
COPAIFERA OFFICINALIS.

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BOTANICAL DESCRIPTION AND HISTORICAL NOTES

Copaiba (popularly known as balsam of copaiba) is obtained from South America, principally from Brazil and Venezuela, being produced by numerous species of the genus *Copaifera*. This genus belongs to the suborder of caesalpinieae, of the vast order of leguminosae, and differs from the ordinary type of the order, as we usually know it, in having more regular flowers (papilionaceous), resembling in this respect our honey-locust (*Gleditschiatricanthos*) and coffee-nut (*Gymnocladus*) tree.

The various species of *copaifera* usually are small trees (sometimes shrubs) which grow in tropical America. The flowers are small, borne in axillary terminal panicles. The calyx consists of four sepals^{2**}, or rather a calyx divided almost to the base with four segments. The segments are thick, smooth outside, white (petaloid) and silver-hairy inside, nearly equal, the upper slightly larger. There are no petals. The stamens are eight or ten, with long slender filaments. The pistil consists of a stipitate two-ovuled ovary,

¹*The thanks of the writer are extended to Mr. C. G. Lloyd for botanical notes, and to Dr. Sigmond Waldbott, librarian of the Lloyd library, for invaluable assistance

²**Bentley and Trimen state five, but their plate only shows four, and this number according to Bentham and Hooker is characteristic of the genus.

densely hairy outside, bearing a slender style. The fruit is a short, thick, oneseeded legume. The leaves of the tree consist of an even number of pinnae, excepting in the species *C. Beyrichii* (Hayne)⁸; the leaflets are smooth, thick, entire. In general appearance the leaves remind us of those of our *rhus venenata*, though this shrub has odd-pinnate leaves.

Flueckiger¹² traced the record of what is probably the first printed statement regarding a resiniferous tree other than the pine, dating back to the last decade of the fifteenth century. He quotes from Michael Herr, "Die Neue Welt der Landschaf ten und Insulen," Strassburg, 1534, which contains a report made by Petrus Martyr of Anghiera to Pope Leo X, wherein this tree is mentioned under the name *copei*.

The next available record dates from a publication of the year 1625¹ wherein a Portuguese monk, probably Manoel Tristaon, of the convent of Bahia contributes an extensive chapter on Brazil and its products. On page 1308, immediately following the description of *Cabueriba* (or Peru balsam tree) he says: "Cupayba. For wounds. Cuypaba is a fig tree, commonly very high, strait and big; it hath much oile, within; for to get it they cut the tree in the midst, where it hath the vent, and there it hath this oil in so great abundance that some of them doe yield a quarterne of oile and more; it is very clear of the color of oile; it is much set by for wounds, and taketh away all the skarre. It serveth also for lights and burne well; the beasts knowing the vertue thereof doe come and rubbe

themselves thereat. There are great store, the wood is good for nothing.”

The first explicit description and illustration of one of the trees yielding copaiba is to be found in the joint work of Piso and Marcgrav (1648),² whose statements form the basis of the subsequent literature on the subject. In this connection it appears rather remarkable that the *Pharmacopoeia Amstelodamensis*, sixth edition, which antedates this publication, being of the year 1630, distinctly mentions *Balsam copae yvae*.¹² Some of the statements of Piso and Marcgrav have given rise to discussion; the fact that Piso figured and described the flowers with five sepals, whereas they are now known to bear only four, being one of the points. The pod, however, is figured and described correctly, and the statement is made that it contains an edible nut, which the monkeys of the forest are very found of eating. As regards the mode of collecting the balsam, Piso² relates that an incision is made through the bark deep into the pith, at the season of the full moon, which causes such an abundant flow of fatty and oily liquid that twelve pounds may exude in three hours. In case no oil should appear, the opening is at once closed with wax or clay, and after two weeks the yield is sufficient to make up for the delay. The fact that the resiniferous ducts in these trees often attain a diameter of one inch, as has been observed more recently by Karsten¹² seems to be quite in harmony with the statement regarding the abundant yield. It is also related that frequently the balsam accumulates in these ducts and exerts pressure

enough upon the enclosing wall to burst the tree with a loud report.¹² According to Piso, the copaiba tree is not very frequent in the province of Pernambuco, but thrives luxuriantly in the island of Maranhon, which he says furnishes the balsam of commerce in great quantity. He also enumerates the many medicinal virtues of the balsam, making the curious statement that its healing virtues are also experienced as an efficient means to check the flow of blood in the Jewish practice of circumcision.

Labat³ reports that in 1696 he had an opportunity to observe for the first time the tree yielding copaiba in the island of Guadeloupe. He relates in detail the manner of collecting the balsam, which he calls *huile de copau*. The vessels in which the balsam is collected are made of the fruit of the calabash, a kind of gourd. The collection, he states, takes place about three months after the rainy season; that is, in March for the countries north of the equator and in September for the countries south of this line. The balsam, he states, closes all kinds of wounds except those inflicted by gunshot. He declares it to be a powerful febrifuge, having been used with almost marvelous effect in the fever epidemics at Rennes and Nantes in 1719.

