

Leaflet No. 9 /1991



Government of the Union of Myanmar
Ministry of Forestry
Forest Department
Forest Research Institute
Yezin



Wood Fluorescence of Indigenous Myanmar Timbers

Daw Yi Yi Han, M.Sc. (Rgn.), Deputy Research Officer
and
U Thein Kywe, M.Sc. (Rgn.), M.S. (SUNY, CESF), Research Officer
Forest Research Institute
1991

မြန်မာ့သစ်မျိုးများ၏ ရောင်ပြောင်တောက်ခြင်းကို စူးစမ်းလေ့လာခြင်း

ဒေါ်ရီရီဟန် M.Sc. (Rgn.) ဒု-သုတေသနမှူး
နှင့်

ဦးသိန်းကြွယ် M.Sc. (Rgn.), M.S. (SUNY, CESF)) သုတေသနမှူး
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

သစ်မျိုးများအား မျိုးခွဲခြားမှုတွင် အသုံးပြုနိုင်ရန်အတွက် မြန်မာ့သစ်မျိုးများ၏ ရောင်ပြောင်း
လက္ခဏာများနှင့် ၎င်းတို့၏ ထုတ်နှုတ်ပစ္စည်းများကို လေ့လာတင်ပြထားပါသည်။ ဤစာတမ်းတွင် မျိုးရင်း
(၅၁)၊ မျိုးစု(၁၃၈)ခုမှ မျိုးစိတ်(၂၃၀)မျိုးသော သစ်အင်္ဂါဗေဒ သုတေသနဌာနစိတ်ရှိ သစ်မျိုးတို့
အနှစ်သားများ နှင့် ၎င်းတို့၏ရေနှင့် အီသနော ထုတ်နှုတ်ပစ္စည်းများကို လှိုင်းရှည်ခရမ်းလွန်ရောင်ခြည်
အောက်တွင် လေ့လာတင်ပြထားခြင်းဖြစ်ပါသည်။ သုတေသန ရလဒ်များမှ တွေ့ရှိရသည့်
ရောင်ပြောင်တောက်သော လက္ခဏာသည် သစ်သားများအား မျိုးခွဲခြားရာတွင် အသုံးဝင်ပြီးလျှင်မြန်၍
လွယ်ကူသောနည်း ဖြစ်ကြောင်း သိရှိရပါသည်။

Wood Fluorescence of Indigenous Myanmar Timbers

Daw Yi Yi Han M.Sc. (Rgn.), Deputy Research Officer

and

U Thein Kywe M.Sc. (Rgn.), M.S (SUNY, CESF), Research Officer,
Forest Research Institute .

Abstract

The Fluorescence Characteristic of Indigenous Myanmar Timbers and their extracts were studied to determine their value in wood identification. In this paper heartwood specimens and water and ethanol extracts of altogether 230 species representing 138 genera and 51 families from Wood Anatomy Research Section were examined in Longwave ultra violet light. These results showed that fluorescence is useful characteristic in wood identification and may be applied as a rapid and easy test to verify certain identification

Contents

	Page
စာတမ်းအကျဉ်းချုပ်	i
Abstract	ii
1. Introduction	1
2. Materials and Methods	1
Heart wood fluorescence	2
Froth test determine the presence of natural saponins	2
Water extract colour	2
Ethanol extract fluorescence	2
Ethanol extract colour	2
3. Results and Discussion	2
4. References	

1. Introduction

The use of ultraviolet light to study the fluorescence characteristics of wood was started many years ago when Goppelsroder studied the fluorescence of extracts of Javanese woods in 1867 (Vodrazka, 1929). These observations were also made in 1921 and concerned the fluorescence of aqueous extracts of *Aesculus hippocastanum* and *Fraxinus excelsior* (Stone, 1921). Similar observations were made on Philippines and Formosan timbers (Kanehira, 1921) and also on some Indian woods (Brown, 1925), while fluorescence studies of the genus *Acacia*, *Ailanthus* and *Rhus* were conducted by Radley and Grant (1933).

The possibility of using fluorescence as a tool in timber identification was formulated by Krishna and Chowdury (1935). These authors studied 100 samples coming from 9 different species of Indian timbers and gave some indications about the chemical origin of fluorescent substances present in the timbers. They also suggested to correlate fluorescence with specific delimitation, age, period of felling and provenance of the trees.

Wood fluorescence has been used for a wide range of applications. These include the distinction of sapwood from heartwood, the study of growth rings, the detection of lignification, the identification of diseased wood (Vodrazka, 1929; Radley and Grant, 1948). More recently Tsoumis (1968) and Panshin and De Zeeuw (1970) gave a short account of wood fluorescence. Vodrazka remarked on the usefulness of wood fluorescence in macro and microscopic studies using three examples: *Robinia pseudoacacia*, *Ailanthus grandulosa* and *Rhus typhina*. He studied the heartwood fluorescence in addition to fluorescence in water, alcohol and acetone extracts. An additional 40 wood species are listed by him as being fluorescent. These include the genera *Rhus*, *Acacia*, *Suartzia* and *Erythrophleum*.

Giordano (1971) gave the first important list of fluorescent timbers concerning 110 species belonging to 31 different families. Miller (1981) introduced fluorescence as a criterion in the computer assisted identification of timbers. Miller and Bass (1981) incorporated the fluorescence of heartwood and its extracts in the IAWA standard list of characters suitable for computerized hardwood identification.

Quirk (1983) used the fluorescence of aqueous and ethanol extracts for computer - assisted identification of 13 genera of tropical, commercially important leguminosae. Dyer (1988) has studied fluorescence of South African hardwoods and their extracts to determine its value in wood identification. Very recently Avella Dechamps and Bastin (1988) has also studied fluorescence of Woody species from the Tervuren collection, Belgium. Therefore the attention of anatomists has been focused on this characteristics as a helpful tool in computer - assisted wood identification. This type of study using Myanmar species have not been carried out previously.

The objective of this study was to assess the presence of UV fluorescence in Myanmar woods with the view to using the results for separating closely related species which show differences in fluorescence.

2. Materials and Methods

All the wood specimens included in the present study were representative of the collection of Myanmar timbers of Wood Anatomy Laboratory, Forest Research Institute, Yezin. Altogether 453 specimens representing 138 genera and 230 species were tested. For each species, the number of observed specimens was two to five, but in a number of cases only a single specimen was available. Where possible, five or more replicates of each species were tested.

