第一章　緒　言

台灣常見藥用植物血藤(*Mucuna macrocarpa* WALLICH)，為豆科(Leguminosae)血藤屬(*Mucuna*)植物。於台灣全境中低海拔山區濕生空曠處、林緣及溪邊自生[1]。

血藤屬(*Mucuna*)為一分布廣泛之豆科(Leguminosae)植物，分佈於中國大陸南部、雲南、印度、琉球，而台灣產之血藤屬植物依台灣植物誌(Flora of Taiwan)所載為大血藤(*M. gigantea*)、血藤(*M. macrocarpa*)、蘭嶼血藤(*M. membranacea*)及虎爪豆(*M. pruriens*)四種[2]。而血藤(*M. macrocarpa*)之藤莖具有補血活血，清肺潤燥，通經活絡功效。民間割取其藤莖，切片、曬乾使用。主治貧血，月經不調，肺熱燥咳，咳血，腰膝酸痛，風濕痺痛，手足麻木，癱瘓。為台灣常見之民間藥[3]。

根據美國伊利諾大學 Napralet 資料庫在 2001 年 1 月份所統計，血藤經文獻考察血藤之成分研究，目前已分離得到 *l*-dopa[4], lupenone, friedelin, pentacosanoic acid 2-3-dihydroxy-propyl ester, hexacosanoic acid 2-3-dihydroxy-propyl ester[5]等，並具有利尿及抗痙攣[6]活性，而本屬其他植物則具有抗凝集、抗菌、解痙、鎮痛、抗發炎、降血糖、產生雄性素活性及殺線蟲活性…等之報導，值得進一步分離追蹤其活性成分。

經由國家衛生研究院細胞毒殺活性試驗，發現血藤莖部之甲醇粗抽物、乙酸乙酯層、水層及沉澱物對胃癌細胞(NUGC)具有明顯的抑制作用。而在以 DPPH 所測試之抗氧化活性試驗中，發現血藤莖部甲醇粗抽物、乙酸乙酯層、正丁醇層、水層及沉澱物具有顯著的抗氧化活性。

因此本研究以細胞毒性及抗氧化能力作為活性指標，進行血藤化學成分之分離，將血藤的乾燥莖部，以甲醇浸泡抽取後，取甲醇抽出物以不同極性的溶媒萃取，經減壓濃縮至乾後，再將各萃取層成分分別以管柱層析法分離，並以再結晶法純化而得到七個化合物，分別為 tetracosanoic acid, β-sitosterol 和 stigmasterol 混合物, friedelin, medicarpin, afrormosin, calycosin, genistein，並利用紅外光譜、紫外光譜、質譜及核磁共振等光譜分析法，進行結構鑑定，盼望藉由台灣藥用植物血藤的化學成分研究，來確定其成分種類，進而瞭解血藤在醫療上的功效，及民間用途使用的正確性，以提高台灣本土藥用植物之利用價值。並期望本研究所分離的化合物，能對往後研究本藥用植物者，提供一些具有價值的參考。

第二章　總　論

第一節　血藤之藥用植物學考察

一、血藤之植物學分類[7]

被子植物門 Angiospermae

雙子葉綱 Dicotyledoneae

離瓣花亞綱 Choripetalae

雙花被類 Dialypetalae

薔薇目 Rosales

豆科 Leguminosae

血藤屬 *Mucuna*

二、豆科(Leguminosae)血藤屬(*Mucuna*)植物之特徵[1]

一年生或多年生藤本，莖汁紅色。三出葉。總狀花序。花萼寬鐘形，5 **齒裂，上方二面合生，最下方一片明顯較長。花瓣蝶形。莢果通常具刺毛。台灣有** 4 **種。**

三、血藤屬(*Mucuna*)植物之種檢索表[2]

1.莖被有白色伏毛；每個莖節有 3 朵花；豆莢不平坦，白色毛狀……
……*M. pruriens* var. *utilis* 虎爪豆

1.莖被有銹色柔毛或無毛；每個莖節有 2 朵花；豆莢平坦，銹色毛狀或無毛。

2.小葉無小托葉；豆莢長於 20 公分，沿縫線處無翼……
……*M. macrocarpa* 血藤

2.小葉有小托葉；豆莢短於 15 公分，沿縫線處有翼。

3.頂小葉橢圓至長菱形；豆莢平滑且無毛……
……*M. membranacea* 蘭嶼血藤

3.頂小葉卵橢圓或卵圓形；豆莢不平滑且無毛……
……*M. gigantean* ssp. *tashiroi* 大血藤

四、血藤(*M. macrocarpa*)之植物形態[1-2]

大型木質攀緣植物，枝條被銹色柔毛。三出複葉，頂小葉橢圓形，長 12-15 cm，寬 6-7 cm，背面被毛，先端尾狀突尖。總狀花序，花軸上有 15-30 朵花，花軸可達 40 cm 長；小花柄約 2.5 cm 長；花萼約 1 cm 長；花冠深紫色約 5 cm 長。豆莢平坦，大部分 7-15 cm 長，5 cm 寬，密被柔毛，種子 6-12 顆。

1. flowering branch; 2. flower removed corolla; 3. standard; 4. wings;
5. keels; 6. pistil; 7. pod; 8. seed.

Figure 2-1: **血藤**(*Mucuna macrocarpa* WALLICH)**植物型態特徵圖**[2]

五、血藤之基原、分佈與功用

1.**學名：***Mucuna macrocarpa* WALLICH

2.**科名：豆科** Leguminosae

3.**別名：黑血藤、長莢油麻藤**[3]**，老鴉花藤、大血藤、嘿良龍**[8]**。**

4.**分佈：台灣、廣東、海南、廣西、貴州、雲南等地**[3]**。**

5.**藥性：味苦、澀，性涼**[3]**。**

6.**效用：莖可強筋壯骨，調經補血。用於小兒麻痺後遺症，月經不調，風濕筋骨痛**[7]**。**

7.**附方：**(1) **治小兒麻痺後遺症：血藤** 60 g**，研細。加粗糠炒熱，外包環跳穴或肩？穴，**3 **天換藥** 1 **次**

(2) **治月經不調：血藤** 15 g **泡酒** 500 mL**。每次** 10 mL**，每日服** 2 **次**[3]**。**

第二節 血藤之植物成分及藥理文獻考察

有關血藤(*Mucuna macrocarpa* WALLICH)植物成分及藥理之文獻，據美國伊利諾大學 Narpralert Database Profiles on *Mucuna* 在 2001 年以前所做的統計，依民俗用法(ethnomedical usage)、抽出物之生物活性(biological activities)及分離之成分(presense of compounds)等三項歸類整理如下：

血藤之民俗用法報導方面，血藤之乾燥全植物，在中國大陸地區有作為藥物使用[9]。而在台灣則是用乾燥莖部治療糖尿病[10]。（詳見 Table 2-1）

血藤植物之生物活性研究方面，血藤乙醇與水抽出物主要有利尿及解痙活性。對大鼠以胃管給藥，劑量為 510.7 mg/kg，顯示具有利尿活性[6]。（詳見 Table 2-2）

血藤植物之成分研究方面，目前已分離得到 *l*-dopa[4], lupenone, friedelin, pentacosanoic acid 2-3-dihydroxy-propyl ester, hexacosanoic acid 2-3-dihydroxy-propyl ester[5]等。（詳見 Table 2-3）

Table 2-1: Ethnomedical information on *M. macrocarpa*

Species	Used part	Area	Ethnomedical usage	Ref.
M. macrocarpa	Dried entire plant	China	Used medicinally	[9]
	Dried stem	Taiwan	Used to treat Diabetes mellitus	[10]

Table 2-2: Biological activities for extracts of *M. macrocarpa*

Species	Used part	Area	Biological activities	Ref.
M. macrocarpa	Dried stem	India	Diuretic activity: rat, dose 510.7mg/kg (A)	[6]
			Spasmolytic activity: rat, conc. used not stated (A)	[6]
			Analgesic activity: mouse, dose not stated (I)	[6]
			Anticonvulsant activity: mouse dose not stated (I)	[6]
			Antiprotozoan activity: broth culture, conc. used 125.0 mcg/ml (I)	[6]
			Antiviral activity: cell culture, conc. used 0.05mg/ml (I)	[6]
			Hypothermic activity: rat, dose not stated (I)	[6]

A: active I: inactive

Table 2-3: Presence of compounds in *M. macrocarpa*

Species	Used part	Area	Presense of compound	Type	Ref.
M. macrocarpa	Root	China	*l*-dopa	Proteid	[4]
	Part not specified	India	lupenone	Triterpene	[5]
			friedelin	Triterpene	[5]
			hexacosanoic acid 2-3-dihydroxy-propyl ester	Lipid	[5]
			pentacosanoic acid 2-3-dihydroxy-propyl ester	Lipid	[5]

由上述整理發現，血藤(*M. macrocarpa*)之民俗用法、生物活性及成分研究方面相當有限，具有值得進一步研究及開發的潛力。

第三節　血藤屬之植物成分及藥理文獻彙整

有關血藤屬(*Mucuna*)**全屬之植物成分及藥理文獻，據** 2001 **年美國伊利諾大學** Narpralert Database Profiles on *Mucuna* **在** 2001 **年以前所做的統計，依民俗用法**(ethnomedical usage)**、抽出物之生物活性**(biological activities)**及分離之成分**(presense of compounds)**等三項歸類整理如下：**

一、血藤屬(*Mucuna*)植物之民俗用法報導方面：[11-70]

1. *M. bracteata*

做為止血劑(hemostatic)。

2. *M. collettii*

用於治療癌症(cancer)。

3. *M. coriacea*

治療尿道血吸蟲病(urinary schistosomiasis)；**做為經期外的止血劑**(as styptic for extended menstruation)。

4. *M. currannii*

當作食物。

5.*M. flagellipes*

做為調經劑(emmenagogue)。

6. *M. gigantea*

治療血吸蟲病(schistosomiasis)；**種子粉末用作催情劑**(aphrodisiac)。

7. *M. macrocarpa*

當作藥用(used medicinally)、**治療糖尿病**(diabetes mellitus)。

8. *M. monosperma*

用於檢查外部出血情形(external hemorrhages)。

9. *M. poggei*

當作食物。

10. *M. pruriens*

做為刺激物質(irritant)、**調經劑**(emmenagogue)、**驅蟲劑**(anthelmintic)、**子宮興奮劑**(uterine stimulant)、**神經滋補劑**(nerve tonic)、**神經鎮定劑**(nervine)、**催情劑**(aphrodisiac)、**利尿劑**(diuretic)、**墮胎劑** (used as an abortifacient)、**避孕劑**(antifertility agent)、**抗蛇毒素**

(antivenin)；**用於治療癌症**(cancer)、**風濕症**(rheumatism)、**痛風**(gout)、**糖尿病**(diabetes)、**腎臟結石**(kidney stones)、**肺結核**(pulmonary tuberculosis)、**長期咳嗽**(persistent coughs)、**痢疾**(dysentery)、**腹瀉**(diarrhea)、**腸道寄生物**(intestinal parasites)、**蠍子螫傷和蛇咬傷**(scorpion stings and snakebite)、**男性無能和不孕症**(male impotence and sterility)。

11.*M. pruriens* var. *pruriens*

做為催情劑(aphrodisiac)。

12. *M. pruriens* var. *utilis*

當作食物；用於治療蛇咬傷(snakebite)。

13. *M. rostrata*

做為解毒劑(antidote)；**治療糖尿病**(diabetes)、**痔瘡**(hemorrhoids)。

14. *M.* species

做為墮胎藥(abortive)；**用於減輕胃部疼痛**(stomach pains)。

15. *M. urens*

做為消化劑(digestive)、**驅蠕蟲藥**(vermifuge)**並用於治療淋病**(gonorrhea)、**偏頭痛**(migraine)、**疼痛**(aches and pains)、**咬傷及螫傷**(bites and stings)。

（詳見 Table 2-4**）**

Table 2-4: Ethnomedical information on *Mucuna*

Species	Used part	Area	Ethnomedical	Ref.
M. bracteata	Entire plant	India	Used as a hemostatic	[11]
M. collettii	Dried seed	Thailand	Used for cancer	[12]
M. coriacea	Part not specified	Zimbabwe	Used to treat urinary schistosomiasis	[13]
	Root	Tanganyika	Decoction drunk as styptic for extended menstruation	[14]
M. currannii	Dried seed	Philippines	Used as a food	[15]
M. flagellipes	Entire plant	Ivory Coast	Administered as an emmenagogue	[16]
M. gigantea	Dried root	Switzerland	Used to treat schistosomiasis	[17]
	Seed	Guam	Powdered seeds taken as an aphrodisiac	[18]
M. macrocarpa	Dried entire plant	China	Used medicinally	[19]
	Dried stem	Taiwan	Used to treat diabetes mellitus	[20]
M. monosperma	Dried leaf	Bangladesh	Tender leaves and curculigo capitulata rhizomes are made into a paste and mixed with tobacco ash; this paste is used to check external hemorrhages	[21]
M. poggei	Seed	Tanzania	Used as a food	[22]
M. pruriens	Entire plant	Ivory coast	Used as an emmenagogue	[16]
	Dried fruit	Haiti	Used for intestinal parasites	[23]
		India	A decoction of the fruits is given internally to children in case of stomach worms	[24]
			Used as an anthelmintic	[25]
			Used as an irritant	
	Leaf	India	Used as a uterine stimulant	[26]
			Used as a nerve tonic	
			Used in dysentery	
			Used as an aphrodisiac	
			Used as a diuretic	
			Used for scorpion stings	[27]
	Dried leaf + stem	Thailand	Used for burns	[28]
			Used for cuts	
	Part not specified	India	Used for cancer	[29]
			Used to improve male sexual function	[30]
			Used to improve sexual function traditionally recommended for males, but the author advocates their use by females as well	
			Used as an abortifacient	[31]
			Used as an antifertility agent	
	Part not specified	Panama	Used medicinally, perhaps as an aphrodisiac	[32]
	Part not specified	Virgin Islands	Used for worms	[33]
	Plant juice	Guinea	Used as an emmenagogue	[34]
	Pod trichomes	India	Used as an anthelmintic	[35]
	Root	India	Used as an emmenagogue	[36]
	Root	Nepal	Used as an aphrodisiac	[37]
	Dried root	India	Used for rheumatism	[38]
			Used for gout	
			Used for delerium in ayurvedic and unani medicine	[39]
			Used as a blood purifier	[40]

M. pruriens			Used as a diuretic	
			Used for kidney stones	
	Fresh root	India	Used to relieve dysmenorrhea	[41]
	Seed	Guadeloupe	Seeds crushed and mixed with syrup to be given to infants as a vermifuge	[42]
		Guinea	Used as an aphrodisiac	[34]
		India	Used to cure night dreams and impotency	[43]
			Used to promote fertiltiy	
			Used as an emmenagogue	[44]
			Used as an aphrodisiac to increase seminal fluid and manly vigour	
			Used as an aphrodisiac	[45]
			Used as an aphrodisiac	[35]
			Used for diarrhea	[46]
			Used as an antivenin	[47]
			Used for diabetes	[48]
			Used for scorpion stings and snakebite	[27]
			Used as a nervine	[39]
			Used as an aphrodisiac in ayurveda and unani medicine	
		Madagascar	Used as an aphrodisiac	[49]
		Nepal	Used as an aphrodisiac	[50]
		Pakistan	Used as an aphrodisiac	[51]
			Used as an aphrodisiac	[52]
		Trinidad	Seeds crushed and taken with molasses for intestinal worms	[53]
	Dried seed	Brazil	Used as a nerve tonic	[54]
			Used as an aphrodisiac	
		India	Used to treat male impotence and sterility	[55]
			Used for abortion	[56]
			Used as an aphrodisiac	[57]
			Used for sexual debility	[58]
			Used for persistent coughs	[59]
			Used for pulmonary tuberculosis	[60]
		Pakistan	Used for diabetes	[61]
	Fresh seed	India	Used as an aphrodisiac, and for seminal weakness and impotence	[40]
	Dried seed pods	India	Used as an anthelmintic in ayurvedic and unani medicine	[39]
	Fresh stem	Philippines	Used to treat sore/wind burns-cut a fresh stem and blow one end of the stem allowing sap to flow to other end over the mouth of the child	[62]
M. pruriens var.*pruriens*	Seed	Mozambiq-ue	Used as an aphrodisiac	[63]
M. pruriens var.*utilis*	Dried leaf	Nigeria	Used to treat snakebite	[64]
	Dried seed	Brazil	Used as a food	[65]
M. rostrata	Seed	Peru	Used as a diuretic	[66]
			Used as an antidote	
			Used against hemorrhoids	
M. species	Part not specified	Peru	Known as an abortive	[67]
	Fresh stem	Papua-new guinea	Used to relieve stomach pains	[68]
M. urens	Part not specified	Peru	Used to treat gonorrhea	[66]
			Used to treat migraine	
			Used as a vermifuge	
	Sap	Nicaragua	Used for aches and pains	[69]

			Used for bites and stings	
			Used as a digestive	
			Used for skin rashes	
	Seed	Guatemala	Used for gonorrhea	[70]

二、血藤屬(*Mucuna*)植物之生物活性研究方面：[71-117]

1. *M. argyrophylla*

紅血球凝集活性(hemagglutinin activity)。

2. *M. aterrima*

線蟲毒殺活性(nematocidal activity)。

3. *M. birdwoodiana*

前列線素合成抑制作用(prostaglandin synthetase inhibition)；**固醇類去氫酵素抑制作用**(hydroxysteroid dehydrogenase inhibition)。

4. *M. capitata*

毒性反應(toxic effect)。

5. *M. currannii*

胰蛋白酵素抑制作用(trypsin inhibition)。

6. *M. ferruginea*

抗菌活性 (antibacterial activity)。

7. *M. flagellipes*

自律神經反應 (autonomic effects)。

8.*M. macrocarpa*

利尿作用 (diuretic activity)。

抗痙攣作用 (spasmolytic activity)。

9. *M. monosperma*

墮胎作用 (abortifacient effect)。

10. *M. pruriens*

抗痙攣作用(antispasmodic activity)；**低血糖作用**(hypoglycemic activity)；**止痛作用**(analgesic activity)；**抗發炎作用**(antiinflammatory activity)；**解熱作用**(antipyretic activity)；**抗高膽固醇血症作用**(antihypercholesterolemic activity)；**抗高脂血症作用**(antihyperlipemic

activity)；**促進代謝作用**(anabolic activity)；**改善前列腺肥大**(benign prostatic hyperplasia improvement)；**雄性激素作用**(androgenic effect)；**增加睪固酮濃度作用**(testosterone level increased)；**催情作用**(aphrodisiac activity)；**陰莖勃起刺激作用**(penis erectile stimulant)；**性行為改善作用**(sexual behavior modification)；**促進精液產生作用**(spermatogenic effect)；**提升生育力作用**(fertility promotion effect)；**刺激組織胺釋放作用**(histamine release stimulation)；**增加褪黑激素濃度作用**(melatonin level increase)；**血清素釋放作用**(serotonin releasing effect)；**抗高血糖症作用**(antihyperglycemic activity)；**抗巴金森氏症作用**(antiparkinson activity)；**催乳激素抑制作用**(prolactin inhibition)；**絛蟲毒殺活性**(taenicide activity)；**致畸胎作用**(teratogenic activity)；**毒性反應** (toxic effect)；**抗蛇毒素反應**(antivenin effect)；**骨骼肌興奮作用**(skeletal muscle stimulant activity)；**平滑肌興奮作用** (smooth muscle stimulant activity)。

