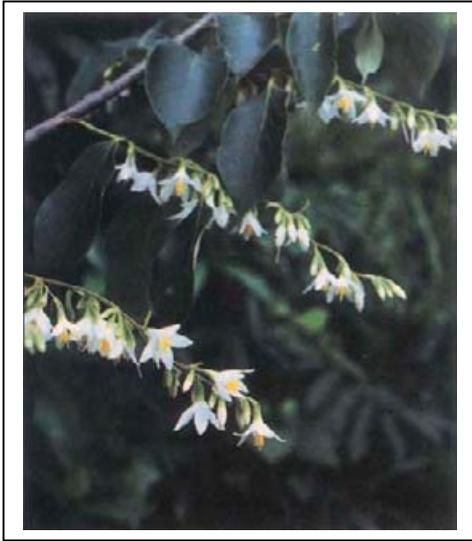


Photo 2.1

Flowers of *Styrax tonkinensis*
(at the tapping trial plot in Ban
Kachet. 13 May 1998)



Photo 2.2 Fruits of *Styrax tonkinensis*
(at the tapping trial plot in Ban Kachet. 13 May 1998)