Medicinal plants in Maliau Basin, Sabah, Malaysia

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ABSTRACT. This report consists of a combination of diversity and phytochemical studies on medicinal plants at Maliau Basin Conservation Area during the Maliau Basin Scientific Expedition 2005. The diversity survey was conducted by a team from the Forest Research Centre Sepilok, Sabah Forestry Department, from 7 Mar until 17 Mar 2005. Two methods of survey were applied, namely 100% survey in a 20m x 20m plot and random surveys. A total of 55 species of medicinal plants were collected. The relative density of medicinal plant species found was 12.8% in 38.8% plant individuals. Plant samples for phytochemical screening were collected by the Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah plant team from 27 February until 5 March 2007. Plant samples were tested for the presence of phenolics, alkaloids, saponins, steroids and triterpenoids. The presence of all alkaloids was determined using the method of Culvenor and Fitzgerald, and ferric chloride was used to determine the presence of phenolics. For steroids or triterpenes, the Liebermann-Burchard test was used, and the froth test for saponins. From the samples screened, 80 species tested positive for alkaloid, 93 were positive for phenolics, 67 gave positive result for saponin and 110 contained steroid.

Keywords: Medicinal plants, phytochemical screening, phenolics, alkaloids, saponins, steroids, triterpenoids.

INTRODUCTION

In Malaysia, there are about 14,500 species of flowering plants (Ministry of Agriculture, 1995) of which about 1,300 are said to be medicinal (Burkill. 1965), and only about a hundred have been investigated fully for their potential. Out of the approximately 7,411 plant species (excluding Bryophyta, Algae and Fungi) identified so far in Sabah, about 1,200 are used statewide for medicinal purposes by local communities and about 80% of them are indigenous plants (Kulip, 2004).

The current trend of forest destruction for the sake of development and the timber industry makes it important for scientists and the science involved to progress even faster in order to get potential of natural products from remaining forests. Biodiversity of medicinal plants is yet to be well studied in Malaysia. This is very important in view of the extensive destruction of habitats and also reduction of knowledgeable persons. Revenue of forest products from timber alone is going down and there are many more forest products other than

timber such as medicinal plants. Extraction of timber and plants with medicinal value can increase revenue for the State. The huge diversity of the Malaysian flora means that we can expect diverse chemical structures from their secondary metabolites.

The systematic phytochemical screening of Malaysia was first carried out in Sabah in June of 1952 (Ikram *et al*. 1988), where 200 species were collected from Jesselton (now Kota Kinabalu), Ranau and Keningau and screened for alkaloids, triterpenoids and steroid compounds, saponins, essential oils, glycosides, and hydrogen cyanide (Arthur,1954).

The phytochemical screening of plants from Maliau Basin Conservation Area (MBCA) is another effort from Universiti Malaysia Sabah (UMS) and Sabah Foundation to determine the potential use of plants found in the Ginseng camp and its surrounding area as a source for useful chemicals and pharmaceutical products. Phytochemical surveys are seen as the first step towards the discovery of useful drugs now that the tropical rain forest has been identified as a potential source due to its diverse richness in flora.

The objective of this study is to get a general idea on how many medicinal plants occur in this area in term of species diversity and their quantity, and the status of phytochemical occurrence of plants collected during the expedition.

MATERIALS AND METHODS

Diversity of medicinal plants

The survey was conducted in the MBCA which is located in the south of Sabah in the district of Tibow during an expedition from 7 Mar until 17 Mar. 2005 jointly organised by UMS and Yayasan Sabah.

The definition of medicinal plants used in this survey is any plants that have been used by the local communities in Malaysia for medicinal purposes. Various reference books and journals are referred to, such as Burkill (1935), Kulip (1997, 2003 & 2004), Kulip & Majawat (2000), Kulip *et al.* (2000 & 2005) and Perry & Metzger (1980). There were two methods applied during the survey, namely establishing a temporary 20m x 20m large plot and random surveys.

