

Java Vetiver Oil

Sustainable valorization for the perfume market

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Vetiver roots (*Vetiveria zizanoides* (L.) Nash, Poaceae.) are a major focus for the fragrance industry, as the essential oil they provide is a key ingredient for all perfumers. However, there is an important distinction to be made between the various origins and qualities of vetiver oil, because Bourbon and Haitian oils have traditionally been the preferred grades, whilst the Indonesian product has always been characterized as second-rate, despite Indonesia being globally the largest volume producer.

Growing and harvesting vetiver is a very labor-intensive process, due to its deep, compact, aromatic, branched, fibrous root system. In Indonesia, after 12 months (or 15–18 months depending upon the conditions of cultivation) from planting the vetiver roots are ready to be harvested. Initially, the ground needs to be broken up in order to make the roots ready for hand harvesting. Yields per hectare are highly variable depending on the amounts of rainfall during the collecting season. Variations can be as much as 40% of the potential crop size (from 2.8–4.0 metric tonnes per hectare). By closely following the economics of vetiver cultivation, it has been found, however, that the variations in yield and cultivation costs are not the primary factor governing the price of the essential oil on the world market.

Planting of vetiver: In Java, the quality of vetiver oil has frequently been classified as burnt or smoky. This unwanted olfactory quality provided the impetus to perform extensive studies into the processes used to go from harvested roots to oil production. These studies have allowed the authors to obtain a greater understanding of the techniques used and explain the reasons for the distinctions in value among vetiver oil origins.

Cost Factors for the Distiller

In the course of this investigation it became obvious to the authors that the harvested vetiver roots (the feedstock for oil production) was not something that could be changed. The intrinsic conditions (cultivar and the age of the harvested roots) and the extrinsic conditions known in French as *terroir* (rainfall, sunlight, environment, altitude, soil quality, etc.) yield the oil production feedstock. Consequently, the main cost for oil production must be in the cost of distillation, and any changes in the distillation parameters directly affect the cost of the oil.



A planting of vetiver.

However, if there is no room to adjust value at the point of feedstock purchase, the processor has traditionally tried to work at higher still pressures and temperatures in order to reduce the distillation time.

This approach typically resulted in greater yields and savings on fuel and labor. It was determined that these higher processing temperatures were the cause of the smoky notes in vetiver oil. As a result, the authors decided to perform a series of trials at reduced pressures in order to determine if one could overcome the negative olfactory quality that has been associated with Indonesian vetiver oil (**F-1**). In essence, the authors wanted to rediscover the natural characteristics of the vetiver root with its classical woody and orris aspects.