All tests were carried out according to the methods prescribed by Miller (1981), with minor modification.

Heartwood fluorescence

Heartwood fluorescence was determined by removing some shavings with a file and studying the freshly exposed surface under longwave UV lights. The specimens were recorded as either fluorescent (colour given) or not fluorescent. Only samples which exhibited a definite yellow and yellowish-green fluorescence were recorded as being fluorescent.

Froth test determine the presence of natural saponins.

Approximately 5 ml of sawdust were removed by shaving from each sample, placed in a vial and covered with 10 ml of distilled water which buffered at a P^H of 6.8. Then they were shaken vigorously for 10 to 15 seconds, and immediately viewed under UV light to check for water extract fluorescence. One minute after shaking, the froth (if present) formed by the water extract was recorded as follows: Positive (+) if froth was still present and completely covered the surface of the solution, negative (-) if all froth had disappeared, and variable (V) if froth was present, but only around the edge of the test tube and did not cover the entire surface.

Water extract fluorescence

Immediately after shaking the extract for the froth test, the solution was examined under ultraviolet light. Extracts with fluorescence exhibits definite blue, green, yellow, yellowish-green, brown and purplish-blue colours. Some extracts showed positive fluorescence but the colours were weaker.

Water extract colour

After completing the froth test, the extracts were boiled for approximately one minute, and the extract colour recorded as brown, yellow reddish-brown, yellowish-green, greenish-brown, colourless or none of these as in Miller (1981).

Ethanol extract fluorescence

The method for this test was similar to that for water extract fluorescence, except that 95 % ethanol was used instead of water. The recording was the same as for the test for water extract fluorescence.

Ethanol extract colour

The same method as that for water extract colour was used.

3. Results and Discussion

The list of families, indicating for each of them, the number of genera, species and various tested colours are given in Table 1. Out of 51 families tested for the heartwood fluorescences, 3 were positive. The fluorescence colours was yellow and yellowish-green and the colours varied in intensity.

The species which exhibit bright fluorescence in heartwood are shown in Table 2. The majority of the genera tested of the Anacardiaceae and Mimosaceae were positive for

this test. The results correspond with those of Miller (1981) who indicated that the heart wood of the species of Leguminosae (Mimosaceae) and Anacardiaceae fluoresce. Therefore heart wood fluorescence is a rapid test that can be useful in macroscopic identification or in verifying a microscopic identification.

In the forth test for natural saponins in wood, the most intense reactions were found with *Acacia*, *Albizia* and some other species of Leguminosae (Mimosaceae). The water extracts of these specimens produced large amounts of foam when shaken. Other families of which, the majority or some of the genera tested positive, are Caesalpiniaceae, Papilionaceae, Anacardiaceae, Apocynaceae, Dipterocarpaceae, Rubiaceae, Combretaceae, Meliaceae and Sterculaceae.

Water extract fluorescence was encountered more frequently than heartwood fluorescence as mentioned by Dyer (1988). The colour reactions were variable as brown, green, blue, yellow, bluish-green, greenish-yellow, yellowish-green, greenish-brown and purplish-blue. Nineteen species exhibited a brilliant water extract fluorescence as shown in Table 3.

The results produced by water extract colour test showed that dark-coloured wood had reddish-brown, green, dark green and brownish-yellow and light coloured woods produced colourless or yellow extracts. However, these are a few interesting exceptions, which are important for identification.

Salmalia malabarica (Bombacaceae) and *Gmelina arborea* (Verbenaceae), both had yellowish-white or light yellowish-brown wood but produced distinct bright green and dark green extracts which are unexpected characters for these woods. Species which also have a distinct, bright green coloured water extract are *Diospyros kaki* (Ebenaceae) and *Litsaea glutinosa* (Lauraceae). However, in the case of *Tetrameles nudiflora* (Datisceae), a green (milky) water extract is an important character for the identification.

In accordance with the results of ethanol extract fluorescence test, it is found that this test had more interesting and colourful reactions than both heartwood and water extract tests. Out of 51 families tested, 42 have positive testing species. The fluorescence colours were blue, green, purple, bluish-green, brownish-green and purplish-blue. The most significant results are listed in Table 4. The results obtained from this tests indicated that the ethanol extract fluorescence is particularly useful for identification purposes.

The colours of the ethanol extracts of the wood tested, were similar or slightly darker or lighter than the colours of the water extracts. However, there were a number of species of which the colour of the ethanol extract was completely different to that of water extract as shown in Table 5 and it could be useful in identification.

As shown in Table 6, it appears that 8 species are clearly fluorescent. This represent 3.5 % of the total species examined. Therefore it is hoped that the present investigation is a preliminary survey and a pilot study to give more information about this characteristics and to try to establish some general trends in the relationships for fluorescence between family and between genus.

Table 1. Fluorescence Characteristics of indigenous Myanmar Hardwoods.

SPECIES	Number of samples tested	Heartwood fluoresc.	Froth test; Positive (+) Negative (-) Variable (v)	Water extract fluoresc.	Water extract colour	Ethanol extract fluoresc.	Ethanol extract colour
ANACARDIACEAE							
<i>Buchanania lacifolia</i>	1	-	-	bluish green	green	light blue	light blue
<i>Buchanania lantifolia</i>	2	-	V	yellowish green	pale green	light blue	blue
<i>Lannea grandis</i>	1	-	+	brown	brown	brown	brown
<i>Mangifera indica</i>	1	-	+	green	green	green	green
<i>Melanorrhoea usitata</i>	4	yellowish green	+	yellowish brown	reddish brown	bright green	bright green
<i>Odina wodier</i>	4	-	-	green	green	light blue	blue
<i>Spondia mangifera</i>	3	-	-	light green	light green	-	colourless
<i>Swintonia floribunda</i>	3	yellow	+	-	brown	light green	light green
ANNONACEAE							
<i>Miliusa roxburghiana</i>	1	-	+	greenish yellow	greenish yellow	-	colourless
<i>Miliusa velutina</i>	3	-	V	light green	green	light green	light green
APOCYNACEAE							
<i>Alstonia scholaris</i>	2	-	V	bluish green	bluish green	-	colourless
<i>Holarrhena antidysenterica</i>	2	-	+	yellowish green	yellowish green	-	colourless
<i>Plumeria alba</i>	1	-	+	green	dark green	-	colourless
BARRINGTONIACEAE							
<i>Careya arborea</i>	3	-	+	-	colourless	-	colourless
BETULACEAE							
<i>Alnus nepalensis</i>	1	-	-	-	colourless	-	light blue
<i>Betula alnoides</i>	2	-	-	-	colourless	-	light blue
BIGNONIACEAE							
<i>Heterophragma odonoseem</i>	1	-	+	purplish blue	purplish blue	yellow	yellow
<i>Markhamia stipulata</i>	2	-	V	green	bluish green	bluish green	light green
<i>Oroxylum indicum</i>	3	-	V	light green	blue green	bluish green	bluish green
<i>Stereospermum personatum</i>	2	-	V	green	green	bluish green	bluish green
<i>Stereospermum suaveolens</i>	1	-	V	dark green	dark green	blue	blue
BOMBACACEAE							
<i>Ceiba pentandra</i>	1	-	V	bright green	bright green	light green	light green
<i>Salmalia insignis</i>	1	-	V	bright green	bright green	light green	light green
<i>Salmalia malabarica</i>	2	-	V	bright green	bright green	light blue	light blue

