113 27/1-1485

INFORMATION LEAFLET
FOREIGN WOODS

Forest Products Laboratory,¹ Forest Service
U. S. Department of Agriculture
1951

AVODIRÉ¹

Turraeanthus africana (Welw.) Pellegrin
(= Guarea africana Welw. = Bingeria africana A. Chev.)
Family: Meliaceae

By

CAROL M. MILLER, Scientific Aid
Division of Silvicultural Relations

Avodiré¹ (Turraeanthus africana (Welw.) Pellegrin) is a species from tropical West Africa that has recently become of considerable commercial importance on European and American hardwood markets. The species was first described in 1878 by Dr. Welwitsch as Guarea africana (C. DC.) from Angola, West Africa. In 1909, A. Chevalier described and named it as Bingeria africana A. Chev., but 2 years later Pellegrin referred the species to the genus Turraeanthus, and the recognized scientific name is now Turraeanthus africana (Welw.) Pell.

It is a member of the Meliaceae family (20, 22, 25),² which includes some of the best known cabinet woods, such as mahogany (Swietenia spp.), African mahogany (Khaya spp.), Spanish cedar, and andiroba (6).

Avodiré¹ is manufactured in the same manner as African mahogany, and when stained and finished, the wood is difficult to distinguish from African mahogany, although the trees do not look alike externally (22). It has been offered for sale as white mahogany, African mahogany, African satinwood, and African furniture wood (14). The principal handicaps to its extensive use are its comparatively small size and limited occurrence, the poor shape of the logs, and the tendency of freshly cut timber to stain if not carefully handled (29). Although the wood has come on the market only comparatively recently, its popular blond color, low price, beautiful figure, and easy-working qualities have created a considerable demand (6).

¹Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

²Underlined numbers in parentheses refer to the list of numbered references at the end of the article.

Trade and Vernacular Names

Avodiré¹ is the generally accepted trade name for Turraeanthus africana. It has the advantage of not conflicting with that of any other commercial wood on the American market. Whether this name is a combination of various native names or one given by the French is not known. The name "white mahogany" has also been used, because the wood is much like that of African mahogany except for its color, which is pale tan approaching white (22). Other names are:

African furniture woods.....	U. S. trade
African satinwood.....	U. S. trade
Agboui (Abé, Ébrie).....	Ivory Coast
Apapaye.....	Gold Coast
Apaya.....	Nigeria
Apeya.....	Gold Coast
Appayia.....	Gold Coast
Avodiré (Appolonian).....	Ivory Coast
Engan.....	Cameroon
Esu.....	Belgian Congo
³ Hagué (Agni).....	Ivory Coast
Hakúé (Attie).....	Ivory Coast
Olon.....	Ivory Coast
Lusamba.....	Belgian Congo
Songo.....	Belgian Congo
Wansewa.....	Gold Coast
White mahogany.....	U. S. trade

Distribution and Habitat

Avodiré¹ occurs as an understory tree in the rain forests of parts of tropical West Africa, including the Gold Coast, Ivory Coast, and Angola, but is essentially an Ivory Coast species. The trees are not uniformly distributed in the rain forests, but are often localized in almost pure groups (1). Avodiré is reported as abundant in the region of the east Ivory Coast from the Agneby River on the west to the Bia River on the east. Avodiré and other species of Turraeanthus are also said to grow in the Gold Coast, Nigeria, the Cameroons, Gabon, Liberia, and the Belgian Congo, although they are not as common in these regions, and there is little information on the occurrence (7) or on the wood of some of these species.

Avodiré¹ is probably typical of the genus (29). According to Dr. Welwitch, avodiré is not a coastal or low-altitude species but attains its best development in the foothills 50 to 100 miles inland in the upland forests. It does

³Name applied also to the Bossé¹ wood (Guarea cedrata Pell.), which possesses different characteristics (6).

not grow, however, above the 2,500-foot contour line where conditions grade into the highland-forest type. It occurs in rich, moist soil on the borders of streams and the margins of meadows, swamps, and lakes (22).

