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Preliminary Study on Anthraquinone Extractives in Teak

U Myo Aung, B.Sc. (Chem.) (Rgn.), M.S. (U.W) (C.F.R), Deputy Researcher,
Forest Research Institute.
1988

Acknowledgements

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ကျွန်းတွင်ပါဝင်သော အင်သရာကွီနုံး (**Anthraquinone**) ဒြပ်ပေါင်းများအား ပဏာမ လေ့လာခြင်း

ဦးမျိုးအောင်၊ B.Sc. (Chem.) (Rgn.), M.S. (U.W) C.F.R ဒု-သုတေသနမှူး
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

မီသနောပျော်ရည်တွင် ပျော်ဝင်သော ကျွန်း၏ ဓါတုဗေဒ ဒြပ်ပေါင်းများကို ခေတ်မှီနည်းစနစ်ဖြစ်သော HPLC (High Performance Liquid Chromatography) ဖြင့်လေ့လာပါသည်။ ဓါတုဒြပ်ပေါင်း အမျိုးမျိုး၏ ကွဲထွက်ချိန် (retentiontime) နှင့် ခရမ်းလွန်ရောင်စဉ်များ (Ultra Violet Spectra) နှိုင်းယှဉ်ခြင်းဖြင့် ဓါတ်ခွဲလေ့လာမှုပြုပါသည်။ ဤဓါတ်ခွဲမှုနည်းစနစ်ဖြင့်၊ မီသနော (methanol) ပျော်ရည်တွင် ပျော်ဝင်သော ကျွန်း၏ ဓါတုဗေဒဒြပ်ပေါင်းများအနက်မှ ဒြပ်ပေါင်း (၅) မျိုးအား ဓါတ်ခွဲပြီး ဤစာတမ်းတွင် တင်ပြထားပါသည်။ ဤဒြပ်ပေါင်းများအနက် 2-methyl anthraquinone ဒြပ်ပေါင်းသည် ကျွန်းတွင်အများဆုံး ပါဝင်ပြီး column chromatography နည်းဖြင့် သန့်စင်ခွဲထုတ်ယူ နိုင်ကြောင်း ဤစာတမ်းတွင် တင်ပြထားပါသည်။

Preliminary Study on Anthraquinone Extractives in Teak

U Myo Aung, B.Sc. (Chem.) (Rgn.), M.S. (U.W) C.F.R ,
Deputy Researcher,
Forest Research Institute.

Abstracts

A HPLC program has been developed to separate the methanol soluble extractives in teak. Through the use of matched retention times to standard and by comparison of UV spectra, five anthraquinone extractives were identified by HPLC. One of them has not been reported in literature namely 2,3-dimethyl anthraquinone. The most abundant compound in teak methanol extract was 2-methyl anthraquinone. 2-methyl anthraquinone was isolated by column chromatography.

Contents

1. Introduction

The tropical hard wood known commercially as Teak (*Tectona grandis* Linn f :) is a member of the family Verbennacea which is famous for producing wood of exceptional durability and strength. Among the important tropical commercial timbers, teak is the most durable timber in the world. Teak is practically impervious to fungus and the white ant, though not immune to marine borers. The heartwood of teak does not require preservative treatment to prolong its life. Teak grows naturally throughout Myanmar, India, Thailand and Indonesia. Now it is extensively planted in north India and New Guinea.

Teak is usually found in mixed deciduous type of forests in a fairly moist, warm tropical climate with good loamy soil with good drainage. Teak grows in groups scattered or throughout the forest amongst many other species. The trees have a rounded crown and under favourable conditions, grow to large sizes with tall cylindrical boles. The average mature teak trees attains a height of 150 feet and girth of 15 feet or more. The size of the tree is variable and reflects the climatic conditions.

The wood of teak is brown, strong fairly hard and extremely durable. Teak wood has a specific gravity of 0.55 to 0.7 and is either straight or wavy grained. When grown in dry localities it is very coarse and uneven in texture.

The heartwood is golden to yellow when freshly cut, turning brown and darkening with age. It is oil to tough and has a characteristic strong scent. The heartwood of teak is very durable is suitable for almost every purpose. The sapwood is white to pale yellowish brown and is less durable than heartwood. Teak wood has no characteristic taste. It seasons slowly but well, especially in the log form. It is a common practice to girdle the tree, before felling, in order to reduce the moisture content to approximately 30%. The inner sapwood loses moisture at a greater rate than the outer sapwood.

The bark of teak is light brown or gray with long shallow cracks, peeling off in long thin flakes. The leaves are large and strong, mostly one feet to two feet wide. The lower leaf surface is like soft felt with hard brown veins. The upper surface has a texture of fine sand paper. In young trees the leaves are larger.

Data on the woody cells in teak are summarized in Table 1.

For trading purpose, teak timber is divided into several classes. First class teak is characterized by a uniform golden brown color, straight and even grained with few marketing. Second class timber is less straight grained, somewhat harder and darker in color and commonly with darker broad wavy streaks. Third class teak timber has closer grain and is generally of uniform gray brown color. Generally plantation teak timber is considered of inferior quality and is sold as fourth class timber which is much lighter, more yellow and has a distinct character of its own.

The differences in quality are probably the result of difference in extractive concentration.

Teak is extensively used in construction, and where available, practically for every part of a house, especially doors, windows, flooring and staircases. It is also used in other types of construction including bridges, harbor work as piles and balks, in wells and for other purposes where strength and durability are essential. Teak also has many excellent qualities for ship building.

Table 1. Density, Cell Dimensions and Percentage of Teak cell type.

		(Fengel, Grosser. 1976)
Density	g/cm	0.44 -0.63-0.82
Cell Dimensions		
Tracheids/Fibers		
Length	m	0.7-1.4
Vessels		
Diameter	m	50-37
		(% Average Values)
Tracheids/fibers		66.3
Vessels		11.6
Longitudinal		
Parenchyma		11.6
Rays		15.5

2. Literature Review

2.1 Extractives and Durability of Teak

Teak is well known for its natural durability due to resistance to fungi, termites and insects. The extractives present in the heartwood are believed to be responsible for this durability. Certain extractives, even when present in amounts of 0.05% or less, are responsible for the resistance of wood to fungi and termites. Teak grows well in plantations out of its natural habitat and therefore has been available to many researchers interested in examining the extractives in the heartwood.

Costa (1925) studied heartwood formation in teak. The evidence indicated that polyphenols are formed in dead ray cells containing starch, provided that sufficient water is present. Apparently on the death of these cells, their contents become accessible to the enzymes in the sapwood or attached to the cell wall. Evidence of extractives being responsible for teak durability was obtained by Rudman (1950). Extraction of extractive of the heartwood with either followed by methanol rendered the sample decay susceptible. (Rudman, 1950). The amount of extractives content of teak increase gradually from pith to the heartwood. The concentration is highly variable. Rudman (1959) reported the natural teak from one country was more durable than the natural teak from a different Asian country due to genetic difference. In teak, higher growth rates are usually associated with the first years of growth, and wood around the pith is of lower durability than the outer heartwood. Rudman and Dacosta (1957) suggested that decay resistance increase from the pith to the sapwood due to the gradual change either in cell wall composition or in structure as the tree become older. They found that the decay resistance of teak heartwood was related to the age, rate of growth and extractive content. They also found a winder range of variation in decay resistance both between trees and within one tree. These differences among trees were largely dependent on genetic rather than environmental factors.

The total amount of ether and methanol extractives from the heartwood of teak is between 10.3 and 15.2% (Dacosta et al, 1958). The middle to outer heartwood is the durable region and this region also contains the highest concentration of extractives (Narayanamuti et al, 1962). The total extractives content increases as the trees become older, but the methanol extractives content is highest in young trees

(Narayanamuti et al, 1962). Verma (1960) found that the basal portion of a teak tree was not very durable. The most durable portion being about 380 cm from the base.

Several studies of teak heartwood extractives and decay resistance show that most teak heartwood extractives directly contribute to the natural durability of teak timber. Moreover, ether and methanol soluble extractives were toxic to wood rotting fungus and termites. Dacosta, Rudman and Gay (1958) reported the high content of 2 - methyl anthraquinone in teak in its inhibition toward termite attack. The composition of the teak extractives is fairly complex and almost all of the anthraquonone found in the wood are effective against termites but ineffective against fungal attack. However, napthoquinone compounds are fungicidal. Some varieties of teak cause skin disease. Lapachol and deoxylapachol harms the skin even when its content is low. The drying of polyester lacquers is inhibited by tectol, dehydrotectol and some napthaquinones.

2.2 Teak Extractives

Due to the interest in the cause of the natural durability of teak, some 40 extractives compounds have been isolated from the wood. Tectoquinone was first isolated by Romins (1887, 1888) and was characterized as 2-methyl anthraquinone by Kafuku and Sebe (1932). The presence of a high content of 2-Methyl Anthraquinone (Tectoquinone) in both the sapwood and heartwood is believed to be responsible for teak resistance to dry wood termite attack. Rudman and Dacosta, (1959) and Wolcott (1953) and Sanderman have shown that a group of extractives impart termite resistance to a wide range of timbers. These compounds include tectoquinone and lapachol. Tha chemical composition of teak is shown in Table 2. The extractives content of teak sawdust using different solvents was reported by Savard et al, (1960) and Narayanamuti and Das (1955). The percent extractives content is shown in Table 3 and 4.