<i>SPECIES</i>	Number of samples tested	Heartwood fluoresc.	Froth test; Positive (+) Negative (-) Variable (v)	Water extract fluoresc.	Water extract colour	Ethanol extract fluoresc.	Ethanol extract colour
<i>BURSERACEAE</i>							
<i>Garuga pinnatea</i>	4	-	-	bluish green	dark green	light blue	light blue
<i>Protium serratum</i>	9	-	-	bright green	dark green	purple	purple
<i>CAPPARIDACEAE</i>							
<i>Crataeva religiosa</i>	1	-	V	bluish green	light green	light blue	light blue
<i>Crataeva roxburghii</i>	3	-	V	light blue	light blue	light blue	light blue
<i>CELASPRACEAE</i>							
<i>Euonoymus tingens</i>	1	-	+	green	dark green	light blue	light blue
<i>Lophopetalum wallichii</i>	2	-	+	green	dark green	light blue	light blue
<i>COMBRETACEAE</i>							
<i>Anogeissus acuminata</i>	3	-	v	greenish brown	greenish brown	purple	purple
<i>Terminalia belleric</i>	5	-	-	greenish brown	greenish	white (milky)	white (milky)
<i>Terminalia bialata</i>	1	-	v	brown	brown	white (milky)	white (milky)
<i>Terminalia chebula</i>	5	-	v	greenish yellow	brown	light blue	light blue
<i>Terminalia citrine</i>	1	-	+	greenish yellow	brown	light blue	light blue
<i>Terminilia oilveri</i>	2	-	-	brown	brown	light blue	light blue
<i>Terminilia pyrifolia</i>	3	-	v	greenish yellow	greenish yellow	light blue	light blue
<i>Terminalia tomentosa</i>	5	-	v	green	brown	purple	purple
<i>CORDIACEAE</i>							
<i>Cordia brunnea</i>	2	-	v	bright green	bright green	bluish green	bluish green
<i>Cordia fragrantissima</i>	2	-	v	dark green	dark green	bluish green	bluish green
<i>CORNACEAE</i>							
<i>Cornus oblonga</i>	1	-	-	light green	greenish brown	purple	purple
<i>CRYPTERONIACEAE</i>							
<i>Crypteronia paniculata</i>	1	-	v	bluish green	bluish green	purple	purple
<i>DATISCACEAE</i>							
<i>Tetrameles nudiflora</i>	4	-	+	green	green(milky)	light blue	light blue
<i>DILLENIAEAE</i>							
<i>Dillenia indica</i>	1	-	-	green	green	light blue	light blue
<i>Dillenia parkinsonii</i>	1	-	-	green	green	light blue(milky)	light blue (milky)
<i>Dillenia parviflora</i>	1	-	-	green	greenish brown	purple	purple
<i>Dillenia pentagyna</i>	2	-	-	green	green	light blue	light blue
<i>Dillenia pulcherrima</i>	1	-	v	-	colourless	-	colourless

SPECIES	Number of samples tested	Heartwood fluoresc.	Froth test; Positive (+) Negative (-) Variable (v)	Water extract fluoresc.	Water extract colour	Ethanol extract fluoresc.	Ethanol extract colour
<i>DIPTEROCARPACEAE</i>							
<i>Anisoptera glabra</i>	1	-	+	-	colourless	purple	purple
<i>Anisoptera oblonga</i>	1	-	+	light green	green	milky white	blue green
<i>Anisoptera scaphula</i>	1	-	-	green	green	milky purple	milky purple
<i>Dipterocarpus alatus</i>	3	-	v	green	green	light blue	light blue
<i>Dipterocarpus obtusifolius</i>	2	-	+	dark green	dark green	purple (milky)	purple (milky)
<i>Dipterocarpus tuberculatus</i>	6	-	+	dark green	dark green	purple (milky)	purple (milky)
<i>Dipterocarpus turbinatus</i>	1	-	-	green	green	purple	purple
<i>Hopea adorata</i>	1	-	+	green	green	light blue	milky blue
<i>Parashorea stellata</i>	4	-	v	green	dark green	purple (milky)	purple (milky)
<i>Pentacme siamensis</i>	1	-	-	-	colourless	purple (milky)	purple (milky)
<i>Pentacme suavis</i>	2	-	+	dark green	dark brownish green	purple (milky)	purple (milky)
<i>Shorea assamica</i>	1	-	v	green	green	purple	purple
<i>Shorea oblongifolia</i>	2	-	v	yellowish green	green	purple	purple
<i>EBENACEAE</i>							
<i>Diospyros burmanica</i>	1	-	v	-	colourless	-	colourless ss
<i>Diospyros chretioides</i>	4	-	v	-	colourless	-	colourless ss
<i>Diospyros glandulosa</i>	1	-	v	green	colourless	-	light blue
<i>Diospyros kaki</i>	1	-	-	bright green	bright green	light blue	light blue