Nic. Jos. Jacquin, a noted Viennese botanist who traveled in the West Indies in Linnaeus' time, first observed the tree yielding copaiba in cultivation in the village of Le Carbet at Martinique, and subsequently (1760 and 1765) described it under the name of copaiva

officinalis.⁴ He states that this tree was indigenous to the continent, where it grows frequently around the town of Tolu near Carthagena promiscuously among trees yielding balsams of Tolu and Peru. Jacquin described the flowers of this tree as having four petals, and the calyx as being nonexistent; yet he considers it identical with that of Piso and Marcgrav, which is, however, emphatically denied by De Tussac in Dictionnaire des Sciences Naturelles.⁶

Linnaeus, in 1762, gave Jacquin's plant the name *Copaifera officinalis*.⁵

Until 1821 it was generally believed that *Copaifera officinalis* was the only tree yielding copaiba; in this year, however, Desfontaines added two new species, *C. guianensis* and *C. Langsdorffii*.⁷ At the same time Desfontaines changed the name of *C. officinalis* to *C. jacquini*, in honor of its discoverer. The fact that Jacquin's plant was foreign to Brazil and yielded a balsam of inferior quality would indicate that it could not well have been the official balsam tree, while by reason of the publication of Piso's account Brazil had been generally considered the geographical source of the official balsam. However, the name *C. officinalis* Linn., has subsequently been upheld, although the official copaiba balsam is now considered as being mainly derived from *C. Langsdorffii*, the species named by Desfontaines in 1821 in honor of Mr. Langsdorff, the Russian consul general at Rio Janeiro, from whom the specimens were obtained. This name was erroneously spelled "Lansdorffii" by Bentley and Trimen,¹¹ who thus

perpetuated what was undoubtedly an error of print in Desfontaines' original memoir⁷. Soon thereafter the recorded species of copaiba increased rapidly. In 1826 Hayne (Arznei-Gewächse)⁸ published and described sixteen different species, which, however, all bear resemblances, their distinctive features residing mainly in the form and the arrangement of the leaves. Hayne especially endeavors to place the species made known by Piso, the difficulty being that this ancient work stated that the wood is colored as if with minium. The only species that, in the opinion of Hayne, would answer that description is *C. bijuga*, the wood of the branches of which is pale-red, which color may appear as red in the trunk of the tree. Hayne also states that copaiba is gathered from all species known to the natives, and concludes that most of the balsam is yielded by *C. multijuga* in the province of Para, a species, however, which is now questioned.

According to Flueckiger,¹² the following species are the principal sources of the copaiba of commerce:

1. *Copaifera officinalis*, L. (Guiana, Venezuela, Colombia, Trinidad).
2. *Copaifera guianensis*, Desf. (Lower Amazon, lower Rio Negro, Cayenne, Surinam.)
3. *C. coriacea*, Martius. (Bahia and Piauhy).
4. *C. Langsdorffii*, Desf. (Continental provinces of Brazil).

The number of known species has steadily increased until now the Index Kewensis recognizes twenty three American and five African species.

The copaiba obtained from the vast territory of the Brazilian continent, along the Amazon and its tributaries, is collected in the shipping port of Para. Maranham island is also a place of export. Other shipping ports are Maracaibo and Angustura in Venezuela, Trinidad, Demerara (British Guiana), Cartagena (Colombia) and Rio de Janeiro.

The imports of copaiba into this country during a recent period were as follows:

In 1888, pd. 12,262	In 1891, pd. 205,480
1889, pd. 163,624	1892, pd. 185,280
1890, pd. 206 240	1893, pd. 80,000
	1894, pd. 82,000

CONSTITUENTS AND ADULTERATIONS.

Two varieties of copaiba are distinguished in commerce: the Para variety from Brazil, a thin clear, pale aromatic, somewhat active and bitter fluid; and the Maracaibo variety from the Antilles and the adjacent parts of the continent, a thick, golden-yellow, sometimes faintly fluorescent oil, having an odor suggestive of turpentine.

Balsam of copaiba, so-called, is not a balsam in the strict sense, for the term balsam is properly

applied to such resinous exudations as contain the aromatic principles benzoic or cinnamic acid, both of which are absent in copaiba. Copaiba is an oleoresin, consisting of a volatile oil, which holds a nonvolatile resin of acid properties in solution. The proportion of oil varies considerably with the different specimens, ranging from 30 to 60 per cent, sometimes being as high as 80 per cent, or even more. Both the oil and resin have been extensively investigated (see e. g. Flueckiger¹²). Yet the closer chemical study of the oleoresin is beset with many obstacles, owing to the difficulty of procuring authentic specimens, as well as to the great variation in the product itself, due to its being collected from different species or even different trees, and also to the possibility of sophistications not easily to be recognized.