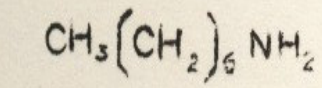
Table 2. Chemical composition of teak.

% Cellulose	% Pentosan	% Lignin	% Ash
39.1	13.0	29.3	0.7
40.4	11.5	32.8	1.4
55.4	14.7	39.1	0.7
57.2	7.7	34.2	0.9

Table 3. Extractives content of Teak.

Ethanol/Benzene Extract (%)	Hot water Extract (%)
13.0	1.8
10.4	2.2
1.4	6.2
1.0	3.7

Literature reported anthraquinone extractive compounds are shown in Table 5. Corresponding structures of extractive compounds are shown in Figures 1,2,3 and 4.



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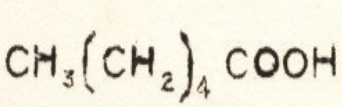

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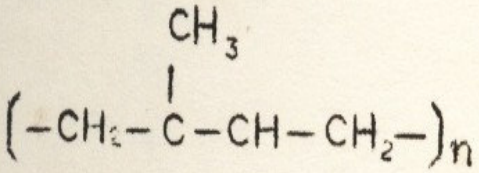

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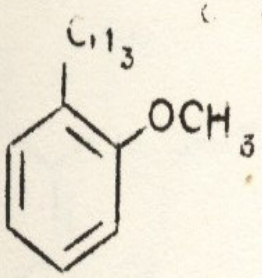

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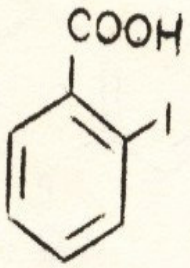

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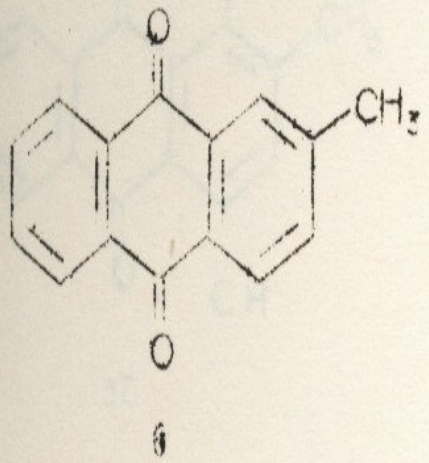
Figure 1. The structure of 1. N-Heptylamine, 2. N-Butyric Acid, 3. Cis-1,4-Polyprene, 4. O-Cresyl methyl Ether, 5. O-Iodo Benzoic Acid.



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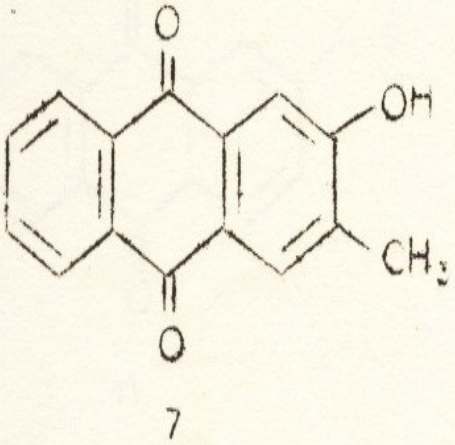

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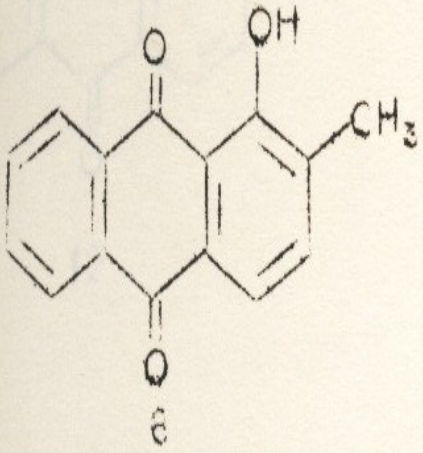

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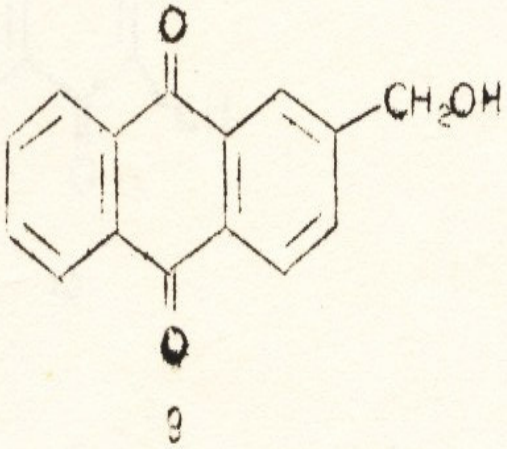

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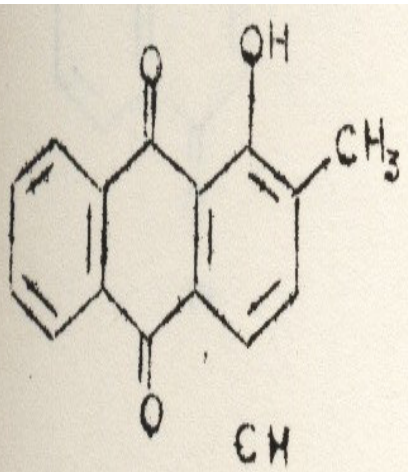
Figure 2. The structure of 6. 2-Methyl Anthraquinone,
7. 2-Hydroxy-3-Methyl Anthraquinone,
8. 1-Hydroxy-2-Methyl Anthraquinone,
9. 2-Hydroxy Methyl Anthraquinone.



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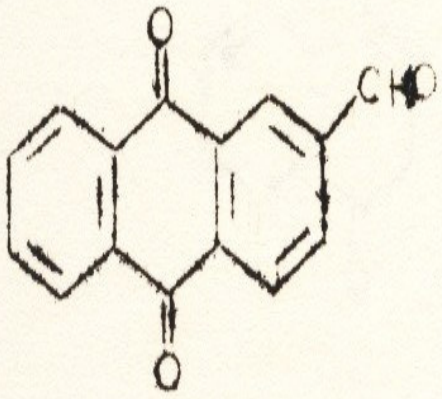

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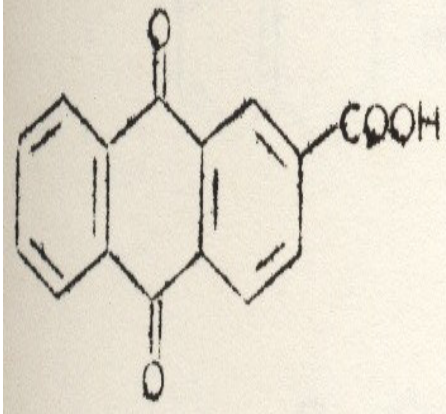

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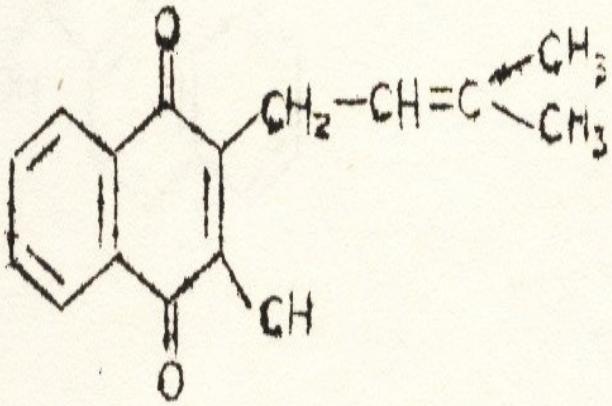

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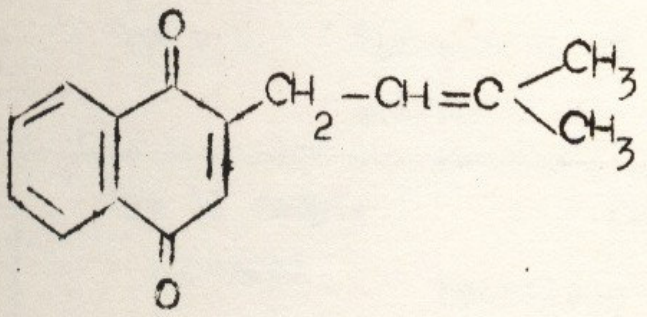
Figure 3. The structure of 10. 1,4-Dihydroxy-2-Methyl Anthraquinone, 11. Anthraquinone-2-Aldehyde, 12. Anthraquinone-2-Carboxylic Acid, 13. Lapachol.



