P&F May 2005 vol. 30 no.3 | www.PerfumerFlavorist.com

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A Cultivated Zest

The lemon's origins, production and processing

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Known as golden apples centuries ago, lemons were once regarded as luxuries, traded for precious items in marketplaces around the world. Today, with over 3 million tonnes produced each year — the equivalent of approximately 21,000 million individual lemons — this fruit is as popular as it has ever been. Though, considering the sheer volume of production, one is unlikely to gain much return from bartering with a lemon.

The origins of the lemon, *Citrus limon*, are as old as civilization itself, lost in the sands of China and the Middle East. Wherever its geographical origins lie, by the first and second centuries AD lemons were being cultivated in the Middle East and Greece. In the ruins of Pompeii there is a mosaic that depicts a lemon, and there is documentary evidence that by the second century AD Rome was importing lemons from North Africa. During subsequent centuries, the fruit spread throughout the Roman Empire, thriving in the warm climates of the Iberian Peninsula and the Mediterranean, before reaching the Americas around 500 years ago.

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Global Lemon Production

Lemons are not only cultivated for the fresh fruit market, but also for their juice and other valuable derivatives, including a number of specialist flavor and fragrance products. In fact, lemon is one of the most widely used materials in the flavor and fragrance industry. Today, the six largest lemon-producing countries are Argentina, the United States, Spain, Italy, Brazil and South Africa. South America overall has considerably increased its lemon output over the past 15 years to become the largest producer and processor of lemons worldwide.

Argentina, the single largest grower of lemons worldwide, primarily designates its output for processing, not the fresh fruit market. Two other Latin American countries — Brazil and Mexico — are also increasing their lemon oil output, the former capitalizing on its considerable orange-based citriculture expertise. The position of Spain in today's juice and by-product market is declining as its lemons are increasingly diverted to the well-established fresh fruit market.

Significant volumes of Argentinean lemons are exported each year, an estimated 800,000 tonnes are processed each year, yielding some 3.2 million kg of lemon oil, equating to around 45 percent of global production. The United States, in comparison, produces around 1 million kg of lemon oil each year, a figure that seems to be declining. Lemon oil production is also decreasing in Italy, specifically in Sicily. Over the past decade, this once dominant producer has encountered great difficulties in competing against Argentinean costs and scale of production.

The FMC-type extractor is the most common method used to extract the oil and juice from the lemon.

The Brown Oil Extractor (BOE or Brown) process extracts the oil from the fruit first by gently puncturing the flavedo, or peel, of the fruit with thousands of stainless steel needle points.

Science of Cultivation

Growing lemons is very much a science. Significant investment in both time and money is required to find the optimum rootstock/cultivar combination to produce abundant fruit that are both disease resistant and tolerant of unfavorable weather conditions. Sophisticated varieties may also be cultivated if specific analytical parameters are required for processing purposes, for instance a particularly high oil content. Some South American varieties, to cite just one example, yield an oil content in excess of 6 kg per tonne of fruit. Other varieties mature at a slower or faster rate, enabling the grower to supply the market out of season, thereby improving or maximizing the price they receive for the fruit at different times of year.

Processing Potential

There are three main methods to extract the juice and oil from lemons. The most common method is the FMC-type extractor, widely used in orange processing worldwide. In this method the oil and juice are simultaneously extracted by a cutter tube that pierces the fruit and removes the juice while the oil is extracted. The separate juice and oil products are then piped away for further processing and finishing.

The Brown Oil Extractor (BOE or Brown) process, particularly common in the United States and South America and less so in Europe, differs from FMC in that the oil is extracted from lemons first by gently puncturing the flavedo, or peel, with thousands of stainless steel needle points. The oil sacks are then ruptured, releasing the oil, which is subsequently captured in a water spray. Next, it is centrifuged to separate the water and to polish and finish the oil.

The third main method of processing involves Pelatrice-type rasping equipment. It is similar to the Brown process, but rather than using stainless steel needle points to pierce the fruit and remove the oil,

The Pelatrice-style rasper is the third main method of processing, in which the fruit is subjected to rolling disc graters that allow the flavedo to be rasped.

the fruit is subjected to rolling disc graters that allow the flavedo to be rasped. The oil is then captured in a water spray and piped away for centrifuging and polishing. After the oil has been extracted, the fruit, by now largely flavedo free, is further processed for juice using specialist equipment.

Further Processing of the Oil

To produce market-quality lemon oil, the extracted material has to undergo a process of winterization to clarify and de-wax the oil. The actual process of winterization varies slightly around the world, but all share the same basic theme of exposing the oil to very low temperatures.

Lemon oil is typically bulked in tanks of up to 100-drum capacity. The material is left in the tanks for around three weeks at temperatures as low as -30ºC. During this time, up to 10 percent of the oil can be lost through de-waxing — the cold temperature clarifies the oil, and the waxy portion of the oil settles at the bottom of the tank. Usually, the remaining 90 drums of lemon oil are then stored at temperatures of around 5ºC.

Although it is normal for any expressed or cold pressed citrus oil to contain a certain amount of wax, it is usually imperceptible in the finished oil. Excessive waxiness is undesirable because it may have a negative impact on the end usage of the oil, such as clear beverages or fine fragrances. Waxes can continue to form within lemon oils following the winterization process. This is a natural phenomenon and cannot be totally prevented. The waxes can, however, be removed from the oil by filtration.

Conclusion

The lemon is one of the most instantly recognizable of the citrus fruits, second only to the orange for universal appeal. The value of an individual lemon, or golden apple, may not be as great as it once was, but its ongoing popularity and demand looks assured thanks to its continual and widespread use throughout the world in many different flavors and fragrances.

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