Probably the most frequent adulteration of the balsam is that of turpentine, which is facilitated when the pharmacopeial demand calls for the more viscid variety of the balsam. The U. S. pharmacopeia mentions as the only test for this substance, that when copaiba is heated it should not evolve the odor of turpentine. The German pharmacopeia, third edition, (additions) introduces two ammonia tests for colophony (suggested by Gehe & Co.), the second, the more sensitive, being as follows: "Expel the volatile oil by heating on the water-bath, pulverize the residual resin, and dissolve one part in five parts of ammonia water. The cloudy solution should not gelatinize even after one day's standing." This test is said to detect about 10 per cent of colophony.¹⁷ In this connection,

however, see Bosetti, *Chemiker Zeitung*, 1896, p. 846.

The absence of fixed oils in copaiba is indicated, according to the U. S. pharmacopeia, if upon complete evaporation of the volatile oil, the residue, when cold, becomes amorphous, transparent and friable. One of the direct tests for castor oil is based upon its insolubility in petroleum- benzin, while copaiba, in excess of the solvent, is completely soluble, save a flocculent precipitate. However, it requires the addition of at least ten volumes of petroleum-benzin (Maisch¹⁰) for the precipitation of part of the admixed castor oil.

Another possible (perhaps probable) admixture is that of gurjun balsam, or wood-oil, obtained from various species of gigantic trees (*Dipterocarpus*) native to India.³ * This balsam has the property of thickening when heated to 130 deg. C., especially in closed tubes. Mr. L. F. Kebler has employed with much satisfaction the following test suggested by Messrs. Dodge and Olcott, for the presence of gurjun balsam in copaiba: "Place 1 Cc of glacial acetic acid (99. 5 per cent) in a test-tube; to this add 4 drops of pure concentrated nitric acid (s. g. 1.42), mix well; then add to this mixture, carefully, 4 drops of the balsam in question; if gurjun balsam is present, within five minutes a reddish zone will appear between the layer of balsam and the acid. On mixing the contents of the test tube well, the

³ * According to Mr. Kebler, about 80,000 pounds of gurjun balsam were imported in 1894 without any authentic information being obtainable concerning its disposition.

whole will assume a reddish or purple color.”¹⁵ Another test, by which it is claimed that 1 per cent of gurjun balsam may be detected is given by Ed. Hirschsohn,¹⁶ and consists in heating a mixture of 1 volume of the balsam, 3 volumes of 95-per-cent alcohol, and 1 gram of stannous chlorid. If gurjun balsam is present, a pink coloration appears, becoming violet-red after one-half hour, but after one hour's standing its vividness disappears.

In testing copaiba the German pharmacopeia, 1890, introduces directions for the determination of the acid number and the ester number, calculated to detect an admixture of colophony and compound ethers (or esters).

Copaiba has the property of solidifying when triturated with 6 per cent of its weight of calcined magnesia (mass of copaiba, U. S. P.). According to Roussin, the condition necessary to bring about solidification is the presence of water, either in the balsam or in the base. When both bodies are anhydrous the balsam remains liquid.⁹ In this connection it may be said that the process of the U. S. pharmacopeia (and of other pharmacopeias as well) for making solidified copaiba directs the magnesia to be previously triturated with a little water.

PHARMACOPEIAL RECORD.

As before stated, an early Amsterdam pharmacopeia mentions “*balsam copae yvae*” as early as the year 1630. Although we find the drug on record in *Pharmacopoeia Amstelaed-*

amensis Renovata, 1726, we are unable to find it mentioned in the earlier *Pharmacopoeia Ultrajectina* of 1664.

Flueckiger¹² states that to his knowledge the earliest record of the drug in English pharmacy dates back to the year 1677. Yet the London pharmacopoeia of 1689 does not contain it.

The modern pharmacopoeias refer the origin of the drug, which they respectively call copaiba (U. S. P.), also copaiva (Br. P.), copahu (Fr. Cod.) to several species of *Copaifera*, especially from *Copaifera Langsdorffii* (Desf.) (sometimes and, as previously stated, wrongly spelled *Lansdorffii*. (See Proc. Am. Phar. Asso., 1879, p. 250.)

SUMMARY.

In closing our study on this very interesting substance (balsam of copaiba), we need scarcely remark that the work has been as unsatisfactory as it is enticing. Possibly no other drug is more unfortunate. Its uncertain origin, owing to the number of species that yield it, as well as the sophistication at home and abroad, render attempts at scientific exactness in tests a problem for the future. Unquestionably the pharmacopoeia is wisely conservative in its method concerning the drug that has no precise origin and that admits of such possibilities in the line of admixtures.

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