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PRELIMINARY STUDIES ON NATURAL PLANT EXTRACTS AS SUNSCREEN AGENTS

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Abstracts

The aim of this study is to evaluate several plant extracts with a view to developing UV sunscreen agents. In this study, 150 plant extracts were screened to elucidate their UV spectra using spectrophotometric method. Several plant extracts such as *Phellodendron amurense, Morus alba, Rhododendron mucronulatum, Brassica alba* have strong absorbency at UVA region (350nm), the suntanning wavelength. And *Sophora flavescens, Caesalpinia sappan, Morus alba, Phellodendron amurense*, showed absorption plateau value at UVB region (308nm), the erythema action wavelength. These extracts have a good absorbency property as synthetic filter and could be served as substitutes for synthetic UV sunscreen agents.

Introduction

Sun radiation gives a lot of benefits to us. But many studies showed the harmful effects of sun radiation, especially ultraviolet (UV) radiation on skin. It is the main factor for skin damage like skin cancer, photoaging, phototoxicity.

UV radiation is divided into three wavelength bands A, B and C. UVC (200-280nm) is very dangerous to skin structure but is also strongly absorbed by ozone layer. UVB (280-320nm) is perceived as the most serious threat to the skin like sunburn (erythema) and skin cancer, although it is also the zone for vitamin D synthesis. Recently, UVA (320-400nm) has received more attention. It has been thought to be negligible for its low energy. But more than 90% of UV radiation is composed of UVA, the dose of UVA is 1,000 times more than UVB and it is more penetrating, making connective tissue and fibroblast an accessible target[1]. So, it is very important to screen UVA as well as UVB radiation to prevent skin damage and photoaging.

In general, synthetic sunscreen agents mainly have been used as sun blocking agent. They are generally aromatic compounds such as p-aminobenzoic acid (PABA) derivatives, benzophenones and cinnamates [3]. However, from point of biological view, it is more useful to search natural plant extracts having the structural and functional analogy to synthetic UV screen agents. In this experiment, we examined the UV absorbance of plant extracts. Especially, in UVB and UVA region we focused on the absorbency at 308nm and 350nm respectively. Because 308nm is the peak of erythema action spectrum and 350nm is the tanning wavelength[2].

So that, we screened 150 plant extracts to evaluate sunscreen agents and chose some plant extracts as sunscreen agents (UVA, UVB)

Methods

Preparation of plant extracts: 150 plants were obtained from the oriental medicinal market in Seoul. Each powdered plant (1kg) was soaked in 5L of 80% methanol solution and after filtration the filtrates were evaporated to dryness under vacuum. These extracts were used for further study.

UV absorption spectrum of plant extracts: The plant extracts were evaluated for UV absorption at 200-400nm. Spectrophotonetric analysis were made with a *CARY-I UV-Visible Spectrophotometer*(Varian), using ethanol as the solvent. We determined the coefficient of extinction($E^{\%}_{cm}$) of each plant extract at 308, 350nm. And we determined absorbance of each extract at 0.01 1.0mg/ml

Results and Discussion

We have screened 150 plant extracts for their UV spectrum at 200-400nm. We determined coefficient of extinction($E^{\%}_{cm}$) and UV absorbency at a concentration of 0.1mg/ml of each extracts. Table 1 represents the result of the preliminary screening test. 41 plant extracts showed $E^{\%}_{cm}$ at 308nm with more than 20 and 16 plant extracts showed higher $E^{\%}_{cm}$ at 350nm. We determined the UV absorption of the plant extracts.

4 plant extracts- *Phellodendron amurense, Morus alba, Rhododendron mucronulatum, Brassica alba-* showed UV absorb at UVA. And, 4 plant extracts- *Sophoa flavescens, Caesalpinia sappan, Morus alba, Phellodendron amurense*,- had strong absorbency at UVB region, the erythema action wavelength(Fig.1, Fig., Fig.3, Fig.4). Especially, *Phellodendron amurense, Morus alba* have a good sun-protective properties. *Phellodendron amurense* has twi absorption peaks at 282nm, 332nm. *Morus alba* has two absorption peaks at 285nm and 314nm.