SPECIES	Number of samples tested	Heartwood fluoresc.	Froth test; Positive (+) Negative (-) Variable (v)	Water extract fluoresc.	Water extract colour	Ethanol extract fluoresc.	Ethanol extract colour
<i>Diospyros montana</i>	1	-	+	-	green	blue(milky)	blue (milky)
<i>Diospyros pendula</i>	1	-	+	-	pale green	-	pale green
<i>Diospyros virginia</i>	1	-	-	light green	light green	light blue	light blue
ELAEOCARPACEAE							
<i>Elaeocarpus lanceaefolius</i>	2	-	V	-	colourless	-	colourless
EUPHORBIACEAE							
<i>Aporosa planchoniana</i>	1	-	v	green	green	light blue	light blue
<i>Aporosa villosa</i>	2	-	-	blue green	blue green	light blue	light blue
<i>Bridelia retusa</i>	3	-	-	-	Colourless	purple	purple
<i>Croton oblongifolius</i>	2	-	-	bluish green	bluish green	light blue	light blue
<i>Excoecaria agallocha</i>	1	-	-	bluish green	blue green	light purple	light purple
<i>Phyllanthus emblica</i>	2	-	-	-	Colourless	purple	purple
FAGACEAE							
<i>Quercus serrata</i>	1	-	+	bluish green	Green	light blue	light blue
FLACOURTIACEAE							
<i>Flacourtia cataphrocta</i>	1	-	+	-	Brown	-	white (milky)
<i>Homalium tomentosum</i>	2	-	v	green	Green	light blue	light blue
<i>Hydnocarpus kurzii</i>	1	-	v	bluish green	bluish green	bluish green	bluish green
<i>Garcinia cowa</i>	1	-	v	bluish green	Colourless	-	colourless
<i>Garcinia paniculata</i>	1	-	v	bluish green	Colourless	-	colourless
<i>Mesua femca</i>	3	-	v	blue	blue (milky)	purple	colourless
HYPERICIACEAE							
<i>Cratoxylon neriifolium</i>	1	-	-	bluish green	bluish green	-	colourless
<i>Cratoxylon prunifolium</i>	1	-	-	-	Colourless	-	colourless
JUGLANDACEAE							
<i>Engelhardtia spicata</i>	2	-	v	-	Colourless	-	colourless
LAURACEAE							
<i>Cinnamomum iners</i>	1	-	-	bluish green	bluish green	light blue	light blue
<i>Cinnamomum inunctum</i>	2	-	-	bluish green	Colourless	light blue	light blue
<i>Cinnamomum nitidum</i>	1	-	v	bluish green	Green	light blue	light blue
<i>Cinnamomum obtusifolium</i>	1	-	-	grey	Purple	purple	purple
<i>Lindera caudata</i>	1	-	-	bluish green	Colourless	-	light blue
<i>Litsaea amora</i>	1	-	-	bluish green	Colourless	light blue	colourless
<i>Litsaea glutinosa</i>	1	-	-	bright green	bright green	light blue	light blue
<i>Persea lingue</i>	1	-	-	bluish green	Colourless	light blue	light blue
MIMOSACEAE							
<i>Acacia arabica</i>	2	-	+	bluish green	Green	-	colourless
<i>Acacia catechu</i>	5	-	+	brownish green	brownish green	brownish green	brownish green

SPECIES	Number of samples tested	Heartwood fluoresc.	Froth test; Positive (+) Negative (-) Variable (v)	Water extract fluoresc.	Water extract colour	Ethanol extract fluoresc.	Ethanol extract colour
<i>Acacia leucophloea</i>	2	-	+	green	green	greenish white	greenish white
<i>Acacia pennata</i>	1	-	+	-	greenish-brown	bluish white	bluish white
<i>Adenanthera pavonina</i>	1	yellow	v	dark green	dark yellowish green	yellowish green	bright yellowish green
<i>Albizzia chinensis</i>	3	yellow	+	bluish green	bluish green	bluish green	light blue
<i>Albizzia lebbek</i>	2	yellowish green	+	yellowish brown	dark brown	yellowish green	dark green
<i>Albizzia lucida</i>	1	-	+	light blue	light blue	light blue	light blue
<i>Albizzia adoratissima</i>	4	yellowish green	+	yellowish brown	greenish brown	greenish yellow	greenish yellow
<i>Albizzia procera</i>	4	yellow	+	dark yellowish green	dark yellowish green	yellowish green	bright yellowish green
<i>Samanea saman</i>	2	-	+	blue green	bluish white	-	colourless
<i>Xylia dolabriformis</i>	6	-	+	bluish green	greenish brown	brownish green	brownish green
CAESALPINIACEAE							
<i>Bauhinia malabarica</i>	1	-	v	bluish green	green	-	colourless
<i>Bauhinia nariagata</i>	1	-	+	bluish green	colourless	-	colourless
<i>Bauhinia purpurea</i>	1	-	v	-	colourless	light blue	light blue
<i>Bauhinia racemosa</i>	1	-	v	dark green	dark green	-	colourless
<i>Cassia fistula</i>	2	-	-	lightblue (milky)	light blue (milky)	purple	purple
<i>Cassia renigera</i>	1	-	v	dark green	dark green	blue (mikly)	blue (mikly)
<i>Cassia siamea</i>	2	-	v	bluish green	colourless	yellowish brown	yellowish brown
<i>Cynometra ramiflora</i>	1	-	v	bluish green	colourless	bluish green	bluish green
PAPILIONACEAE							
<i>Butea frondosa</i>	1	-	v	light green	light green	purple	purple
<i>Butea monosperma</i>	1	-	v	-	colourless	-	colourless
<i>Dalbergia cultrata</i>	4	-	+	green	green	dark green	dark green
<i>Dalbergia fusca</i>	1	-	-	green	green	purple	purple
<i>Dalbergia oliveri</i>	6	-	v	bluish green	bluish green	purple	purple
<i>Dalbergia ovata</i>	2	-	+	green	green	-	colourless
<i>Dalbergia sisoo</i>	1	-	v	green	green	blue	blue
<i>Derris robusta</i>	1	-	v	-	colourless	purple	purple
<i>Erythrina lithosepima</i>	2	-	-	-	colourless	purple	purple
<i>Erythrina suberosa</i>	3	-	v	-	colourless	publish white	publish white
<i>Millettia pendula</i>	5	-	+	green	green	purple (milky)	purple (milky)
<i>Millettia piscidia</i>	1	-	-	whitish blue	whitish blue	white (milky)	white (milky)
<i>Pongamia glabra</i>	1	-	+	blue green	green	-	bluish white