11. *M. pruriens* var. *utilis*

抗血液凝集作用(anticoagulant activity)；**紅血球凝集作用**(hemagglutinin activity)；**胰蛋白酵素抑制作用**(trypsin inhibition)。

12.*M. pruriens* var. *utilis*

植物成長抑制作用(plant growth inhibitor)。

13. *M.* species

中樞神經作用(CNS effects)；**抗痙攣作用**(spasmolytic activity)。

14.*M. utilis*

抗痙攣作用(spasmolytic activity)。

（詳見 Table 2-5**）**

Table 2-5: Biological activities for extracts of *Mucuna*

(A:active, S:strong, W:weak, I:inactive)

Species	Used part	Area	Biological activities	Ref.
M. argyrophylla	Seed	Mexico	Hemagglutinin activity: H_2O ext., cow, conc. used not stated, Rbc (I) H_2O ext., human adult, conc. used not stated, Rbc (W) H_2O ext., rabbit, conc. used not stated, Rbc (A)	[71]
			Trypsin inhibition: H_2O ext., conc. used not stated, 13.43 trypsin units inhibited (W)	
M. aterrima	Dried leaf + stem	Brazil	Nematocidal activity: hexane ext., conc. used not stated, meloidogyne incognita (W)	[72]
M. birdwoodiana	Dried stalk	Hong Kong	Prostaglandin synthetase inhibition: $CHCl_3$ ext., conc. used 0.5 mg/ml (A) H_2O ext., conc. used 0.75 mg/ml (A)	[73]
	Dried stem	South Korea	Hydroxysteroid(3-alpha) dehydrogenase inhibition: MeOH ext., rat, IC50 26.65 mcg/ml, cytosol(liver) (A)	[74]
M. capitata	Dried seed	India	Toxic effect(general), H_2O ext., in ration, rat, conc. used variable (A) feeding caused weight loss unless supplemented with l-methionine and l-tryptophan. The protein fraction of the seeds was incorporated into the experimental ration.	[75]
M. currannii	Dried seed	Philippines	Trypsin inhibition: alkaline ext., conc. used not stated (A)	[15]
M. ferruginea	Dried entire plant	Taiwan	Antibacterial activity: decoction, agar plate, mic 62.5 mg/ml: *Bordetella bronchiseptica* (I), *Proteus vulgaris* (I), *Staphylococcus aureus* (I), *Staphylococcus epidermidis* (I) mic 125.0 mg/ml: *Bacillus cereus* (I), *Bacillus subtilis* (I) *Micrococcus flavus* (I), *Pseudomonas aeruginosa* (I) mic 250.0 mg/ml: *Escherichia coli* (I), *Klebsiella pneumoniae* (I), *Salmonella typhi type 2* (I), *Sarcina lutea* (I)	[76]
M. ferruginea	Dried stem	Taiwan	Antibacterial activity: decoction, agar plate, mic 121.9 mg/ml, streptococcus mutans (W)	[77]
M. flagellipes	Dried fruit	Congo	Autonomic effects(unspecified): H_2O ext., ip, rat, dose not stated, enophthalmus, lacrimation, micturation (A)	[78]
	Dried seed	Congo	Autonomic effects (unspecified) : H_2O ext., ip, rat, dose not stated, exophthalmia (A)	
M. imbricata	Aerial parts	India	Analgesic activity: EtOH- H_2O (1:1) ext., ip, mouse, dose 0.5 mg/kg, vs. tail pressure method (I)	[79]
			Antibacterial activity: EtOH- H_2O (1:1) ext., agar plate, conc. used >25.0 mcg/ml, *Bacillus subtilis* (I), *Escherichia coli* (I), *Salmonella typhosa* (I), *Staphylococcus aureus* (I), *Agrobacterium tumefaciens* (plant pathogens) (I)	
			Anticonvulsant activity: EtOH- H_2O (1:1) ext., ip, mouse, dose 0.5 mg/kg, vs. electroshock-induced convulsions (I) vs. strychnine-induced convulsions (I)	
			Antifungal activity: EtOH- H_2O (1:1) ext., agar plate, conc. used >25.0 mcg/ml, *Microsporum canis* (I), *Trichophyton mentagrophytes* (I), *Aspergillus niger* (plant pathogens) (I)	

M. imbricat			Antiinflammatory activity: EtOH- H_2O (1:1) ext., oral, rat, male, dose 0.5 mg/kg, vs. carrageenin-induced pedal edema, animals dosed one hour before carrageenin injections (I)	
			Antispasmodic activity (unspecified type): EtOH- H_2O (1:1) ext., guinea pig, conc. used not stated, ileum, vs. ach- and histamine-induced spasms (I)	
			Antitumor activity: EtOH- H_2O (1:1) ext., ip, mouse, dose not stated, leuk-p388 (I)	
			Antiyeast activity: EtOH- H_2O (1:1) ext., agar plate, conc. used >25.0 mcg/ml, *Candida albicans* (I), *Cryptococcus neoformans* (I)	
			Barbiturate potentiation: EtOH- H_2O (1:1) ext., ip, mouse, dose 0.5 mg/kg (I)	
			Diuretic activity: EtOH- H_2O (1:1) ext., ip, rat, male, dose 0.25 mg/kg, saline-loaded animals used, urine collected for 4 hours post-drug (I)	
			Hypoglycemic activity: EtOH- H_2O (1:1) ext., oral, rat, dose 250.0 mg/kg, less than 30% drop in blood sugar level (I)	
			Hypolipemic activity: EtOH- H_2O (1:1) ext., oral, rabbit, dose 50.0 mg/kg (I)	
			Hypothermic activity: EtOH- H_2O (1:1) ext., ip, mouse, dose 0.5 mg/kg (I)	
			Semen coagulation: EtOH- H_2O (1:1) ext., rat, conc. used 2.0%, sperm (I)	
			Spermicidal effect: EtOH- H_2O (1:1) ext., rat, male, conc. used not stated, sperm (I)	
			Toxicity assessment (quantitative): EtOH- H_2O (1:1) ext, ip, mouse, LD_{50} 1.0 gm/kg	
M. macrocarpa	Dried stem	India	Analgesic activity: EtOH- H_2O (1:1) ext., intragastric, mouse, dose not stated, vs. hot plate method, vs. tail clip method (I)	[80]
			Anticonvulsant activity: EtOH- H_2O (1:1) ext., ip, mouse dose not stated, vs. supramaximal electroshock-induced convulsions. (I)	
			Antiprotozoan activity: EtOH- H_2O (1:1) ext., broth culture, conc. used 125.0 mcg/ml, *Entamoeba histolytica* (I)	
			Antiviral activity: EtOH- H_2O (1:1) ext., cell culture, conc. used 0.05 mg/ml, virus-ranikhet (I), virus-vaccinia(I)	
			Diuretic activity: EtOH- H_2O (1:1) ext., intragastric, rat, dose 510.7 mg/kg (A)	
			Hypothermic activity: EtOH- H_2O (1:1) ext., intragastric, rat, dose not stated (I)	
			Spasmolytic activity: EtOH- H_2O (1:1) ext., rat, conc. used not stated, uterus (unspec.cond) (A)	
			Toxicity assessment (quantitative): EtOH- H_2O (1:1) ext., ip, mouse, LD_{50} 681.0 mg/kg	
M. monosperma	Dried root	India	Abortifacient effect: type ext. not stated, ip, species not stated, dose not stated (A)	[81]
M. pruriens	Entire plant	Puerto Rico	Insecticide activity: plant, dose not stated (I)	[82]
	Dried entire plant	India	Benign prostatic hyperplasia improvement: hot H_2O ext., oral, human adult, male, dose not stated (A)	[83]
			Fertility promotion effect: type ext. not stated, oral, human adult, male, dose 96.0 mg/day (A)	[84]
			Genitourinary effect (unspecified): H_2O ext., oral, mouse dose 5.0 mg/day (A)	[85]

M. pruriens	Fruit	India	Antis pasmodic activity (unspecified type): EtOH- H_2O (1:1) ext., guinea pig, conc. used not stated, ileum (A)	[86]
			Cytotoxic activity: EtOH- H_2O (1:1) ext., cell culture, ED_{50} >20.0 mcg/ml, CA-9KB (I)	
			Hypoglycemic activity: EtOH- H_2O (1:1) ext., oral, rat, dose 250.0 mg/kg (A)	
			Toxicity assessment (quantitative): EtOH- H_2O (1:1) ext., ip, mouse, maximum tolerated dose 1.0 gm/kg	
	Dried fruit	Italy	Analgesic activity: EtOH (95%) ext., intragastric, rat, vs. hot plate method, dose 1.0 gm/kg (A) vs.acetic acid-induced writhing, dose 2.0 gm/kg (A)	[87]
			Antiinflammatory activity: EtOH (95%) ext., intragastric, rat, vs. carrageenan-induced pedal edema, dose 3.0 gm/kg (A)	
			Antipyretic activity: EtOH (95%) ext., intragastric, rat, vs. yeast-induced pyrexia, dose 1.0 gm/kg (A)	
	Dried leaf	Africa	Analgesic activity: EtOH (95%) ext., intragastric, rat, dose 1.0 gm/kg, vs. hot plate method (A) vs.acetic acid-induced writhing (A)	
			Antiinflammatory activity: EtOH (95%) ext., intragastric, rat, dose 1.0 gm/kg, vs. carrageenan-induced pedal edema (A)	
			Antipyretic activity: EtOH (95%) ext., intragastric, rat, dose 1.0 gm/kg, vs. yeast-induced pyrexia (A)	
	Dried leaf + root + seed	India	Antiinflammatory activity: root, oral, human adult, dose variable (A)	[88]
	Commercial sample of leaf	Italy	Antihypercholesterolemic activity: decoction, intragastric, rat, dose 5.0 gm/kg, vs. diet-induced hypercholesterolemia (A) vs. triton-induced hypercholesterolemia (A)	[89]
			Antihyperlipemic activity: decoction, intragastric, rat, dose 5.0 gm/kg, vs. diet-induced hypercholesterolemia (A) vs. triton-induced hypercholesterolemia (A)	
	Part not specified	India	Anabolic activity: plant, oral, mouse (castrate) , male, dose 7.70 mg/animal (A)	[90]
			Androgenic effect: plant, oral, mouse (castrate) , male (child) , dose 7.7 mg/animal (A) mouse(infant), male, dose 22.0 mg/animal (A)	
			Aphrodisiac activity: plant, oral, human adult, male, dose not stated (A)	[91]
	Dried part not specified	India	Histamine release stimulation: type ext. not stated, intragastric, rat, dose 1.0 gm/kg (A)	[92]
			Melatonin level increase: type ext not stated, intragastric, rat, dose 1.0 gm/kg (A)	
			Serotonin releasing effect: type ext. not stated, intragastric rat, dose 1.0 gm/kg (A)	
	Dried prothallus	Japan	Antiradiation effect: MeOH ext, ip, mouse, dose 100 mg/kg, vs. soft x-ray irradiation at lethal dose (I)	[93]
	Root	India	Antispasmodic activity (unspecified type): EtOH-H_2O (1:1) ext., guinea pig, conc. used not stated, ileum, vs. ach: and histamine-induced spasms (A)	[86]
			Cytotoxic activity: EtOH-H_2O (1:1) ext., cell culture, ED_{50} >20.0 mcg/ml, CA-9KB (I)	
			Hypoglycemic activity: EtOH-H_2O (1:1) ext., oral, rat, dose 250.0 mg/kg more than 30% drop in blood sugar level (A)	

M. pruriens			Toxicity assessment (quantitative): EtOH-H_2O (1:1) ext., ip, mouse, maximum tolerated dose 250.0 mg/kg	
	Seed	India	Antihyperglycemic activity: intragastric, rat, sex not indicated (adult) , vs. glucose tolerance tests; albino rats, ash, dose 90.0 mg/kg (A) EtOH (100%) ext., dose 250.0 mg/kg (I)	[48]
			Hypoglycemic activity: EtOH-H_2O (1:1) ext., oral, rat, dose 250.0 mg/kg less than 30% drop in blood sugar level (I)	[79]
	Boiled seed	Nigeria	Spasmogenic activity: decoction, guinea pig, ED_{50} 3.3 mg/ml, ileum, atropine, promethazine, nifedipine, cyproteptadine and verapamil antagonized effect with increasing effectiveness (A)	[94]
	Commercial sample of seed	Sri Lanka	Nematocidal activity: decoction, conc. used 10.0 mg/ml, *Toxocara canis* (I)	[95]
	Dried seed	No address given	Penis erectile stimulant: type ext. not stated, oral, human adult, male, dose not stated (A)	[96]
	Dried seed	Bangladesh	Nematocidal activity: H_2O ext., conc. used 10.0 mg/ml, *Toxocara canis* (I) MeOH ext., conc. used 1.0 mg/ml, *Toxocara canis* (I)	[97]
	Dried seed	Cuba	Bronchodilator activity: hot H_2O ext., iv, guinea pig, dose 1.5 ml/animal (I)	[98]
	Dried seed	India	Antigalactagogue effect: seeds, oral, human adult, female, dose 15.0 gm/animal (I)	[99]
			Antiparkinson activity: endocarp tissue, in ration, rat, dose 5.0 gm/kg, carbidopa also administered required to have effect (A)	[100]
			Antiparkinson activity: MeOH ext., ip, rat, dose 200.0 mg/kg an alcohol-insoluble methanol ext.ract ,free from *l*-dopa, was tested, data incomplete - derived from an abstract (A) seeds, gastric intubation, rat, dose 400.0 mg/kg data incomplete - derived from an abstract (A)	[101]
			Cholinesterase inhibition: MeOH ext., ip, rat, dose 200.0 mg/kg, an alcohol-insoluble methanol ext.ract, free from *l*-dopa,was tested, data incomplete - derived from an abstract (I)	
			Antiparkinson activity: seeds, oral, human adult, dose 15-40 gm/person *l*-dopa content was about 4.5-5.5%, study involving 33 patients with parkinson's disease (A)	[102]
			Antiparkinson activity: type ext. not stated, oral, human adult, dose not stated, levodopa has been isolated from this extract (A)	[103]
			Aphrodisiac activity: ip, rat, male, dose not stated, no effect on social behavior including homosexual mounting, sniffing, lying over one another, etc, data incomplete - derived from an abstract, Ether ext. (I) EtOH (95%) ext. (I)	[57]
			Embryotoxic effect: H_2O ext., intragastric, rat (pregnant), dose 175.0 mg/kg (I)	[56]
			Hypocholesterolemic activity: seeds, in ration, rat, dose not stated (A)	[104]
			Hypoglycemic activity: seeds, in ration, rat, dose not stated (A)	
			Aphrodisiac activity: oral, human adult, male, dose variable, the product contained a mixture (A)	[105]

M. pruriens			FSH release inhibition: oral, human adult, male, dose variable, the product contained a mixture (equivocal)	
			FSH release stimulation effect: oral, human adult, male, dose variable, the product contained a mixture (equivocal)	
			FSH synthesis stimulation: oral, human adult, male, dose variable, the product contained a mixture (equivocal)	
			Gonadotropin release stimulation (unspecified): oral, human adult, male, dose variable, the product contained a mixture (equivocal)	
			Gonadotropin synthesis stimulation (unspecified): oral, human adult, male, dose variable, the product contained a mixture (equivocal)	
			LH-release inhibition: oral, human adult, male, dose variable (equivocal)	
			LH-release stimulation: oral, human adult, male, dose variable (equivocal)	
			LH-synthesis stimulation: oral, human adult, male, dose variable (equivocal)	
			Pharmacokinetic study: powder, oral, human adult, male dose 300.0 ml (A)	[106]
			Prolactin inhibition: seeds, oral, human adult, female, dose 15.0 gm/person (I)	[99]
			Prolactin inhibition: seeds, oral, human adult, male, dose 15.0 gm/person, inhibition of prolactin response to chlorpromazine injection, five subjects were studied (A)	[107]
			Sexual behavior modification: H_2O ext., intragastric, dose 500.0 mg/kg, effects described are from a multi-component rx, rat, male (A) rat, male, in alcohol exposed rats (A)	[55]
			Sexual behavior modification: seeds, intragastric, rat, male, dose 1.0 gm/kg (A)	[108]
			Spermatogenic effect: oral, human adult, male, dose variable, the product used contained a mixture (equivocal)	[109]
			Spermatogenic effect: H_2O ext., intragastric, dose 500.0 mg/kg, effects described are from a multi- component rx rat, male (A) rat, male, in alcohol exposed rats (A)	[55]
			Spermatogenic effect: plant, oral, human adult, male, dose not stated used to increase fertility, this was a human study involving 40 subjects, most of whom were claimed to show (A)	[58]
			Taenicide activity: conc. used not stated, taenia solium EtOH (95%) ext. (A) H_2O ext. (A)	[110]
			Teratogenic activity: H_2O ext., intragastric, rat (pregnant) dose 175.0 mg/kg (A)	[56]
			Testosterone level increased: H_2O ext., intragastric, dose 500.0 mg/kg, effects described are from a multi-component rx rat, male (A) rat, male, in alcohol exposed rats (A)	[55]
			Toxic effect (general): H_2O ext., in ration, rat, conc. used variable, feeding caused weight loss unless supplemented with l-methionine and l-tryptophan, the protein fraction of the seeds was incorporated into the experimental ration (A)	[75]