The Tree

Size and Form

Avodiré is a medium-sized tree in comparison to the giants of West Africa. It may reach 60 to 100 feet in height but attains 90 feet or more only under favorable conditions (1, 29). It often has a diameter at the base of 3 to 4 feet, even up to 5 feet. Generally, the tree is of poor habit of growth. The trees do not develop very clear or straight trunks, which results in considerable waste in logging (22). The utilizable part of the bole is usually from 25 to 50 feet in length, rarely more than 65 feet (7). Therefore, a large percentage of the wood has to be rejected in the forest as unfit for export. A small percentage of the choicest material yields figured wood suitable for fine veneer (6). The stems very often divide into wide spreading branches and form large crowns (22). Dr. Welwitch is quoted (22) as describing Turraeanthus africana as "an immense, handsome tree" in his monograph on the flora of tropical Africa.

The Bark

The bark is ash-colored, tinged with red, and stands out in contrast with the very dark, glossy green of the foliage (22). The bark is said to have toxic properties (1). It peels off in thin strips, the inner portion being creamy yellow and possessing a very characteristic aromatic odor (29). In order to prevent fungus damage, it is necessary to remove the bark to help the wood dry out promptly; consequently, the logs entering the market are invariably free of bark (6).

Leaves

The compound leaves are large (2 feet or more in length), and are composed of 4 to 12 pairs of alternate, oblong leaflets, 4 to 6 inches long, about 1-1/2 inches wide, and rounded at the apex. The leaflets are smooth, shiny, and leathery. The midrib is very prominent on the upper surface and has many fine lateral nerves. The leaf buds, young petioles, and flower stalks are covered with a fine, rusty pubescence (29). The leaves are crowded at the ends of the branches and thus give the tree an unusual appearance (22).

Flowers and Fruit

The white to creamy-yellow flowers are in clusters in the axils of the leaves and form very conspicuous panicles that have numerous flowers. The flowers differ very little from those of mahogany. They may be found nearly all the

year round, although the main flowering period is in the spring, with a second, though less abundant blossoming in the autumn (1, 22).

The fruit takes about 6 months to develop and generally matures in the autumn. It is in the form of a fig-shaped, fleshy capsule. These capsules are over an inch in diameter, yellow or orange in color, scented, and have a soft, whitish pulp in which the seeds (usually 4 or 5 in number) are imbedded. The seeds germinate readily, and the young seedlings are plentiful, although few survive in the dense shade of the old-growth forests. They quickly fill up any openings in the stand and are easily transplanted (1, 29).

The Wood

General Appearance

Although avodire¹ belongs to the Meliaceae family, the wood has few characteristics of mahogany. When stained and finished, however, the figured wood may greatly resemble African mahogany superficially (22). Its natural pale color and high, satiny luster have occasioned the use of the wood as a substitute for satinwood (6). The logs vary greatly in color, grain, figure, and quality (14). The crooked, irregular logs often contain ring checks and even cross or wind breaks (22).

Color

The wood is creamy white to pale yellow, sometimes darkening to golden yellow (19). Unlike most of the Meliaceae, the color is light and uniform throughout. Since the heartwood is not distinctly colored, it is difficult to distinguish the sapwood from the heartwood areas; the wood is therefore easy to match in use and is especially valued for use where blond wood is desired (6, 24).

Luster

When worked, the wood has a high, satiny, natural luster (1, 18).

Weight

The wood is rather light to heavy in weight and soft to moderately hard; specific gravity 0.45 to 0.60 (air-dry), which is in the mahogany range; weight usually about 31 to 37 pounds per cubic foot (18, 26). It is fairly resistant to indentation (29). Avodire proved less hard than most of the cabinet woods tested by Harrar (10). The results given in table 1 are taken from his tests.

Table 1.--Results of tests of hardness on cabinet woods

Species	Moisture	Specific	Average and comparative hardness ¹	
	content	gravity	-----	
		(oven-dry	Average of 100	Compared to
		weight	tests on	black walnut
		and	10 pieces	
		volume)		
	Percent		Pounds	Percent
Avodiré (W. Africa)				
<i>Turraeanthus africana</i>	5.8	0.48	860	68
Mahogany (Colombia)				
<i>Stietenia macrophylla</i>	5.2	.51	1,050	83

¹Load required to embed a 0.444-inch ball to one-half its diameter.