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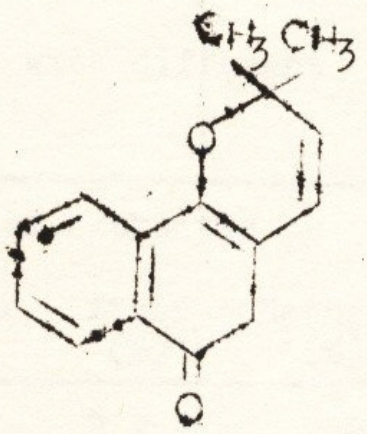

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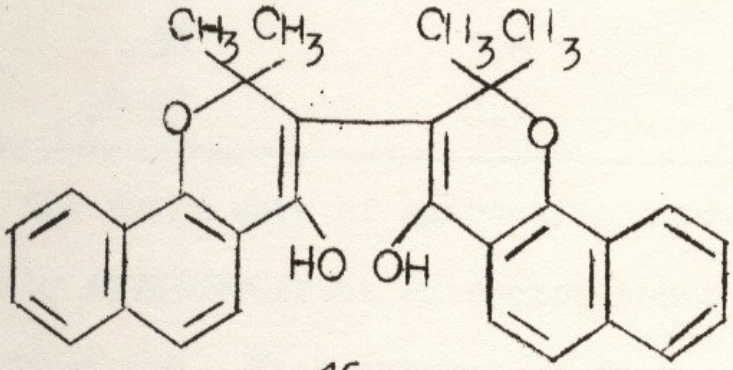

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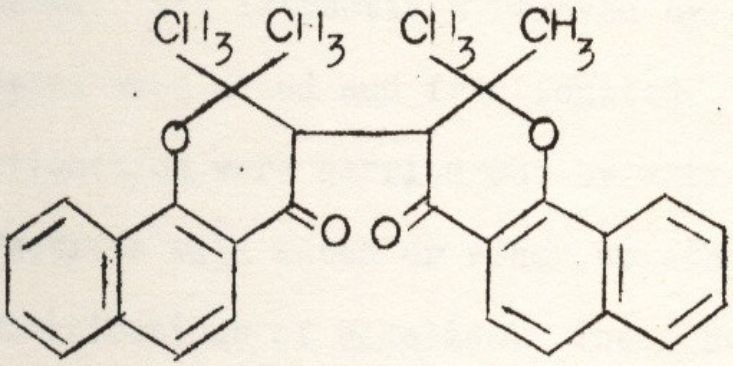

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Figure 4. The structure of 14. Deoxylapachol, 15. Dehydrolapachon, 16. Tectol, 17. Dehydrotectol.

Table 4. Extraction of wood with different solvents.

Age of sample (years)	Products extracted by		
	Petroleum ether %	Ether %	Methanol %
25-30	2.7	2.2	2.0
40-45	2.5	2.2	2.0
45-50	2.4	2.3	2.9
55-60	2.6	1.5	2.4
75-80	3.7	1.9	2.0

The early work of extraction of teak extractive was done by countercurrent extractor and by soxhlet extraction apparatus. Teak extractive from sawdust was extracted in a soxhlet first with ether and then, after drying with methanol. The extractives removed by ether and also by methanol were mixed and fractionated. Isolation and fractionation were carried out by extracting the crude extractives with water or ether or ethyl acetate and also by distributions of alkalies. The scheme below shows fractionation of teak extractives (Figure 5). Isolation and separation of teak extractives were carried out by using paper chromatography.

Table 5. Literature reported anthraquinone extractives in teak.

Compound	Percent (%)	Reference
n-heptylamine	n. a.	Sandermann and Dictrichs (1957)
n-butyric acid	n. a.	Sandermann and Dictrichs (1957)
cis-1,4-polyprene	n. a.	Sandermann (1958)
o-cresyl methyl ether	n. a.	Dhamacharii, B. (1957)
o-iodo benzoic acid	n. a.	Dhamacharii, B. (1957)
2-methyl anthraquinone (tectoquinone)	0.12	Kafuku and Sebe (1932)
2-hydroxy-3-methyl anthraquinone	0.12	Pavanaram and Row (1957)
1-hydroxy-2-methyl anthraquinone	trace	Row (1960)
1,4-dihydroxy-2-methyl anthraquinone	trace	Sandermann and Simatupaung (1964)
2-hydroxy methyl anthraquinone	0.4	Runman (1960)
anthraquinone-2-aldehyde	trace	Rudman (1960)
anthraquinone-2-carboxylic acid	trace	Rudman (1960)
lapachol	n. a.	Sandermann and Dictrichs (1957)
deoxylapachol	n. a.	Sandermann and Simatupaung (1965)
beta-dehydrolapachon	n. a.	Sandermann and Simatupaung (1965)
tectol	n. a .	Sandermann and Simatupaung (1963)
dehydrotectol	n. a.	Sandermann and Simatupaung (1964)

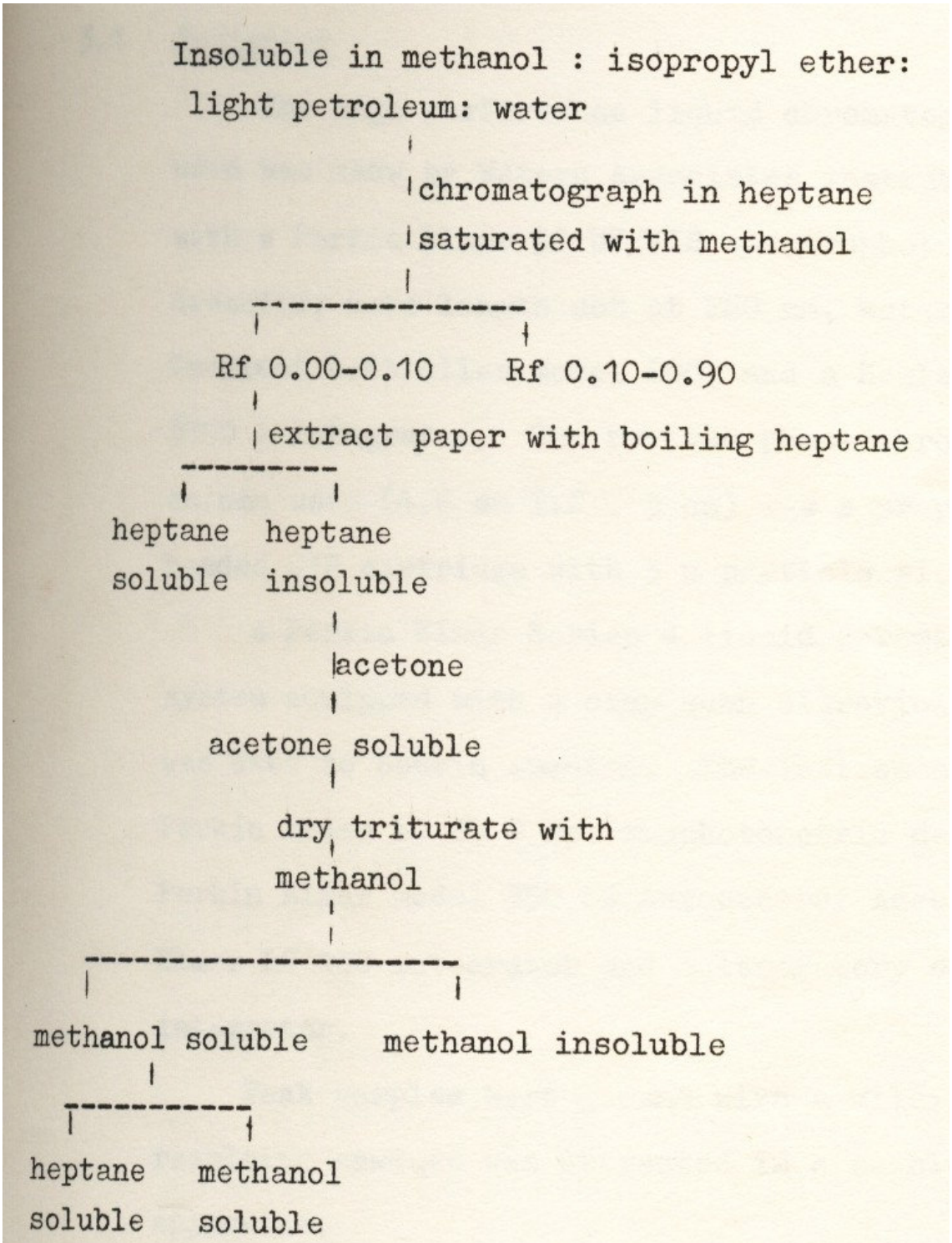


Figure 5. The fractionation scheme of Teak extractives (Rudman, R., 1961).

3. Exprimental

3.1 Equipment

The high performance liquid chromatograph (HPLC) used was made by Waters Associates instrument equipped with a Perkin Elmer LC UV/VIS spectrophotometer detector, wave length set at 280 nm, Waters automated Gradient controller model 680, and a Hewlatt Packard 3390 A Integrator. The reverse phase chromatographic column used (4.6 mm I.D * 3 cm) was a prepacked Altech bonded C18 cartridge with 3 u particle size.

A Perkin Elmer Series 4 liquid chromatography system equipped with a stop scan ultraviolet detector was used to obtain spectra. The instrument used a Perkin Elmer LC 85 B spectrophotometric detector, Perkin Elmer model 550 LC Autocontrol Accessory, Perkin Elmer LC 100 integrator and a laboratory computing integrator.

Teak samples were ground with a Wiley mill. The resulting sawdust was extracted in a soxhlet extraction apparatus.

3.2 Chemicals

Double distilled water was filtered and degassed prior to use on the HPLC.