From all of these results, it is clear that *Morus alba* and *Phellodendron amurense* were able to use UV-screen agent. And other plant extracts also revealed interesting potential for UV protection: *Rhododendron mucronulatum, Brassica alba, Sophoa flavescens, Caesalpinia sappan.*

Reference

Kligman L. H., Akin F.J., Kligman A.M, The concentration of UVA and UVB to connective tissue damage in hairless mice J. Invest. Dermatol. *: 1985; 272 276.*

Bobin M.F., Raymond M., Martini M. C., UVA/UVB absorption properties of natural products Cosmetics & Toiletries, *1994, Vol. 109(Nov.), 63-70.*

David C. Steinberg, Sunscreen encyclopedia regulatory update , Cosmetics & Toiletries , *1996, Vol.111(Dec.), 77-86.*

Table 1. $E^{\%}_{cm}$ of plant extracts

Plant extracts	Medicinal name	$E^{\%}_{cm}$ 308nm	$E^{\%}_{cm}$ 350nm
Acanthopanax sessiliforum	Acanthopanacis Cortex	9.5569	3.2213
Achyranthes japonica	Achyranthis Radix	0.9203	17553
Aconitum loczyanum	Aconiti loczyani Radix	9.2190	1.7663
Aconitum carmichaeli	Aconiti Tuber	0.8767	0.3390
Aconitum creanum	Aconiti Tuber	11.6249	4.6490
Acorus gramineeus	Acori graminei Rhizoma	27.5096	3.5358
Adenophora remotiflora	Remotoflorae Radix	3.5323	1.1601
Adenophora triphylla var. japonica	Adenophorae Radix	3.0842	0.9555
Agastaches rugosa	Agastachis Herba	18.0882	10.4742
Akebia quinata	Akebia Caulis	17.1022	7.9131
Alisma orientale	Alismatis Rhizoma	0.7063	0.1527
Alpinia officinarum	Alpinia officinarrum Rhizoma	27.6010	25.0533
Amomum cardamomum	Amomi Cardamomi Fructus	9.0848	4.3315
Amonum tsaolio	Amomi Tsaolio Fructus	4.4464	0.1727
Amonumx anthioides	Amomi Semen	12.4880	5.7516
Anemarrhena asphodeloides	Anemarrhenae Rhizoma	16.2151	9.8363
Angelica dahurica	Amgelicae Dahuricae Radix	27.2361	7.9790
Angelica tenuissima	Angelicae tenuissimae Radix	25.5301	10.2159
Anthriscus sylvestris	Anthrisci Radix	13.4829	5.6615
Aralia cordata	Araliae Cordatae Radix	4.8483	1.5752
Arctium lappa	Arctii Semen	9.2164	3.3216
Areca catechu	Arecae Semen	18.5033	12.6491
Arenbia euchroma	Arenbia Radix	20.5715	10.4957
Arisaema heterophyllum	Ariaematis Tuber	1.6466	0.4052
Aristolochia contorota	Aristolochiae Fructus	8.4761	4.2433
Astragalus membranaceus	Astragali Radix	6.2223	2.3072
Atractylodes coreana	Atractylodis Rhizoma	4.3565	1.1190
Atractylodes japonica	Atractylodis Rhizoma	13.7403	2.4261
Belamcanda chinensis	Belamcandae Rhizoma	13.4541	2.6212
Boswellia carterii	Olibanum	20.6256	14.0690
Brassica alba	Sinaphis Semen alba	9.6980	5.0932
Bupleurum falcatum	Bupleuri Radix	27.8523	24.9411
Buthus martensi	Scorpio	6.6243	2.6595
Caesalpinia sappan	Caesalpinia Lignum	0.8922	0.4423
Caragana sinica	Caraganae Radix	28.0274	23.2289
Carthamus tinctorius	Carthami Flos	25.5277	22.3581
Carthamus tinctorius	Carthami Semen	20.1554	9.6583
Cassia obtusifolia	Cassiae Semen	13.5845	7.4574
Chaenomeles speciosa	Chaenomelis Fructus	1.2071	0.1384
Chrysanthemum indicum	Chrysanthemi indici Flos	14.9378	1.9180
Chrysanthemum zawadskii var. latilbum	Zawadsii Herba	28.0365	25.0345
Cimicifuga heracleifolia	Cimicifugae Rhizoma	26.9952	14.1412
Citrus aurantium	Aurantii Fructus Immaturus	28.0307	25.0345
Citrus unshiu	Aurantii lammaturi Pericarpium	14.1321	3.5909
Clematis mandshurica	Clemmatidis Radix	13.9242	5.3899
Codonopsis pilosula	Codonopsis pilosulae Radix	1.6762	0.1756
Cornus officinalis	Corni Fructus	1.7345	0.1677
Croton tiglium	Tiglii Semen	15.3821	4.0342
Corydalis ternata	Corydalis Tuber	25.4488	2.9313
Crataegus pinnatifida	Crataegi Fructus	3.1985	1.3855
Curcuma zedoaria	Zedoariae Rhizoma	7.3822	3.0288