M. prurien	Dried seed	Nigeria	Antivenin effect: type ext. not stated, ip, mouse, dose variable, using serum immunoglobulins from *M. Pruriens*- sensitized rabbits (A)	[111]
			Skeletal muscle stimulant activity: H_2O ext., rat, conc. used 300 mcg/ml, phrenic nerve- diaphragm (A)	[112]
			Smooth muscle stimulant activity: H_2O ext., guinea pig, conc. used 1.2 mg/ml, ileum (A) rabbit, conc. used 1.5 mg/ml, jejunum (A)	
	Dried seed	Pakistan	Antihyperglycemic activity: type ext. not stated, intragastric, rabbit, dose not stated, vs. alloxan-induced hyperglycemia (A)	[61]
			Hypoglycemic activity: type ext. not stated, intragastric, rabbit, dose not stated (A)	
			Toxic effect (general): type ext. not stated, intragastric, rabbit, dose 8.0 gm/kg (I)	
M. pruriens var.*utilis*	Dried leaf	Nigeria	Anticoagulant activity: H_2O ext., conc. used 1.0 mg/ml, blood- human-whole (A)	[64]
M. pruriens var.*utilis*	Dried seed	Brazil	Hemagglutinin activity: protein fraction, conc. used 25.0 microliters/well, Rbc (I)	[65]
			Trypsin inhibition: protein fraction, dose 5.0 microliters (A)	
M. pruriens var.*utilis*	Dried seed	Japan	Plant growth inhibitor (unspec): plant, conc. used not stated, plant exhibits allelopathic effect in field tests (A)	[113]
M. pruriens var.*utilis*	Fresh seedling	Japan	Plant growth inhibitor (unspec): EtOH (80%) ext., external, plant, the acid fraction of given extract inhibited the growth of lactuca sativa seedlings (A)	[114]
M. sloanei	Fresh entire plant	Puerto Rico	Molluscicidal activity: aqueous slurry (homogenate) LD_{100} >1m ppm, fruits, roots and leaves were tested *Lymnaea columella* (I) *Lymnaea cubensis* (I)	[115]
M. species	Fresh stembark	Samoa	CNS effects (general): hippocratic screen intragastric, mouse, dose 1.0 gm/kg (A) ip, mouse, dose 1.0 gm/kg (W)	[116]
			Spasmolytic activity: guinea pig, conc. used 2.0 mg/ml, ileum, vs. electrical stimulation (A)	
M. urens	Seed	Guatemala	Antibacterial activity: EtOH- H_2O (1:1) ext., agar plate, conc. used 50.0 microliters/disc, *Neisseria gonorrhea* (I)	[70]
M. utilis	Seed	India	Analgesic activity: EtOH- H_2O (50%) ext., intragastric, mouse, dose not stated, vs. hot plate method, vs. tail clip method (I)	[117]
			Antiviral activity: EtOH- H_2O (50%) ext., cell culture, conc. used 0.05 mg/ml, virus- vaccinia (I)	
			Diuretic activity: EtOH- H_2O (50%) ext., intragastric, rat, dose 750.0 mg/kg (I)	
			Spasmolytic activity: EtOH- H_2O (50%) ext., rat, conc. used not stated, uterus (A)	
			Toxicity assessment (quantitative): EtOH- H_2O (50%) ext., ip, mouse, LD_{50} >1000 mg/kg	

三、血藤屬(*Mucuna*)植物之成分研究方面：[118-147]

1.Benzenoids:

2-6-dimethoxyphenol; syringic acid; vanillic acid; protocatechuic acid

2.Terpenes:

asiatic acid; 3-*O*-(6-*O*-methyl-beta-d-glucuronopyranosyl) asiatic acid; 28-*O*-beta-D-glucopyranoside-3-*O*-(6-*O*-methyl-beta-D-glucuronopyranosyl) asiatic acid; 3-*O*-[alpha-l-arabinopyranosyl(1-2)]-6-*O*-methyl-beta-D-glucuronopyranosylasiatic acid; maslinic acid; 3-*O*-[alpha-l-arabinopy-ranosyl(1-2)]-6-*O*-methyl-beta-D-glucuronopyranosyl) maslinic acid; *M*. genin a; *M*. genin b; friedelin; lupenone; friedelinol

3.Steroids:

beta-sitosterol; stigmasterol

4.Alkanes:

1-triacontanol

5.Lipids:

tetracosanoic acid triacontyl ester; linoleic acid; oleic acid; palmitic acid; stearic acid; hexacosanoic acid 2,3-dihydroxy-propyl ester; pentacosanoic acid 2,3-dihydroxy-propyl ester; *threo*-12,13-dihydroxyoctadec-cis-9-enoic acid; cis-12,13-epoxyoctadec-trans-9-enoic acid; threo-12,13-dihydroxyoctadec-trans-9-enoic acid

6.Phenylpropanoids:

trans-para-coumaric acid

7.Proteids:

l-dopa; stizolobic acid; hemagglutinin; lectin

8.Flavonoids:

daidzin; 7-*O*-beta-D-glucoside-4'-8-dimethoxyisoflavone; ononin; cyclosin; daidzein; pratensein; 3'-methoxydaidzein; formononetin; isoformononetin; genistein; geraldol; luteolin; orobol; apigenin 6,8-di-*C*-alpha-l-arabinosyl; luteolin 8-*C*-alpha-l-arabinosyl; isoorientin; kievitone

9.Alkaloids:

(1) Isoquinoline alkaloid: 3-carboxy-6,7-dihydroxy-1-methyl-1,2,3,4-tetrahydroisoquinoline; 3-carboxy-6,7-dihydroxy-1,2,3,4-tetrahydroisoquinoline; 2,6-dimethoxyphenol; syringic acid; vanillic acid; *N*-(*trans*)-feruloyltyramine; dopamine

(2) Indole alkaloid: bufotenine; *N*,*N*-dimethyltryptamine; *N*-oxide-*N*,*N*-dimethyltryptamine; 5-hydroxytryptamine; methoxy-*N*,*N*-dimethyltryptamine

(3)Alkaloid-misc.: *Mucuna pruriens* alkaloid p, q, r, s, x; prurienidine; prurieninine; choline

10.Carbohydrates:

phytic acid; lecithin; D-pinitol

11. Inorganic:

hydrocyanic acid

（詳見 Table 2-6**）**

Table 2-6: Presence of compounds in *Mucuna*

Species	Used part	Area	Isolated compounds	Type	Ref.
M. acuminata	Seed	Indonesia	*l*-dopa	Proteid	[118]
M. aterrima	Seed	Mexico	*l*-dopa	Proteid	[119]
		USA	*l*-dopa	Proteid	
		Colombia	*l*-dopa	Proteid	
		Sri Lanka	*l*-dopa	Proteid	[120]
			3-carboxy-6,7-dihydroxy-1-methyl-1,2,3,4-tetrahydroisoquinoline; 3-carboxy-6,7-dihydroxy-1,2,3,4-tetrahydroiso-quinoline	Isoquinoline alkaloid	
	Leaf + stem	Brazil	tetracosanoic acid triacontyl ester	Lipid	[72]
			1-triacontanol	Alkane	
M. aterrima	Seed	Colombia	*l*-dopa	Proteid	[119]
		Costarica	*l*-dopa	Proteid	
		Nigeria	*l*-dopa	Proteid	
M. birdwoodiana	Stalk	China	*l*-dopa	Proteid	[121]
			asiatic acid; 3-*O*-(6-*O*-methyl-beta-D-glucuronopyranosyl)asiatic acid; 28-*O*-beta-D-glucopyranoside-3-*O*-(6-*O*-methyl-beta-D-glucuronopyranosyl)asiatic acid; 3-*O*-[alpha-l-arabinopyranosyl(1-2)]-6-*O*-methyl-beta-D-glucuronopyranosylasiatic acid; maslinic acid; 3-*O*-[alpha-l-arabinopyranosyl(1-2)]-6-*O*-methyl-beta-D-glucuronopyranosyl)maslinic acid; *M.* genin a; *M.* genin b	Triterpene	[122]
		Hong Kong	2,6-dimethoxyphenol; syringic acid; vanillic acid	Benzenoid	[73]
			N-(*trans*)-feruloyltyramine	Isoquinoline alkaloid	
	Stem	South Korea	daidzin; 7-*O*-beta-d-glucoside-4',8-dimethoxyisoflavone; ononin	Flavonoid	[74]
		China	2,6-dimethoxyphenol; syringic acid; vanillic acid	Benzenoid	[123]
			N-(*trans*)-feruloyltyramine	Isoquinoline alkaloid	
M. capitata	Seed	India	amino acid analysis	Proteid	[124]
M. cochinchinensis	Fruit	China	*l*-dopa	Proteid	[125]
	Seed	China	*l*-dopa	Proteid	[126]
M. currannii	Seed	Philippines	hydrocyanic acid	Inorganic	[15]
			phytic acid	Carbohydrate	
M. deeringiana	Seed	Sri Lanka	*l*-dopa	Proteid	[120]
			3-carboxy-6,7-dihydroxy-1-methyl-1,2,3,4-tetrahydroisoquinoline; 3-carboxy-6,7-dihydroxy-1,2,3,4-tetrahydroisoquinoline	Isoquinoline alkaloid	
M. deeringiana	Seed	Zimbabwe	*l*-dopa	Proteid	[119]
		USA	*l*-dopa	Proteid	
M. deeringiana cv. early jumbo	Suspension culture	Not stated	*l*-dopa	Proteid	[127]

	Leaf	Not stated	stizolobic acid	Proteid	[128]
M. diabolica	Seed	Indonesia	*l*-dopa	Proteid	[118]
M. flagellipes	Proteid	Nigeria	hemagglutinin	Proteid	[129]
M. gigantea	Seed	Indonesia	*l*-dopa	Proteid	[118]
M. holtonii	Seed	Guatemala	*l*-dopa	Proteid	[119]
M. imbricata	Seed oil	India	linoleic acid; oleic acid; palmitic acid; stearic acid	Lipid	[130]
M. macrocarpa	Root	China	*l*-dopa	Proteid	[10]
	Part not specified	China	hexacosanoic acid 2,3-dihydroxy-propyl ester; pentacosanoic acid 2,3-dihydroxy-propyl ester	Lipid	[4]
			friedelin; lupenone	Triterpene	
M. macrophylla	Seed	Indonesia	*l*-dopa	Proteid	[118]
M. membranacea	Root	China	*trans*-para-coumaric acid	Phenylpropanoid	[131]
			vanillic acid; protocatechuic acid	Benzenoid	
			beta-sitosterol; stigmasterol	Steroid	
			friedelin; friedelinol	Triterpene	
			cyclosin; daidzein; pratensein; 3'-methoxydaidzein; formononetin; isoformononetin; genistein; geraldol; luteolin; orobol	Flavonoid	
M. nivea	Seed	Sri Lanka	*l*-dopa	Proteid	[120]
			3-carboxy-6,7-dihydroxy-1,2,3,4-tetrahydroisoquinoline	Isoquinoline alkaloid	
M. pruriens	Seed	India	*l*-dopa	Proteid	[132]
			l-dopa	Proteid	[133]
			l-dopa	Proteid	[100]
			l-dopa	Proteid	[99]
			lecithin	Carbohydrate	[134]
			Mucuna pruriens alkaloid p, q, r, s, x prurienidine; prurieninine	Alkaloid-misc	[135]
	Seed oil	India	*threo*-12,13-dihydroxyoctadec-*cis*-9-enoic acid; *cis*-12,13-epoxyoctadec-*trans*-9-enoic acid; *threo*-12,13-dihydroxyoctadec-*trans*-9-enoic acid	Lipid	[136]
	Leaf	Not stated	*l*-dopa	Proteid	[137]
		Netherlands	*l*-dopa	Proteid	[138]
			dopamine	Isoquinoline alkaloid	
		India	bufotenine; *N*,*N*-dimethyltryptamine; *N*-oxide-*N*,*N*-dimethyltryptamine	Indole alkaloid	[26]
			choline	Alkaloid-misc	
	Leaf + stem	Not stated	bufotenine; 5-hydroxytryptamine; methoxy-*N*,*N*-dimethyltryptamine	Indole alkaloid	[139]
	Stem	Netherlands	*l*-dopa	Proteid	[138]
	Root	Netherlands	*l*-dopa	Proteid	
		China	*l*-dopa	Proteid	[10]
	Fruit	Not stated	bufotenine; 5-hydroxytryptamine; methoxy-*N*,*N*-dimethyltryptamine	Indole alkaloid	[139]
	Shoots	Not stated	*l*-dopa	Proteid	[137]

M. pruriens	Pod trichomes	India	5-hydroxytryptamine	Indole alkaloid	[26]
	Suspension culture	Not stated	*l*-dopa	Proteid	[140]
		Netherlands	*l*-dopa	Proteid	[138]
			dopamine	Isoquinoline alkaloid	
M. pruriens fa.*cochinchinensis*	Seed	Indonesia	*l*-dopa	Proteid	[118]
M. pruriens fa.*hirsuta*	Seed	Indonesia	*l*-dopa	Proteid	
M. pruriens fa.*pruriens*	Seed	Indonesia	*l*-dopa	Proteid	
M. pruriens fa.*utilis*	Seed	Indonesia	*l*-dopa	Proteid	[118]
	Suspension culture	Not stated	*l*-dopa	Proteid	[141]
M. pruriens var.*utilis*	Seed	Japan	*l*-dopa	Proteid	[113]
	Leaf	Japan	*l*-dopa	Proteid	[114]
	Root	Japan	*l*-dopa	Proteid	
M. sempervirens	Leaf	Japan	apigenin 6,8-di-*C*-alpha-l-arabinosyl; luteolin 8-*C*-alpha-l-arabinosyl; isoorientin	Flavonoid	[142]
		France	D-pinitol	Carbohydrate	[143]
	Seed	China	lectin	Proteid	[144]
M. sloanei	Seed	India	*l*-dopa	Proteid	[145]
M. species	Seed	Indonesia	*l*-dopa	Proteid	[118]
		Sri Lanka	*l*-dopa	Proteid	[120]
			3-carboxy-6,7-dihydroxy-1-methyl-1,2,3,4-tetrahydroisoquinoline; 3-carboxy-6,7-dihydroxy-1,2,3,4-tetrahydroisoquinoline	Isoquinoline alkaloid	
M. urens	Seed	USA	*l*-dopa	Proteid	[119]
M. utilis	Seed	India	*l*-dopa	Proteid	[146]
			kievitone	Flavonoid	[147]
		Sri Lanka	*l*-dopa	Proteid	[120]
		Sri Lanka	3-carboxy-6,7-dihydroxy-1,2,3,4-tetrahydroisoquinoline	Isoquinoline alkaloid	

第三章　實驗部分

第一節　實驗試劑與儀器

一、溶媒、試藥與層析材料：

1.**溶媒**

(1)**正己烷、氯仿、乙酸乙酯、甲醇、苯、乙醚、正丁醇等溶媒（以上購自** Merck**）。**

(2)**乙醇為台灣省菸酒公賣局之** 95%**酒精。**

(3) **測核磁共振** (NMR) **光譜所用之溶媒** $CDCl_3$ (Deuterated chloroform)、CD_3OD (Deuterated methanol)**等均為光譜級（以上購自** Merck**）。**

2.**顯色劑**

(1) 10 % Sulfuric acid spray reagent。

(2) Anisaldehyde sulfuric acid spray reagent。

(3) Vanillin sulfuric acid spray reagent。

3.**薄層層析**(Thin Layer Chromatography)

TLC plate：Kieselgel 60 F_{254} silica gel pre-coated aluminium plate，**厚度** 0.2 mm (Merck)。

4.**管柱色層層析**(Column Chromatography)

以 Pyrex **或** Merck **公司生產之不同型號管柱。**

填充物質：Kieselgel 60 70~230 mesh (Merck)，Kieselgel 60 230~400 mesh (Merck)，Sephadex LH-20 (Pharmacia)，Diaion HP-20。

5.**試藥**

醋酸、硫酸、硝酸、氫氧化銨、無水硫酸鈉、茴香醛、香莢蘭醛及溴化鉀等均為試藥級（以上購自 Merck **公司）。**

二、實驗儀器：

1.**迴轉式濃縮機：**Rotavapor R-114 (Büchi)。

2.**烘箱：**Chanel Drying Oven OV602。

3.**電子乾燥箱：用於保存** TLC **片、**NMR **溶媒及紅外線譜用之** KBr。

4.**電子天平：**Mettler AJ100 and Metter Toledo PB 602。

5.**電熱板：**Coroning Model PC-320。

6.**超音波震盪器：**

(1) Bandelin Sonorex Super PK1028BH

(2) Aquusonic^{TM} Model 150D。

7.**玻璃展開槽：**120 mm × 150 mm **及** 220 mm × 70 mm。

8.**紫外線燈：**

CAMAG Universal UV lamp，**波長** 254 nm **及** 366 nm。

9.**微量熔點測定器：**

Yanaco MP-500，**其溫度未經校正。**

10.**紅外線分光光譜儀** (Infared Spectrophotometer)

使用 Nicolet Impact 400 FT-IR Spectrophotometer **測定，固體以乾的** KBr **粉末混合均勻，在真空下加壓成透明薄片測定之，光譜單位為波數**(cm^{-1})**（中國醫藥學院）。**

11.**質譜儀**(MS)

(1) VG Platform II Mass Spectrometer**，離子化電壓為** 70 eV **（中國醫藥學院）**

(2) JOEL JMS-SX/SX 102A Tandem Mass Spectrometer **（中興大學）。**

12.**核磁共振光譜儀**

(1) Bruker DPX-200 FT-NMR **（中國醫藥學院）。**

(2) Bruker AMX-400 FT-NMR **（中國醫藥學院）。**

(3) Varian VXR-600 FT-NMR **（中興大學）。**

Internal standard **為** Tetramethy Silane (TMS)**，化學位**(Chemical shift) **以δ表示，單位** ppm**，以** J **表示偶合常數**(coupling constant)**，單位** Hz **峰線訊號以**"s"**表示單峰**(singlet)**，**"d"**表示雙重峰**(doublet)**，**"t" **表示三重峰**(triplet)**，**"q"**表示四重峰**(quartet)**，**"m"**表示多重峰**(multiplet)**，**"br"**表示寬峰**(broad)**。**

第二節　實驗藥材來源及其抽提與分離

一、植物採集及前處理：

植物血藤(*Mucuna macrocarpa* WALLICH)**於民國九十年十二月在南投縣魚池鄉中採得。經中國醫藥學院技正邱年永老師鑑定，確認為豆科**(Leguminosae)**之血藤**(*M. macrocarpa*)**後，先將莖部與葉部分開處理後，針對血藤莖部之甲醇粗抽物及莖部之各有機溶媒萃取層，進行細胞毒殺活性試驗及抗氧化活性之探討。**

Figure 3-1: **血藤**(*Mucuna macrocarpa* WALLICH)**植物圖**[1]

二、提取與分離：

陰乾後之血藤約 4.46 公斤。將莖部切片並用甲醇於室溫下浸泡一週後，經過濾取濾液減壓濃縮，殘渣再經甲醇浸泡，如此反覆浸泡抽取 3 次，得到莖部的甲醇粗抽物約 619.9 公克(Fr. M)，抽出率約為 13.9%。