Temporary 20m x 20m plot

The plot established was temporary and 100% sampling was conducted. It was located just above the Ginseng base camp at N 04° 44. 714', E 116° 55.139' with an altitude of 625 m a.s.l. There were 16 smaller sub plots of 5m x 5m made and surveyed inside the 20m x 20m plot.

Random survey

Trails where random surveys conducted were:

i) Trail to Camel Trophy camp
ii) Trail to Maliau falls

Phytochemical screening

Plant samples for phytochemical screening were collected from 27 February to 5 March 2005. Sample collection was limited to flowering and/or fruiting plant species for easier identification. In spite of that, many collected samples are yet to be identified to species level. Voucher specimens of each sample were deposited at BORNEENSIS Herbarium, UMS (BORH) and FRCSE (Forest Research Centre Ethnobotanical Herbarium).

The presence of all alkaloids was determined using method described by Culvenor & Fitzgerald (1963), phenolic compounds were determined by ferric chloride (Shriner *et al.,* 1980), steroids and triterpenes by Liebermann-Burchard test and saponins by froth test (Simes *et al.,* 1959).

Culvenor and Fitzgerald method

About 2-4 gm of plant material, preferably soft tissue like inner part of the rhizome was ground using a mortar and pestle with clean sand and chloroform to yield a thick slurry. 10 ml ammoniacal chloroform (6.71 NH_4OH in 993.29 chloroform, 0.10N) was added and macerated with the plant material. Then, the chloroform was drawn off and filtered into a test tube. Dilute sulfuric acid (2N, 0.501ml) was added to the test tube and shaken, then allowed to separate from the chloroform layer. The aqueous layer was withdrawn using a pipette, with cotton wool as a filter and placed in another test tube. Upon addition of Mayers reagent, a precipitate will form with any alkaloids in the solution. The amount and colour of precipitate can give a crude estimate of the relative amount of alkaloid in the sample.

Ferric chloride colour test

A non-volatile standard solution of anhydrous ferric chloride was prepared with 0.56% ferric chloride and HCl in diluted H_2SO_4. 30-50 mg of ground plant sample was added to 2 mL of pure chloroform in a clean, dry test tube. Then the solution was stirred thoroughly. If the unknown does not dissolve, even partially, 2-3 ml more chloroform will be added and the mixture is warmed gently. After the solution was cooled to 25^oC, two drops of 1% solution of anhydrous ferric chloride in chlorofrom was added followed by three drops of pyridine. The test tube was shaken and the colour produced was immediately noted. The appearance of blue, violet, purple, green, or red-brown colour is a positive test.

Liebermann-Burchard test

The ground plant samples were extracted with 80% ethanol and the ethanolic extract was re-extracted with petroleum ether and chloroform respectively. Ten drops of the above solutions of ethanol, petroleum ether and chloroform were added in separate dry test tubes followed by three drops of acetic anhydride and one drop of concentrated sulfuric acid. Triterpene, steroid and cholesterol reacts with acetic anhydride and concentrated sulfuric acid, to give a positive test, which is a blue colouration. Formation of a green or green-blue colour after a few minutes is positive. The results for this test might vary due to different type of steroidal group. For example, coconut oil sometimes gives a green colour, and unsaturated oils invariably do, whereas lard often gives a brown colour. The variabilities might also be due to using old solutions; they should be made fresh with reasonably fresh samples, which is fairly inconvenient.

The Froth Test

The test for saponins were conducted on aqueous extracts from dried ground plants. Saponins are surfactants, and have a ''soaplike'' foam-forming property in aqueous solutions (hence their name). The quantity of saponins present in a sample was indexed using the Froth test which involves mixing the sample with deionized water, shaking the sample, and measuring the froth formed after set intervals (60 sec and 300 sec).

RESULTS AND DISCUSSION

Diversity of medicinal plants

Plot survey 20m x 20m

Survey of 20m x 20m temporary plot revels that there were 264 total species in 1,172 totals of individual plants inside the plot. There were 34 species of plants with medicinal value inside the plot with a total of 455 individuals (Table 1). Full list of plants surveyed in each 5m x 5m sub-plots can be seen in Appendix 1. The total number of species and individuals of plants without any medicinal uses are 230 and 717, respectively.