SPECIES	Number of samples tested	Heartwood fluoresc.	Froth test; Positive (+) Negative (-) Variable (v)	Water extract fluoresc.	Water extract colour	Ethanol extract fluoresc.	Ethanol extract colour
<i>Pterocarpus macrocarpus</i>	4	-	+	green	green	white (mikly)	white (mikly)
<i>Pterocarpus santalinus</i>	2	-	v	green	dark green	purple	purple
<i>Sesbania grandiflora</i>	1	-	v	bluish green	bluish green	purple	purple
LYTHRACEAE							
<i>Duabanga grandiflora</i>	2	-	-	dark green	dark green	purple	purple
<i>Lagerstroemia calyculata</i>	1	-	-	light blue	light blue	colourless	-
<i>Lagerstroemia flos-reginae</i>	1	-	-	-	colourless	purplish white	purplish white
<i>Lagerstroemia hypoleuca</i>	1	-	-	bluish green	bluish green	-	colourless
<i>Lagerstroemia macrocarpa</i>	1	-	+	pale green	pale green	-	colourless
<i>Lagerstroemia parviflora</i>	1	-	v	colourless	-	purple	purple
<i>Lagerstroemia speciosa</i>	3	-	-	blue green	blue green	-	colourless
<i>Lagerstroemia tomentosa</i>	4	-	-	bluish green	dark green	whitish purple	whitish purple
<i>Lagerstroemia venusta</i>	1	-	-	-	colourless	whitish purple	whitish purple
<i>Lagerstroemia villosa</i>	3	-	v	bluish green	dark green	whitish purple	whitish purple
<i>Sonneratia apetala</i>	2	-	-	bluish green	dark green	-	colourless
<i>Sonneratia griffithii</i>	1	-	-	-	colourless	-	colourless
MAGNOLIACEAE							
<i>Michelia baillonii</i>	1	-	+	bluish green	bluish green	pale green	yellowish green
<i>Michelia champaca</i>	3	-	v	bluish green	bluish green	green	green
<i>Michelia velutina</i>	1	-	v	pale green	pale green	pale green	pale green
<i>Talauma spongocarpa</i>	1	-	v	green (mikly)	green	green	green
MALVACEAE							
<i>Thespesia populnea</i>	1	-	-	-	brown	brown	brown
MELIACEAE							
<i>Amoora rohituka</i>	1	-	v	blue green	colourless	purple	purple
<i>Amoora wallichii</i>	1	-	v	blue green	colourless	purple	purple
<i>Carapa moluccensis</i>	3	-	-	-	colourless	-	colourless
<i>Carapa obovata</i>	2	-	-	green	dark green	light green	light green
<i>Cedrela febrijuga</i>	1	-	v	blue green	blue green	light blue	light blue
<i>Cedrela serrata</i>	2	-	v	green	dark green	blue	blue
<i>Cedrela toona</i>	2	-	-	-	colourless	-	colourless
<i>Chukrasia tabularis</i>	3	-	-	green	colourless	blue	whitish blue
<i>Melia burmanica</i>	2	-	v	blue green	colourless	-	colourless
<i>Melia dubia</i>	1	-	v	-	colourless	-	colourless
<i>Swietenia macrophylla</i>	1	-	v	-	colourless	-	colourless
MORACEAE							
<i>Artocarpus chaplasha</i>	2	-	v	blue (milky)	green	blue (milky)	blue (milky)

SPECIES	Number of samples tested	Heartwood fluoresc.	Froth test; Positive (+) Negative (-) Variable (v)	Water extract fluoresc.	Water extract colour	Ethanol extract fluoresc.	Ethanol extract colour
<i>Artocarpus heterophyllus</i>	1	-	v	blue (milky)	green	purple	purple
<i>Artocarpus lakoocha</i>	4	-	v	blue (milky)	blue (milky)	purple	purple
MYRTACEAE							
<i>Eucalyptus citriodora</i>	1	-	-	green	green	-	colourless
<i>Syzygium cumini</i>	2	-	+	green	green	purple	purple
OLACACEAE							
<i>Strombosia javanica</i>	1	-	+	light blue	light blue	light blue	light blue
OLEACEAE							
<i>Schrebera swietenoides</i>	1	-	-	green	green	whitish purple	whitish purple
PROTEACEAE							
<i>Grevillea robusta</i>	3	-	-	green	green	-	colourless
RHIZOPHORACEAE							
<i>Bruguiera cylindrica</i>	1	-	v	-	colourless	purple	purple
<i>Bruguiera gymnorhiza</i>	2	-	-	-	colourless	-	colourless
<i>Carallica brachiata</i>	2	-	v	-	colourless	whitish purple	whitish purple
<i>Rhizophora mucronata</i>	2	-	-	reddish brown	reddish brown	light green	light green
ROSACEAE							
<i>Eriobotrya petiolata</i>	1	-	v	green	green	-	colourless
<i>Prunus acuminata</i>	1	-	-	green	green	-	colourless
<i>Prunus cerasoides</i>	1	-	v	green	colourless	-	colourless
RUBIACEAE							
<i>Adina cordifolia</i>	3	-	-	blue (milky)	blue (milky)	-	colourless
<i>Anthocephalus cademba</i>	1	-	+	green	green	green	green
<i>Gardenia coronaria</i>	1	-	+	brown	brown	purplish white	purplish white
<i>Hymenodictyon excelsum</i>	7	-	v	green	green	purplish white	purplish white
<i>Mitragyna diversifolia</i>	1	-	-	blue	blue	purple	purple
<i>Mitragyna parvifolia</i>	1	-	v	purplish blue	purplish blue	purple	purple
<i>Mitragyna rotundifolia</i>	1	-	v	blue (milky)	blue (milky)	purple	purple
<i>Morinda tinctoria</i>	1	-	v	green	green	-	colourless
<i>Nauclea excelsa</i>	1	-	+	green	green	purple	purple
<i>Nauclea orientalis</i>	3	yellow	v	green	green	blue	blue
<i>Neonauclea sessilifolia</i>	1	-	+	bluish green	bluish green	purplish blue	purplish blue
<i>Morinda tinctoria</i>	1	-	v	purplish blue	purplish blue	purple	purple
RUTACEAE							
<i>Aegle marmelos</i>	1	-	v	bluish green	colourless	-	colourless
<i>Limonia acidissima</i>	1	-	-	light blue	light blue	light blue	light blue
<i>Zanthoxylum budrunga</i>	1	-	+	bluish green	bluish green	purple	purple
<i>Zanthoxylum oxyphyllum</i>	1	-	v	light greenish brown	light greenish brown	white	white