The following standard chemicals were purchased from Aldrich Chemical Company:

2,6 - dihydroxy methly Anthraquinone
2 - hydroxy methyl Anthraquinone
2 - methoxy anthraquinone
Anthraquinone - 2 - carboxylic acid
Anthrone
Anthraquinone
Lapachol
9 - Anthraldehyde
2 - methyl Anthraquinone
2,3 dimethyl anthraquinone
1,4 dimethyl Anthraquinone
Hexane
Chloroform
Anhydrous ether

3.3 Procedure

Teak samples were collected from a natural teak-forest of Myanmar.

(a) A Teak methanol extract was separated by column chromatography using with 200 mesh size silica gel. A methanol extract aliquot was added to the top of the silica gel column and run through with hexane. The hexane soluble fraction was collected. A second fraction was eluted from column with chloroform and a third fraction was eluted using methanol. Each fraction was analyzed by HPLC.

(b) Teak sawdust was extracted with ether followed by methanol using a sozhlet extraction apparatus for 5 hours. A 50 ml aliquot of methanol was evaporated to dryness under reduced pressure and redissolved in 5 ml methanol prior to injection on the HPLC.

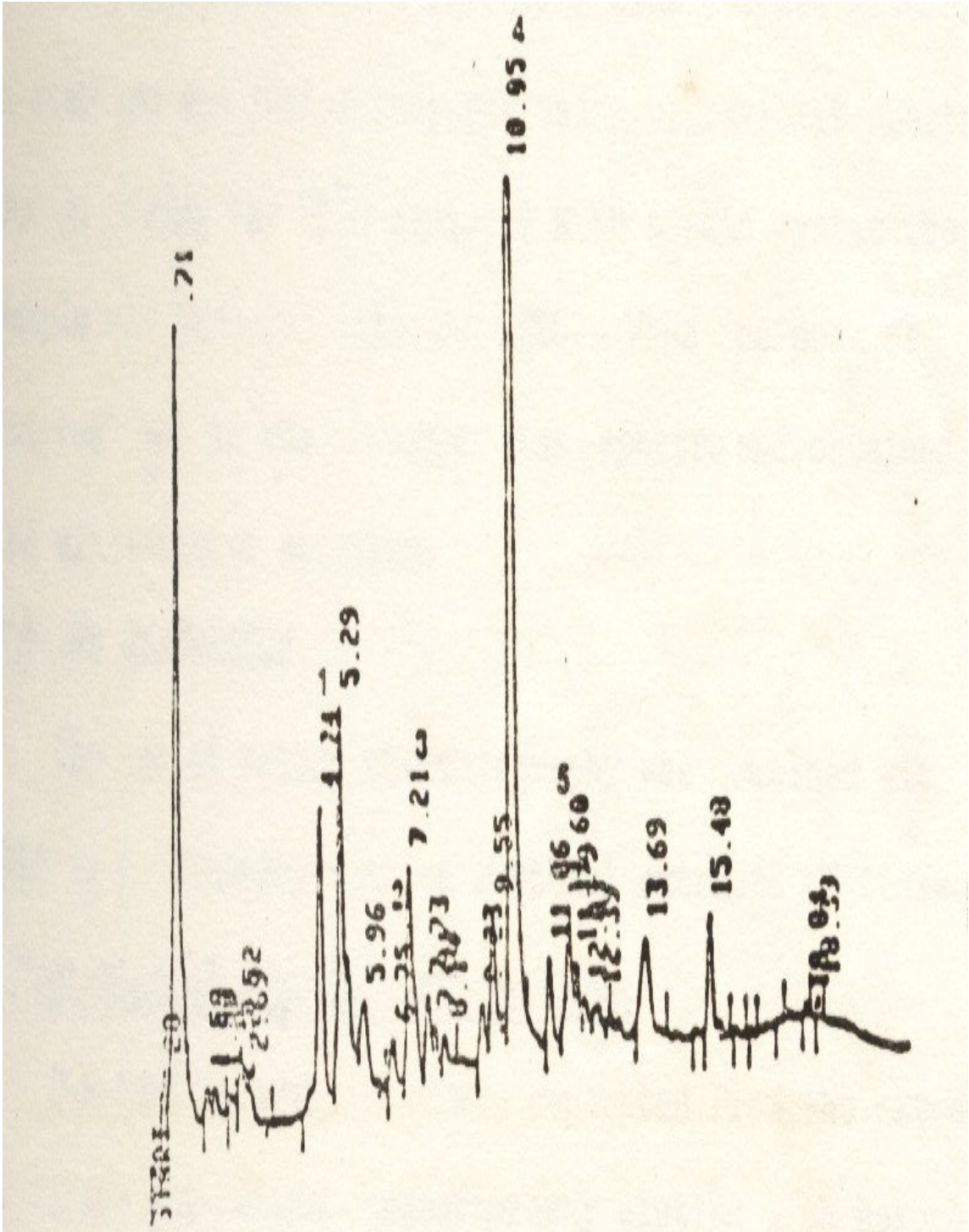


Figure 6. HPLC chromatogram of teak methanol extract.

Table 6. Developed Gradient Program

TIME (MIN)	FLOW ML/MIN	% METHANOL	%WATER
INITIAL	1.5	40	60
15	1.5	80	20
18	1.5	100	0
23	1.5	100	0
28	1.5	40	60
30	1.5	40	60

The HPLC analysis was done with a solvent program using methanol and water. The program started at 40 percent methanol and ran to 90% methanol along a linear gradient during a 15 minute period at a flow rate of 1.5 ml per minute. An example of the chromatogram is shown in Figure 6.

The developed HPLC gradient program is shown in Table 6.

Teak methanol extractive compounds were identified by retention time, and by spiking samples with standard compounds.

A sample peak whose retention time matched that of a standard was further compared using ultraviolet spectroscopy. Using the HPLC equipped with a scan system the sample was injected into the HPLC. When the peak of interest was in the, scanned the spectra and obtained the ultra-violet spectrum.

4. Result and Discussion

The use of column chromatography was combined with HPLC in preliminiry work on methanol extracts of teakwood.

4.1 Isolation of 2-methyl Anthraquinone

2-methyl anthraquinone was separated from the extract by silica gel column chromatography eluting with hexane.

The Figure 7 shows the column chromatography separation scheme of teak methanol extract.

Three separate fractions were collected hexane soluble fraction, chloroform soluble fraction and methanol soluble fraction. Each fraction was analyzed by HPLC. HPLC chromatograms of the three different soluble fractions are shown in m Figure 8.

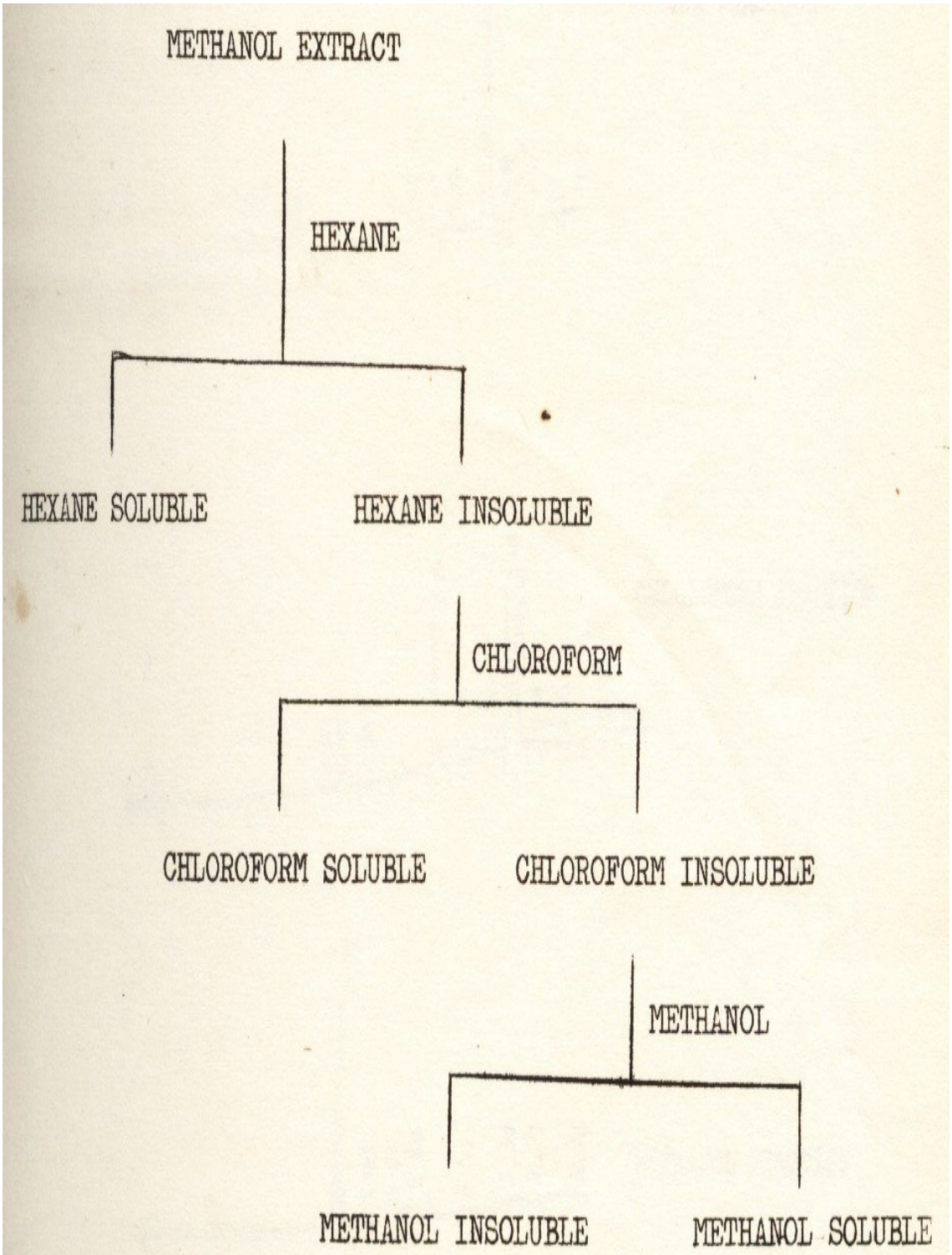


Figure 7. Separation scheme of teak methanol extract.