Table 1. List of medicinal plants found / observed in 20m x 20m plot

NO.	SPECIES	QUANTITY	%
1.	*Alstonia angustiloba*	1	
2.	*Ampelocissus cinnamomea*	1	
3.	*Aquilaria malaccensis*	3	
4.	*Ardisia oxyphylla*	13	
5.	*Artabotrys roseus*	1	
6.	*Artabotrys suaveolens*	1	
7.	*Bauhinia kockiana*	1	
8.	*Curculigo latifolia*	12	
9.	*Decaspermum fruticosum*	3	
10.	*Dinochloa scandens*	279	61.32
11.	*Dracaena elliptica*	2	
12.	*Drynaria sparsisora*	7	
13.	*Eurycoma longifolia*	12	2.63
14.	*Fagraea cuspidata*	1	
15.	*Ficus recurva*	3	
16.	*Fordia splendidisima*	6	
17.	*Garcinia mangostana*	4	
18.	*Globba pendula*	34	7.47
19.	*Glochidion littorale*	2	
20.	*Guioa pleuropteris*	1	
21.	*Hanguana malayana*	2	
22.	*Labisia pumila var. longifolia*	52	11.42
23.	*Litsea umbellata*	6	
24.	*Mallotus miquelianus*	16	
25.	*Polyalthia bullata*	1	
26.	*Polyalthia sumatrana*	1	
27.	*Pterisanthes cissoids`*	3	
28.	*Scaphium affine*	5	
29.	*Smilax leucophylla*	1	
30.	*Strychnos cuspidata*	4	
31.	*Syzygium cernia*	1	
32.	*Tetracera scandens*	41	9.01
33.	*Urophyllum hirsutum*	3	
34.	*Zizyphus horsfieldii*	4	
	TOTAL	455	100

Random survey along trails

The total number of species of plants that have medicinal value along the trail to Maliau Falls is 12. It was observed that *Eurycoma longifolia, Polyalthia insignis* and *Tetracera scandens* were the most abundant species in this area (Table 2).

The total number of species of plants that have medicinal value along the trail to Camel Trophy Hut is nine. It was observed that *Asplenium nidus* was the most abundant species in this area (Table 3).

Table 2. Trail to Maliau falls

NO.	SPECIES	ABUNDANCE
1.	*Costus speciosus*	**
2.	*Eurycoma longifolia*	*****
3.	*Fibraurea chloroleucea*	**
4.	*Flagellaria indica*	*
5.	*Heleciopsis artocarpoides*	*
6.	*Labisia pumila* var. *pumila*	**
7.	*Nephrolepis biserrata*	*
8.	*Polyalthia insignis*	***
9.	*Rennelia borneensis*	*
10.	*Schefflera elliptica*	*
11.	*Smilax borneensis*	***
12.	*Tetracera scandens*	****

Table 3. Trail to Camel Trophy Hut

NO.	SPECIES	ABUNDANCE
1.	*Alstonia angustiloba*	*
2.	*Asplenium nidus*	***
3.	*Cymbopogon citrates*	*
4.	*Heliciopsis artocarpoides*	*
5.	*Hoya coronaria*	*
6.	*Melastoma malabathricum*	**
7.	*Nephrolepis biserrata*	*
8.	*Polygala paniculata*	**
9.	*Pteridium caudatum*	*

Note: * = Few ; *** = Abundant

Phytochemical screening

Approximately 80 species from 58 genera (48 families) of plants were collected over an 80 period covering the area around the Ginseng camp and Maliau Fall. Due to the low richness of the plant diversity at the area at the time of the expedition, only 149 samples including leaves, stem, seed, and fruit samples were collected for screening. This number is very small considering the eight-day time spent.

The samples were screened for the presence of alkaloids, phenolics, triterpenes and steroidsas well as saponins. All the samples were screened at the field on the very same day of collection to retain the freshness of the sample. From 128 samples, which constitute approximately 58 genera, 80 samples were tested positive for alkaloids, 93 showed the presence of phenolics, 110 showed positive tests for steroids and 67 were tested positive for saponins (Table 4).