將莖部的甲醇粗抽物，加入蒸餾水形成懸浮液。再以正己烷分配分離正己烷層合併減壓濃縮至乾後得正己烷層(Fr. H)共 6.6 公克，以氯仿層和水層分配分離出氯仿層(Fr. C)共 46.5 公克，以乙酸乙酯和水層分配分離出乙酸乙酯層(Fr. E)減壓濃縮後為 11.2 公克，以正丁醇和水層分配分離出正丁醇層(Fr. B)減壓濃縮後為 23.5 公克，最後剩餘水層(Fr. W)為 532.1 公克。

利用管柱色層層析法(column chromatography)，**以** silica gel (70-230 mesh**及** 230-400 mesh)、Sephadex LH-20 **或** Diaion HP-20 **充填在玻璃管柱內為固定相，經不同溶媒梯度沖提管柱，並利用再結晶法純化化合物，結果分離得到下列化合物：**

1.**正己烷層**(Fr. H)：

tetracosanoic acid (H-1)

friedelin (H-2)

2.**氯仿層**(Fr. C)：

mixture of β-sitosterol and stigmasterol (C-1)

medicarpin (C-2)

3.**乙酸乙酯層**(F. E)：

afrormosin (E-1)

genistein (E-2)

calycosin (E-3)

三、實驗抽提流程圖：

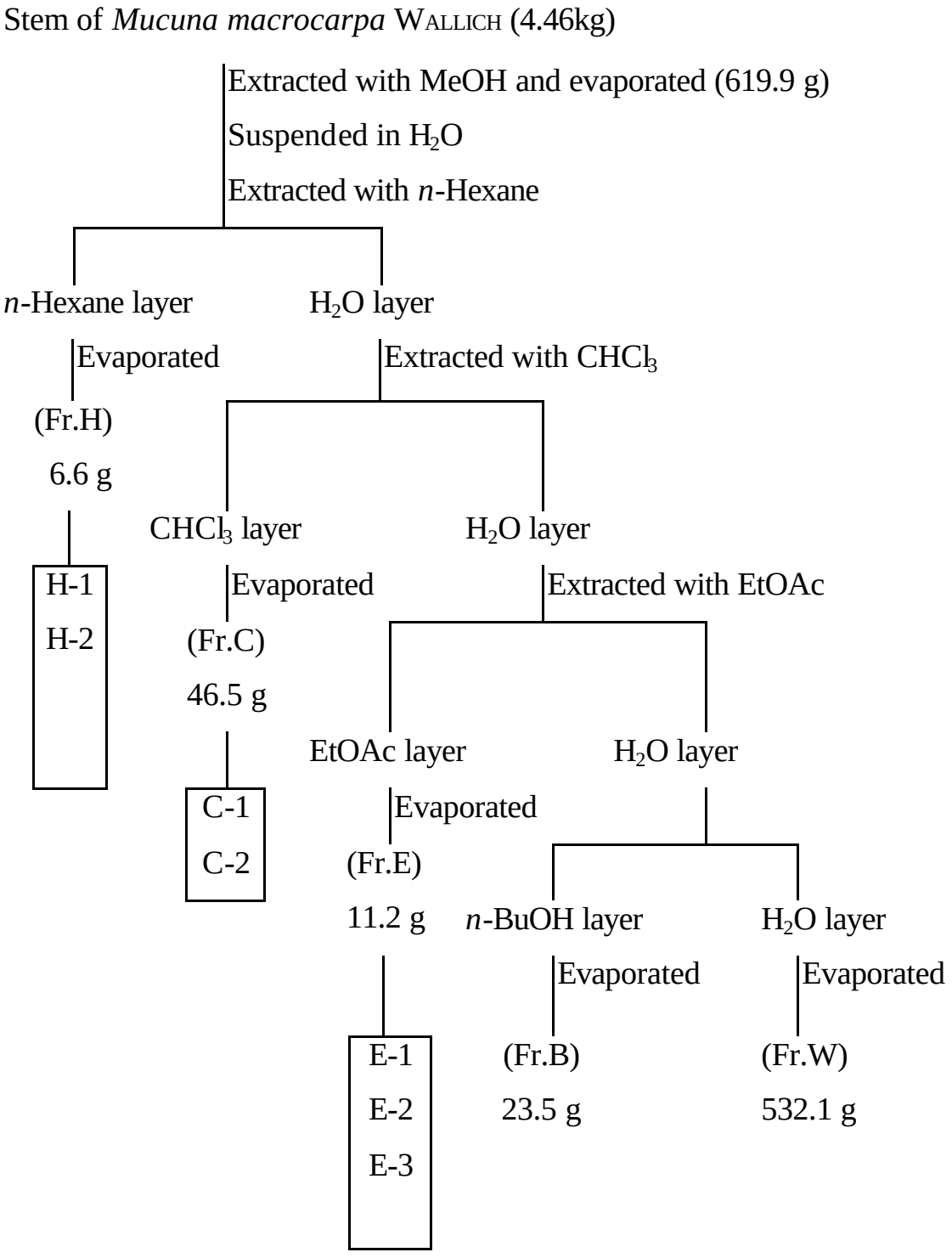


Figure 3-2: **血藤**(*Mucuna macrocarpa* WALLICH)**莖部之抽提流程圖**

第三節　血藤之藥理活性評估

一、細胞毒殺活性試驗：

此部分實驗委託國家衛生研究院 陳淑貞博士與陳華鍵博士代為進行細胞毒殺活性測試，利用 MTS 分析法，將人類癌細胞植入 96 孔培養皿中。經過一夜的適應，在每孔中加入置於無胎牛血清、最終濃度為 50 μg/ml 之待測物。三天後，由 MTS 還原試劑決定細胞存活能力。Actinomycin D 10 μM 及 0.1 % DMSO 為正對照組及控制組，其結果與 DMSO 相比，換算成百分比。

MTS：

5-(3-carboxymethoxyphenyl)-2-(4,5-dimethyl-thiazolyl)-3-(4-sulfophenyl) tetrazolium

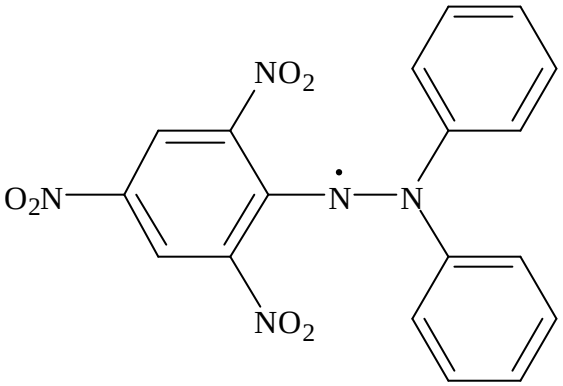
培養人類腫瘤細胞：

NUGC（胃癌細胞）、HONE-1（鼻咽癌細胞）在 Dulbecco' s modified Eagle' s 培養基培養。（5 % CO_2 濕式培養基，維持在 37℃，外加 10 % 胎牛血清和非必需胺基酸）。

二、抗氧化活性實驗：

參考 Shyu YS (2002)[148]等之方法，以 DPPH 自由基清除能力之試驗，測試植物萃取物(crude extract)之抗氧化活性。DPPH 為一相對安定的自由基，熔點為 137°C，其甲醇溶液為紫蘿蘭色(violet)在 517 nm 下有強吸光，當 DPPH 自由基與抗氧化劑反應時，將會降低吸光值[149]。因而藉此判斷抗氧化劑清除 DPPH 自由基的能力，其吸光值愈低，表示試樣清除 DPPH 自由基的能力愈強。

DPPH: 1,1-Diphenyl-2-picrylhydrazyl



$$DPPH + AH \rightarrow DPPH_2 + A$$

violet　　decolorized (yellow)

DPPH 自由基的甲醇溶液會隨著 pH 值的不同及時間長短而有所變化，DPPH 自由基甲醇溶液在 pH 5.0-6.5 比較穩定而有適當的吸收，在鹼性時則不穩定。此外，DPPH 自由基的甲醇溶液會隨時間的增長而逐漸劣化，故實驗時需新鮮配製[150]。

依 Shyu YS (2002)**等之實驗方法及步驟：**

1. **先檢測** DPPH (75 μM)**甲醇溶液在可見光** 517nm **之吸收值**(A_0)**。**
2. **將血藤甲醇萃取物**(Fr. M)**、正己烷層**(Fr. H)**、氯仿層**(Fr. C)**、乙酸乙酯層**(Fr. E)**，正丁醇層**(Fr. B)**、水層**(Fr. B)**及沈澱物**(Fr. P)**等萃取層，分別配製出** 50, 100, 200, 250, 500 μg/mL **等五種濃度之樣品**(sample)**兩組。接著在** 10 mL **的試管中加入各樣品** 0.3 mL **再加入** 0.2 mL **之甲醇溶液。**
3. **此時將樣品分成兩組，一組為空白實驗，一組則加入** 2.5 mL **的** DPPH (75 μM)**甲醇溶液至總體積為** 3 mL**。將兩組溶液置於室溫反應** 90 **分鐘，之後分別將各組使用可見光** 517 nm (A_{517})**吸收波長偵測並記錄。**
4. **將各測得之吸光值代入下列公式換算成自由基清除能力**(Scavenging effect)[148]**：**

$$\text{Scavenging effect (\%)} = \frac{[A_0 - (A - A_b)]}{A_0} \times 100\%$$

A_0: A_{517} of DPPH without sample

A: A_{517} of sample and DPPH

A_b: A_{517} of sample without DPPH

第四章　結　果

第一節　血藤各成分之物理性質及光譜數據

【一】H-1：tetracosanoic acid

1. **白色粉末（以氯仿—甲醇再結晶）**
2. **熔點：**82-84**℃**
3. TLC：R_f = 0.45 (*n*-Hexane：$CHCl_3$ = 5：1)
4. 10% H_2SO_4 spray：**灰黑色**(110**℃**)
5. IR ν_{max}(KBr) cm^{-1}：2918, 2849, 1699, 1463。
6. MS (m/z % ; EI 30 eV)：

368 (M^+, 3)	340 (1)	241 (1)	213 (1)
199 (1)	185 (2)	171 (1)	129 (9)
101 (5)	97 (23)	85 (26)	83 (43)
73 (80)	60 (100)	57 (73)	

7. ^{1}H-NMR (in $CDCl_3$, 400 MHz) ppm：

2.37	(2H, t, *J* = 7.5 Hz, H-2)
1.63	(2H, m, H-3)
1.26	(40H, s, br)
0.89	(3H, t, *J* = 7.5 Hz, H-24)

8. ^{13}C-NMR (in $CDCl_3$, 100MHz) ppm：

178.0 (C-1)	33.7 (C-2)	31.9 (C-22)	29.7 (C-4~21)
24.7 (C-3)	22.7 (C-23)	14.1 (C-24)	

【二】H-2：friedelin

1. **白色針晶（以氯仿—甲醇再結晶）**
2. **熔點：**238-240**℃**
3. TLC：R_f = 0.45 (*n*-Hexane：$CHCl_3$ = 3：1)
4. 10% H_2SO_4 spray：**藍紫色**(110**℃**)
5. IR ν_{max}(KBr) cm^{-1}：1715, 1457, 1389, 1261, 1108, 1051, 802。
6. MS (m/z % ; EI 70eV)：

426 (M^+, 14)	411 (5)	341 (3)	302 (11)
273 (20)	246 (20)	205 (27)	191 (20)
123 (71)	109 (84)	95 (35)	81 (85)
69 (100)	55 (100)		

7. ^{1}H-NMR (in $CDCl_3$, 200 MHz) ppm：

1.18	(3H, s, H-28)
1.05	(3H, s, H-27)
1.00	(6H, s, H-26, H-30)
0.96	(3H, s, H-29)
0.90	(3H, s, H-23)
0.87	(3H, d, *J* = 6.5 Hz, H-25)
0.73	(3H, s, H-24)

8. ^{13}C-NMR (in $CDCl_3$, 50 MHz) ppm：

213.1 (C-3)	59.2 (C-10)	58.0 (C-4)	52.9 (C-8)
42.6 (C-18)	41.9 (C-5)	41.3 (C-2)	41.0 (C-6)
39.5 (C-14)	39.0 (C-22)	38.1 (C-13)	37.2 (C-9)
35.8 (C-16)	35.4 (C-19)	35.1 (C-11)	34.8 (C-30)
32.5 (C-21)	32.2 (C-15)	31.8 (C-28)	31.5 (C-29)
30.3 (C-12)	29.8 (C-17)	27.9 (C-20)	22.0 (C-1)
20.0 (C-27)	18.4 (C-26)	18.0 (C-7)	17.7 (C-25)
14.4 (C-24)	6.6 (C-23)		

9. DEPT ($\pi/4$, $2\pi/4$, $3\pi/4$, in $CDCl_3$, 50 MHz) ppm：

CH_3 : 35.0, 32.0, 31.7, 20.2, 18.6, 17.9, 14.6, 6.8

CH_2 : 41.5, 41.2, 39.2, 36.0, 35.6, 35.3, 32.7, 32.4, 30.5, 22.2, 18.2

CH : 59.4, 58.2, 53.0, 42.7

【三】C-1：β-sitosterol 和 stigmasterol 混合物

1. **白色粉末（以氯仿—甲醇再結晶）**
2. **熔點：**138-141℃
3. TLC：R_f = 0.45 ($CHCl_3$：EtOAc = 9：1)
4. 10% H_2SO_4 spray：**藍紫色**(110℃)
5. IR ν_{max}(KBr) cm^{-1}：3421, 2936, 2867, 1464, 1380, 1052。
6. MS (m/z % ; EI 70eV)：

414 (M^+, 14)	412 (M^+, 5)	271 (8)	255 (13)
213 (10)	159 (18)	145 (18)	105 (15)
95 (28)	81 (37)	69 (64)	55 (100)

7. ^{1}H-NMR (in $CDCl_3$, 200 MHz) ppm：

5.36	(1H, d, H-6)
5.10	(1H, m, H-23)
5.05	(1H, m, H-22)
3.51	(1H, m, H-3)
0.93	(3H, s, H-19)
0.84	(6H, m, H-26, H-27)
0.68	(3H, s, H-18)

8. ^{13}C-NMR (in $CDCl_3$, 50 MHz) ppm：

140.5 (C-5)	138.1 (C-22)	129.0 (C-23)	121.5 (C-6)
71.6 (C-3)	56.5 (C-14)	55.8 (C-17)	49.9 (C-9)
45.6 (C-24)	42.1 (C-4)	40.2 (C-13)	39.5 (C-12)
37.0 (C-1)	36.3 (C-10)	35.9 (C-20)	35.4 (C-7)
31.7 (C-8)	31.4 (C-2)	28.9 (C-25)	28.7 (C-16)
28.0 (C-23)	26.0 (C-22)	25.2 (C-15)	22.8 (C-28)
20.8 (C-11)	19.6 (C-26)	19.2 (C-19)	18.8 (C-27)
18.5 (C-21)	12.0 (C-29)	11.7 (C-18)	

9. DEPT (π/4, 2π/4, 3π/4, in $CDCl_3$, 50 MHz) ppm：

CH_3 : 19.8, 19.3, 19.0, 18.7, 12.2, 11.8

CH_2 : 42.2, 39.7, 37.2, 33.9, 31.6, 29.1, 28.9, 24.3, 23.0, 21.0

CH : 138.3, 129.2, 121.7, 71.8, 56.7, 56.0, 50.1, 45.8, 36.1, 31.9, 28.9

【四】C-2：medicarpin

1. **白色針晶（以甲醇再結晶）**
2. **熔點：**128-130**℃**
3. TLC：R_f = 0.55 ($CHCl_3$：EtOAc = 4：1)
4. 10% H_2SO_4 spray：**橘黃色**(110**℃**)
5. IR ν_{max}(KBr) cm^{-1}：3409, 1621, 1597, 1496, 1471 ,1454。
6. MS (m/z % ; EI 70 eV)：

270 (M^+, 100)	269 (42)	255 (34)	197 (7)
181 (7)	161 (20)	152 (9)	148 (30)
147 (33)	139 (11)	137 (17)	135 (13)
134 (13)	133 (12)	128 (8)	105 (13)
90 (13)	89 (18)	69 (37)	65 (29)
63 (40)	51 (36)		

7. ^{1}H-NMR (in $CDCl_3$, 200 MHz) ppm：

7.41	(1H, d, *J* = 8.4 Hz, H-1)
7.15	(1H, d, *J* = 8.9 Hz, H-7)
6.57	(1H, dd, *J* = 8.4 and 2.4 Hz, H-2)
6.48	(2H, m, H-8 and H-10)
6.44	(1H, d, *J* = 2.4 Hz, H-4)
5.52	(1H, d, *J* = 6.8 Hz, H-11a)
4.23	(1H, m, H-6eq)
3.77	(3H, s, OCH_3)
3.55	(2H, m, H-6ax, 6a)

8. ^{13}C-NMR (in $CDCl_3$, 50 MHz) ppm：

160.9 (C-9)	160.4 (C-10a)	156.9 (C-3)	156.4 (C-4a)
132.0 (C-1)	124.5 (C-7)	118.9 (C-6b)	112.3 (C-11b)
109.6 (C-2)	106.2 (C-8)	103.5 (C-4)	96.7 (C-10)
78.3 (C-11a)	66.3 (C-6)	55.3 (9-OCH_3)	39.3 (C-6a)

9. DEPT ($\pi/4$, $2\pi/4$, $3\pi/4$, in $CDCl_3$, 50 MHz) ppm：

CH_3 : 55.5

CH_2 : 66.5

CH : 132.2, 124.7, 109.8, 106.4, 103.6, 78.5, 96.9, 39.5

【五】 E-1：afrormosin

1. **白色針晶（以甲醇再結晶）**
2. **熔點：**227-229**℃**
3. TLC：R_f = 0.48 ($CHCl_3$：EtOAc = 1：1)
4. 10% H_2SO_4 spray：**黃色**(110**℃**)
5. IR ν_{max}(KBr) cm^{-1}：3124, 2924, 1622, 1576, 1517, 1479, 1463, 1282。
6. MS (m/z % ; EI 70 eV)：

298 (M^+, 100)	283 (13)	255 (13)	166 (56)
151 (23)	149 (28)	132 (51)	123 (35)
95 (32)	89 (67)	69 (100)	63 (50)
51 (35)			