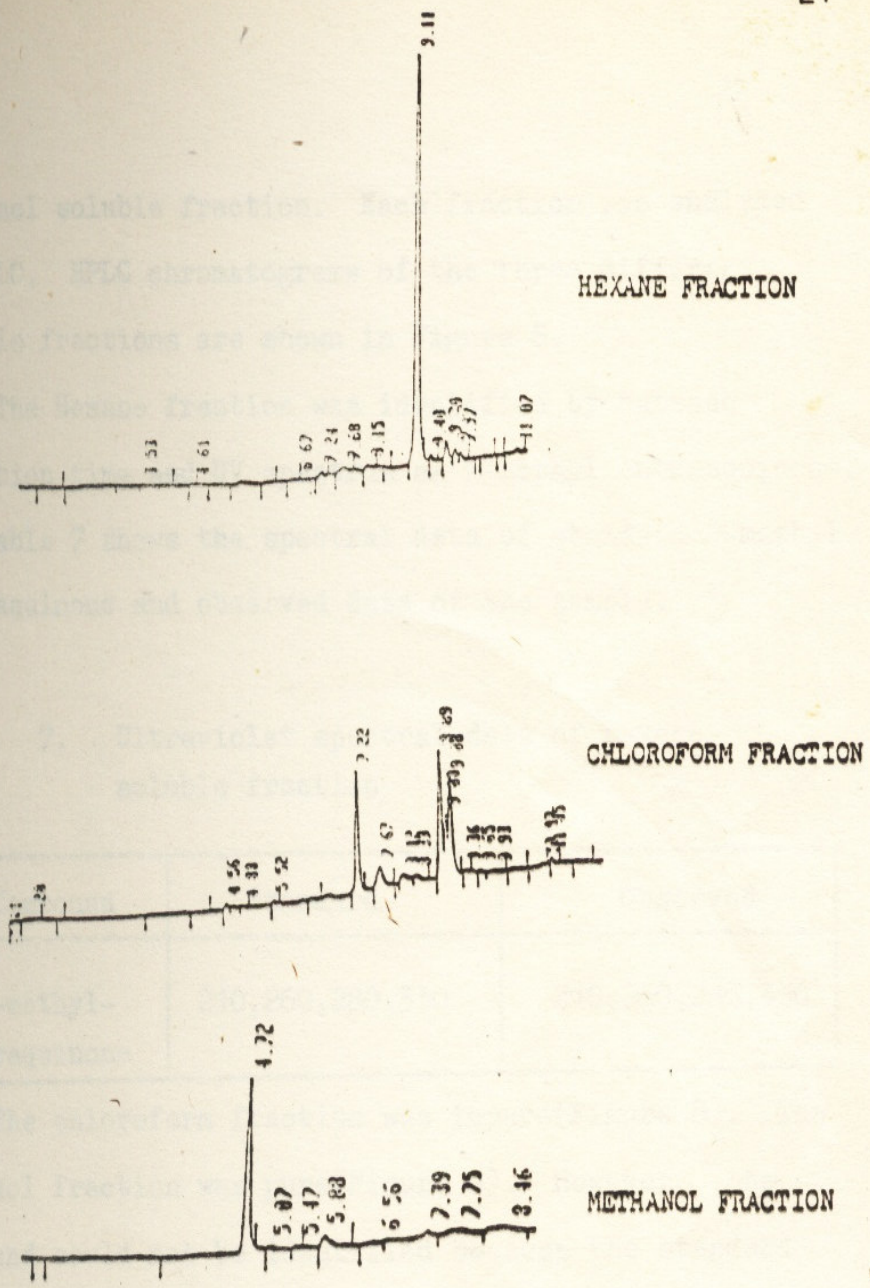


Figure 8. HPLC chromatogram of three different solvent fraction.

The Hexane fraction was identified by matched retention time and UV spectrum as 2-methyl Anthraquinone. The Table 7 shows the spectral data of standard 2-methyl anthraquinone and observed data of the sample.

Table 7. Ultraviolet spectral data of hexane soluble fraction

Compound	Standard	Observed
2- methyl-anthraquinone	210,260, 280, 330	210,260, 280, 330

The chloroform fraction was impure (Figure 8). The methanol fraction was pure (Figure 8). However the compound could not be identified because the standard compound is not commercially available.

4.2 Identification of Teak Methanol extract by HPLC

Although teak methanol extract is complex, five of the extractive compounds were identical by retention time comparison, further confirmed by spiking samples. The figure 9 shows the HPLC chromatogram of teak methanol extract.

Figure 10 shows the HPLC chromatogram of standard compounds which were used for identification of teak extractives.

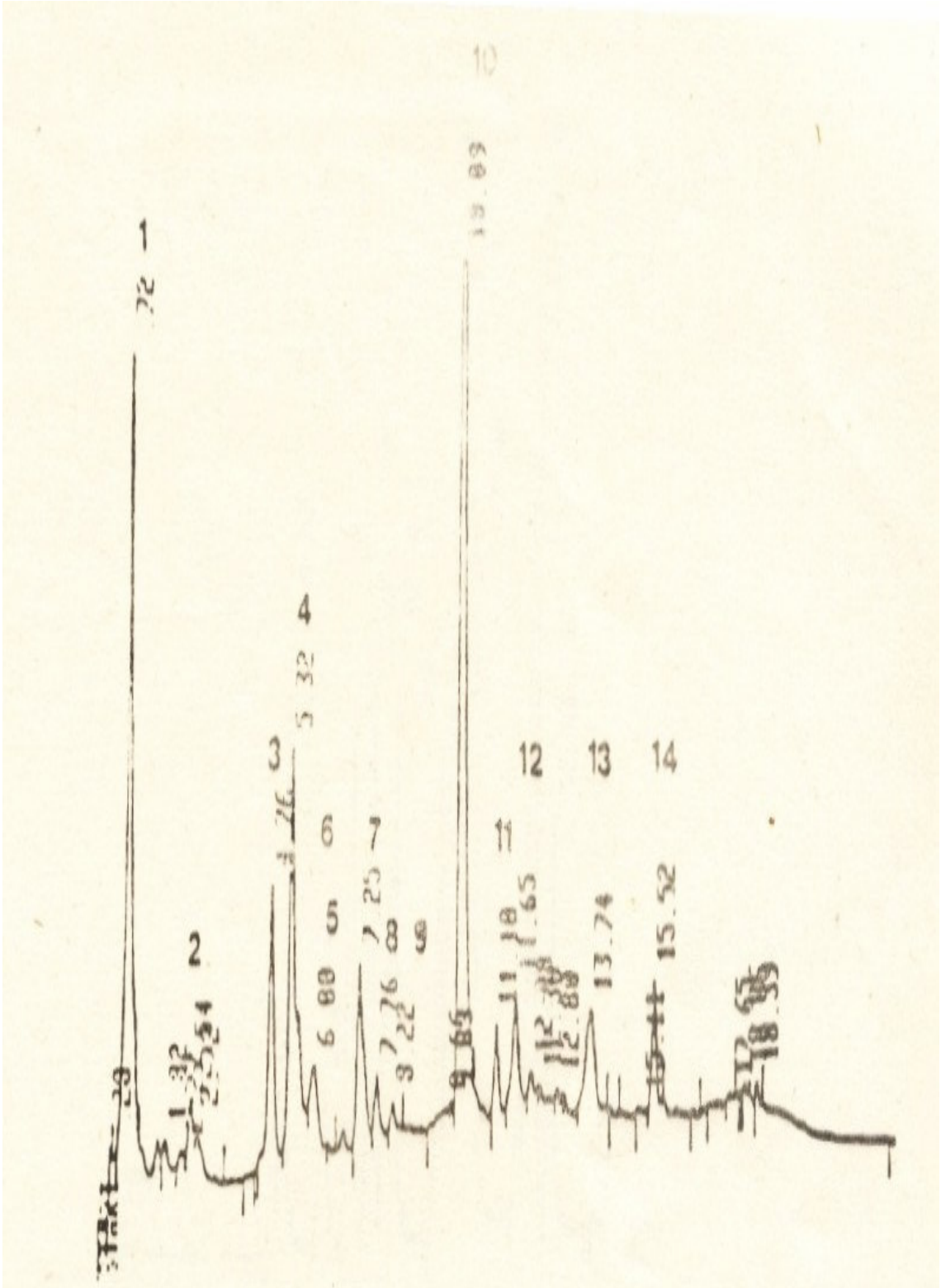
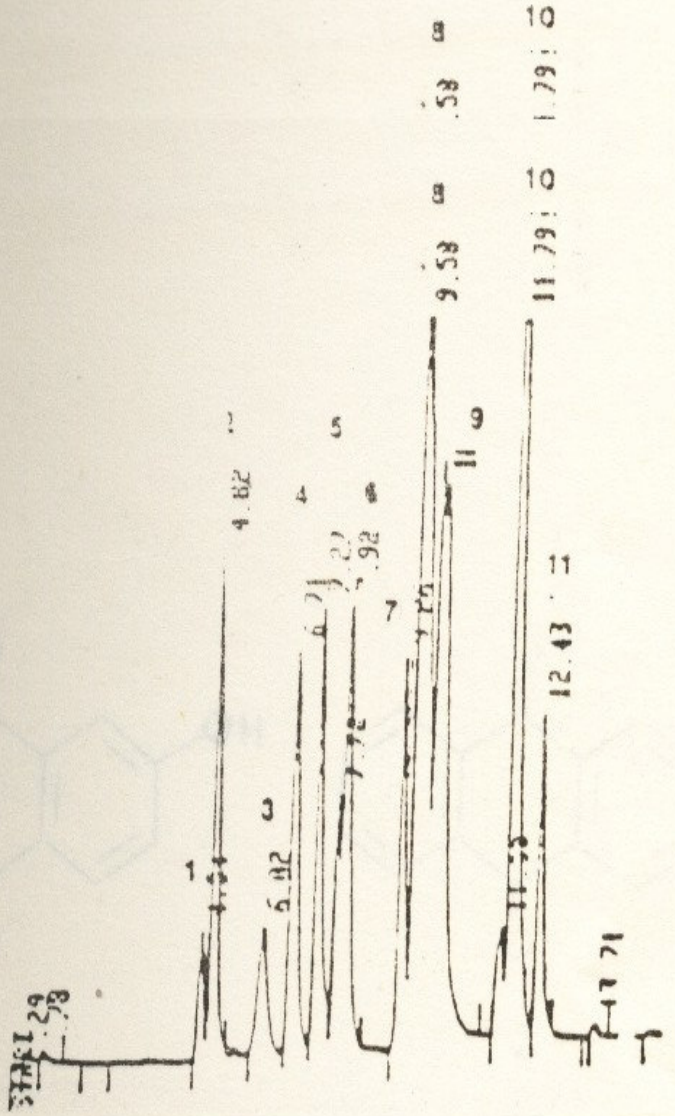


