Woody notes in perfumery

Patchouly Oil, Absolute and Aroma Chemicals: Part I

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Patchouli is a valuable perfume material used in traditional and contemporary women's and men's fragrances, as well as in cosmetic and soap perfumes. The word "patchouli" (also "patchouly") in Tamil is *paccilai*: *paccu* (green) + *ilai* (leaf).*[1] Patchouli is known in India as *putchaput* and in Hindustan as *pacholi*.

In an early classification of odors done by Rimmel, the odor of patchouli was classified in the camphor group.[2] In the 1950s, Cerbelaud described the odor of patchouli as "heavy, vibrant with musty, herbaceous and camphoraceous notes, warm and lasting."[3]

Today, the odor description and classification have changed. Now, various types of processed patchouli oils are available, and patchouli is listed by suppliers among woody materials. Both researchers and perfumers concur, considering patchouli to be in the woody family of odors.

Botanical Origin

Patchouli (family Labiatae) is a bushy plant about 3 feet high, native to the Philippines and Indonesia. It is cultivated in India, China and South America. There are several species of patchouli plants, but only *Pogostemon cablin* Benth. is used to obtain patchouli oil.

Mode of Production, Yield and Type of Oil

Patchouli oil is extracted from the leaves of the *P. cablin* Benth. plant. Dried leaves are steam distilled. The yield is about 3%. Molecular distillation is used to obtain an iron-free, lighter-color patchouli oil. Patchouli absolute is obtained by solvent extraction of patchouli leaves.

The following patchouli oils are available commercially:

- Patchouli Indonesia
- Patchouli China

Some of the processed patchouli oils offered by various suppliers include:

- Patchouli molecular distillation
- Patchouli rectified
- Patchouli tartarized (light)
- Patchouli "Keva" India (contains no solvent residues, inorganic salts or heavy metals)
- Patchouli absolute Indonesia (earthy, woody and herbaceous, with a camphoraceous note that is not pronounced)
- Patchouli absolute molecular distillation (especially suitable for alcoholic fragrances)

Patchouli Oil Composition

Although patchouli alcohol was isolated by Gal in 1869, relatively little was known of the patchouli oil composition in the early part of the 20th century.

In 1952, Guenther mentioned the following patchouli components:[4]

- azulene (1863)
- benzaldehyde (traces) (1904)

*Other sources cite the word "patchouli" as being derived from two Tamil words: *patchai* (green) and *ellai* (leaf), which is similar to the above. The variation may be explained by simple phonetics.

- cinnamic aldehyde
- eugenol benzoate
- patchouli alcohol (structural formula not clarified)
- a sesquiterpene alcohol

In 1951, Cerbelaud listed a few additional components: cadinene, cinnamic alcohol and eugenol.[5] In the 1960s, Büchi et al. isolated and identified two nitrogen-containing sesquiterpenes, which they named patchoulipyridine and epiguaiapyridine.[6]

In 1966, Mookherjee et al. isolated norpatchoulenol and nortetrapatchoulol, which they considered as "the principal odor-containing components of patchouli oil."[7] In connection with this work, three different patchouli oils were fractionated. The odor evaluation showed that only the neutral fraction of each oil had "a warm, herbaceous, camphoraceous, woody" patchouli odor. An in-depth analysis of each oil was performed, characterizing 209 components, of which 180 were new to patchouli; some were novel compounds. Among them were: β-patchoulenone, possessing a strong woody patchouli odor (patented by IFF); α-guaienone, possessing a strong carvone, camphoraceous odor; and α-cedrenal, possessing a strong woody odor. According to the researchers, the compounds, in concert with patchouli alcohol (whose structural determination was done by Büchi), "play a definite role in producing the characteristic odor of patchouli oil."