SPECIES	Number of samples tested	Heartwood fluoresc.	Froth test; Positive (+) Negative (-) Variable (v)	Water extract fluoresc.	Water extract colour	Ethanol extract fluoresc.	Ethanol extract colour
<i>SALICACEAE</i>							
<i>Salix tetrasperma</i>	4	+	-	light blue	light blue	-	colourless
<i>SAPINDACEAE</i>							
<i>Schleichera oleosa</i>	5	-	v	pale green (milky)	green	-	colourless
<i>Turpinia pomifeta</i>	1	-	v	pale green (milky)	colourless	purple	purple
<i>SAPOTACEAE</i>							
<i>Madhuca longifolia</i>	1	-	-	bluish green	bluish green	light blue	light blue
<i>Mimusops elengi</i>	1	-	+	light green	colourless	-	colourless
<i>Palaquium polyanthum</i>	1	-	+	pale green	colourless	-	colourless
<i>Sideroxylon tomentosum</i>	1	-	+	light green	colourless	-	colourless
<i>STERCULIACEAE</i>							
<i>Firmiana colorata</i>	2	-	v	green	browish yellow	-	colourless
<i>Heritica fomes</i>	1	-	v	bluish green	colourless	bluish green	bluish green
<i>Heritica pures</i>	1	-	v	-	colourless	-	colourless
<i>Mansonia gagei</i>	1	-	v	blue green	green	blue green	green
<i>Pterospermum accrifolium</i>	2	-	v	-	colourless	-	colourless
<i>Pterospermum semisagittatum</i>	5	-	-	bluish green	-	whitish blue	whitish blue
<i>Sterculia campanulata</i>	1	-	v	light green	light green	colourless	colourless
<i>Sterculia versicolor</i>	1	-	v	bright green	green	green	green
<i>Tarrietia javanica</i>	1	-	-	blue green	colourless	blue green	colourless
<i>STRYCHACEAE</i>							
<i>Strychnus nux-blanda</i>	6	-	+	pale green	pale green	whitish blue	whitish blue
<i>Strychnus potatorum</i>	1	-	+	whitish blue	light blue	whitish blue	light blue
<i>THEACEAE</i>							
<i>Anneslea fragrans</i>	3	-	+	yellowish green	yellowish green	whitish purple	whitish purple
<i>Eurya acuminata</i>	1	-	v	bluish green	bluish green	light blue	light blue
<i>Schima wallichii</i>	4	-	+	light green	colourless	-	colourless
<i>TILIACEAE</i>							
<i>Berrya ammonilla</i>	2	-	-	bright green	bright green	light blue	light blue
<i>Columbia floribunda</i>	1	-	-	-	colourless	Purplish blue	Purplish blue
<i>Grewia microcostemma</i>	2	-	-	blue green	blue green	light blue	light blue
<i>Grewia tiliaefolia</i>	1	-	-	bright green	bright green	blue	blue
<i>Pentace burmanica</i>	2	-	-	green	green	bluish green	bluish green
<i>Pentace griffithii</i>	2	-	-	blue green	blue green	Purplish blue	Purplish blue
<i>ULMACEAE</i>							
<i>Holoptelea integrifolia</i>	3	-	-	pale green	pale green	blue	blue

SPECIES	Number of samples tested	Heartwood fluoresc.	Froth test; Positive (+) Negative (-) Variable (v)	Water extract fluoresc.	Water extract colour	Ethanol extract fluoresc.	Ethanol extract colour
<i>Ulmus cmapestris</i>	1	-	-	blue	blue	Purplish blue	Purplish blue
VERBENACEAE							
<i>Avicennia officinalis</i>	3	-	+	blue green	green	whitish blue	whitish blue
<i>Gmelina arborea</i>	6	-	-	dark green	dark green	light blue	light blue
<i>Lantana aculeata</i>	1	-	-	light green	yellowish green	colourless	colourless
<i>Premna latifolia</i>	1	-	-	yellow	yellow	-	colourless
<i>Premna pyramidata</i>	1	-	-	yellow	yellow	-	colourless
<i>Tectona grandis</i>	12	-	-	light green	colourless	yellowish green	yellowish green
<i>Tectona hamiltoniana</i>	4	-	-	light blue	colourless	light green	whitish blue
<i>Vitex glabrata</i>	1	-	-	-	-	whitish blue	whitish blue
<i>Vitex limonifolia</i>	1	-	v	yellow	yellow	-	colourless
<i>Vitex peduncularis</i>	1	-	-	-	colourless	-	colourless
<i>Vitex pubescens</i>	6	-	-	yellow	yellow	-	colourless

Table 2. Species which exhibit bright fluorescence in heartwood.

Species	Family	Colour
<i>Melanorrhoea usitata</i>	Anacardiaceae	Yellowish -green
<i>Swintonia floribunda</i>	Anacardiaceae	Yellow
<i>Adenantha pavonina</i>	Mimosaceae	Yellow
<i>Albizzia chinensis</i>	Mimosaceae	Yellow
<i>Albizzia lebbek</i>	Mimosaceae	Yellow - green
<i>Albizzia procera</i>	Mimosaceae	Yellowish
<i>Albizzia odoratissima</i>	Mimosaceae	Yellowish -green
<i>Nauclea orientalis</i>	Rubiaceae	Yellow

Table 3. Species which show a brilliant water extract fluorescence .