7. ^{1}H-NMR (in $CDCl_3$, 200 MHz) ppm：

7.93	(1H, s, H-2)
7.66	(1H, s, H-5)
7.51	(2H, d, *J* = 8.5 Hz, H-2’ and H-6’)
6.99	(2H, d, *J* = 8.5 Hz, H-3’ and H-5’)
6.96	(1H, s, H-8)
4.02	(3H, s, OCH_3)
3.85	(3H, s, OCH_3)

8. ^{13}C-NMR (in $CDCl_3$ + CD_3OD (1：3), 50 MHz) ppm：

176.0 (C-4)	159.2 (C-4')	152.5 (C-2)	152.0 (C-6)
152.0 (C-9)	146.3 (C-7)	129.9 (C-2')	129.9 (C-6')
124.1 (C-3)	123.8 (C-1')	117.0 (C-10)	113.6 (C-3')
113.6 (C-5')	104.4 (C-5)	102.5 (C-8)	55.9 (OCH_3)
55.0 (OCH_3)			

【六】 E-2：genistein

1. **白色針晶（以甲醇再結晶）**
2. **熔點：**278-280**℃**
3. TLC：R_f = 0.45 ($CHCl_3$：EtOAc = 1：1)
4. 10% H_2SO_4 spray：**黃色**(110**℃**)
5. IR $?_{max}$(KBr) cm^{-1}：3443, 2924, 1653, 1623, 1540, 1519, 1472, 1457, 1262。
6. MS (m/z % ; EI 70 eV)：

270 (M^+, 94)	269 (35)	153 (70)	152 (49)
135 (9)	124 (69)	118 (85)	111 (14)
96 (45)	89 (82)	77 (43)	69 (100)
63 (52)	51 (59)		

7. ^{1}H-NMR (in CD_3OD, 400 MHz) ppm：

8.05	(1H, s, H-2)
7.37	(2H, d, *J* = 8.4 Hz, H-2’ and H-6’)
6.85	(2H, d, *J* = 8.4 Hz, H-3’ and H-5’)
6.35	(1H, d, *J* = 2.1 Hz, H-8)
6.23	(1H, d, *J* = 2.1 Hz, H-6)

8. ^{13}C-NMR (in CD_3OD, 100 MHz) ppm：

180.9 (C-4)	164.6 (C-7)	162.4 (C-5)	158.3 (C-9)
157.5 (C-4')	153.4 (C-2)	130.1 (C-2')	129.9 (C-6')
123.3 (C-3)	121.9 (C-1')	115.2 (C-3')	114.8 (C-5')
104.9 (C-10)	98.8 (C-6)	93.5 (C-8)	

【七】E-3：calycosin

1. **白色針晶（以甲醇再結晶）**
2. **熔點：**245-246**℃**
3. TLC：R_f = 0.45 (*n*-Hexane：EtOAc = 1：2)
4. 10% H_2SO_4 spray：**黃色**(110**℃**)
5. IR ν_{max}(KBr) cm^{-1}：3421, 3169, 1624, 1572, 1508, 1541, 1472。
6. MS (m/z % ; EI 70 eV)：

284 (M^+, 48)	283 (21)	269 (13)	241 (21)
213 (17)	148 (11)	137 (56)	136 (8)
133 (51)	126 (33)	112 (64)	105 (64)
77 (29)	69 (35)	63 (100)	51 (76)

7. ^{1}H-NMR (in CD_3OD, 400 MHz) ppm：

8.13	(1H, s, H-2)
8.05	(1H, d, *J* = 8.8 Hz, H-5)
7.04	(1H, s, H-5')
6.97	(2H, s, H-2' and H-6')
6.94	(1H, dd, *J* = 8.9 and 2.2 Hz, H-6)
6.85	(1H, d, *J* = 2.1 Hz, H-8)
3.88	(3H, s, OCH_3)

8. ^{13}C-NMR (in CD_3OD, 100 MHz) ppm：

176.6 (C-4)	163.2 (C-7)	158.3 (C-9)	153.5 (C-2)
147.8 (C-4')	146.0 (C-3')	127.1 (C-5)	124.8 (C-1')
124.4 (C-3)	119.9 (C-6')	116.8 (C-2')	116.3 (C-10)
115.7 (C-6)	110.9 (C-5')	102.2 (C-8)	55.6 (4'-OCH_3)

第二節　血藤之藥理活性試驗結果

一、細胞毒殺活性試驗：

將血藤甲醇萃取物(Fr. M)**以不同溶媒分別萃取後，分成正己烷層**(Fr. H)**、氯仿層**(Fr. C)**、乙酸乙酯層**(Fr. E)**，正丁醇層**(Fr. B)**、水層**(Fr. B)**及沈澱物**(Fr. P)**等。以** MTS **分析法試驗血藤各萃取層之細胞毒殺活性，結果發現血藤莖部之甲醇粗抽物、乙酸乙酯層、水層及沉澱物對胃癌細胞**(NUGC)**具有明顯的抑制作用。此部分結果委託國家衛生研究院代為測試。（詳見** Table 4-1**）**

Table 4-1**：血藤各層對細胞毒殺活性測試結果**

Cell Line / Plant		NUGC 50 μg/mL	HONE-1 50 μg/mL
Mucuna macrocarpa	Fr. M	3%	97%
	Fr. H	110%	112%
	Fr. C	106%	109%
	Fr. E	30%	96%
	Fr. B	51%	94%
	Fr. W	21%	91%
	Fr. P	1%	85%

(1) Sample conc.: 50 μg/mL**；**

(2) **以**%**表** cell **之存活率，小於** 50%**表示有效。**

二、抗氧化活性試驗：

依 Shyu YS (2002)等之方法，以 DPPH 自由基清除能力之試驗，測試血藤甲醇萃取物(Fr. M)、正己烷層(Fr. H)、氯仿層(Fr. C)、乙酸乙酯層(Fr. E)，正丁醇層(Fr. B)、水層(Fr. B)及沈澱物(Fr. P)等萃取層，結果發現血藤之甲醇萃取物、乙酸乙酯層、正丁醇層、水層及沉澱物具有顯著的抗氧化活性。本實驗以 Quercertin 及 Vit. E (α-tocopherol) 為正對照組。（詳見 Table 4-2, Figure 4-1）

Table 4-2：Scavenging effect (%) of the fractions of *M. macrocarpa*

Sample conc. / Fraction	50 μg/mL	100 μg/mL	200 μg/mL	250 μg/mL	500 μg/mL
Fr. M	65.43	96.39	98.84	98.71	100.25
Fr. H	33.80	37.84	47.37	48.71	65.56
Fr. C	32.29	34.95	44.04	50.60	67.68
Fr. E	53.45	82.39	99.31	100.12	104.28
Fr. B	59.46	92.42	97.28	97.31	97.91
Fr. W	50.20	73.83	93.52	99.93	103.03
Fr. P	44.44	72.83	96.61	97.07	97.14
*Quercertin	97.33	97.46	97.76	97.91	98.14
*Vit. E	52.01	84.39	97.01	97.72	97.68

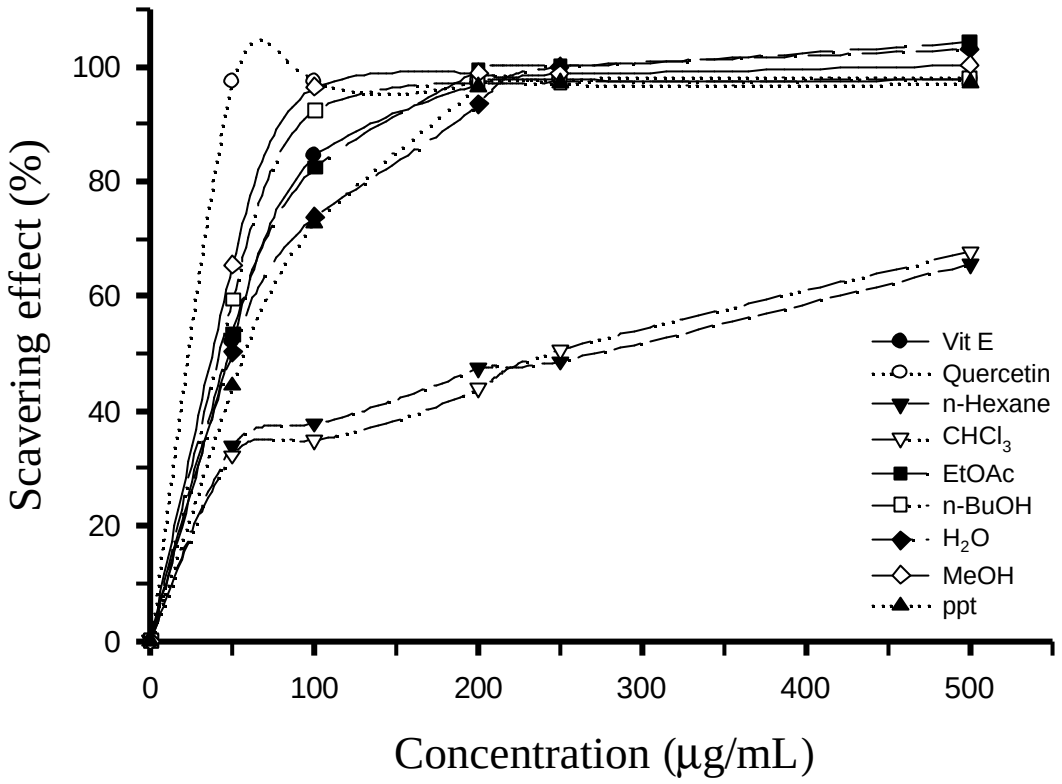


Figure 4-1：Scavenging effect (%) of the fractions of *M. macrocarpa*

第五章　討　論

第一節　血藤化學成分之結構鑑定

【一】H-1：tetracosanoic acid

化合物 H-1 **於正己烷層中得到，為白色固體粉末，以氯仿—甲醇再結晶，熔點** 82-84℃**，可溶於正己烷、氯仿，其** TLC **片經溶媒** (*n*-Hexane：$CHCl_3$ = 5：1)**展開後，**R_f **值為** 0.45**，噴** 10% H_2SO_4 **溶液，加熱後呈灰黑色。**

IR **圖譜（**Chart 1**）顯示** 2918 cm^{-1} **及** 2849 cm^{-1} **為飽和碳氫的特性吸收，**1699 cm^{-1} **為** carbonyl group **的特性吸收，**1463 cm^{-1} **為**-CH_3 **基。**

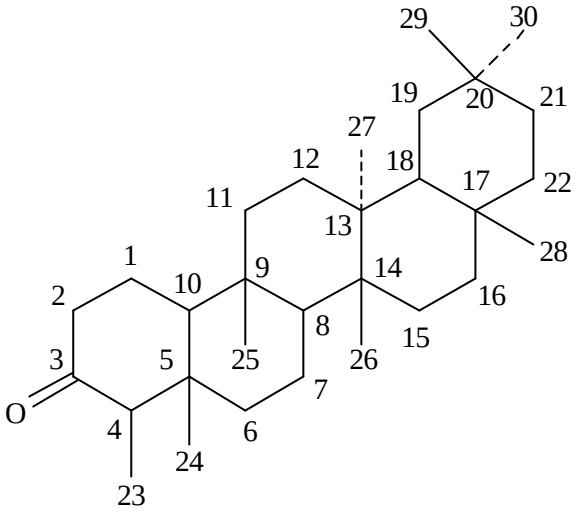
MS **圖譜（**Chart 2**）** M^+ (m/z %)**顯示分子量為** 368**，推測分子式為** $C_{24}H_{48}O_2$**。**

^{1}H-NMR **圖譜（**Chart 3**）顯示** d 2.37 (2H, t)**為** H-2 **的吸收訊號，**d 1.26 (40H, s, br)**為長鏈** methylene (-CH_2-)**的吸收訊號，**d 0.89 (3H, t)**為長鏈末端甲基之吸收訊號。**

^{13}C-NMR **圖譜（**Chart 4**）顯示** d 178.0 **為** carboxyl carbon **的吸收訊號，**d 22.7~33.7 **為長鏈** methylene (-CH_2-)**的吸收訊號，**d 14.1 **為長鏈末端甲基之吸收訊號。**

綜合上述資料與文獻值[151, 152]**比對，確認此化合物之結構為** tetracosanoic acid**。**

【二】H-2：friedelin



化合物 H-3 **於正己烷層中得到，為白色針晶，以氯仿－甲醇再結晶，熔點** 238-240**℃，可溶於氯仿，其** TLC **片經溶媒**(*n*-Hexane：$CHCl_3$ = 3：1)**展開後，**R_f**值為** 0.45**，噴** 10% H_2SO_4**溶液，加熱後呈藍紫色。**

IR **圖譜（**Chart 5**）顯示在** 1715 cm^{-1} **有** carbonyl group **的特性吸收，也有一般三？類所含有的特性吸收**(1457, 1389, 1261, 1108, 1051, 802 cm^{-1})。

MS **圖譜（**Chart 6**）**M^+ (m/z %)**顯示分子量為** 426**，推測分子式為** $C_{30}H_{50}O$。**由碎片** m/z 411, 341, 302, 273, 246, 205, 191 **的斷裂方式，推測化合物可能為** friedelin。**（詳見** Figure 5-1**）**

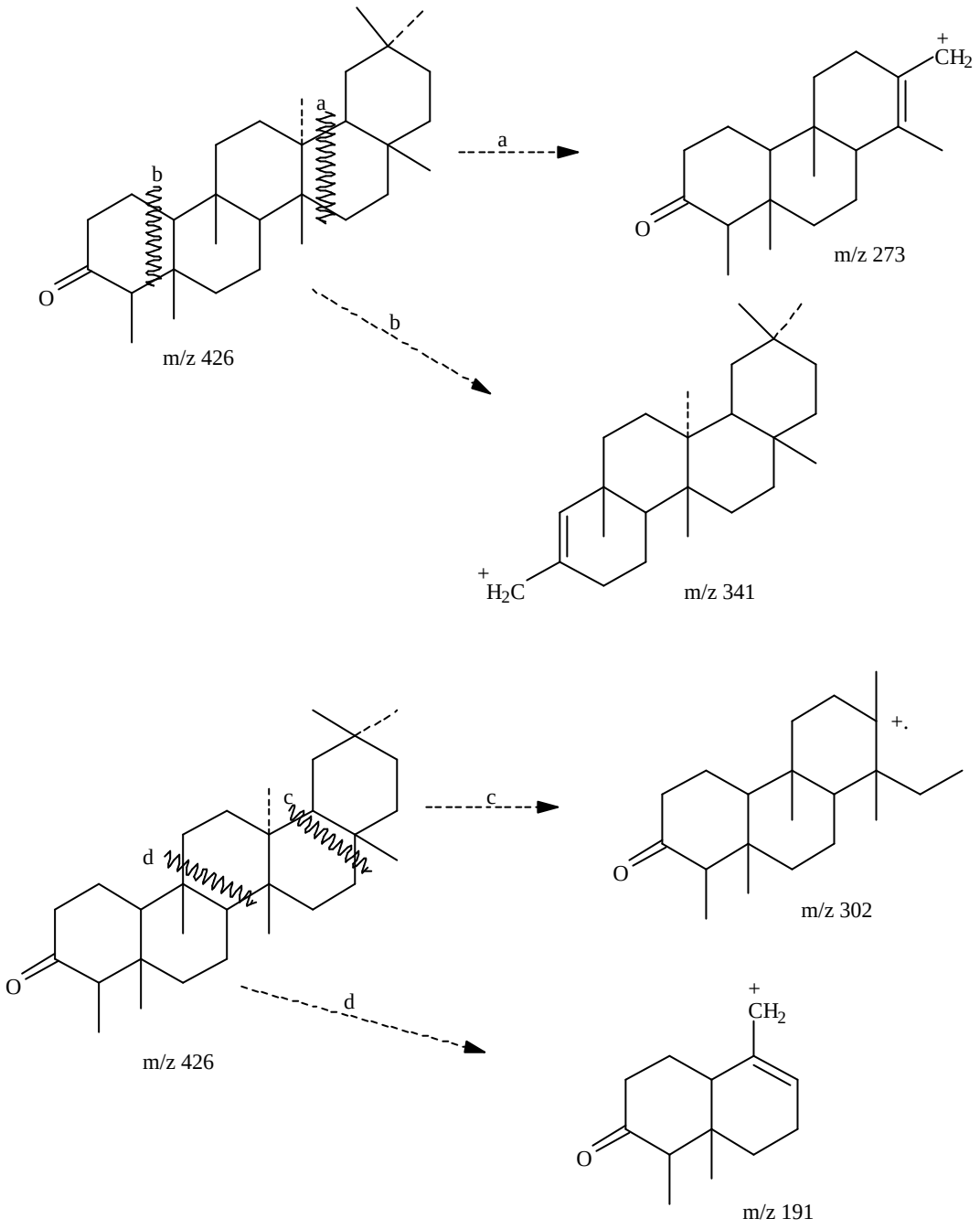


Figure 5-1: Friedelin **之質譜**(MS)**斷裂方式**

^{1}H-NMR 圖譜（Chart 7）顯示 d 1.18 (3H, s, H-28), 1.05 (3H, s, H-27), 1.00 (6H, s, H-26, 30), 0.96 (3H, s, H-29), 0.90 (3H, d, *J*=6.5 Hz H-23), 0.87 (3H, s, H-25), 0.73 (3H, s, H-24)共有八個甲基吸收訊號，八個甲基分別為 C-24, C-25, C-23, C-29, C-30, C-26, C-27, C-28 的甲基訊號，配合 EI-MS 質譜的斷裂方式，推測為 friedelin 化合物。

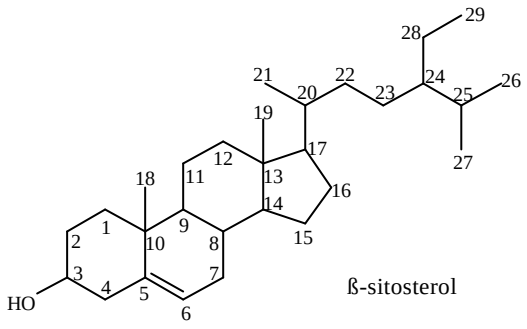
^{13}C-NMR 圖譜（Chart 8）及 DEPT 圖譜（Chart 9）中顯示其共有三十個碳原子吸收訊號，其中有八個碳原子訊號是屬於 CH_3，分別為 δ 34.8 (C-30), 31.8 (C-28), 31.5 (C-29), 20.0 (C-27), 18.4 (C-26), 17.7 (C-25), 14.4 (C-24), 6.6 (C-23)。有十一個碳原子訊號屬於 CH_2，分別為δ 41.3 (C-2), 41.0 (C-6), 39.0 (C-22), 35.8 (C-16), 35.4 (C-19), 35.1 (C-11), 32.5 (C-21), 32.2 (C-15), 30.3 (C-12), 22.0 (C-1), 18.0 (C-7)。有四個碳原子屬於 CH，分別為δ 59.2 (C-10), 58.0 (C-4), 52.9 (C-8), 42.6 (C-18)，其餘的六個碳原子訊號屬於四級碳，在最低磁場出現的δ 213.1 (C-3)是來自於 C-3 的 carbonyl carbon 之訊號，剩下的訊號分別為δ 41.9 (C-5), 39.5 (C-14), 38.1 (C-13), 37.2 (C-9), 29.8 (C-17), 27.9 (C-20)。