Grain, Texture, and Figure

The grain may be straight but is frequently wavy or interlocked, which produces a mottled figure on quarter-cut material. The texture is fine and uniform (16). The irregular grain combined with the high luster may give a fine moiré appearance to the finished surface, which at its best suggests figured satinwood (1). The figured wood may show considerable variety, such as stripe, curl, or mottle (22).

Odor and Taste

Odor and taste are absent or not distinctive (29).

Mechanical Properties

The information on the mechanical properties of avodiré is meager, but it is reputed to be a strong, tough, elastic timber in proportion to its weight (1, 14, 16). The following comparison of West African species is taken from an article by Monnin and Collardet quoted in *Weltholzwirtschaft*, "Übersee Hölzer Beilage Nr. 16, April 1950 (31).

Table 2.--Physical and strength properties of three West African species

Species	Physical properties		Strength properties			
	Specific gravity ¹	Volumetric shrinkage ²	Compression : parallel to grain	Bending	Tension : perpendicular to grain	Cleavage
		Percent	Kg./cm. ²	Kg./cm. ²	Kg./cm. ²	Kg./cm. ²
Avodiré <u>Turraeanthus africana</u>	0.55	11.6	410	840	21.0	14.0
Limba <u>Terminalia superba</u>	.56	12.3	440	800	20.5	13.0
Obeche <u>Triplachiton scleroxylon</u>	.40	9.5	270	580	12.0	6.5

¹Based on weight and volume when air dry.

²Based on green volume.

Durability

Because avodiré¹ is subject to decay and insect attack, logs should be converted into lumber as soon as possible after felling, unless storage in fresh water is provided (7). The wood should not be used in damp situations and is not durable in contact with the ground or in exposed situations (16, 22).

Seasoning

Avodiré¹ is reported to season readily, but care is needed to avoid splitting and warping (16). From tests by Harrar (12), the percent of shrinkage of avodiré is compared in table 3 to that of some of the cabinet woods with which it competes.

Table 3.--Percent directional and volume shrinkage from green to oven-dry condition

Species	Shrinkage			
	Longitudinal	Radial	Tangential	Volumetric
	Percent	Percent	Percent	Percent
Avodiré (W. Africa) <u>Turraeanthus africana</u>	0.24	4.03	6.19	¹ 10.41
Mahogany, African <u>Khaya ivorensis</u>	.28	4.96	8.36	16.88
Mahogany, Colombian <u>Swietenia macrophylla</u>	.18	2.46	3.80	6.53
Satinwood, Ceylon <u>Chlorophora swietenia</u>	.12	5.71	8.51	14.94

¹Compare with value in table 2.

Working Characteristics

Straight-grained wood is quite easy to work, but care is required in planing either quartered boards showing stripe figure or curly- or wavy-grained material to avoid surface tearing (1). A small cutting angle is desirable for a clean finish. Avodiré makes excellent veneer, especially sliced veneer, and has fairly good nailing, screw-holding, and gluing properties. It will take an excellent finish and can be stained evenly, although because of the present popularity of its light, natural color, this is not generally desired (16). The surface can be filled and holds filler well (22). In Harrar's tests (11) on the screw-holding power of cabinet woods, avodiré showed lower values than the three other woods cited in table 4.

Table 4.--Screw-holding power of cabinet woods

Species	Withdrawal resistance of --											
	No. 6 screws						No. 10 screws					
	Side			End			Side			End		
	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Avodiré ¹ (W. Africa)												
<i>Turraeanthus africana</i>	488:	556:	424:	416:	476:	350:	560:	636:	496:	504:	574:	428
Mahogany, African												
<i>Khaya ivorensis</i>	568:	630:	484:	484:	552:	418:	666:	736:	590:	538:	616:	464
Mahogany, Colombian												
<i>Swietenia macrophylla</i>	540:	626:	474:	424:	516:	346:	624:	710:	564:	514:	588:	442
Satinwood, Ceylon												
<i>Chlorophora swietenia</i>	782:	854:	706:	664:	712:	610:	916:	1088:	780:	744:	860:	648

Uses

The figured material is usually converted into veneer for use in decorative work, such as cabinet work, paneling, interiors of railway coaches, ships' fittings (cabins on the Queen Mary), and lighter types of furniture. The plain stock may go into lumber or ordinary plywood and joinery. There is less demand for the wood as lumber because of the cross breaks and irregularities of growth (1, 14, 16, 22, 24).