Figure 9. HPLC chromatogram of teak methanol extract.



1. 2,6-DIHYDROXY METHYL ANTHRAQUINONE
2. 2-HYDROXY METHYL ANTHRAQUINONE
3. 2-METHOXY METHYL ANTHRAQUINONE
4. ANTHRAQUINONE -2-CARBOXYLIC ACID
5. ANTHRONE
6. ANTHRAQUINONE
7. LAPACHOL
8. 9-ANTHRALDEHYDE
9. 2-METHYL ANTHRAQUINONE
10. 2,3-DIMETHYL ANTHRAQUINONE
11. 1,4-DIMETHYL ANTHRAQUINONE

Figure 10. HPLC chromatogram of standard compounds.

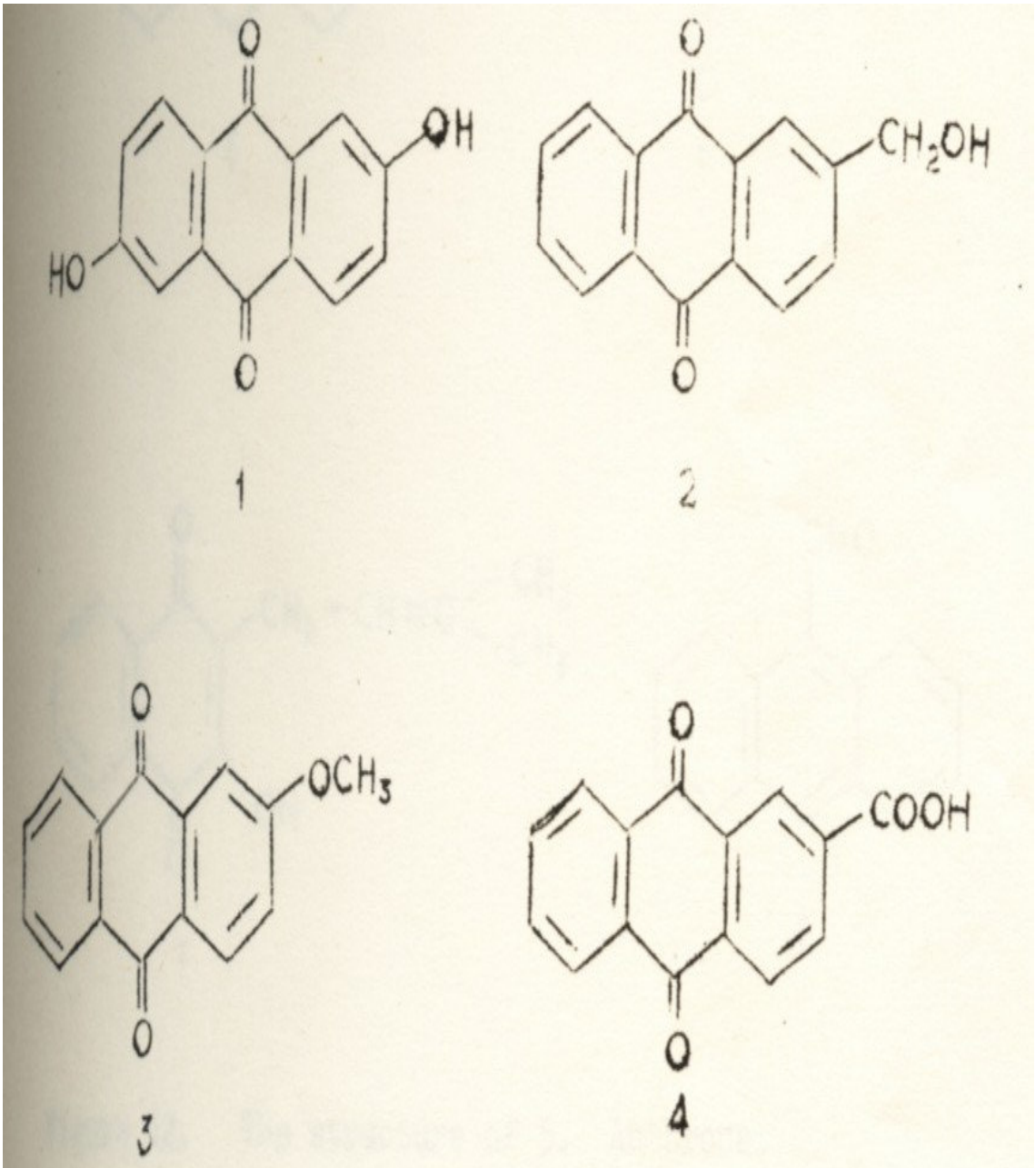
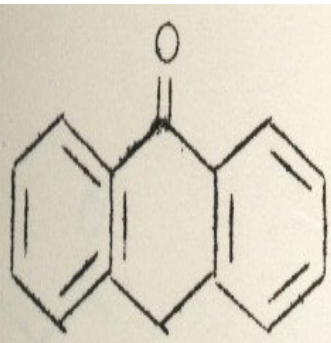


Figure 11. The structure of 1. 2,6-Dihydroxy Anthraquinone, 2. 2-Hydroxy Methyl Anthraquinone, 3. 2-Methoxy Anthraquinone, 4. Anthraquinone-2-Carbocylic Acid.



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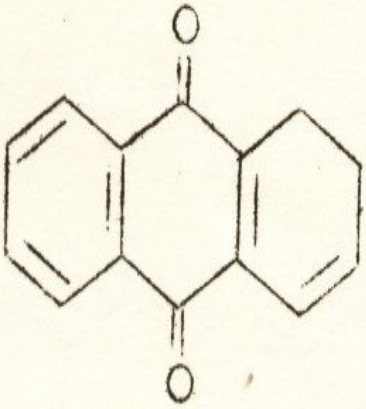

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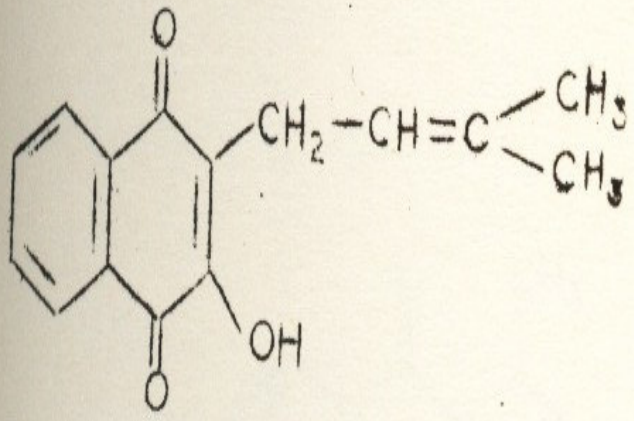

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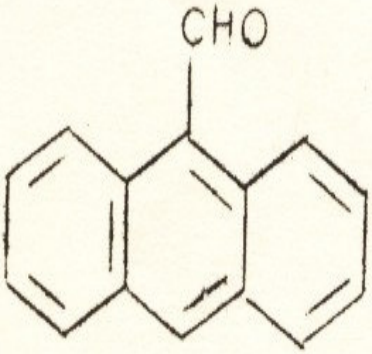

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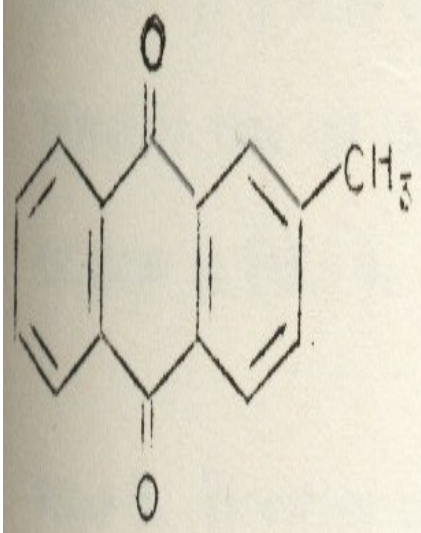
Figure 12. The structure of 5. Anthrone, 6. Anthraquinone, 7. Lapachol, 8. 9-Anthraldehyde.