Out of 128 samples screened, 80 species (62.5%) gave positive reactions for alkaloids. Most of them belong to the family of Anisophylleaceae, Annonaceae,Apocynaceae, Aspleniaceae, Elaeocarpaceae, Fabaceae, Lauraceae, Melastomataceae, Myrsinaceae, and Rubiaceae. For steroids/triterpenes, positive reactions were obtained from 110 samples (85.9%). This is comparatively very high for a normal phytochemical survey. Latiff and Said (1989) recorded a range of 21.27% positive reaction for steroids/triterpenes. Most

of plants tested gave positive reactions. A total of 67 species (52.3%) gave positive reactions for saponins. Very strong reactions were observed in leaf samples belonging to Anisophylleaceae, Ebenaceae, Elaeocarpaceae, Melastomataceae, Rubiaceae, and Symplocaceae. Ninety-three species (72.7%) showed positive reactions for phenolics content. Strong reactions usually observed in samples with bright colour such as red, orange, yellow and purplish red.

Table 4. List of species screened for alkaloids, phenolics, steroids and saponins (+ presence, - absence; +++ strongly positive, + weakly positive).

Family/ Spesies	Herbarium number	Part Used	Alkaloid	Steroid/ Triterpene	Saponin	Phenolic
Anisophylleaceae						
Anisophyllea sp.1	GC 75	leaves	+	+	+	+
Anisophyllea sp.1	GC 75	stem	+	-	+	+
Anisophyllea sp.2	GC 34	leaves	+	+	+	-
Annonaceae						
Fissistigma sp.1	GC 54	leaves	-	+	-	-
Fissistigma sp.1	GC 131	leaves	-	+	-	-
Polyalthia sp.1	GC 130	leaves	-	+	-	+
Uvaria sp.	GF 43	leaves	+	+	+	+
Indet. 1	GC 110	leaves	+	+	-	+
Indet. 2	GC 110	stem	-	+	-	-
Indet. 3	GC 84	leaves	+	+	-	+
Indet. 4	GC 84	stem	-	-	-	+
Indet. 5	GC 24	leaves	+	+	-	+
Indet. 6	GC 18	leaves	+	+	+	+
Indet. 7	GC 18	stem	-	+	-	+
Indet. 8	GC 14	leaves	++	+	-	-
Indet. 9	GF 48	leaves	+++	+	+	+
Apocynaceae						
Indet. 10	GC 25	leaves	++	+	-	+
Araceae						
Schimatoglottis sp.1	GF 46	leaves	-	+	+	-
Scindapsus pictus	GF 44	leaves	+	+	-	+
Scindapsus pictus	GF 44	stem	-	+	+	+
Scindapsus sp.1	GC 69	leaves	+	+	-	-
Scindapsus sp.1	GC 69	stem	+	-	+	+
Scindapsus sp.2	GC 13	leaves	-	-	-	+
Scindapsus sp.2	GC 13	stem	-	+	-	+
Aspleniaceae						
Asplenium sp.	GC 126	leaves	+	+	-	-
Begoniaceae						
Begonia sp.1	MF 121	leaves	+	-	+	+
Begonia sp.2	GF 50	leaves	-	-	+	+
Begonia sp.2	GF 50	stem	+	-	-	+

