YLANG-YLANG OIL PRODUCTION
IN MADAGASCAR AND THE COMOROS

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Madagascar and the Comoros islands have been the dominant world suppliers for a century of the fragrant flower oil, ylang-ylang, which is obtained from the tree *Cananga odorata* Hook.f & Thompson forma *genuina*.

This paper describes for Madagascar and the Comoros:
- the historical evolution of the industry;
- cultivation and harvesting methods;
- oil distillation and concrete extraction methods;
- the characteristics of ylang-ylang oil grades; and
- production trends and the challenges for the industries on the islands.

**Botanical Background**

The family *Anonaceae* contains two sub-species (or forms) of *Cananga odorata* that are used commercially to produce essential oils:

<table>
<thead>
<tr>
<th>Species / form</th>
<th>Common name (and of the oil)</th>
<th>Main origin of oil today</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cananga odorata</em> Hook.f &amp; Thompson forma <em>genuina</em></td>
<td>Ylang-ylang</td>
<td>Madagascar and Comoros</td>
</tr>
<tr>
<td><em>Cananga odorata</em> Hook.f &amp; Thompson forma <em>macrophylla</em></td>
<td>Cananga</td>
<td>Indonesia</td>
</tr>
</tbody>
</table>
Both species are indigenous to the island archipelagos of Southeast Asia, although their precise geographic origins are uncertain, and they grow into tall trees when mature.

It is generally thought that ylang-ylang originated from either the Molucca islands or the Philippines. Its name arises from the Filipino word Alang-Ilang, which expresses the lightness and the mobility of the flower to the least breath of wind.

Cananga oil today is mainly produced from wild or semi-cultivated trees on Java.

**The History of Ylang-ylang Oil**

**In the Philippines**

The first cultivation of ylang-ylang for commercial distillation occurred in the 19th century to the north of Manila on the island of Luzon in the Philippines.

Until the beginning of the 20th century, ylang-ylang ‘Manila’ was almost the only source of the oil and it was regarded as the best and the finest for a long time afterwards.

**In the French Indian Ocean Islands**

At the end of the 18th century, French navigators searching for spices and new plants brought back seeds of ylang-ylang to the French possessions of Mauritius and Réunion in the Indian Ocean. At that time, however, the tree was regarded as a botanical curiosity.

It was not until the end of the 19th century that the economic potential of the tree was recognized and this stimulated the first phase of production with the establishment of vast plantations on Mauritius and Réunion.
The second phase of development occurred at the beginning of the 20th century on the initiative of the religious order, the ‘White Fathers’ in Madagascar, particularly in the northwest and on Nosy-Be island. This area was the source of the famous ‘Peres Missionnaires’ brand.

A few years later, the increase in demand for ylang-ylang oil promoted the establishment of new plantations on the Comoros islands.

Thereafter, Madagascar and the Comoros became the world’s dominant sources of ylang-ylang oil for the world market.

**The Cultivation of Ylang-ylang**

The ylang-ylang tree needs a hot and wet climate, preferably a rich volcanic soil and protection from strong winds.

New plants are grown from seed, which are collected in the months of June – July. Each fruit contains up to eleven seeds. Specially constructed nursery beds are used for seed germination and sowing is carried out 1 to 2 months before the arrival of the rain season (September - October). Germinated seedlings are protected from the sun and are regularly watered.
Two or three months after germination, the seedlings reach around 50 cm in height and are ready for field planting.

In a wild state, the ylang-ylang tree can grow to 25-30 m high. For increased productivity and ease of harvesting, however, plantation trees are regularly pruned from an early stage not to exceed a height of 2-3 metres.

The trees are planted at an average spacing of 5-6 m in order to permit training into an umbrella shape. The average planting densities are 280-340 trees / ha.

It should be noted that in the Comoros Islands the large plantations of first half of the 20th century were parcelled out almost in their entirety and the trees today belong to hundreds of smallholders. In Nosy-Be by contrast, plantations of several tens of hectares have remained with the traditional growers.
The ylang-ylang tree flowers throughout the year with:
  • low flowering periods in December - March and July – September, and
  • high flowering in April - July and in October - December.

The flowers grow in bunches along the branches and each has six petals, which initially have a green colour and then become yellow while maturing. The optimum harvesting stage is when the centre displays a carmine crown.