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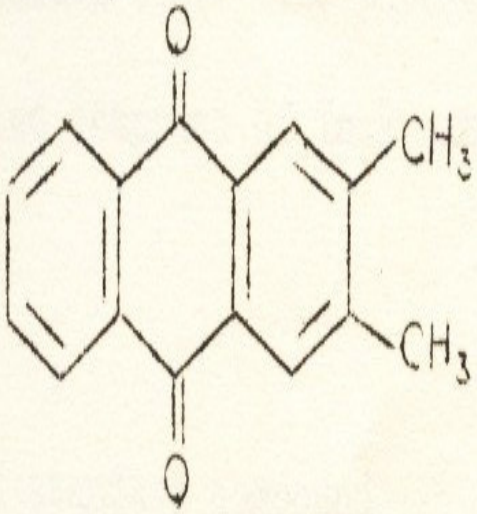

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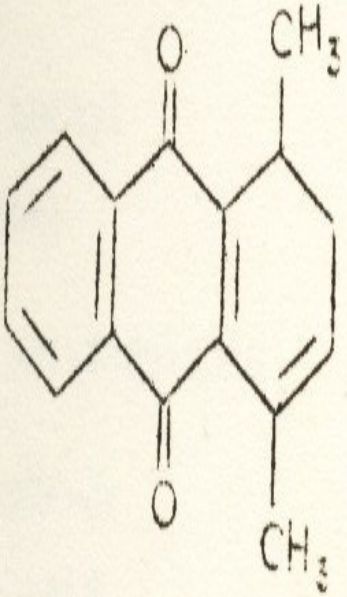

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Figure 13. The structure of 9. 2-Methyl Anthraquinone, 10. 2,3-Dimethyl Anthraquinone, 11. 1,4-Dimethyl Anthraquinone.

Table 8 and Figure 11, 12, 13 show the retention time of standard compounds and their corresponding structure, Preliminary identification of teak methanol extract was matched by retention time. The matched retention time and identified compound of Teak extract is shown in Table 9.

Table 8. Retention time of standard compound

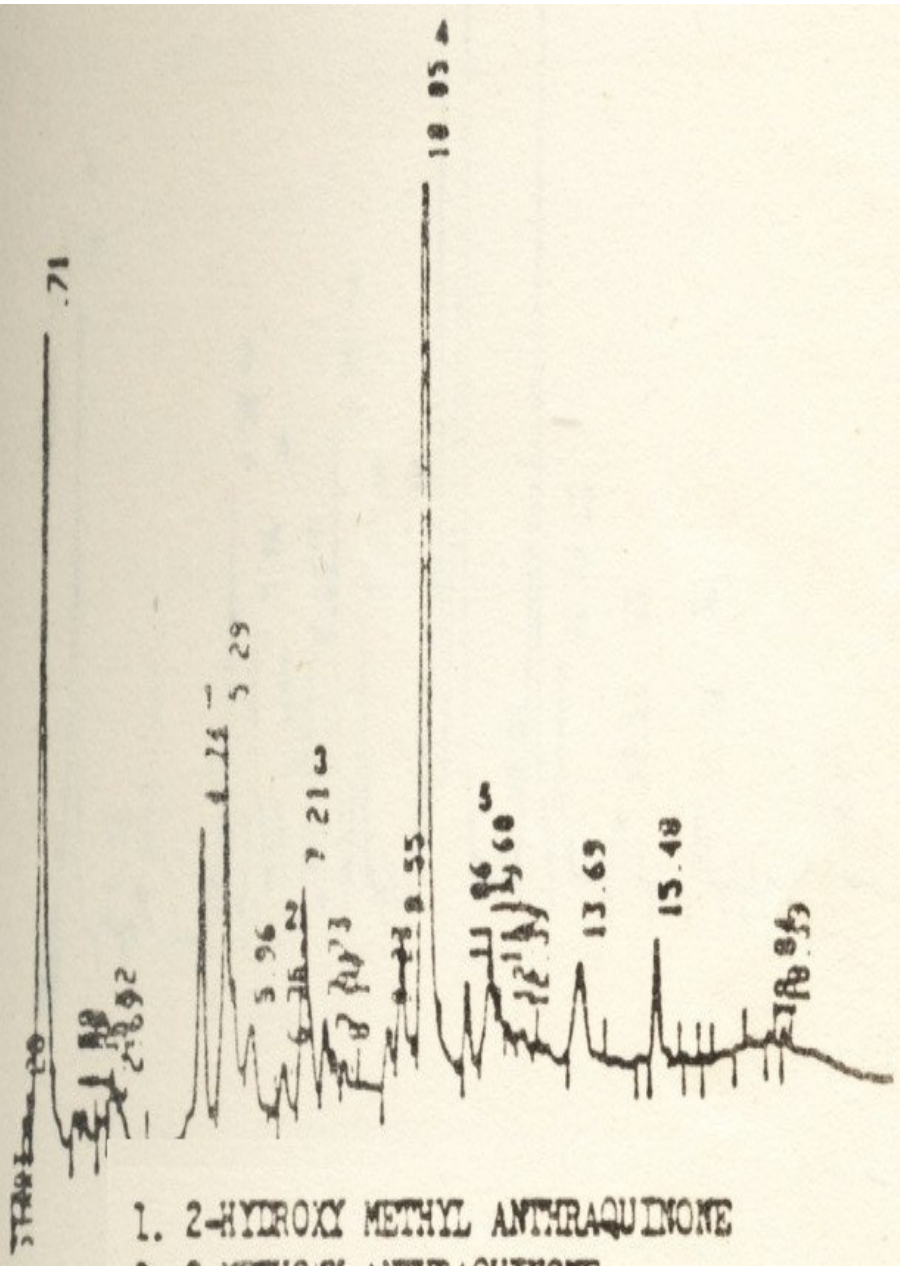
Compound	Retention Time (min)
2,6- dihydroxy anthraquinone	4.54
2-hydroxy methyl anthraquinone	4.82
2-methoxy anthraquinone	6.02
anthraquinone-2- carboxylic acid	6.71
anthrone	7.27
anthraquinone	7.92
lapachol	9.26
9-anthraldehyde	9.58
2-methyl anthraquinone (tectoquinone)	10.16
2,3-dimethyl anthraquinone	11.79
1-4-dimethyl anthraquinone	12.43

Table 9. Retention time of identified and standard compounds

Peak No.	Compound	Identified Retention Time (min)	Std. Retention Time (min)
1.	unknown	0.72	
2.	unknown	2.54	
3.	2-hydroxy methyl anthraquinone	4.76	4.82
4.	unknown	5.32	
5.	unknown	6.08	
6.	2-methoxy anthraquinone	6.75	6.75
7.	anthraquinone-2-carboxylic acid	7.25	7.21
8.	unknown	7.76	
9.	unknown	8.22	
10.	2-methyl anthraquinone	10.09	10.05
11.	unknown	11.18	
12.	2,3-dimethyl anthraquinone	11.65	11.68
13.	unknown	13.74	
14.	unknown	15.50	

Spiked HPLC chromatogram of teak methanol extract is shown in Figure 14.

The identified compound of teak methanol extract using matching retention time and spiking samples is shown in Figure (15).



1. 2-HYDROXY METHYL ANTHRAQUINONE
2. 2-METHOXY ANTHRAQUINONE
3. ANTHRAQUINONE-2-CARBOXYLIC ACID
4. 2-METHYL ANTHRAQUINONE
5. 2,3-DIMETHYL ANTHRAQUINONE

Figure 15. HPLC chromatogram of teak methanol extract.