Burseraceae						
Sp.1	GC 88	leaves	+	+	-	+
Clusiaceae						
Garcinia sp.	GC 38	leaves	-	+	-	-
Garcinia sp.	GC 94	leaves	-	+	-	-
Garcinia sp.	GC 94	stem	-	+	+	+
Connaraceae						
Rourea sp.	GC 86	leaves	+	+	-	+
Costaceae						
Costus globosus	GF 47	leaves	+	+	+	+
Costus globosus	GF 47	stem	-	-	+	+
Cyperaceae						
Mapania sp.	GC 101	leaves	-	+	-	-
Mapania sp.1	GC 21	leaves	-	+	-	+
Dilleniaceae						
Tetracera sp.1	GC 33	leaves	+	+	-	+
Tetracera sp.1	GC 81	leaves	+	+	-	+
Tetracera sp.1	GC 81	stem	-	-	-	-
Tetracera sp.1	GC 117	leaves	+	+	-	+
Dipterocarpaceae						
Shorea sp.	GC 107	leaves	+	+	-	+
Dracaenaceae						
Dracaena sp.	GC 125	leaves	-	+	-	-
Ebenaceae						
Diospyros sp.1	GC 93	leaves	-	+	+	+
Diospyros sp.1	GC 93	stem	-	+	+	+
Diospyros sp.1	GC 113	leaves	-	+	+	+
Diospyros sp.2	GC 92	leaves	+	+	+	+
Elaeocarpaceae						
Elaeocarpus sp.1	GC 8	leaves	+	+	-	+
Euphorbiaceae						
Antidesma sp.1	GC 72	leaves	+	+	+	
Antidesma sp.2	GC 2	leaves	+	+	-	+
Baccaurea sp.1	GC 76	leaves	-	+	+	-
Baccaurea sp.1	GC 77	leaves	-	+	+	-
Baccaurea sp.2	GC 55	leaves	-	+	+	-
Croton sp.	GC 37	leaves	+	+	-	+
Mallotus sp.1	GC 70	leaves	+	+	+	+

Fabaceae						
Bauhinia sp.1	GC 9	leaves	+	-	-	+
Bauhinia sp.1	GC 134	leaves	+	-	-	+
Spatholobus sp.3	GC 71	leaves	+	+	+	-
Spatholobus sp.3	GC 59	leaves	-	+	+	-
Indet. 11	GC 109	leaves	+	+	+	-
indet. 12	GC 29	leaves	+	+	-	+
indet. 13	GC 74	leaves	+	+	-	+
Indet. 14	GC 85	leaves	+	+	-	+
Indet. 15	GC 85	stem	-	-	-	+
Indet. 16	GC 7	leaves	-	+	-	+
Flacourtiaceae						
Hydnocarpus sp.1	GC 27	leaves	+	+	+	+
Gnetaceae						
Gnetum sp.1	GC 51	seed		-	-	+
Gnetum sp.1	GC 51	fruit	+	-	+	+
Lauraceae						
Cinnamomum sp.1	GC 137	leaves	++	+	+	-
Litsea sp.1	GC 60	leaves	-	+	-	+
Litsea sp.2	GC 22	leaves	+++	+	-	+
Indet. 17	GC 98	leaves	+	+	-	+
Indet. 18	GC 52	leaves	+	+	+	+
Marantaceae						
Phrynium sp.	GC 56	leaves	+	+	+	-
Melastomataceae						
Memecylon sp.1	GC 64	leaves	+	+	+	+
Indet. 19	GC 53	leaves	+	+	+	+
Indet. 20	MF 118	leaves	+	+	+	+
Meliaceae						
Aglaia sp.	GC 4	leaves		-	-	-
Aglaia sp.1	GC 103	leaves	-	+	-	+
Aglaia sp.2	GC 102	leaves	+	+	+	+
Indet. 21	GC 90	leaves	+	+	-	-
Indet. 22	GC 78	leaves	+	+	-	-
Indet. 23	GC 78	stem	-	-	-	-
Moraceae						
Artocarpus sp.	GC 104	leaves	-	+	-	+
Indet. 24	GC 106	leaves	+	+	+	+
Myristicaceae						
Knema sp.1	GC 63	leaves	+	+	+	+
Knema sp.2	GC 132	leaves	-	+	+	-