In the 1970s, Maurer identified methoxy pyrazine and 2-amino-acetophenone, which were considered likely contributors to the odor of patchouli oil.[8] In the same period, sesquiterpenes, pogostol, bulnesol, norpatchoulenol, α-guaiene, α-bulnesene and β-patchoulene were identified by various researchers. Other components found included cycloseychellene (a tetracyclic sesquiterpene), pogostone (a lactone), humulene (a sesquiterpene hydrocarbon), 1α-5α-epoxy-α-guaiene and epoxycaryophyllene (oxygenated sesquiterpenes). Patchouli oil was found to be composed mainly of patchouli alcohol (ca. 40%).[9]

In 1976, Taveira Magalhaes et al. reported a quantitative analysis of patchouli from plantings introduced into Brazil:[10]

β-patchoulene	1.9–2.2%
α-guaiene and caryophyllene	11.3–22.2%
α-patchoulene and aromadendrene	10.8–20.9%
α-bulnesene	13.0–20.3%
patchouli alcohol	23.6–45.9%

In the 1980s, Mookherjee et al. reported the major odorous compounds of patchouli oil.[11] They were:

patchouli alcohol	30%
α-bulnesene	25%
β-caryophyllene	20%
α-guaiene	15%
α-bulnesene oxide	4%
caryophyllene oxide	2%
β-elemene	1%
α-guaiene oxide	1%
pogostol	1%
norpatchoulenol	0.5%

In 1991, Ishihara et al. noted that patchouli oil contained the following sesquiterpene hydrocarbons:[12]

α-copaene	3%
β-patchoulene	4%
α-gurjunene	4%
β-caryophyllene	7%
α-guaiene	21%
γ-patchoulene	1%
α-humulene	1%
α-patchoulene	12%
seychellene	11%
α-bulnesene	24%
δ-cadinene	1%

In 1992, Maurer and Hauser reported the presence of 3-(1-butenyl) pyridines in patchouli oil.[13] In 1997, Rakotonirainy et al. determined that the main sesquiterpene hydrocarbons of patchouli oil were:[14]

α-guaiene	21.5%
seychellene	9.6%
α-patchoulene	9.1%
α-bulnesene	34.6%

In 2000, Buré et al. characterized the presence of the following four sesquiterpenes in patchouli oil: aromadendrene, allo-aromadendrene, dehydroaromadendrane and ledene.[15]

As can be seen in the previous analyses by various researchers, the percentages of identical patchouli oil components differ. This is illustrated in T-1.

Comparative percentage range of a few selected patchouli oil components **T-1**

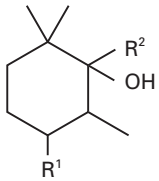
Compound	Percentage
patchouli alcohol	23.6–45.9%
α-bulnesene	13.0–34.6%
α-guaiene	15.0–21.5%
seychellene	9.6–11.0%
α-patchoulene	9.1–12.0%
β-patchoulene	1.9–4.0%

Mookherjee et al. noted that although norpatchoulenol has a stronger odor than patchouli alcohol, it loses about 50% of its strength within 24 h, while the odor of patchouli alcohol remains fairly constant during the same period of time.[11] Nortetrapatchoulol was found to retain its odor strength much longer.

Another researcher's findings are, interestingly, diametrically opposite in regard to patchouli alcohol. According to Teissiere, patchouli alcohol in a high state of chemical purity is practically odorless, and the main carrier of the patchouli odor is norpatchoulenol, whose concentration in patchouli oil is 0.3–0.4%.[16]

In their study of monocyclic derivatives starting from 2,6,6-trimethylcyclohex-2-en-1-one3, Weyerstahl et al. found that the materials most reminiscent of patchouli alcohol were the type A alcohols 18–21:[17]

However, although the four compounds possessed patchouli odor elements, they were not well-balanced, with a dominating camphor odor.



18–21
Type A

Spreitzer et al. studied the structure-activity relationship of the bridgehead-bonded methyl group of patchouli alcohol and norpatchoulenol, as well as the olfactory properties of the unsaturated resp. saturated derivatives.[18] The organoleptic analyses of the tricyclic alcohols and the differences from the naturally occurring patchouli alcohol and norpatchoulenol were discussed. The researchers believed that "the two sesquiterpene alcohols—patchouli alcohol and norpatchoulenol—are the principal cause of the patchouli odor."