Cuscuta australis	Cuscutae Semen	28.3065	18.9501
Cynanchum wilfordi	Cynanchi wilfordii Radix	6.1922	2.0786
Cyperus rotundus	Cyperi Rhizoma	6.9900	3.0057
Dendrobium moniliforme	Dendrobii Herba	28.0519	18.8044
Dioscorea batatas	Dioscorreae Herba	5.6633	1.6188
Dioscorea japonica	Dioscoreae Rhizoma	1.3641	0.4350
Dolichos lablab	Dolichoris Semen	2.8960	0.6375
Dryopteris crassirhizoma	Crassirrhizomae Rhizoma	18.9476	14.7098
Ephedra sinica	Ephedrae Radix	13.2581	7.6912
Equisetum hyemale	Equiseti majoris Herba	20.9610	19.9902
Eucommia ulmoides	Eucommiae Cortex	11.4418	4.1424
Eucommia ulmoides	Eucommiae Folium	12.8983	8.1514
Euonymus alatus	Euonymi Lignum	12.7373	13.4711
Foeniculum vulgare	Foeniculi Fructus	17.2163	15.1490
Forsythia viridissima	Forsthiae Fructus	13.4411	9.4161
Fritillaria ussuriensis	Fritillariae Bulbus	6.3723	2.8214
Ganoderma lucidum	Ganoderma	12.7361	7.4410
Gardenia jasminodes	Gaardenia Fructus	27.3548	22.6081
Gastrodia elata	Gastrodiae Rhizoma	0.9602	0.2370
Gbotium barometz	Gbotii Rhizoma	16.2120	9.2744
Gentiana scabra var. buergeri	Gentianae radix	3.5225	-
Glycyrrihiza glabra	Glycyrrhzae Radix	27.7195	24.0685
Hordeum vulgare	Hordei Fructus Germinatus	13.6034	8.4690
Houttuynia cordata	Houttuyniae Herba	8.4665	8.4721
Kochia scoparia	Kochia fructus	13.7143	12.2832
Kalopanax pictus	Kalopanacis Cortex	9.35132	2.7868
Ledebouriella seseloides	Ledebouriellae Radix	2.7262	1.1072
Leonurus sibricus	Leonuri Herba	3.0345	14.3141
Liriope platyphylla	Liriopis Tuber	0.1637	0.0580
Lonicera japonica	Loniserae Flos	25.7576	15.8345
Luffa cylindrica	Luffae Fructus	2.30630	1.4417
Lycium barbarum	Lycii Fructus	4.0322	1.5255
Lycium chinense	Lycii Cortex Radicis	7.1664	2.5835
Magnolia kobus	Magnoliae Flos	19.0505	14.3213
Morinda officinalis	Morindae Radix	0.7686	0.4023
Morus alba	Mori Cortex	27.8562	25.0397
Mucuna birdwoodiana	Mucunae Aculis	18.5622	7.0962
Myristica fragrans	Myristica semen	15.6453	0.0953
Nelumbo nucifera	Nelumbinis Semen	1.5566	0.7023
Nepada japonica	Nepetae Herba	4.5511	2.3164
Paeonia ovobata	Paeoniae Radix rubra	9.3601	0.9301
Perilla frutescens var. crispa	Perillae Semen	25.7877	18.1019
Peucedanum terebinthaceum	Peucedani Radix	8.2854	2.2268
Phaselous radiatus(China)	Phaseoli Semen	2.3401	1.5465
Phaseolus radiatus(Korea)	Phaseoli Semen	14.0684	14.4372
Phellodendron amurense	Phellodendri Cortex	28.1752	25.5816
Pholmis umbrosa	Pholmis Radix	21.5123	12.4870
Pinellia ternata	Pinelliae Tuber	15.9795	18.0962
Pinus densiflora	Pini Folium	3.8465	0.5323
Plantago asiatica	Plantaginis Semen	16.2530	10.6002
Platycodon grandiflorum	Platicogo Radix	23.2781	14.6540
Polygala tenuifolia	Polygalae Radix	0.8444	0.2813
Polygonatum sibiricum	Polygonati Rhizoma	27.9812	11.2172
Polygonum multiflorum	Polygoni Multiflori Radix	0.4364	0.1634
Poncirus trifoliata	Ponciri Fructus	14.6777	4.3012