From 5 years of age to more than thirty years, the tree is in full output and can produce, under the best climatic conditions and of maintenance, a fresh flower yield of up to 10 kg / year.

At the present time, because of the poor maintenance of many plantations and the advanced age of many trees, the average yield of flowers has fallen to 5 kg / tree / year.
Flower harvesting is entirely manual and is carried out early in the morning by women from neighbouring villages.

The harvested flowers are then collected by the owners of the plantations (in Nosy-Be) or by the distillers (in the Comoros).

Each woman can gather from 10-20 kg of flowers per day and remuneration is according to the weight of gathered flowers.

The fresh harvested flowers then are transported to the distillery or the concrete extraction plant.

**Oil Distillation**

The large colonial era distilleries have now almost entirely disappeared and today oil is produced on direct-fired, small artisan units by water-steam distillation. Still vessel sizes vary from 150-500 litres.

The Comoros has more than 250 bush stills, often constructed out of galvanized sheets:
In Madagascar, there are ten small distilleries with several stills and a score of distilleries with one or two stills.

The Nosy-Be distilleries are most commonly constructed out of copper.

Distilleries on Nosy-Be
The distillation procedure is as follows:
• Before adding flowers, the water at the base
  of the vessel is heated to boiling point.
• Flowers are then loaded to occupy about one
  third of the available capacity above the water
  level.
• Distillation is undertaken for 18-24 hours,
  according to the size of the vessel and the
  individual distiller’s practise.

Oil is collected in one of two ways:
• The complete oil can be collected (as is the
  case with cananga oil).
• Fractions of the oil are collected over the
  course of the distillation to obtain the
  different grades, varying in specific gravity.

This fractionation method is the one generally
used and a series of varying size bottles are
employed for individual distillation fractions.

After about one hour of distillation, the first
ylang-ylang oil appears and these fractions are
collected in small bottles of a capacity of hundred
grams.

Towards the end of the distillation, one litre
bottles are used to collect the last oil fractions.

The most difficult challenges with the equipment
are to maintain a constant heat, avoiding steam
surges or reflux, and to keep the condenser
cooling efficiently.

On completion of distillation, the oil fractions are
classified, either by the distiller or by a collector,
according to specific gravity at a temperature of
27°C (the average local temperature), into four
grades [see the specifications overleaf]:
• Extra & Extra “S”
• First
• Second
• Third

This classification has the function not only of
determining the various qualities but is used also
to calculate the price of the grade. Except for
ylang Third, which is paid by kilo, the other
grades are bought according to their density.
Oil grade specifications and yields

The total yield of ylang-ylang oil is about 2% of the mass of distilled flowers and the percentage obtained for each of the four grades is shown in the following table:

<table>
<thead>
<tr>
<th>Ylang-ylang oil grades</th>
<th>Specific density (at 27°C)</th>
<th>As % of total distilled oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td></td>
<td>In Comoros</td>
</tr>
<tr>
<td>Extra &amp; Extra “S”</td>
<td>0.950 – 0.970</td>
<td>24%</td>
</tr>
<tr>
<td>First</td>
<td>0.934 – 0.945</td>
<td>10%</td>
</tr>
<tr>
<td>Second</td>
<td>0.920 – 0.932</td>
<td>8%</td>
</tr>
<tr>
<td>Third</td>
<td>0.900 – 0.916</td>
<td>58%</td>
</tr>
</tbody>
</table>

The table reveals that by comparison with the Comoros very little Extra grade is produced by Madagascar.

Prior to packaging for export, oils are bulked by grade, filtered and then conditioned in storage tanks.

The properties of differing ylang-ylang oils

The grade classification for ylang-ylang oils has arisen through combining organoleptic and classical physicochemical criteria:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Aroma</th>
<th>Specific density (20/20ºC)</th>
<th>Refractive index (20ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Madagascar</td>
<td>Comoros</td>
</tr>
<tr>
<td>Extra</td>
<td>Strong floral, jasmine-like</td>
<td>Highest</td>
<td>0.950-9.965</td>
</tr>
<tr>
<td>First</td>
<td>Floral and jasmine-like</td>
<td>↑</td>
<td>0.933-0.945</td>
</tr>
<tr>
<td>Second</td>
<td>Duller</td>
<td>↑</td>
<td>0.923-0.929</td>
</tr>
<tr>
<td>Third</td>
<td>Dull with sometimes burnt and harsh notes</td>
<td>Lowest</td>
<td>0.906-0.921</td>
</tr>
</tbody>
</table>

It is difficult to establish definite limits for the physicochemical properties of each fraction, because in fractionating almost every producer follows his own method. Also, many export lots consist of bulked oils, made up by the producers, local dealers and exporters in accordance with their own standards or to the request of an overseas buyer.