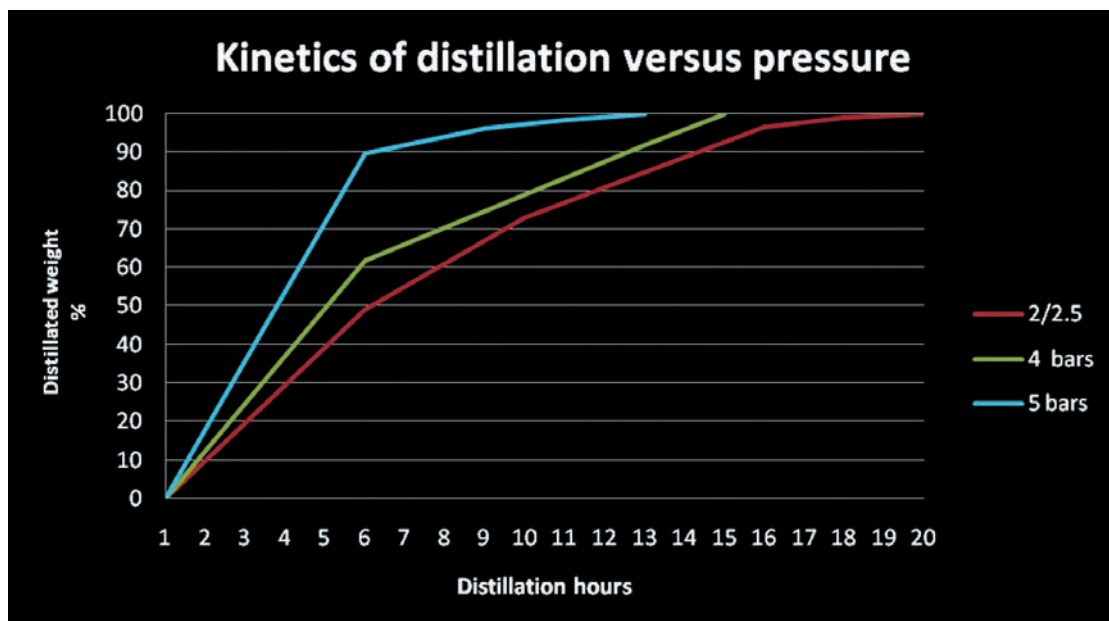
Analysis and Interpretation

Examination of the data shown in **F-1** reveals that the effect of pressure on the distillation time can be easily seen, for example:

1. In five hours at 5 bars, 90% by weight of the oil has been processed, compared to 62% at 4 bars, and 50% at 2.5 bars.
2. Ninety-five percent by weight of the oil has been obtained in eight hours at a pressure of 5 bars, in 14 hours at 4 bars and in 17 hours at 2.5 bars.

Graph of distillation time as a function of still pressure

F-1



Without paying any attention to the olfactive quality of the resulting oil, it is easy to see why the distiller would prefer to work at higher temperatures and pressures. The authors' studies were directed to finding a cost-effective and practical compromise between the still pressure and the distillation time, in order to produce oil that is more attractive in terms of odor, yield and composition.

Oil Compositions Resulting from Still Pressures at 5, 4 and 2.5 Bars

The authors wanted to determine if the effect of varying still pressure paired with a slower distillation time would result in a greater isolation of key components of the oil from the roots. The trials used the same field plots with fixed parameters such as:

1. Age and size of the root, yield by hectare, and *terroir*.
2. Standardized washing and drying time of the roots.

Using the data obtained from the earlier trials (shown in the graph T-1), a distillation time was established for each pressure level based on the following:

1. Production cost per distillation time.
2. Yield of oil.

The averaged GC results clearly showed that a slower distillation time combined with lower still pressures allowed an increase in the isolation of

the desired main vetiver oil constituents contained in the vetiver roots. Two successes became evident by reducing the still pressures, and they were:

1. Improved isolation of the major vetiver oil constituents.
2. The slower distillation times resulted in a reduction of the smoky note at the 4 bars level, and virtual elimination of this note at 2.5 bars pressure. This reduction was accompanied by a revelation of the genuine desired woody and orris notes and grapefruit accents.

The authors believe that with the 2/2.5 grade they have recreated the desired olfactory quality associated with vetiver oil and now have a prime quality vetiver oil of Indonesian origin.

This is the grade on which the authors are focused in order to requalify and raise the value of vetiver oil from Indonesia, and particularly Java.

Analysis of the oils produced by GC: average yields for the main vetiver oil constituents

T-1

	5 bars *	4 Bars *	2.5 Bars *	Process ^{***}
Distillation time:	12 hours	14 hours	16 hours	-
β-Vetevenene	8.15	7.65	6.3	1.82
β-Vetivone + khusimol (B)	9.7	11.56	13.6	24.42
α-Vetivone (C)	1.21	1.51	1.8	3.19
Isovalencenol (D)	2.31	3.76	4.55	7.36
Zizanoic acid	4.2	5.26	6.4	7.5
Compounds (B + C + D)	13.2	16.83	19.95	34.97

Conditions of results: *Average of four distillations with a loading of 1,200 kilos of roots per distillation % GC normalization; **Process^o is a trademark of Payan Bertrand



Vetiver processors have traditionally tried to work at higher still pressures and temperatures in order to reduce the distillation time.

Concentration of the Main Oil Constituents

Using vetiver oil from the vetiver 2/2.5 process, the authors undertook a further fractionation in order to concentrate the main vetiver oil constituents, and to obtain a material that was fully acceptable for fine fragrance work through the sophistication and high quality of its olfactory profile.