Poria cocos(red)	Hoelen	28.3123	25.4951
Poria cocos(white)	Pachymae Fungus	6.8322	3.3690
Prunus armenica var.ansu	Armeniacae Semen	1.8025	0.8632
Prunus mume	Mume Fructus	2.3001	0.8328
Pueraria thunbergiana	Puerariae Flos	6.5024	2.4617
Pulsatilla koreana	Pulsatillae Radix	27.6612	18.3735
Raphanus sativus	Raphani Semen	15.1831	7.8821
Raphanus sativa var. hortensis	Raphani Herba	22.8288	13.2150
Rehmannia glutinosa var. purpurea	Rehmanniae Radix	13.3883	10.5492
Rehmannia glutinosa var. purpurea	Rehmanniae Radix preparata	3.1284	1.8153
Rhododendron mucronulatum	Mucronulati Flos	26.6355	25.1603
Rhus javanica	Galla Rhois	27.5554	1.8727
Rhus verniciflua	Lacca Sinica Exsicata	28.2893	25.8040
Rosa laevigata	Rosae Laeviagata Fructus	8.7246	3.4736
Rubus coreanus	Rubi Fructus	17.8111	8.5722
Salvia miltiorrhiza	Salvia Radix	17.1662	9.7561
Saussurea lappa	Saussureae Fructus	9.4343	4.5120
Schisandra chinensis	Schizandra Fructus	2.6050	1.2154
Selaginella tamariacina	Selaginellae Herba	14.8181	11.3182
Sinomenium acutum	Sinomelni Caulis Rhizoma	6.0710	1.5695
Sophora flavescens	Sophorae Radix	27.9592	24.2730
Sophora subprostrata	Sophora subprostara	27.9472	15.4561
Sparganium stoloniferum	Sparganii Rhizoma	11.0024	4.3231
Taraxacum platycarpum	Taraxaci Radix	5.8949	14.1191
Terminalia chebula	Terminaliae Fructus	27.7243	18.8170
Torilis japonica	Torilis Fructus	9.5782	3.4696
Tribulus terrestris	Tribuli Fructus	8.8339	3.8944
Trichosanthes kirilowi	Trichosanthis Radix	0.5526	0.2043
Tussilago farfara	Farrarae Flos	24.9855	16.0852
Typha oriemtalis	Typhae Pollen	16.5915	13.4843
Veronica sibiriam	Veronicastry Herba	26.9645	10.7520
Xcutellaria baicalensis	Scutellariae Radix	23.4714	16.2512
Zanthoxylum piperatum	Zanthoxyli Fructus	27.6025	24.0655
Zanthoxylum piperitum	Zanthoxyli Pericarpium	26.3810	23.2383
Zingiber officinale	Zingberis Rhizoma	24.9554	0.3536
Ziziphus vulgaris var. spinosa	Zizyphi spinosi Semen	18.8682	17.0714
Zizyphus jujuba var. inermis	Zizyphi Fructus	1.1543	0.5244