Table 5-1: **化合物** H-2 **碳譜數據與文獻** friedelin **碳譜數據比對表**

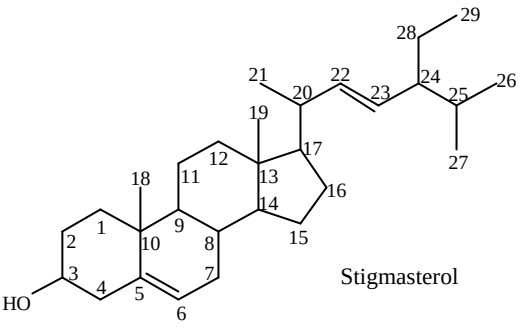
No. of C	δ_c of H-2	δ_c of literature data
C-1	22.0	22.3
C-2	41.3	41.5
C-3	213.1	213.3
C-4	58.0	58.2
C-5	41.9	42.1
C-6	41.0	41.3
C-7	18.0	18.2
C-8	52.9	53.1
C-9	37.2	37.4
C-10	59.2	59.5
C-11	35.1	35.3
C-12	30.3	30.5
C-13	38.1	38.3
C-14	39.5	39.7
C-15	32.2	32.4
C-16	35.8	36.0
C-17	29.8	30.0
C-18	42.6	42.8
C-19	35.4	35.6
C-20	27.9	28.2
C-21	32.5	32.8
C-22	39.0	39.2
C-23	6.6	6.8
C-24	14.4	14.7
C-25	17.7	17.9
C-26	18.4	18.7
C-27	20.0	20.3
C-28	31.8	32.1
C-29	31.5	31.8
C-30	34.8	35.0

綜合以上光譜資料與文獻[153, 154, 155]**比對，推定此合物為** friedelin。

【三】C-1：β-sitosterol 和 stigmasterol 混合物



ß-sitosterol



Stigmasterol

化合物 C-1 **於氯仿層中得到，為白色粉末，以氯仿—甲醇再結晶，熔點** 139-140**℃，可溶於氯仿，其** TLC **片經溶媒**($CHCl_3$**：** EtOAc = 9**：**1)**展開後，**R_f**值為** 0.45**，噴** 10% H_2SO_4**溶液，加熱後呈藍紫色。**

IR **圖譜(**Chart 10**)顯示在** 3421 cm^{-1}**有**-OH**基特性吸收，** 2936 cm^{-1}**及** 2867 cm^{-1}**為飽和碳氫鍵伸縮震動之特性吸收，** 1464 cm^{-1}**為** CH_2**的之特性吸收，** 1052 cm^{-1}**為醚基**(C-O-C)**之特性吸收。**

MS **圖譜（**Chart 11**）** M^+ (m/z %)**顯示分子離子峰為** 414, 412**，其裂片斷裂型式與**β-sitosterol, stigmasterol **相同，推測分子式為** $C_{29}H_{50}O$ **及** $C_{29}H_{48}O$**。**

^{1}H-NMR **圖譜（**Chart 12**）顯示** d 5.36 (1H, d, H-6)**為雙鍵上** H-6 **之質子訊號，** d 5.10 (1H, m, H-23), 5.05 (1H, m, H-22)**分別為支鏈雙鍵** H-23, H-22 **之質子訊號，** d 3.51 (1H, m, H-3)**為** C-3 **連接**-OH **基之次甲基的質子訊號，** d 0.70~2.31 (m)**為植物固醇特有訊號。**

^{13}C-NMR **圖譜（**Chart 13**）顯示**δ 140.4 (C-5), 121.5 (C-6)**分別為環上雙鍵** C-5 **及** C-6 **之碳原子訊號，**δ 138.1, 129.0 **則為支鏈雙鍵** C-22 **及** C-23 **之碳原子訊號，**δ 71.6 (C-3)**為帶有**-OH **基的** C-3 **之碳原子訊號。**

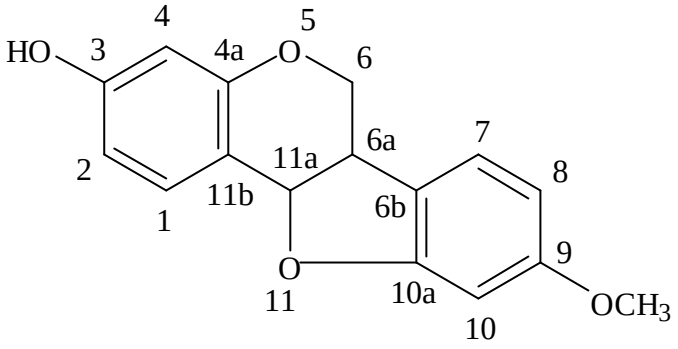
DEPT 圖譜（Chart 14）中顯示有六個碳原子訊號是屬於 CH_3，分別為δ 19.8 (C-26), 19.3 (C-19), 19.0(C-27), 118.7(C-21), 12.2(C-29), 11.8 (C-18)。有十個碳原子訊號屬於 CH_2，分別為 δ 42.2 (C-4), 39.7 (C-12), 37.2 (C-1), 33.9 (C-2), 31.6 (C-7), 29.1 (C-16), 28.9 (C-16), 24.3 (C-15), 23.0 (C-28), 21.0 (C-11)。有十一個碳原子屬於 CH，分別為δ 138.3 (C-22), 129.9 (C-23), 121.7 (C-6), 71.8 (C-3), 56.7 (C-14), 56.0 (C-17), 50.1 (C-9), 45.8 (C-24), 36.1 (C-20), 31.9 (C-8), 28.9 (C-25)。其餘的二個碳原子訊號屬於四級碳，分別為δ 140.5 (C-5)及δ 36.3 (C-10)。

Table 5-2: **化合物** C-1 **碳譜數據與文獻** phytosterol **碳譜數據比對表**

No. of C	δ_c of C-1	δ_c of literature data
C-1	37.0	37.2
C-2	31.4	31.6
C-3	71.6	71.8
C-4	42.1	42.3
C-5	140.5	140.8
C-6	121.5	121.7
C-7	35.4	33.9
C-8	31.7	31.8
C-9	49.9	50.1
C-10	36.3	36.5
C-11	20.8	21.0
C-12	39.5	39.7
C-13	40.2	40.5
C-14	56.5	56.7
C-15	25.2	24.2
C-16	28.7	28.3
C-17	55.8	56.0
C-18	11.7	11.8
C-19	19.2	19.3
C-20	35.9	36.1
C-21	18.5	18.7
C-22	26.0, 138.1	26.0, 138.4
C-23	28.0, 129.0	28.2, 129.3
C-24	45.6	45.8
C-25	28.9	29.1
C-26	19.6	19.8
C-27	18.8	19.0
C-28	22.8	23.0
C-29	12.0	11.9

綜合以上光譜資料與文獻[156, 157, 158]**比對，推定此合物為** β-sitosterol **和** stigmasterol **之混合物。**

【五】C-2：medicarpin



化合物 C-2 **氯仿層中得到，為白色針晶，以甲醇再結晶，熔點** 128-130℃**，可溶於氯仿，其** TLC **片經溶媒**($CHCl_3$：EtOAc = 4：1) **展開後，**R_f**值為** 0.55**，在紫外光** 200-380 nm **內有吸光，噴** 10% H_2SO_4 **溶液，加熱後呈橘黃色。**

IR **圖譜**（Chart 15）**顯示** 3409 cm^{-1} **有** -OH **基的吸收訊號，** 1621 cm^{-1} **有** carbonyl group **的特性吸收，** 1597, 1496, 1471 ,1454 cm^{-1} **有芳香環之共軛雙鍵特性吸收。**

MS **圖譜**（Chart 16）M^+ (m/z %)**顯示分子量為** 270**，推測分子式為** $C_{16}H_{14}O_4$**。**

^{1}H-NMR **圖譜**（Chart 17）**顯示** d 5.52 (1H, d, *J* = 6.8 Hz, H-11a), 4.23 (1H, m, H-6eq), 3.55 (2H, m, H-6ax, 6a)**為** petrocarpan **類化合物之特有吸收訊號，另外，** d 7.41 (1H, d, *J* = 8.4 Hz, H-1), 6.57 (1H, dd, *J* = 8.4 and 2.4 Hz, H-2), 6.44 (1H, d, *J* = 2.4 Hz, H-4)**為一組** ABX **形式之訊號。** d 3.77 (3H, s, OCH_3)**為甲氧基之訊號。**

^{13}C-NMR **圖譜**（Chart 18）**及** DEPT **圖譜**（Chart 19）**中顯示共有十六個碳原子吸收訊號，其中有一個碳原子訊號是屬於** CH_3**，為**δ 55.5 (9- OCH_3)**。有一個碳原子訊號屬於** CH_2**，為** δ 66.5 (C-6)**。有八個碳**

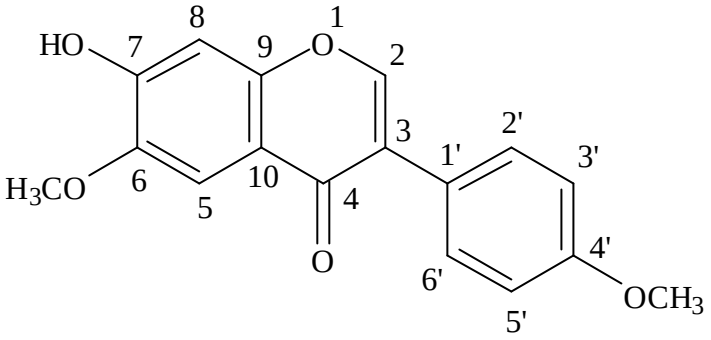
原子屬於 CH**，分別為**δ 132.2 (C-1), 124.7 (C-7), 109.8 (C-2), 106.4 (C-8), 103.6 (C-4), 78.5 (C-11a), 96.9 (C-10), 39.5 (C-6a)**。其餘的六個碳原子訊號屬於四級碳，分別為**δ 160.9 (C-9), 160.4 (C-10a), 156.9 (C-3), 156.4 (C-4a), 118.9 (C-6b), 112.3(C-11b)**。另外，**δ 55.3 **為** C-9 **上之**-OCH_3 **基之吸收訊號。**

Table 5-3: **化合物** C-2 **碳譜數據與文獻** medicarpin **碳譜數據比對表**

No. of C	δ_c of C-2	δ_c of literature data
C-1	132.0	132.6
C-2	109.6	109.8
C-3	156.9	157.5
C-4	103.5	104.1
C-4a	156.4	157.1
C-6	66.3	67.0
C-6a	39.3	39.9
C-6b	118.9	119.5
C-7	124.5	125.2
C-8	106.2	106.8
C-9	160.9	161.1
C-10	96.7	97.3
C-10a	160.4	161.5
C-11a	78.3	79.0
C-11b	112.3	113.0
9-OCH_3	55.3	55.9

綜合上述資料與文獻[159, 160 , 161]**比對，確認此化合物之結構為** medicarpain。

【五】E-1：afrormosin



化合物 E-1 **乙酸乙酯層中得到，為白色針晶，以甲醇再結晶，熔點** 278-280**℃，可溶於甲醇與氯仿溶液，其** TLC **片經溶媒**($CHCl_3$：EtOAc = 1：1)**展開後，**R_f**值為** 0.45**，在紫外光** 200-380 nm **內有吸光，噴** 10% H_2SO_4 **溶液，加熱後呈黃色。**

IR **圖譜（**Chart 20**）：顯示在** 3124 cm^{-1} **有** -OH **基之特性吸收，** 2924 cm^{-1} **為不飽和碳氫鍵之伸縮震動特性吸收，** 1623 cm^{-1} **為** carbonyl group **之特性吸收，** 1576, 1517, 1479, 1463 cm^{-1} **為芳香環共軛雙鍵之特性吸收，** 1282 cm^{-1} **為醚基**(C-O-C)**之特性吸收。**

MS **圖譜（**Chart 21**）** M^+(m/z %)**顯示分子量為** 298**，其他斷片離子有** 297, 283, 167, 166, 132, 123 **等，符合異黃酮類質譜的斷裂方式，推測分子式為** $C_{17}H_{14}O_5$

^{1}H-NMR **圖譜（**Chart 22**）顯示** d 7.93 (1H, s, H-2)**為位於** carbonyl group **的β位上之** H-2**，** d 7.51 (2H, d, *J* = 8.5 Hz, H-2’ and H-6’)**及** d 6.99 (2H, d, *J* = 8.5 Hz, H-3’ and H-5’)**有耦合關係，分別為** B-ring **上** H-2’, H-6’**及** H-3’, H-5’**之吸收訊號，為一對** A_2X_2 **型式之芳香族訊號，並推測** H-4’**有甲氧基取代。** d 7.66 (1H, s, H-5)**及** d 6.96 (1H, s, H-8)**則為** A-ring **上的氫，** H-8 **因相鄰有供電子的** -OH **基，會位於較高磁場，故**

d 7.66 為 H-5，d 6.96 為 H-8。

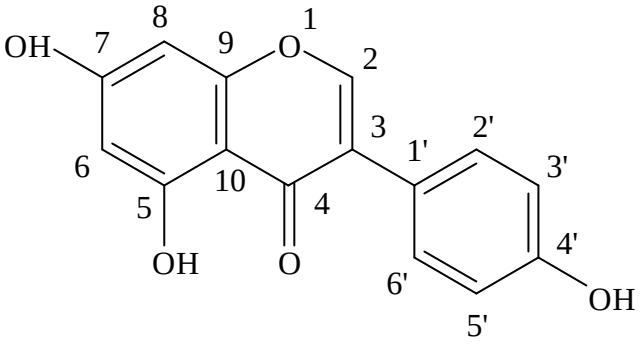
^{13}C-NMR 圖譜（Chart 23）中顯示共有十七個碳原子吸收訊號，其中 d 176.0 (C-4)為黃酮類(flavonoids)之 carbonyl carbon 吸收訊號，d 146.3 (C-7)為帶有-OH 基之 C-7 的吸收訊號。d 129.9 (C-2’), 129.9 (C-6’)及 113.6 (C-3’), 113.6 (C-5’)為 B-ring 上碳之吸收訊號。d 104.4 (C-5), 102.5 (C-8)為 A-ring 上碳之吸收訊號。另外，δ 55.9, 55.0 為 C-4’及 C-6 上之-OCH_3 基之吸收訊號。

Table 5-4: **化合物** E-1 **碳譜數據與文獻** afrormosin **碳譜數據比對表**

No. of C	δ_c of E-1	δ_c of literature data
C-2	152.5	152.6
C-3	124.1	124.0
C-4	176.0	176.0
C-5	104.4	104.2
C-6	152.0	152.5
C-7	146.3	146.6
C-8	102.5	102.5
C-9	152.0	152.1
C-10	117.0	116.6
C-1’	123.8	123.6
C-2’	129.9	129.8
C-3’	113.6	113.4
C-4’	159.2	159.1
C-5’	113.6	113.4
C-6’	129.9	129.8
OCH_3	55.9	55.6
OCH_3	55.0	54.8

綜合上述資料與文獻[161-163]**比對，確認此化合物之結構為** afrormosin。

【六】E-2：genistein



化合物 E-2 **於乙酸乙酯層中得到，為白色針晶，以甲醇再結晶，熔點** 227-229**℃，可溶於甲醇，其** TLC **片經溶媒**($CHCl_3$**：**EtOAc = 1**：**1)**展開後，** R_f **值為** 0.48**，在紫外光** 200-380 nm **內有吸光，噴** 10% H_2SO_4 **溶液，加熱後呈黃色。**

IR **圖譜（**Chart 24**）顯示在** 3443 cm^{-1} **有-**OH **基的特性吸收，**2924 cm^{-1} **為不飽和碳氫之伸縮震動特性吸收，**1653 cm^{-1} **為** carbonyl group **之特性吸收，**1623, 1540, 1519, 1472 cm^{-1} **為芳香環共軛雙鍵的特性吸收，** 1262 cm^{-1} **為醚基**(C-O-C)**之特性吸收。**

MS **圖譜（**Chart 25**）** M^+ (m/z %)**顯示分子量為** 298**，根據斷片離子** 270, 269, 153, 152, 135, 124, 118 **等符合異黃酮類質譜的斷裂方式：**retro Diels-Alder fragmentation**，推測分子式為** $C_{15}H_{10}O_5$**。**

^{1}H-NMR **圖譜（**Chart 26**）顯示** d 8.05(1H, s, H-2)**為位於** carbonyl group **的β位上之** H-2**，**d 7.37 (2H, d, *J* = 8.4 Hz, H-2’ and H-6’)**及** d 6.85 (2H, d, *J* = 8.4 Hz, H-3’ and H-5’)**有耦合關係，分別為** B-ring **上** H-2’, H-6’**及** H-3’, H-5’**之吸收訊號，為一對** A_2X_2 **型式之訊號，故推測** H-4’ **有-**OH **基取代。**d 6.35 (1H, d, *J* = 2.1 Hz, H-8)**及** d 6.23 (1H, d, *J* = 2.1 Hz, H-6)**則為** A-ring **上的氫，**H-6 **因相鄰兩邊都有供電子的-**OH **基，**

會位於較高磁場，故 d 6.23 為 H-6，d 6.35 為 H-8。

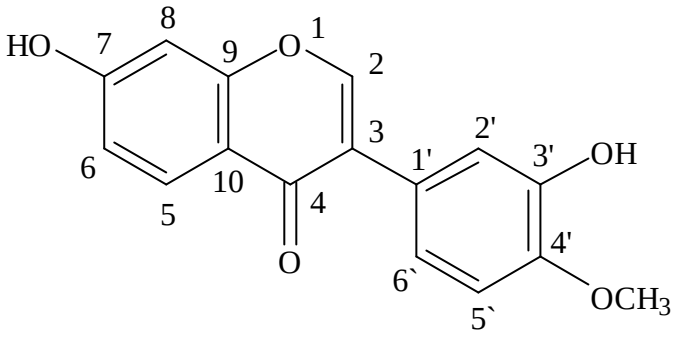
^{13}C-NMR 圖譜（Chart 27）中顯示共有十五個碳原子吸收訊號，其中 d 180.9 (C-4)為黃酮類之 carbonyl carbon 吸收訊號，d 164.6 (C-7), 162.4 (C-5), 157.5 (C-4')，分別為帶有 -OH 基之 C-7, C-5 及 C-4'的吸收訊號。d 130.1 (C-2'),129.9 (C-6')及 115.2 (C-3'), 114.8 (C-5')為 B-ring 上碳之吸收訊號。d 98.8 (C-6), 93.5 (C-8)為 A-ring 上碳之吸收訊號。