Pulp from the light-colored avodiré yields paper that compares well with paper obtained from the ordinary commercial hardwoods (7).

Supplies

In the past, the Ivory Coast has been one of the main sources of log supply, especially of figured material, because logs are conveniently transported to seaports from this region. Overland transportation of logs has been poorly developed. More recently, the Gold Coast has become another of the main sources of log supply (1, 16, 22). Avodiré is not available in large amounts, but logs were imported before World War II with average girths of 5 to 6 feet and lengths up to 15 feet (16). The logs first entered the French markets soon after World War I, and not until 1923 was much shipped into German markets. Several years later, it attracted notice in England and America (22).

Minute Structure

Growth rings.--The growth rings tend to be poorly defined, sometimes indicated only by a flattening of the fibers (6, 18, 24, 29).

Vessels.--The individual vessels are relatively small, oval to nearly round in cross section, and not distinct without magnification. They are numerous, evenly distributed, solitary or in radial groups of 2 to 4 vessels. They have simple perforations. The vessels frequently contain yellowish gum but no tyloses (17, 18, 22, 29).

Rays.--The rays are fine and often indistinct without magnification. Although the marginal cells are not markedly upright, the rays are classed as heterogeneous, mostly biseriate (occasionally 3 cells wide at the middle), and may be 6 to 25 but are generally 12 to 15 cells high. Low rays, rarely over 6 cells high, are usually found to be uniseriate (18, 29). Ripple marks and gum ducts are absent (18, 29).

Parenchyma.--Parenchyma is sparingly developed about the vessels and may often contain calcium oxalate crystals (18, 29).

Fibers.--Growth zones may be somewhat defined by rows of radially flattened fibers. The fibers are libriform and nonseptate with simple pits. They have relatively thin walls. Fiber dimensions are recorded as follows: length, 1 to 2 mm. (av. 1.5 mm.); diameter, 12 to 26 mm. (av. 19 mm.) (5, 18, 24, 29).

Wood Composition

Avodiré wood is composed of ash, 4.56 percent; fats and waxes, 0.80 percent; cellulose, 62.15 percent; lignin, 32.49 percent (all on a dry-weight basis). On digestion with NaOH in 5 percent concentrations for 8 hours under a pressure of 3 kilograms, avodiré gave a light, brownish-yellow pulp, which bleached easily and yielded 37 percent of bleached pulp (5, 24).

List of References

1. Anonymous.
1940. Avodiré (Turraeanthus africana). Wood (Brit.) 5(4):87-38, April.
2. _____
1930. Nos bois Coloniaux (Côte d'Ivoire). Avodiré (Turraeanthus africana (Welw.) Pellegrin.) Assn. Colonies-Sciences et Comité Natl. des Bois Coloniaux, Paris; 4 pp.; 2 plates; 2 veneer samples.
(Rev. Tropical Woods 24:48)
3. _____
1938. Gold Coast Timbers. Pub. in connection with the Gold Coast Exhibit at the Empire Exhibition at Glasgow, Scotland; 27 pp.; 11 colored plates; 1 map.
4. Aubréville, André
1930. Essai d'Identification des Meliacées de la Côte d'Ivoire. Reprinted from Acts et Comptes Rendus de l'Assn. Colonies-Sciences (Paris) 57, 58, March, April, 15 pp.
5. Balsac, F. Heim de; Cercelet, G. S., and Balsac, R. Heim de
1925. Wood from the Ivory Coast. Bull. Agence Gen. Colonies 18, 520; Bull. Imp. Inst. 23, 482; (Cf. Chem. Abs. 20(8)1322, April 20, 1926)
6. Bergstrom, E.
1929. Avodiré (Turraeanthus africana). Natures Treasure Chest No. 3. Penrod, Jurden & Clark Co., Cincinnati, Ohio.
7. Brush, W. D. and Sparhawk, W. N.
1943. West African Timbers for Use in North America. Unpublished material in U. S. Forest Service files. U. S. Dept. of Agriculture.
8. Cooper, G. Proctor⁴
1931. Unpublished Memorandum of Turraeanthus sp. in Liberia.
9. Engler, A. and Prantl, K.
1889. Die natürlichen Pflanzenfamilien (Harms 1897) 3:4:294 and revised ed.
1912. (1940) 19 b, I.; pp. 147-150.
10. Harrar, Ellwood S.
1941. Some Physical Properties of Modern Cabinet Woods. I. Hardness. Tropical Woods 68:4, Yale Univ. School of Forestry, December 1.
11. _____
1942. Some Physical Properties of Modern Cabinet Woods. II. Screw-holding Power. Tropical Woods 70:5, Yale Univ. School of Forestry, June 1.