Myrsinaceae						
Ardisia sp.	GC 17	leaves	+++	+	+	+
Ardisia sp.1	GC 17	stem	+	+	-	+
Ardisia sp.1	GC 79	leaves	-	+	+	+
Ardisia sp.2	GC 11	leaves	-	-	-	+
Ardisia sp.3	GC 124	leaves	+	+	+	+
Ardisia sp.4	GC 35	leaves	+	+	-	+
Labisia sp.1	GC 32	leaves	+	+	-	+
Myrtaceae						
Syzygium sp.1	GC 95	leaves	-	-	+	+
Syzygium sp.1	GC 95	stem	-	-	-	+
Syzygium sp.2	GC 80	leaves	-	+	+	+
Syzygium sp.3	MF 123	leaves	+	+	+	+
Syzygium sp.4	GC 15	leaves	+	+	-	+
Syzygium sp.5	GC 15	stem	-	+	-	+
Ochnaceae						
Gomphia serrata	GC 111	leaves	-	+	-	-
Oxalidaceae						
Sarcotheca diversifolia	GC 128	leaves	+	-	+	-
Rhamnaceae						
Zizyphus sp.	GC 41	leaves	+	+	+	-
Rubiaceae						
Canthium sp.1	GC 1	leaves	+	-	-	+
Lasianthus sp.1	GC 68	leaves	-	+	+	-
Lasianthus sp.2	GC 26	leaves	+	+	+	+
Mitchella sp.	GC 28	leaves	+	+	+	+
Physcotria sp.	GC 97	leaves	+	+	-	+
Poterandia sp.1	GC 116	leaves	-	+	+	-
Poterandia sp.1	GC 116	stem	-	-	+	-
Pyschotria sp.1	GC 83	leaves	-	+	+	+
Pyschotria sp.1	GC 87	leaves	-	+	+	+
Pyschotria sp.1	GC 87	stem	-	-	-	+
Pyschotria sp.1	GC 91	leaves	-	+	+	+
Pyschotria sp.2	GC 23	leaves	+	+	-	+
Rothmannia sp.	GC 5	leaves	-	-	+	+
Uncaria sp.1	GC 129	leaves	+	+	-	-
Indet. 25	GC 100	leaves	+	+	-	+
Indet. 26	GC 6	leaves	+	+	+	-
Indet. 27	GC 20	leaves	+	+	+	-
Indet. 28	GC 20	stem	-	-	-	-
Indet. 29	GF 45	leaves	+	+	+	-
Indet. 30	GC 40	leaves	+	+	+	+
Indet. 31	GC 42	leaves	+	+	+	+

Rutaceae						
Evodia sp.1	GC 61	leaves	-	-	-	-
Selaginellaceae						
Selaginella sp.1	MF 120	leaves	-	-	+	-
Simaroubaceae						
Eurycoma longifolia	GC 36	leaves	-	+	-	+
Smilacaceae						
Smilax sp.1	GC 136	leaves	-	+	-	+
Symplocaceae						
Symplocos sp.1	GC 3	leaves	-	+	-	+
Symplocos sp.1	GC 19	leaves	-	+	-	+
Symplocos sp.1	GC 73	leaves	-	+	-	+
Symplocos sp.1	GC 82	leaves	-	+	-	+
Symplocos sp.1	GC 133	leaves	-	+	-	+
Theaceae						
Gordon sp.	GC 105	leaves	+	+	+	-
Gordon sp.	GC 105	stem	-	-	+	-
Thymelaeaceae						
Wilkstroemia sp.	GC 39	leaves	+	+	+	+
Vitaceae						
Ampelocissus cinnamomea	GC 10	leaves		+		+
Tetrastigma sp.	GC 16	leaves	+	+	-	+
Tetrastigma sp.	GC 16	stem	-	+	-	+
Vittariaceae			-		-	
Vittaria sp.1	GC 135	leaves	+	+	+	+
Zingiberaceae						
Boesenbergia sp.1	GC 122	leaves	-	-	+	-
Boesenbergia sp.2	GC 12	leaves	-	+	-	+
Boesenbergia sp.2	GC 30	leaves	+	+	-	+
Plagiostachys sp.1	MF 119	leaves	-	+	+	+
Plagiostachys sp.2	GC 89	leaves	-	+	-	+
Indet.1		leaves	+	+	-	+
Indet.2		stem/ root	+	+	-	+

* GC: Ginseng Camp
MF: Maliau Fall
GF: Ginseng Fall

CONCLUSION

In the 20m x 20m plot, the total number of medicinal plants found was 34 species in 455 plant individuals. Relative percentage of the number of medicinal plants species density is 12.8%, and about 38.8 % total number of individuals. Whereas, in random surveys the total number of medicinal plants found was 19 species. *Eurycoma longifolia* and *Tetracera scandens* were found to be abundant in this area. The total number of medicinal plants species found in Maliau Basin during this survey was 53 (Appendix I).