Jean-Claude Ellena, Hermès' exclusive perfumer, has followed the Indonesian project since its inception. He recently evaluated the fractionation of the 2/2.5 process vetiver oil. "This new quality of vetiver oil is very different [from the] usual oil of the market. We can identify well-defined dense woody notes, sulfurous, matchstick, and very interesting grapefruit zest notes. This vetiver lost the earthy, potato-peel unpleasant aspects of common Java qualities."

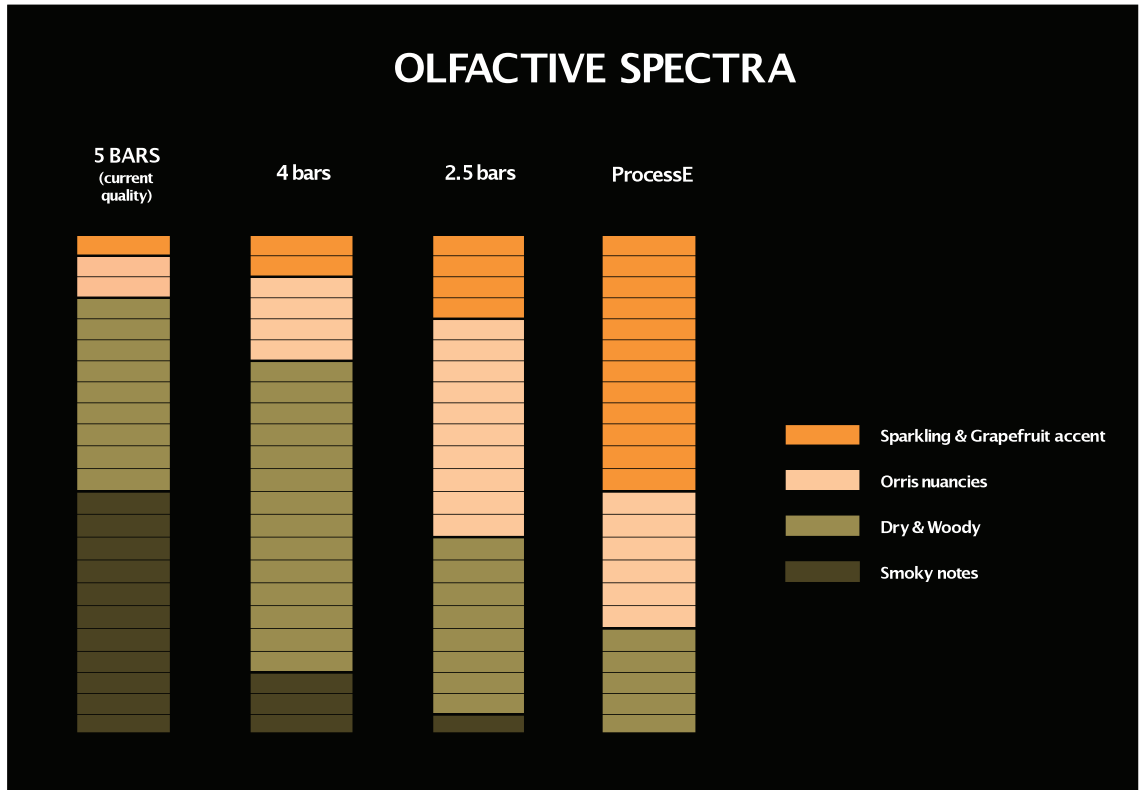
Conclusion

This project reconfirms the possibility of returning to the true olfactive quality of vetiver oil originating from Java, but only if producers take into proper account the true circumstances and factors under which it is produced (**F-2**).

As always the industry must realize that providing high-quality natural ingredients for fragrances results from understanding numerous human, economic and technical variables.

An enduring outcome of studies such as the present one can only be achieved by partnership with all those involved and by correctly valuing the true cost of production at source.

The intent and goal of the authors' distillation process study is to provide quality ingredients that are not designed as substitutes, but rather can be seen as new and unique materials for the creative perfumer. To achieve this it is imperative that sustainable turnkey projects like the one described here be developed for the producer at source.



Harvest of the roots of vetiver in Indonesia; view 1



Harvest of the roots of vetiver in Indonesia; view 2

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