⁴Listed in Record's bibliography (29).

12. 1942. Some Physical Properties of Modern Cabinet Woods. III. Directional and Volume Shrinkage. Tropical Woods 71:27, Yale Univ. School of Forestry, September 1.
13. Hedin, Louis⁴
1930. Etude sur la forêt et les bois du Cameroun sous Mandat français. Paris, pp. 88, 96-97.
14. Howard, A. L.
1948. Timbers of the World. Macmillan and Co., Ltd., London. 3rd edition, pp. 50-51.
15. Hutchinson, J. & Dalziel, J. M.⁴
1928. Flora of West Tropical Africa. Vol. 1, Pt. 2, pp. 495-496.
16. Jay, B. A.
1950. Timbers of West Africa. Timber Development Assoc. Ltd., 75 Cannon St., London E.C.4, pp. 20-21.
17. Kribs, David A.
1930. Comparative Anatomy of the Woods of the Meliaceae. Amer. Jour. of Botany 17:8:724-738, October.
18. Kribs, David A.
1950. Commercial Foreign Woods on the American Market. Edward Bros., Ann Arbor, Mich., p. 116.
19. Lamb, George N.
1947. Foreign Woods, Origin, Use, Properties, and Nomenclature. Wood Products 52(12):26, December.
20. Mansell, R.
1948. Avodiré. Turraeanthus africanus Pellegr. (Meliaceae). Furniture Mfg. February 1948, pp. 28, 34.
21. Martineau,
1930. Etude sur les temperament des principales essences de la Côte d'Ivoire. Actes et Comptes Rendus de l'association Colonies-Sciences (Paris) 6:56:30-35, February.
22. Mell, C. D.
1929. Avodiré, One of the Newer, Fine Imported Woods. Veneers, Vol. XXIII, No. 9, p. 17.
23. Meniaud, J. and Bretonnet, F.⁴
1926. Les Bois Coloniaux d'Afrique dans l'Industrie. Melun, pp. 34-35.
24. Meyer, Hans
1928. Avodiré, ein Nutholz Westafrikas. Tropenpflanzer 31(1):15-16, January.

25. Meyer, Hans
1933. Book of Wood Names. (Buch der Holznamen) N. & H. Schaefer, Hannover, Germany.
26. Monnin, M. M. et Collardet, J.
1930. Etude Physique et Mécanique des Bois Coloniaux, p. 90, table III. Asso. Colonies-Sciences et Com. Natl. de Bois Coloniaux, 60, Rue Taitbout, Paris, France.
27. Normand, D.
1943. La denomination officielle des principaux bois coloniaux française. Re. Bot. App. et d'Agr. Tropical 23:260, 261, 262: 160-164.
28. Pearson, C. H. and Son Hardwood Co., Inc.⁴
1930. Avodiré. Leaflet. New York.
29. Record, S. J.
1931. West African Avodiré, (Turraeanthus africana). Tropical Woods 26:1, Yale University School of Forestry, June.
30. Roddis Plywood Corporation
1950. Characteristics of Modern Woods. 3rd edition, p. 5.
31. Schmidt, Von Eberhard
1950. Avodiré. Weltholzwirtschaft (4): Beilage Nr. 16, April, 1 colored plate.
32. Vigne, C.⁴
1931. Memorandum on "Turraeanthus spp. in the Gold Coast."

Additional Reference

- Lebacqz, L. and Istas, J. R.
1950. Les Bois des Meliacées. Annales du Musée du Congo Belge Tervuren (Belgique) Série in 8° Vol. 2, illus. (See pp. 55-59, analysis).