Table 5-5: **化合物** E-2 **碳譜數據與文獻** genistein **碳譜數據比對表**

No. of C	δ_c of E-2	δ_c of literature data
C-2	153.4	154.1
C-3	123.3	122.4
C-4	180.9	180.4
C-5	162.4	162.1
C-6	98.8	99.1
C-7	164.6	164.4
C-8	93.5	93.8
C-9	158.3	157.7
C-10	104.9	104.6
C-1’	121.9	121.4
C-2’	130.2	130.1
C-3’	115.2	115.2
C-4’	157.5	157.6
C-5’	114.8	115.2
C-6’	130.2	129.9

綜合上述資料與文獻[158, 164]**比對，確認此化合物之結構為** genistein。

【七】E-3：calycosin



化合物 E-3 **乙酸乙酯層中得到，為白色針晶，以甲醇再結晶，熔點** 245-246**℃，可溶於甲醇，其** TLC **片經溶媒(***n***-**Hexane**：**EtOAc = 1**：**2)**展開後，**R_f **值為** 0.45**，噴** 10% H_2SO_4 **溶液，加熱後呈黃色。**

IR **圖譜（**Chart 28**）顯示在** 3421, 3169 cm^{-1} **為-**OH **基之特性吸收，** 1624 cm^{-1} **為** carbonyl group **之特性吸收，** 1572, 1508, 1541, 1472 cm^{-1} **為芳香環共軛雙鍵的特性吸收。** 1242 cm^{-1} **為醚基(**C-O-C**)之特性吸收。**

MS **圖譜（**Chart 29**）** M^+ (m/z %)**顯示分子量為** 284**，其他斷片離子有** 283, 241, 213, 137, 133, 135, 126, 112 **等，符合異黃酮類質譜的斷裂方式，推測分子式為** $C_{16}H_{12}O_5$**。**

^{1}H-NMR **圖譜（**Chart 30**）顯示** d 8.13 (1H, s, H-2)**為位於羰基**(carbonyl group)**的β位上之** H-2**。** d 8.05 (1H, d, *J* = 8.8 Hz, H-5), 6.94 (1H, dd, *J* = 8.8 and 2.1 Hz, H-6), 6.85 (1H, d, *J* = 2.1 Hz, H-8)**為一組** ABX **型式之訊號，將其歸屬為** A-ring **上** H-5, H-6 **及** H-8 **之訊號。** d 7.04 (1H, s, H-5’), 6.97 (2H, s, H-2’ and H-6’)**，將其分別歸屬為** B-ring **上** H-5’ , H-2’**及** H-6’**之訊號。另外，** d 3.88 (3H, s, OCH_3)**為甲氧基(**-OCH_3**)之訊號。**

^{13}C-NMR 圖譜（Chart 31）中顯示共有十六個碳原子吸收訊號，其中 d 176.6 (C-4)為黃酮類之 carbonyl carbon 吸收訊號，d 163.2 (C-7), 146.0 (C-3')，分別為帶有-OH 基之 C-7 及 C-3'的吸收訊號。d 119.9 (C-6'), 116.8 (C-2')及 110.9 (C-5')為 B-ring 上碳之吸收訊號。δ 127.1 (C-5), 115.7 (C-6), 102.2 (C-8)為 A-ring 上碳之吸收訊號。另外，δ 55.6 為 C-4'上之-OCH_3 基之吸收訊號。

Table 5-6: **化合物** E-3 **碳譜數據與文獻** calycosin **碳譜數據比對表**

No. of C	δ_c of E-3	δ_c of literature data
C-2	153.5	153.0
C-3	124.4	123.3
C-4	176.6	174.5
C-5	127.1	127.3
C-6	115.7	115.1
C-7	163.2	162.5
C-8	102.2	102.2
C-9	158.3	157.3
C-10	116.3	116.2
C-1’	124.8	124.7
C-2’	116.8	116.4
C-3’	146.0	146.0
C-4’	147.8	147.5
C-5’	110.9	111.9
C-6’	119.9	119.7

綜合上述資料與文獻[164-167]**比對，確認此化合物之結構為** calycosin。

第二節　血藤之藥理活性試驗討論

一、細胞毒殺活性試驗

Table 4-1 顯示，以 MTS 分析法試驗血藤各萃取層之細胞毒殺活性，結果發現血藤莖部之甲醇粗抽物、乙酸乙酯層、水層及沉澱物對胃癌細胞(NUGC)具有明顯的抑制作用，由此推測血藤之細胞毒殺活性成分可能屬於中高極性之物質。而本研究由血藤莖部分離所得之四個異黃酮類化合物之中，medicarpin 及 afrormosin 為具有抗黴菌與抗結核病菌之活性成分[168]，而對於細胞毒殺活性方面則值得進一步探討。

二、抗氧化活性實驗

依 Shyu YS (2002)等之方法，以 DPPH 自由基清除能力之試驗，測試血藤莖部各萃取層，結果發現血藤之甲醇萃取物、乙酸乙酯層、正丁醇層、水層及沉澱物具有顯著的抗氧化活性。顯示血藤之化學成分中含有具抗氧化能力之活性成分。因此以抗氧化能力為活性指標，由乙酸乙酯層中得到三個具有抗氧化活性之異黃酮類化合物 afrormosin, genistein, calycosin，顯示以活性引導分離之方式相當可行，而其他各萃取層之活性成分仍有待進一步追蹤。

第六章　結　論

血藤(*Mucuna macrocarpa* WALLICH)**之莖部經乾燥、萃取後，以細胞毒殺活性及抗氧化能力為活性指標，使用管柱層析分離並再結晶純化，結果由正己烷層、氯仿層、乙酸乙酯層中得到七個化合物：**

1. Fatty acid：

tetracosanoic acid (H-1)

2. Triterpene：

friedelin (H-2)

3. Steroid：

mixture of β-sitosterol and stigmasterol (C-1)

4. Isoflavonoid：

medicarpin (C-2)

afrormosin (E-1)

genistein (E-2)

calycosin (E-3)

其中，medicarpin, afrormosin, calycosin **等異黃酮類化合物皆為血藤屬首次發現之成分。**

據文獻[168]**記載異黃酮類化合物** medicarpin, afrormosin **具有抗黴菌及抗結核病菌活性；**genistein **則具有抗氧化、抗潰瘍、溶血抑制及雌性素樣的作用。以上皆為活性成分，顯示以活性引導分離的實驗方法相當可行。**

血藤為台灣之常見民間藥，主治貧血，月經不調，肺熱燥咳，咳血，腰膝酸痛，風濕痺痛，手足麻木，癱瘓。而本研究分離所得之活性成分，若針對固有民間用法，再進一步進行藥理活性確認，將使血藤的使用上更具意義，並有助於本土藥用植物的開發。

參考文獻

1. **劉和義、楊遠波、呂勝由、施炳霖：台灣維管束植物簡誌，行政院農業委員會，台北** 2000; pp.48, 90。
2. Editorial Committee of the Flora of Taiwan, Second Edition. Volumn Three. Editor-in-Chief: Huang TS. Tah Jinn Printing Company, Ltd. Taiwan 1993; pp.341-343.
3. **國家中醫藥管理局（中華本草）編委會：中華本草（4），上海科學技術出版社，上海** 1999；pp.576-577。
4. **陳 勇、甄漢深、許學健：薄層掃瞄法測定貓豆和藜豆中左旋多巴的含量。中草藥** 1993; 24 (6): 294-295.
5. **胡旺云、羅士德、蔡建勛：大果油麻藤化學成分研究。中草藥** 1994; 25 (2): 59-60, 63.
6. Bhakuni DS, Goel AK, Jain S: Screening of Indian plants for biological activity (part XIII). *Indian J Exp Biol* 1988; 26 (11): 883-904.
7. **甘偉松：藥用植物學，國立中國醫藥研究所，台北** 1993；p.316。
8. **江蘇新醫學院：中藥大辭典（上冊），上海科學技術出版社，上海** 1992；p.847。
9. Pei SJ: Preliminary study of ethnobotany in Xishuang Banna. *J Ethanopharmacol* 1985; 13 (2): 121-137.
10. Lin CC: Crude drugs used for the treatment of Diabetes mellitus. *Amer J Chinese Med* 1992; 20 (3/4): 269-279.
11. Jamir NS: Some interesting medicinal plants used by Nagas. *J Res Edu Ind Med* 1990; 92: 81-87.
12. Wasuwat S: A list of thai medicinal plants, asrct, bangkok. report no.1

on res. project. 17. Research report, A. S. R. C. T. , no.1 on research project 17 1967: 22.

13. Ndamba J, Nyazema N, Makaza N: Traditional herbal remedies used for the treatment of urinary schistosomiasis in Zimbabwe. *J Ethnopharmacol* 1994; 42: 125-132.
14. Haerdi F: Native medicinal plants of ulanga district of Tanganyika (East Africa). Dissertation-PH.D.-Univ Basel 1964.
15. Laurena AC, Revilleza MJR, Mendoza EMT: Polyphenols, phytate, cyanogenic glycosides, and trypsin inhibitor activity of several Philippine indigenous food legumes. *J Food Compos Anal* 1994; 7 (3): 194-202.
16. Bouquet A, Debray M: Medicinal plants of the Ivory coast. *Trav Doc Orstom* 1974; 32: 1.
17. Hostettmann K: On the use of plants and plant-derived compounds for the control of schistosomiasis. *Naturwissenschaften* 1984; 71 (5): 247-251.
18. Burkill IH: Dictionary of the economic products of the Malay Peninsula. Volume I. Ministry of agriculture and cooperatives, Kuala Lumpur 1966.
19. Pei S-J: Preliminary study of ethnobotany in Xishuang Banna, People's Republic of China. *J Ethnopharmacol* 1985; 13 (2): 121-137.
20. Lin CC: Crude drugs used for the treatment of diabetes mellitus in Taiwan. *Amer J Chinese Med* 1992; 20 (3/4): 269-279.
21. Alam MK: Medical ethnobotany of the Marma tribe of Bangladesh. *Econ Bot* 1992; 46 (3): 330-335.
22. Johns T, Mhoro EB, Sanaya P: Food plants and masticants of the Batemi of Ngorongoro district. *Econ Bot* 1996; 50 (1): 115-121.
23. Weiger B, Rouzier M, Daguilh R: Popular medicine of the central plateau Haiti. *J Ethnopharmacol* 1986; 17(1): 13-30.

24. Joshi MC, Patel MB, Mehta PJ: Some folk medicines of Dangs. *Bull Med Ethnobot Res* 1980; 1: 8-24.
25. Sebastian MK, Bhandari MM: Medico-ethno botany of Mount Abu. *J Ethnopharmacol* 1984; 12 (2): 223-230.
26. Ghosal S, Singh S, Bhattacharya SK: Alkaloids of *Mucuna pruriens. Planta Med* 1971; 19: 279.
27. Nagaraju N, Rao KN: A survey of plant crude drugs of Rayalaseema. *J Ethnopharmacol* 1990; 29 (2): 137-158.
28. Anderson EF: Ethnobotany of hill tribes of Northern Thailand. I. Medicinal plants of Akha. *Econ Bot* 1986; 40 (1): 38-53.
29. Jain SK, Tarafder CR: Medicinal plant-lore of the santals. *Econ Bot* 1970; 24: 241-278.
30. Nisteswar K, Murthy VK: Aphrodisiac effect of indigenous drugs- a myth or reality. *Probe* 1989; 28(2): 89-92.
31. Casey RCD: 298 alleged antifertility plants of India. *Indian J Med Sci* 1960; 14: 590-601.
32. Duke JA: Ethnobotanical observations on the Cuna Indians. *Econ Bot* 1975; 29: 278.
33. Oakes AJ, Morris MP: The west Indian weedwoman of the United States Virgin Islands. *Bull Hist Med* 1958; 32: 164.
34. Alvaro Viera R: Subsidio para o estudo da flora medicinal da guinea portuguesa. Agencia-geral do ultramar. Lisboa 1959.
35. Bhandary MJ, Chandrashekar KR, Kaveriappa K M: Medical ethnobotany of the siddis of uttara Kannada district. *J Ethnopharmacol* 1995; 47 (3): 149-158.
36. Saha JC, Savini EC, Kasinathan S: Ecbolic properties of Indian medicinal plants. part 1. *Indian J Med Res* 1961; 49: 130-151.
37. Bhattarai NK: Folk use of plants in veterinary medicine in central Nepal. *Fitoterapia* 1992; 63 (6): 497-506.

38. Jain SP: Tribal remedies from Saranda forest. *Int J Crude Drug Res* 1989; 27 (1): 29-32.
39. Kapoor SL, Kapoor LD: Medicinal plant wealth of the Karimnagar district of Andhra Pradesh. *Bull Med Ethnobot Res*1980; 1: 120-144.
40. Pushpangadan P, Atal CK: Ethno-Medico-Botanical investigations in Kerala I. Some primitive tribals of western ghats and their herbal medicine. *J Ethnopharmacol* 1984; 11 (1): 59-77.
41. Hemadri K, Sasibhushanarao S: Antifertility, abortifacient and fertility promoting drugs from Dandakaranya. *Ancient Sci Life* 1983; 3 (2): 103-107.
42. Vitalyos D: Phytotherapy in domestic traditional medicine in Matouba-Papaye (Guadeloupe). Dissertation-PH.D.-Univ Paris 1979: 110.
43. Jain,SK: Studies in Indian ethnobotany. II. Plants used in medicine by the tribals of Madhya Pradesh. *Bull Reg Res Lab (Jammu India)* 1963; 1: 126-128.
44. Das SK: Medicinal, economic and useful plants of India. Bally seed store, West Bengal 1955.
45. Burkill IH: Dictionary of the economic products of the Malay Peninsula. Volume II. Ministry of agriculture and cooperatives, Kuala Lumpur 1966.
46. Girach RD, Aminuddin, Siddioui PA: Traditional plant remedies among the Kondh of district Dhenkanal (Orissa). *Int J Pharmacog* 1994; 32 (3): 274-283.
47. Selvanayahgam ZE, Gnanevendhan SG, Balakrishna K: Antisnake venom botanicals from ethnomedicine. *J Herbs Spices Med Plants* 1994; 2 (4): 45-100.
48. Kar A, Choudhary BK, Bandyopadhyay NG: Preliminary studies on the inorganic constituents of some indigenous hypoglycaemic herbs

on oral glucose tolerance test. *J Exp Bot* 1999; 64 (2): 179-184.

49. Heckel E: Les plantes medicinales et toxiques de madagascar. A. Challamel, Paris 1903.
50. Suwal PN: Medicinal plants of Nepal. Ministry of forests, department of medicinal plants, Thapathali, Kathmandu, Nepal 1970.
51. Ahmad YS: A note on the plants of medicinal value found in Pakistan. Government of Pakistan press, Karachi 1957.
52. Anon: Botanical herbs and drugs, sunrise herb and drugs service, Pakistan 1959.
53. Ayensu ES: Medicinal plants of the West Indies. Unpublished manuscript 1978: 110.
54. Elisabetsky E, Figueiredo W, Oliveria G: Traditional amazonian nerve tonics as antidepressant agents. *J Herbs Spices Med Plants* 1992; 1 (1/2): 125-162.
55. Mitra SK, Muralidhar TS, Rao DRB: Experimental assessment of relative efficacy of drugs of herbal origin on sexual performance and hormone levels in alcohol exposed and normal rats. *Phytother Res* 1996; 10 (4): 296-299.
56. Tahmad MU, Husain SK, Osman SM: Characterization and measurement of HBR-reacting acids in *Mucuna pruriens* and Urena Lobata seed oils. *J Agr Food Chem* 1978; 29 (2): 372-376.
57. Rao MRR, Parakh SR: Effect of some indigenous drugs on the sexual behavior of male rats. *Indian J Pharm Sci* 1978; 40: 236.
58. Pardanani DS, Delima RJ, Rao RV: Study of the effects of speman on semen quality in oligospermic men. *Indian J Surg* 1976; 38: 34-39.
59. Dixit RS, Pandey HC: Plants used as folk-medicine in Jhansi and Lalitpur sections of Bundelkhand. *Int J Crude Drug Res* 1984; 22 (1): 47-51.
60. Kumar DS: Prabhakar YS: On the ethnomedical significance of the

Arjun tree, *Terminalia arjuna*. *J Ethnopharmacol* 1987; 20 (2): 173-190.

61. Akhtar MS: Hypoglycaemic activites of some indigenous medicinal plants traditionally used as antidiabetic drugs. *J Pak Med Ass* 1992; 42 (11): 271-277.
62. Madulid DA, Gaerlan FJM, Romero EM: Ethnopharmacological study of the Ati tribe in Nagpana. *Acta Manilana* 1989; 38 (1): 25-40.
63. Amico A: Medicinal plants of Southern Zambesia. *Fitoterapia* 1977; 48: 101-139.
64. Houghton PJ, Skari KP: The effect on blood clotting of some west african plants used against snakebite. *J Ethnopharmacol* 1994; 44 (2): 99-108.
65. Udedibie ABI, Carlini CR: Brazilian *Mucuna pruriens* seeds (velvet bean) lack hemagglutinating activity. *J Agr Food Chem* 1998; 46 (4): 1450-1452.
66. Duke JA: Mazonian ethnobotanical dictionary. USA 1994; 181.
67. Debelmas J: Plantes medicinales Daltitude. I. Vegetation et plantes medicinales andines. *Fitoterapia* 1975; 46: 99-110.
68. Holdsworth D, Balun L: Medicinal plants of the East and West Sepik provinces. *Int J Pharmacog* 1992; 30 (3): 218-222.
69. Coee FG, Anderson GJ: Ethnobotany of the garifuna of Eastern Nicaragua. *Econ Bot* 1996; 50 (1): 71-107.
70. Caceres A, Menendez H, Mendez E: Antiogonorrhoeal activity of plants used in guatemala for the treatment of sexually transmitted diseases. *J Ethnopharmacol* 1995; 48 (2): 85-88.
71. Giral F, Sotelo A, Lucas B: Chemical composition and toxic factors content in fifteen Leguminosae seeds. *J Crude Drug Res* 1978; 16: 143.
72. Nogueira MA, Deoliveira JS, Ferraz S: Nematicidal hydrocarbons

from *Mucuna aterrima*. *Phytochemistry* 1996; 42 (4): 997-998.