The phytochemical screening of plants in Maliau was successful although the number of species collected was low in the period of eight days. However, the experiment did uncover several potential phytochemical bearing species that need further investigation.

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Appendix 1. Checklist of medicinal plants in Maliau Basin.

NO.	FAMILY	SPECIES
1.	ANNONACEAE	*Artabortys suaveolens*
2.	ANNONACEAE	*Polyalthia bullata*
3.	ANNONACEAE	*Polyalthia insignis*
4.	ANNONACEAE	*Polyalthia sumatrana*
5.	APOCYNACEAE	*Alstonia angustiloba*
6.	ARALIACEAE	*Schefflera elliptica*
7.	ASCLEPIDACEAE	*Hoya coronaria*
8.	ASPLENIACEAE	*Asplenium nidus*
9.	COSTACEAE	*Costus speciosus*
10.	DILLENIACEAE	*Tetracera scandens*
11.	DRACAENACEAE	*Dracaena elliptica*
12.	EUPHORBIACEAE	*Glochidion littorale*
13.	EUPHORBIACEAE	*Mallotus miquelianus*
14.	EUPHORBIACEAE	*Scaphium affine*
15.	FLAGELLARIACEAE	*Flagellaria indica*
16.	GUTTIFERAE	*Garcinia mangostana*
17.	HANGUANACEAE	*Hanguana malayana*
18.	HYPOLEPIDACEAE	*Pteridium caudatum*
19.	HYPOXIDACEAE	*Curculigo latifolia*
20.	LAURACEAE	*Litsea umbellata*
21.	LEGUMINOSAE	*Bauhinia kockiana*
22.	LEGUMINOSAE	*Fordia splendidisima*
23.	LOGANIACEAE	*Fagraea cuspidata*
24.	LOGANIACEAE	*Strychnos cuspidata*
25.	MARANTACEAE	*Marantha arundinacea*
26.	MELASTOMATACEAE	*Melastoma malabathricum*
27.	MELASTOMATACEAE	*Memecylon* sp.
28.	MENISPERMACEAE	*Fibraurea chloroleucea*
29.	MORACEAE	*Ficus recurva*
30.	MYRSINACEAE	*Ardisia oxyphylla*
31.	MYRSINACEAE	*Labisia pumila* var. *longifolia*
32.	MYRSINACEAE	*Labisia pumila* var. *pumila*
33.	MYRSINACEAE	*Rennelia borneensis*
34.	MYRTACEAE	*Decaspermum fruticosum*
35.	MYRTACEAE	*Syzygium cernia*
36.	NEPHROLEPIDACEAE	*Nephrolepis biserrata*
37.	POACEAE	*Cymbopogon citrates*
38.	POACEAE	*Dinochloa scandens*

39.	POLYGALACEAE	*Polygala paniculata*
40.	POLYPODIACEAE	*Drynaria sparsisora*
41.	PROTEACEAE	*Heliciopsis artocarpoides*
42.	RHMNACEAE	*Zizyphus horsfieldii*
43.	RUBIACEAE	*Urophyllum glabrum*
44.	RUBIACEAE	*Urophyllum hirsutum*
45.	SAPINDACEAE	*Guioa pleuropteris*
46.	SIMAROUBACEAE	*Eurycoma longifolia*
47.	SMILACACEAE	*Smilax borneensis*
48.	SMILACACEAE	*Smilax leucophylla*
49.	THYMELAEACEAE	*Aquilaria malaccensis*
50.	VITACEAE	*Ampelocissus cinnamomea*
51.	VITACEAE	*Pterisanthes cissoides*
52.	ZINGIBERACEAE	*Globba patens*
53.	ZINGIBERACEAE	*Globba pendula*