In spite of the progress in the knowledge of patchouli oil composition and the discovery of new components that contribute most to its odor, the complex and lasting odor of patchouli is difficult to imitate. It appears that patchouli alcohol, besides being the main component of patchouli oil, is of importance to the lastingness of its odor. The following formula shows an early attempt to reproduce patchouli:

Patchouli resinoid

425	balsam copaiba
300	cedarwood
300	*Resina alba*
300	rosin
350	patchouli oil
100	phellandrene
100	vetiver
100	balsam Peru
100	oleoresin ginger
20	octyl formate
5	cade oil
5	isoborneol
2,105	

Today's endeavor is to develop patchouli substitutes/extenders:

Accord 8FC1081 (BASF)

250	patchouli oil Indonesian
80	gurjun balsam oil rectified
70	Isolongifolanone (Quest)
60	Koavone (IFF)
60	copaiba balsam oil rectified
25	guaiacwood oil
20	cedarwood oil Texas rectified
15	Rootanol 100 (BASF)
10	caryophyllene
10	Patchone (IFF)
400	Cyclopatchol 50 (BASF)
1,000	

Aroma Chemicals of Woody, Patchouli and Multifaceted Odors

Andrane: 8,9-epoxy cedrane (IFF), woody, patchouli, ambergris.

Dimethyl cyclormol: 4,7-methano-1H-inden-5-ol, 3a,4,5,6,7,7a-hexahydro-2(or 3),4-dimethyl (IFF), diffusive, camphoraceous, earthy patchouli note.

Piconia: 2H-2,4A-methanonaphthalen-8(5H)-one, hexahydro-1,1,5,5-tetramethyl (IFF), diffusive, woody, earthy, camphoraceous patchouli note, long lasting.

Isolongifolanone: 2,2,7,7-tetramethyltricyclo[6.2.1.0~1,6]un-decan-5-one (Quest), possesses a woody, diffusive note with amber and earthy, camphoraceous odor tonalities.

Mahagonat: bicyclo 2.2.2-5-octene-2-carboxylic acid, 1(or 4)-methyl-4(or 1)-(1-methylethyl)-methyl ester $C_{14}H_{22}O_2$ (Symrise), woody-spicy, patchouli, vetiver and sandalwoodlike with a note of iris.

Isobornyl methyl ether: exo 2-methoxy-1,7,7-trimethyl bicyclo 2.2.1 heptane (Takasago), camphoraceous, woody, earthy.

Palisandin: cyclododecyl methyl ether $C_{13}H_{26}O$ (Symrise), woody, cedarwoodlike, earthy with patchouli, orris and tobacco accents.

A new derivative of Isolongifolene: developed by Haarman & Reimer (now Symrise) to be used as an extender of patchouli.[19]

Palisandal: 1,1-dimethoxycyclododecane $C_{14}H_{28}O_2$ (Symrise), woody cedar with a patchouli note and ambergris nuances.

The so-called patchouli epoxide: present in patchouli oil, it has a powdery note, woody, strong and long lasting.[20]

Huminol M: 8-methyl-1,5-dimethylbicyclo-(3,2,1)-octanol, strong, humid, earthy odor, recalling norpatchoulenol.[21]

Patchomint: 3,3-dimethyl-2-norbornane-2-ethanol, camphoraceous, minty, corniferous, with patchouli nuances.[22]

Cyclopatchol 50 (BASF): herbaceous with a warm woody-earthy and slightly ambery note, reminiscent of patchouli oil.

Terrasol 50 (Bedoukian): earthy, fresh soil odor, enhances woody, mossy, earthy notes.

Methyl Undecyl Ketone (Bedoukian): fatty, herbaceous, earthy.

1-Octen-3-ol: Amyl Vinyl Carbinol (Bedoukian), herbaceous, earthy, haylike.

Isophorone: $C_9H_{14}O$ (Aldrich), cedarwood, tobacco, leathery.

Orivone: paratertiary amyl cyclohexanone $C_{11}H_{20}O$ (IFF), woody, orris, camphoraceous.

9-Ethylidene-3-oxatricyclo (6,2,1,0^{22}) undecan: powerful, woody, rooty-earthy, floral, fruity and rhubarb notes.[23]

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In the previous article, "Wood Notes in Perfumery: Vetiver, Derivatives and Aroma Chemicals. Part II" (September 2005), the following errors occurred:

- **page 47:** In the Peau d'Espagne formula, the amount of jasmin absolute is incorrect (14). It should be "15."
- **page 49:** In Vetiver Fragrance, 10 labdanum resinoid does not belong. It should not have been included in the formula.
- **page 50:** The sentence "The dried root is used to scent clothes lines" should have read "to scent clothes and *linen.*"