Species	Family	Colour
<i>Spondias mangifera</i>	Anacardiaceae	Bluish -green
<i>Miliusa roxburghiana</i>	Anonaceae	Greenish -yellow
<i>Alstonia scholaris</i>	Apocynaceae	Bluish -green
<i>Holarrhena antidyseantica</i>	Apocynaceae	Yellowish- green
<i>Salmalia malabarica</i>	Bombacaceae	Bright -green
<i>Terminalia acuminata</i>	Combretaceae	Greenish -brown
<i>Terminalia bellerica</i>	Combretaceae	Greenish -brown
<i>Terminalia chebula</i>	Combretaceae	Greenish -yellow
<i>Terminalia pyrifolia</i>	Combretaceae	Greenish -yellow
<i>Dipterocarpus obtusifolius</i>	Dipterocarpaceae	Dark -green
<i>Dipterocarpus tuberculatus</i>	Dipterocarpaceae	Dark -green
<i>Pentacme suavis</i>	Dipterocarpaceae	Dark -green
<i>Diospyros kaki</i>	Ebenaceae	Bright -green
<i>Bauhinia racemosa</i>	Caesalpiniciaeae	Dark -green
<i>Cassia renigera</i>	Caesalpiniciaeae	Dark -green
<i>Adenantha pavonina</i>	Mimosaceae	Dark -green
<i>Albizzia procera</i>	Mimosaceae	Yellowish- green
<i>Duabanga grandiflora</i>	Lythraceae	Dark- green
<i>Gmelina arborea</i>	Verbenaceae	Dark- green

Table 4. Species with exceptionally bright ethanol extract fluorescence .

Species	Family	Colour
<i>Melanorrhoea usitata</i>	Anacardiaceae	Bright -green
<i>Protium serratum</i>	Burseraceae	Purple
<i>Anogeissus acuminata</i>	Combretaceae	Purple
<i>Terminalia tomentosa</i>	Combretaceae	Purple
<i>Cornus oblonga</i>	Cornaceae	Purple
<i>Bridelia retusa</i>	Euphorbiaceae	Purple
<i>Phyllanthus emblica</i>	Euphorbiaceae	Purple
<i>Mesua ferrea</i>	Guttiferae	Purple
<i>Adenanthera pavonina</i>	Mimosaceae	Yellowish -green
<i>Albizzia lebbek</i>	Mimosaceae	Yellowish -green
<i>Albizzia odoratissima</i>	Mimosaceae	Greenish-yellow
<i>Albizzia procera</i>	Mimosaceae	Yellowish -green
<i>Dalbergia cultrata</i>	Papilionaceae	Purple
<i>Dalbergia oliveri</i>	Papilionaceae	Purple
<i>Erythrina lithosperma</i>	Papilionaceae	Purple
<i>Pterocarpus santalinus</i>	Papilionaceae	Purple
<i>Sesbania grandiflora</i>	Papilionaceae	Purple
<i>Gypteronia panaculata</i>	Lythraceae	Purple
<i>Duabanga grandiflora</i>	Lythraceae	Purple
<i>Lagerstroemia parviflora</i>	Lythraceae	Purple
<i>Talauma spangocarpa</i>	Magnoliaceae	Green
<i>Amoora rohituka</i>	Meliaceae	Purple
<i>Amoora wallichii</i>	Meliaceae	Purple
<i>Artocarpus heterophyllus</i>	Moraceae	Purple
<i>Artocarpus lakoocha</i>	Moraceae	Whitish /Purple
<i>Bruguiera cylindrica</i>	Rhizophoraceae	Purple
<i>Mitragyna diversifolia</i>	Rubicaceae	Purple
<i>Mitragyna parviflora</i>	Rubicaceae	Purple
<i>Mitragyna rotundifolia</i>	Rubicaceae	Purple
<i>Zanthoxylum budrunga</i>	Rutaceae	Purple
<i>Sterculia versicolor</i>	Sterculiaceae	Green
<i>Avicennia officinalis</i>	Verbenaceae	Blue

Table 5. Species which show significant differences in the colour of their water and ethanol extracts.

Species	Family	Water extract	Ethanol extract
<i>Melanorrhoea usitata</i>	Anacardiaceae	reddish- brown	Bright green
<i>Miliusa roxburghiana</i>	Annonaceae	greenish- yellow	Colour -less
<i>Alstonia scholaris</i>	Apocynaceae	Bluish-green	Colourless
<i>Holarrhena antidysentrica</i>	Apocynaceae	yellowish- green	Colourless
<i>Plumeria alba</i>	Apocynaceae	dark - green	Colourless
<i>Heterophragme odonoseem</i>	Bignoniaceae	purplish - blue	Yellow
<i>Stercospermum suaveolens</i>	Bignoniaceae	dark - green	Blue
<i>Salmalia malabarica</i>	Bombacaceae	bright - green	Light blue
<i>Garuga pinnata</i>	Burseraceae	dark - green	Light blue
<i>Protium serratum</i>	Burseraceae	dark - green	Purple
<i>Euonymus tingens</i>	Celastraceae	dark - green	Light blue
<i>Laphopetalum wallichii</i>	Celastraceae	dark - green	Light blue
<i>Terminalia pyrifolia</i>	Combretaceae	greenish - yellow	Light blue`
<i>Tetrameles nudiflora</i>	Datisceae	green (milky)	Light blue`
<i>Anisopthera glabra</i>	Dipterocarpaceae	colourless	Purple
<i>Dipterocarpus obtusifolius</i>	Dipterocarpaceae	dark - green	Purple (milky)
<i>Parashorea stellata</i>	Dipterocarpaceae	dark - green	Purple (milky)
<i>Pentacme siamensis</i>	Dipterocarpaceae	colourless	Purple (milky)
<i>Diospyros kaki</i>	Ebenaceae	bright green	Light blue`
<i>Bridelia retusa</i>	Euphorbiaceae	colourless	Purple
<i>Litsaea glutinosa</i>	Lauraceae	bright green	Light blue
<i>Acacia arabica</i>	Mimosaceae	Green	Colourless
<i>Bauhinia malabarica</i>	Caesalpinaceae	green	Colourless
<i>Bauhinia sacumosa</i>	Caesalpinaceae	dark - green	Colourless
<i>Cassia siamea</i>	Caesalpinaceae	colourless	Yellowish - brown
<i>Cynometra raniflora</i>	Caesalpinaceae	colourless	Bluish green
<i>Dalbergia fusca</i>	Papilionaceae	green	Purple
<i>Dalbergia ovata</i>	Papilionaceae	green	colourless
<i>Derris robusta</i>	Papilionaceae	colourless	Purple
<i>Erythrina lithosperma</i>	Papilionaceae	colourless	Purple
<i>Millettia pendula</i>	Papilionaceae	green	Purple(milky)
<i>Pterocarpus santalinus</i>	Papilionaceae	dark green	Purple
<i>Duabanga grandiflora</i>	Lythraceae	dark green	Purple
<i>Lagerstroemia parviflora</i>	Lythraceae	colourless	Purple
<i>Sonneratia apetala</i>	Lythraceae	dark green	colourless
<i>Amoora rohituka</i>	Meliaceae	colourless	Purple
<i>Amoora wallichii</i>	Meliaceae	colourless	Purple
<i>Eucalyptus citiodora</i>	Myrtaceae	green	colourless
<i>Bruguiera cylindrica</i>	Rhizophoraceae	colourless	Purple
<i>Eriobotrya petiolata</i>	Rosaceae	green	colourless
<i>Prunus acuminata</i>	Rosaceae	green	colourless
<i>Morinda tinctoria</i>	Rubiaceae	green	colourless
<i>Schleichera oleosa</i>	Sapindaceae	green	colourless
<i>Turpina ponifera</i>	Sapindaceae	colourless	Purple`
<i>Grevillea robusta</i>	Sapotaceae	green	colourless
<i>Firmiana colorata</i>	Sterculiaceae	Yellow	colourless
<i>Gmelina arborea</i>	Verbenaceae	dark green	light blue
<i>Lantana aculeata</i>	Verbenaceae	Yellowish -green	colourless
<i>Premna latifolia</i>	Verbenaceae	Yellow	colourless
<i>Vitex limonifolia</i>	Verbenaceae	Yellow	colourless
<i>Vitex pubescens</i>	Verbenaceae	Yellow	colourless