73. Goda Y, Shibuya M, Sankawa U: Inhibitors of prostaglandin biosynthesis from *Mucuna birdwoodiana*. *Chem Pharm Bull* 1987; 35 (7): 2675-2677.
74. Kwon YS, Lee JH, Kim CM: Inhibitory activities of three compounds from *Mucuna birdwoodiana* on 3-alpha-hydroxysteroid dehydrogenase. *Korean J Pharmacog* 1999; 30 (2): 216-221.
75. Niranjan GS, Katiyar SK: Chemical examination and biological evaluation of proteins isolated from some wild legumes. *J Indian Chem Soc* 1981; 58: 70-72.
76. Chen CP, Lin CC, Namba T: Development of natural crude drug resources from Taiwan. (VI). *In vitro* studies of the inhibitory effect on 12 microorganisms. *Shoyakugaku Zasshi* 1987; 41 (3): 215-225.
77. Chen CP, LinCC, Namba T: Screening of Taiwanese crude drugs for antibacterial activity against *Streptococcus mutans. J Ethnopharmacol* 1989; 27(3): 285-295.
78. Sandberg F, Cronlund A: What can we still learn from traditional folklore medicine? Examples from the results of a biological screening of medicinal plants from equatorial Africa. Proc third Asian symposium med plants & spices Colombo Sri Lanka February 6-12 1977; 3: 178-197.
79. Dhawan BN, Patnaik GK, Rastogi RP: Screening of Indian plants for biological activity. VI. *Indian J Exp Biol* 1977; 15: 208-219.
80. Bhakuni DS, Goel AK, Jain S: Screening of Indian plants for biological activity: part XIII. *Indian J Exp Biol* 1988; 26 (11): 883RY-904.
81. Kamboj VP: A review of Indian medicinal plants with interceptive activity. *Indian J Med Res* 1988; 4: 336-355.
82. Sievers AF, Archer WA, Moore RH: Insecticidal tests of plants from

tropical America. *J Econ Entomol* 1949; 42: 549.

83. Mukherjee S, Ghosh TK, De D: Effect of speman on prostatism-a clinical study. *Probe* 1986; 25: 237-240.
84. Madaan S: Speman in oligospermia. *Probe* 1985: 115-117.
85. Rathore HS, Saraswat V: Protection of mouse testes, epididymis and adrenals with speman against cadmium intoxication. *Probe* 1986; 25: 257-268.
86. Dhar ML, Dhar MM, Dhawan BN: Screening of Indian plants for biological activity: part I. *Indian J Exp Biol* 1968; 6: 232-247.
87. Jauk L, Galati EM, Kirjavainen S: Analgesic and antipyretic effects of *Mucuna pruriens. Int J Pharmacog* 1993; 31 (3): 213-216.
88. Dabral PK, Sharma RK: Evaluation of the role of rumalaya and geriforte in chronic arthritis-a preliminary study. *Probe* 1983; 22 (2): 120-127.
89. Iauk L, Galati EM, Forestiri AM: *Mucuna pruriens* decoction lowers cholesterol and total lipid plasma levels in the rat. *Phytother Res* 1989; 3 (6): 263-264.
90. Jayatilak PG, Pardanani DS, Murty BD: Effect of an indigenous drug (speman) on accessory reproductive functions of mice. *Indian J Exp Biol* 1976; 14: 170.
91. Bhargava NC, Singh OP: Fortege and indigenous drug in common sexual disorders in males. *Mediscope* 1978; 21 (6): 140-144.
92. Upadhya L, Shukla SS, Agrawal A: Changes in brain biogenic amines under influence of an indigenous drug, geriforte, following immobilization stress. *Indian J Exp Biol* 1988; 26 (11): 911-912.
93. Ohta S, Sakurai N, Inoue T: Studies on chemical protectors against radiation. XXV. Radioprotective activities of various crude drugs. *Yakugaku Zasshi* 1987; 107 (1): 70-75.
94. Uguru MO, Aguiyi JC, Gesa AA: Mechanism of action of the aqueous

seed extract of *Mucuna pruriens* on the guinea-pig heum. *Phytother Res* 1997; 11 (4): 328-329.

95. Kiuchi F, Hioki M, Nakamura N: Screening of crude drugs used in Sri Lanka for nematocidal activity on the larva of toxocaria canis. *Shoyakugaku Zasshi* 1989; 43 (4): 288-293.
96. Sankaran JR: Problem of male virility - an oriental therapy. *J Natl Integ Med Ass* 1984; 26 (11): 315-317.
97. Ali MA, Mikage M, Kiuchi F: Screening of crude drugs used in bangladesh for nematocidal activity on the larva of toxocara canis. *Shoyakugaku Zasshi* 1991; 45 (3): 206-214.
98. Carbajal D, Casaco A, Arruzazabala L: Pharmacological screening of plant decoctions commonly used in Cuban folk medicine. *J Ethnopharmacol* 1991; 33 (1/2): 21-24.
99. Vaidya RA, Aloorkar SD, Sheth AR: Activity of bromoergocryptine, *Mucuna pruiens* and *l*-dopa in the control of hyperprolactinemia. *Neurology (India)* 1978; 26: 179-182.
100. Hussain G, Manyam BV: *Mucuna pruriens* proves more effective than *l*-dopa in Parkinson's disease animal model. *Phytother Res* 1997; 11 (6): 419-423.
101. Nath C, Gupta GP, Bhargava KP: Study of antiparkinsonian activity of seeds of *Mucuna prurita* Hook. *Indian J Pharmacol* 1981; 13: 94-95.
102. Vaidya AB, Rajagopalan TG, Mankodi NA: Treatment of Parkinson's disease with cowhage plant-*Mucuna pruriens* Bak. *Neurology (India)* 1978; 26: 171-176.
103. Manyam BV: Paralysis agitans and levodopa in Ayurveda: ancient Indian medical treatise. Movement Disorders 1990; 5 (1): 47-48.
104. Pant MC, Uddin I, Bhardwaj UR: Blood sugar and total cholesterol lowering effect of *Glycine soja* (sieb and zucc.), *Mucuna pruriens*

(D.C.) and *Dolichos biflorus* (LINN.) seed diets in normal fasting albino rats. *Indian J Med Res* 1968; 56 (12): 1808-1812.

105. Jayatilak PG, Sheth AR, Mugatwala PP: Effect of an indigenous drug (speman) on human accessory reproductive function. *Indian J Surg* 1976; 38: 12-15.
106. Mahajani SS, Doshi VJ, Parikh KM: Bioavailability of *l*-dopa from HP-200-a formulation of seed powder of *Mucuna pruriens* (Bak): A pharmacokinetic and pharmacodynamic study. *Phytother Res* 1996; 10 (3): 254-256.
107. Vaidya RA, Sheth AR, Aloorkar SD: The inhibitory effect of the cowhage plant *Mucuna pruriens* and *l*-dopa on chlorpromazine-induced hyperprolactinemia in man. *Neurology (India)* 1978; 26: 177-178.
108. Amin KMY, Khan MN, Zillur-Rehman S: Sexual function improving effect of *Mucuna pruriens* in sexually normal male rats. *Fitoterapia* 1996; 67 (1): 53-58.
109. Solepure AB, Joshi NM, Deshkar BV: The effect of 'speman' on quality of semen in relation to magnesium concentration. *Indian Practitioner* 1979; 32: 663-668.
110. Feroz H, Khare AK, Srivastava MC: Review of scientific studies on anthelmintics from plants. *J Sci Res Pl Med* 1982; 3: 6-12.
111. Aguiyi JC, Igweh AC, Egesie UG: Studies on possible protection against snake venom using *Mucuna pruriens* protein immunization. *Fitoterapia* 1999; 70 (1): 21-24.
112. Aguiyi JC, Uguru MO, Johnson PB: Effects of *Mucuna pruriens* seed extract on smooth and skeletal muscle preparations. *Fitoterapia* 1997; 68 (4): 366-370.
113. Fuiji Y, Shibuya T, Yasuda T: Allelopathy of velvetbean: Its discrimination and identification of *l*-dopa as a candidate of

allelopathic substances. *Jarq* 1992; 25 (4): 238-247.

114. Fujii Y, Shibuya T, Yasuda T: *l*-3,4-dihydroxyphenylalanine as an allelochemical cnadidate from *Mucuna pruriens* (L.) DC. var. *utilis*. *Agr Biol Chem* 1991; 55 (2): 617-618.
115. Medina FR, Woodbury R: Terrestrial plants molluscicidal to lymnaeid hosts of *Fasciliasis hepatica* in Puerto Rico. *J Agr Univ Puerto Rico* 1979; 63: 366-376.
116. Cox PA, Sperry LB, Tuominen M: Pharmacological activity of the Samoan ethnopharmacopoeia. *Econ Bot* 1989; 43 (4): 487-497.
117. Abraham Z, Bhakuni SD, Garg HS: Screening of Indian plants for biological activity. Part XII. *Indian J Exp Biol* 1986; 24: 48-68.
118. Lubis I, Sastrapradja S, Lubis SHA: *l*-dihydroxyphenylalanine (*l*-dopa) in *Mucuna* seeds. *Ann Bogor* 1981; 7 (3): 107-114.
119. Daxenbuchler ME, Vanetten CH, Hallinan EA: Seeds as sources of *l*-dopa. *J Med Chem* 1971; 14 5: 463-465.
120. Amarasekera AS, Jansz FR: Studies on *Mucuna* species of Sri Lanka II. Determination of the tetrahydroisoquinoline content of seeds. *J Natl Sci Counc Sri Lanka* 1980; 8: 99-103.
121. Cai J, Zhu ZY: Study on *l*-dopa resources of medicinal plants in the *Mucuna*. *Chung Ts`ao Yao* 1990; 21 (3): 103-104.
122. Ding Y, Kinjo J, Yang CR: Triterpenes from *Mucuna birdwoodiana*. *Phytochemistry* 1991; 30 (11): 3703-3707.
123. Goda Y, Katayama M, Tanaka M: Studies on biologically active compounds contained in Chinese medicinal plants used against the stagnation of disordered blood. *J Pharmacobio Dyn* 1987; 10 (3): 50.
124. Katiyar SK, Niranjan GS: Studies on carbohydrates and amino acids of some non-cultivated Leguminous seeds. *J Indian Chem Soc* 1981; 58: 98-100.
125. Su DR, Tang DG, Xu JW: Determination and extraction of levodopa

in legume of *Mucuna cochinchinensis*. *Tianran Chanwu Yanjiu Yu Kaifa* 1992; 4 (4): 27-30.

126. Zhang X, Su D, Xu JW: New process of extraction of *l*-dopa. *Zhongguo Yiyao Gongye Zazhi* 1991; 22 (5): 207-214.
127. Remmen SFA, Ellis BE: Dopa synthesis in non-producer cultures of *Mucuna deeringiana*. *Phytochemistry* 1980; 19: 1421-1423.
128. Ellis BE: Dopa ring-cleavage in the biogenesis of stizolobic acid in *Mucuma deeringiana*. *Phytochemistry* 1976; 15: 489-491.
129. Mbadiwe EI, Agogbua SIO: An anti-B specific haemagglutinin from the seeds of *Mucuna flagellipes*. *Phytochemistry* 1978; 17: 1057-1058.
130. Badami RC, Patil KB: Minor seed oils. IX. physico-chemical characteristics and component acids of four seed oils. *J Oil Technol Ass India* 1975; 7 (3): 79-81.
131. Lin YL, Tsai WJ, Chen IS: Chemical constituents from *Mucuna membranacea*. *J Chin Chem Soc* 1998; 45 (1): 213-217.
132. Josephine RM, Janardhanan K: Studies on chemical composition and antinutritional factors in three germplasm seed materials of the tribal pulse, *Mucuna pruriens* (L.) DC. *Food Chem* 1992; 43 (1): 13-18.
133. Parikh KM, Doshi VJ, Sawant SV: Estimation of *l*-dopa from the plant *Mucuna pruriens* (HPLC). *Indian drugs* 1990; 27 (6): 353-356.
134. Panikkar KR, Majella VL, Madhavan P: Lecithin from *Mucuna pruriens. Planta Med* 1987; 53 (5): 503.
135. Rakhit S, Majumdar DN: *Mucuna pruriens* DC. Part V. Alkaloidal constituents and their characterisation. *Indian J Pharmacy* 1956; 18: 285-287.
136. Hasan SQ, Sherwani MRK, Ahmad I: Epoxy acids of *Mucuna prurita* seed oil. *J Indian Chem Soc* 1980; 57: 920-923.
137. Sita GL, Vaidyanathan CS: Tissue culture of medicinal plants: Sandalwood, Eucalyptus, *Mucuna* and Agave. Abstr 4th Asian Symp

Med Plants Spices, Bangkok, Thailand, September 15-19 1980: p.106.

138. Wichers HJ, Visser JF, Huizing HJ: Occurrence of *l*-dopa and dopamine in plants and cell cultures of *Mucuna pruriens* and effects of 2,4-d and sodium chloride on these compounds. *Plant Cell Tissue Organ Cult* 1993; 33 (3): 259-264.
139. Smith TA: Tryptamine and related compounds in plants. *Phytochemistry* 1977; 16: 171-175.
140. Wichers HJ: Production of *l*-dopa by suspension grown cells of *Mucuna pruriens. Pharm Weekbl (Sci Ed)* 1987; 9 (1): 34-35.
141. Pras N, Woerdenbag HJ, Batterman S: *Mucuna pruriens*: Improvement of the biotechnological production of anti-Parkinson drug *l*-dopa by plant cell selection. *Pharm World Sci* 1993; 15 (6): 263-268.
142. Ishikura N, Yoshitama K: *C*-glycosylflavones of *Mucuna sempervirens. Phytochemistry* 1988; 27 (5): 1555-1556.
143. Plouvier V: The cyclitols in some botanical groups L-inositol of the composites and D-pinitol of the legumes. *C R Acad Sci* 1962; 255: 1770-1772.
144. Zhou H, Zeng ZK, Bao JK: Purification and characterization of the lectin from *Mucuna sempervirens* Hemsl. *Shengwu Huaxue Zazhi* 1996; 12 (3): 336-340.
145. Rai PP, Saidu M: Characterization of *l*-dopa in seeds of *Mucuna sloanei*. *Curr Sci* 1977; 46: 778.
146. Gosh G: A note on pharmacognostic and chemical identification of *Mucuna utilis* seeds: A substitute of *Mucuna pruriens. Indian Drugs* 1982; 20 (1): 24-25.
147. Narayanaswamy P, Mahadevan A: Phytoalexin production by germinating seeds of *Mucuna utilis*. *Curr Sci* 1981; 50 (20): 905-906.
148. Shyu YS, Hwang LS. Antioxidant activity of the crude extract of

lignan glycosides from unroasted Burma black sesame meal. *Food Research International* 2002; 35: 357-365

149. Williams WB, Cuvelier ME , Berset C: Use of a free radical method to evaluate antioxidant activity. *Lebens-Wiss Technol* 1995; 28 (1): 25-30.
150. Blosi MS: Antioxidant determination by the use of a stable free radical. *Nature* 1958; 26:1199-1200.
151. Sasaki SI, Hanbook of Proton-NMR Spectra and Data, Academic Press 1985-1986; Vol. 5: 190.
152. Lin YT, Kuo YH, Chang BH: Studies on the extractive constitudents of the bark of *Libocedrus formosana* Florin. II. *J Chinese Chem Soc* 1975; 22: 331-334.
153. Lai JS, Liou HS, Huang KF: Constituents of the roots of *Melanolepis multiglandulosa*. *Chin Pharm J* 1996; 48: 177-183.
154. Muhammad SA, Shaukat M, Shaista P: Epimers from the leaves of *Calophyllum inophyllum. Phytochemistry* 1999; 50: 1385-1389.
155. Lin YL, Tsai WJ, Chen IS: Chemical Constituents from *Mucuna membranacea*. *Journal of the Chinese Chemical Society* 1998; 45: 213-217.
156. Wanchai DE, Buppachart P: Biosynthesis of β-sitosterol and stigmasterol in *Croton sublyratus* proceeds via a mixed origin of isoprene units. *Phytochemistry* 2003; 62: 389-398.
157. Vincent C, Ange B, Serge R: Compositon and chemical variability of the triterpene fraction of dichloromethane extracts of cork. *Industrial Crops and Products* 2002; 12: 15-22.
158. Kao KC, Ho YL, Ho LK, Chang YS: 2-Benzoxazolinone, 2-hydroxy-1,4-benzoxazin-3-one form the root of *Strobilanthes cusia*. *J Chin Med* 2001; 12: 41-49.
159. Herath HMTB, Dassanayake RS, Priyadarshani AMA: Isoflavonoids

and a pterocarpan from *Gliricidia sepium. Phytochemistry* 1998; 47 (1): 117-119.

160. **高東英、張如意：雲南甘草化學成分的研究，中草藥** 1994; 25 (10): 507-508.
161. **李偉東、闞毓銘：刺果甘草化學成分的研究，中國藥學雜誌** 1999; 34 (1): 11-13。
162. Toshio M, Seigo F, Yoshihiko A: Studies on the Constituents of *Hedysarum polybotrys* HAND.-MAZZ. *Chem Pharm Bull* 1984; 32 (8): 3267-3270.
163. **黃文哲、段金廒、李正亮：懷槐的化學成分研究 I。中國藥科大學學報** 2000; 31 (1): 8-10。
164. Akira Kananubo, Kazushi Koga, Minoru Isobe: First finding of Daidzein 7-*O*-phosphate and Genistein 7-*O*-phosphate that are hydrolyzed by sulfatase. *Tetrahedron* 2001; 57: 8801-8805.
165. Pierre Kamnaing, Samuel N. Y. Fanso Free, Augustin E. Nkengfack: An isoflavan-quinone and a flavonol from *Millettia laurentii*. *Phytochemistry* 1999; 51: 829-832.
166. Araujo CAC, Alegrio LV and Leon LL: Antileishmanial activity of compounds extracted and characterized from *Centrolobium sclerophyllum*. *Phytochemistry* 1998; 49 (3): 751-754.
167. Mitsugu K, HiroshI N, Ushio S: Formation of Chalcones and Isoflavones by Callus Culture of *Glycyrrhiza uralensis* with Different Production Patterns. *Chem Pharm Bull* 1985; 33 (9): 3811-3816.
168. Jeffrey BH , Herbert B: The hanbook of natural flavonoids. Vol. 2. John Wiley & Sons Ltd, England 1999; pp. 19, 22, 32, 70.