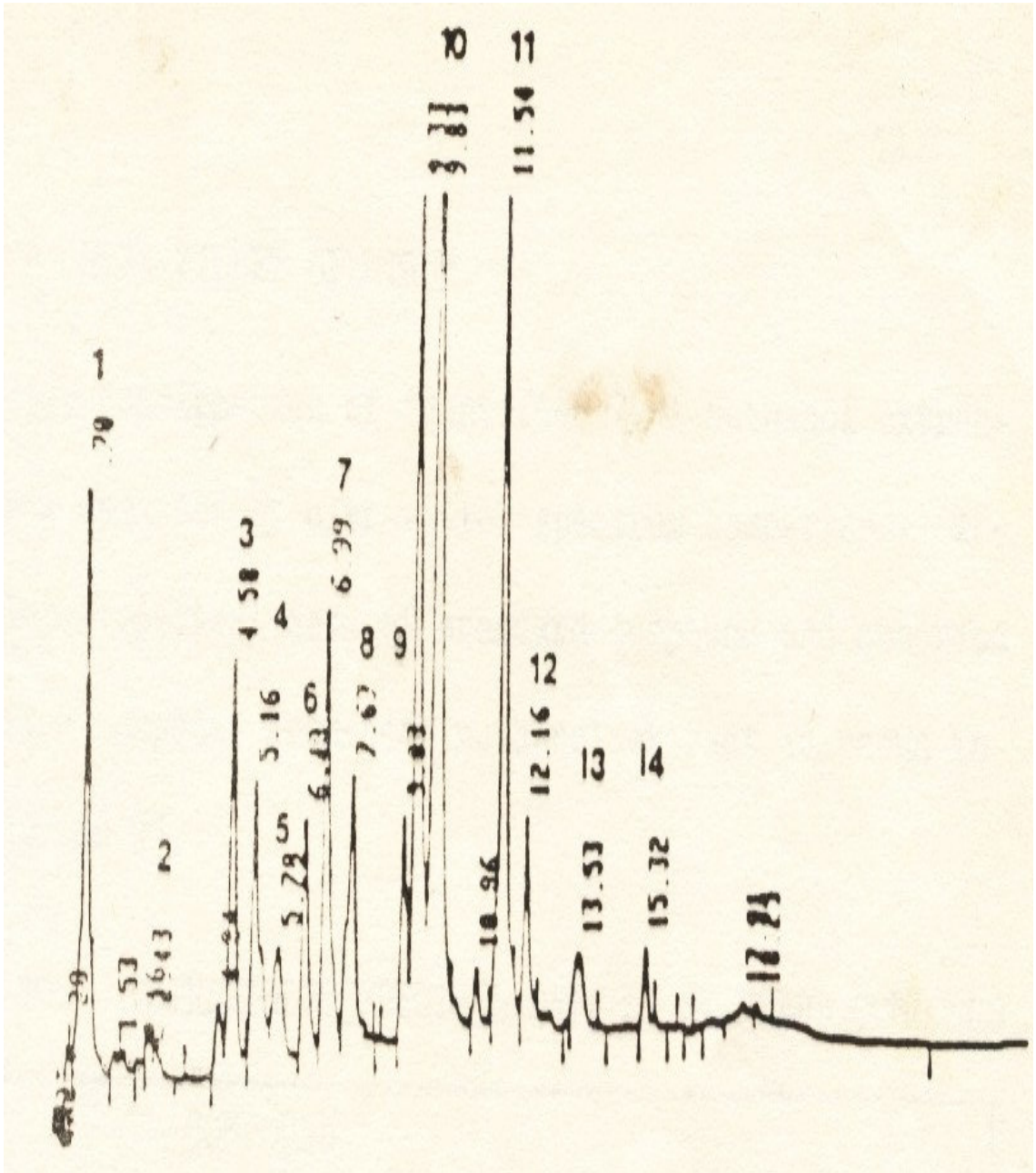


Figure 15. Spiked HPLC chromatogram of teak methanol extract.

4.3 Compared Ultra-Violet Spectrum

Later confirmation of identified Teak methanol extractives was obtained by ultraviolet spectrum comparison. The ultraviolet spectral data of standard compound and observed identified compound from teak methanol extract is shown in table 10 and 11.

Table 10. Ultraviolet Spetral Data of Standard Compound

COMPOUND	
2-HYDROXY METHYL ANTHRAQUINONE	210,260,280,330
ANTHRAQUINONE 2-CARBOXYLIC ACID	210,260,280,330
2-METHYL ANTHRAQUINONE	210,260,280,330
2,3-DIMETHYL ANTHRAQUINONE	210,260,280,330

Table 11. OBSERVED ULTRAVIOLET SPECTRAL DATA

COMPOUND	
2-HYDROXY METHYL ANTHRAQUINONE	210,260,280,330
2-METHOXY ANTHRAQUINONE	210,220,260,280
ANTHRAQUINONE-2-CARBOXYLIC ACID	210,260,280,330
2-METHYL ANTHRAQUINONE	210,260,280,330
2,3-DIMETHYL ANTHRAQUINONE	210,260,280,330

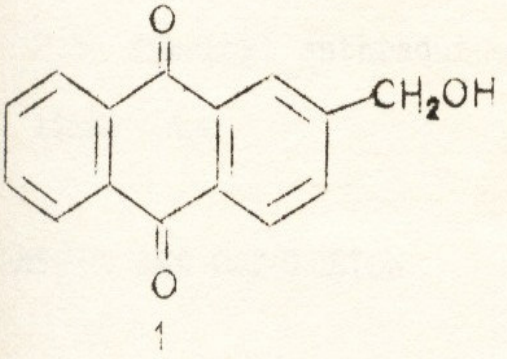
Both standard compound and methanol teak extractives ultraviolet spectrum were obtained by using the same instrument and same gradient program.

The following compound were identified by retention time and stopped scan ultraviolet spectral data. The retention time and their corresponding structure of identified compound are shown in Table 12 and Figure 16.

Table 12. Identified Compounds of teak methanol extract.

Compound	Retention Time (min)
2-hydroxy methyl anthraquinone	4.75
2-methoxy anthraquinone	6.75
anthraquinone-2-carboxylic acid	7.21
2-methyl anthraquinone (tectoquinone)	10.05
2,3-dimethyl anthraquinone	11.68

Peak no. 1 (Retention time 4.74 min) was identified as 2-hydroxy methyl anthraquinone which has been reported in literature (Rudman 1960). Peak no. 2 (retention time 6.75 was identified as 2-methoxy anthraquinone which also has been reported in literature (Dhamacharii, B 1959). Peak no. 3 (retention time 7.21 min) was identified as anthraquinone-2-carboxylic acid which has been reported in the literature (Rudman 1960). The most abundant compound was found in peak no. 4 (retention time 10.5), identified as 2-methyl anthraquinone which has been reported in literature (Kafuku and Sebe 1932). Finally, Peak no. 5 (retention time 11.63 min) was identified as 2,3-dimethyl anthraquinone which has not reported in literature.



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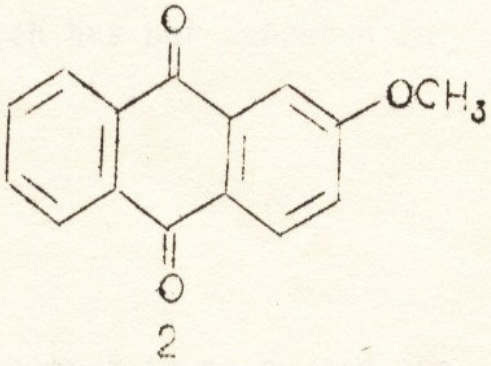

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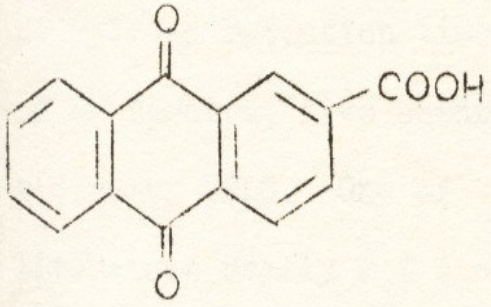

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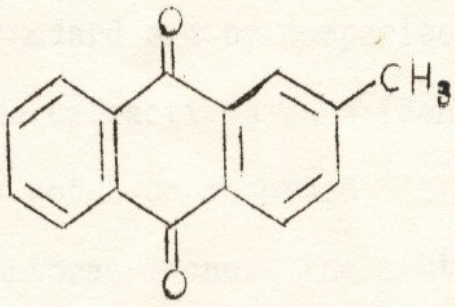

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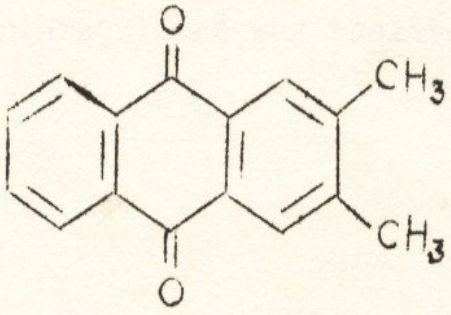

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Figure 16. The structure of 1. 2-Hydroxy Methyl Anthraquinone, 2. 2-Methoxy Anthraquinone, 3. Anthraquinone-2-Carboxylic Acid, 4. 2-Methyl Anthraquinone, 5. 2,3-Dimethyl Anthraquinone.

5. Summary and Conclusion

A HPLC program has been developed to separated the methanol soluble extractives in teak. Though the use of matched retention times to standard and by comparison of UV spectra, five anthraquinone extractives were identified by HPLC. One of them has not been reported in literature namely 2,3 dimethyl anthraquinone. The most abundant compound in teak methanol extract was 2-methyl anthraquinone.

2-methyl anthraquinone was isolated using column chromatography.

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