Table (6) Fluorescence in families represented in the Wood Anatomy collection, Forest Research Institute, Yezin.

Sr. No.	Family	Total specimens	No. of Genera	No. of species	No. of fluoresc. species	% fluoresc. species
1	Anacardraceae	19	7	8	2	25.0
2	Anonaceae	4	1	2	2	0.0
3	Apocynaceae	5	3	3	0	0.0
4	Borringtaniaceae	3	1	1	0	0.0
5	Betulaceae	3	2	2	0	0.0
6	Bignoniaceae	9	4	5	0	0.0
7	Bombacaceae	4	2	3	0	0.0
8	Burseraceae	13	2	2	0	0.0
9	Capparidaceae	4	1	2	0	0.0
10	Celastraceae	3	2	2	0	0.0
11	Combretaceae	25	2	8	0	0.0
12	Cordiaceae	4	1	2	0	0.0
13	Cornaceae	1	1	1	0	0.0
14	Crypteroniaceae	1	1	1	0	0.0
15	Datisceae	4	1	1	0	0.0
16	Dilleniaceae	6	1	5	0	0.0
17	Dipterocarpaceae	26	6	13	0	0.0
18	Ebenaceae	10	1	7	0	0.0
19	Elaeocarpaceae	2	1	1	0	0.0
20	Euphorbiaceae	11	5	6	0	0.0
21	Fagaceae	1	1	1	0	0.0
22	Flacourtiaceae	4	3	3	0	0.0
23	Guttiferae	7	3	4	0	0.0
24	Hypericaceae	2	1	2	0	0.0
25	Juglandaceae	2	1	1	0	0.0
26	Lauraceae	9	4	8	0	0.0
27	Mimosaceae	33	5	13	5	38.5
28	Caesalpiniaceae	10	3	8	0	0.0
29	Papilionaceae	36	8	16	0	0.0
30	Lythraceae	21	3	12	0	0.0
31	Magnoliaceae	6	2	4	0	0.0
32	Malvaceae	1	1	1	0	0.0
33	Meliaceae	19	6	11	0	0.0
34	Moraceae	6	1	3	0	0.0
35	Myrtaceae	3	2	2	0	0.0
36	Olacaceae	1	1	1	0	0.0
37	Oleaceae	1	1	1	0	0.0
38	Proteaceae	3	1	1	0	0.0
39	Rhizophoraceae	7	3	4	0	0.0
40	Rosaceae	3	2	3	0	0.0
41	Rubiaceae	22	9	12	1	8.3
42	Rutaceae	4	3	4	0	0.0
43	Salicaceae	4	1	1	0	0.0
44	Sapindaceae	6	2	2	0	0.0
45	Sapotaceae	4	4	4	0	0.0
46	Sterculiaceae	15	6	9	0	0.0
47	Strychnaceae	7	1	2	0	0.0
48	Theaceae	8	3	3	0	0.0
49	Tiliaceae	10	4	6	0	0.0
50	Ulmaceae	4	2	2	0	0.0
51	Verbenaceae	37	6	11	0	0.0
		453	138	230	8	

References

1. Avella, T., R. Dechamps and M. Bastin. 1988. Fluorescence study of 10610 woody species from the Tervurin (T W) Collection, Belgium. IAWA Bull. n.s 9 : 346-352.
2. Brown, H.P., 1925. Elementary manual of Indian wood technology : 65.
3. Dyer, S.T. 1988. Wood fluorescence of indigenous South African trees IAWA Bull. n.s 9 L D : 75- 87.
4. Giordano, G. 1971. Tecnologia del lengo. 1. La materia prima : 155-159. Unions Tipografico - Editrice Torinese . Torino.
5. Kanehira, R. 1921. Anatomical Characters and identification of Formosan woods. 269- Bur - Prod. Indust Gov. Formosa. Taipei.
6. Krishna, S.L. K.A.Chowdhury. 1935. Fluorescence of wood under ultraviolet light. Indian Forester 61 : 221 - 228 .
7. Miller, R.B. 1981. Explanation of coding procedure IAWA Bull. n.s 2 : 111-131.
8. Miller, R.B. & P. Baas (coord.) 1981. Standard list of characters suitable for computerized hardwood identification IAWA Bull. & n.s 2 : 99-145.
9. Panshin, A.J. & C. de Zeeuw. 1970. Textbook of wood technology. Volume 1. 3rd Ed : 402 . Mc Graw - Hill, New York.
10. Quirk, J.T. 1983. Data for a computer- assisted wood identification system 1. Commercial legumes of tropical Asia and Australia. IAWA Bull. n.s 4 : 118.
11. Radley, J. A & J. Grant. 1933. Fluorescence analysis in ultraviolet light : 66- 67.
12. Stone, H. 1921. A textbook woods : 52.
13. Tsoumis, G. 1968. Wood as raw material chapter 3 : 20 . Pergamon Press, Oxford.
14. Vodratka, O. 1929. Das Mikroskopieren Von Hdz in Filtriertem ultraviolet-light. Botanisches Institute der Hochschule fur Bodenkultur. Irunn. Czechoslovakia.