Moreover, it is often impossible to determine the geographical origin of an oil just by its physicochemical properties.
However, employing gas chromatography analysis permits an insight into the evolution of oil character during the course of distillation. From the Extra to the Third grade, we observe a progressive decrease in the concentration of the desirable aroma compounds (esters, ethers, and phenols) and a simultaneous increase of the sesquiterpenes (α-copaene, β-caryophyllene, α-farnesene) and other compounds without aromatic value:
Similarly, gas chromatography enables determination of the geographical origin of an oil between the two production areas of the Comoros and Madagascar, and to rationalize for their significant olfactory differences. For example, Madagascan oils are characterised by high geraniol and geranyl acetate contents and it is possible to discriminate between the ylang oils from Mayotte, Anjouan and La Grande Comore, which are very similar in aroma.

**Ylang Concrete and Absolute**

There are three concrete / absolute extraction units in Madagascar and one in the Comoros. Only one or two of these units produce concrete on a more or less regular basis. Consequently, the extract industry does not compare in importance to oil production.

The solvent employed for concrete extraction is usually hexane. Yields of concrete are 2.5-3% of the flower charge.

The yield of absolute from the concrete is about 80%.
**Production trends**

Over the last 25 years, there has been a steady fall in ylang-ylang production, which has accentuated since 2002/2003.

### Oil production, 1970-2006

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Comoros archipelago</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grande Comore</td>
<td>12-15</td>
<td>4</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Anjouan</td>
<td>75</td>
<td>60</td>
<td>50</td>
<td>35</td>
</tr>
<tr>
<td>Mayotte</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Comoros total</td>
<td>107-110</td>
<td>76</td>
<td>58.5</td>
<td>39.5</td>
</tr>
<tr>
<td>Madagascar</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>127-130</strong></td>
<td><strong>92</strong></td>
<td><strong>70.5</strong></td>
<td><strong>54.5</strong></td>
</tr>
</tbody>
</table>

This decline in production has arisen from the large consuming companies pushing the importers / distributors to lower prices and, consequently, there has been an adverse impact on producer remuneration.

In real value, the price movements were:
- 1985-1990: ca. €180 / kg
- 2000: ca. €100 / kg.
- 2006: ca. €150 / kg

At the year 2000 price levels, profit margins for the producers became very unattractive and resulted in:
- The planted area under ylang progressively falling. Growers have uprooted their trees in whole or part in order to replant with more profitable cash crops or food crops, such as rice and manioc. At best, old trees have not been replaced.
- Distillers have not invested in replacement of aging equipment.

Other problems encountered have been:
- A disease, fumagine, and the spread of coconuts that block flowering of the ylang trees.
- A decline in soil water retention and availability as a result of uprooting trees and changing the crop systems and this has made the water-cooled distillery condensers inefficient or inoperable for periods. For example, the principal ylang oil producing island of Anjouan formerly had 10 permanent rivers but today there are only 5 to 6 rivers and these have low flows.
- Deforestation has made firewood supply for the distilleries difficult and increasingly expensive.

The combination of the above factors has had an adverse affect across the industry in the Comoros and Madagascar. However, the island of Mayotte – an overseas territory of France - sees its production...
disappearing mainly because of the cost of the labour (which is aligned to that of Metropolitan France).

Today, the demand for ylang-ylang oil remains strong but production is insufficient and this situation has recently led to a market price increase. However, ylang-ylang shortages cannot be rectified in a single year period.

If, growers and distillers can be persuaded to reinvest, we must wait for 3 to 5 years to see a major improvement in supply from the Comoros and Madagascar.

Olivier de Bontin commenced his career in the essential oil trade in 1986 with the Bambao company. Over the years, he has gained specialist knowledge of ylang-ylang and other essential oils from Madagascar and the Comoros. Today, Olivier is the Manager of Quimdis Aromatique, an agency of Quimdis, France and is responsible for the trading of essential oils and aroma chemicals. He served as a member of the IFEAT Executive Committee from 1994 to mid-2006.