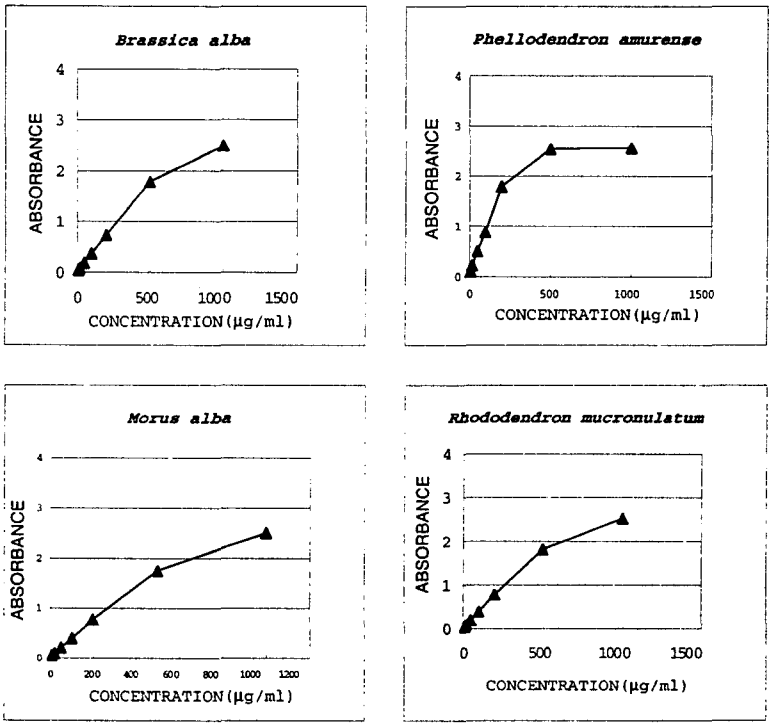

Fig.1. UV absorbance at UVA region (350nm)

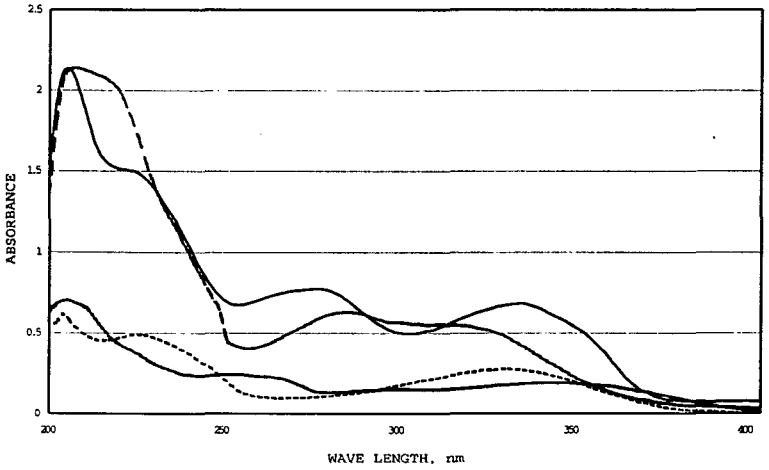

Fig.2. UV spectrum of plant extracts

——— *Phellodendron amurense* — - — · *Rhododendron mucronulatum*

- - - - - *Brassica alba* — — — *Morus alba*

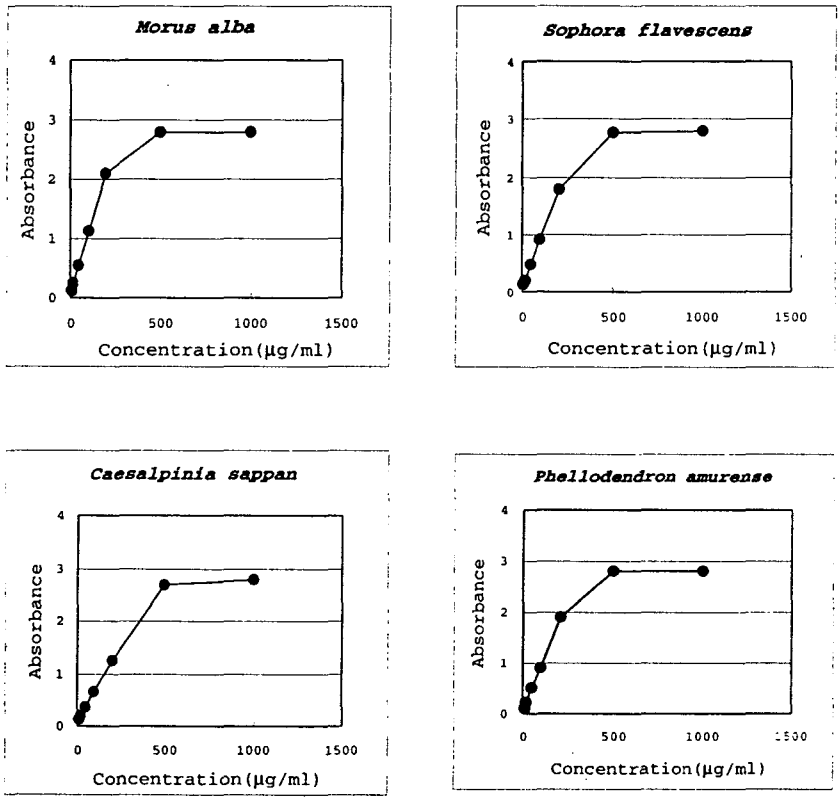

Fig. 3. UV absorbance at UVB region (308nm).

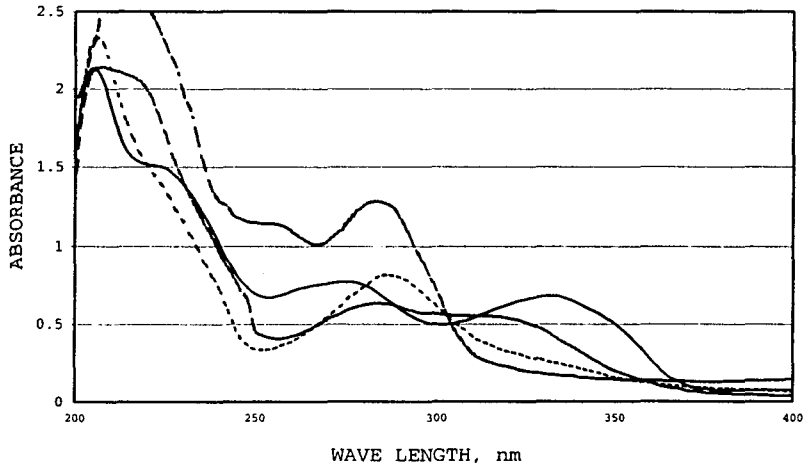

Fig.4. UV spectrum of plant extracts

——— *Phellodendron amurense* — · — · *Caesalpinia sappan*
· · · · · *Sophora flavescens* — — — *Morus alba*