THE DEVELOPMENT OF SUNSCREEN PRODUCTS FROM *KAEMPFERIA GALANGA*

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ABSTRACT: The aim of this study is to prepare sunscreen oil-in-water cream incorporated with volatile oil isolated from dry rhizome of *Kaempferia galanga* Linn. Volatile oil was extracted by hydrodistillation and then analyzed of its main chemicals by means of GC/MS. Sunscreen preparations containing 3, 5 and 7%w/w of volatile oil were prepared and their physical properties (e.g. pH, viscosity) were determined. Further, accelerated stability testing by storing the preparations at 45°C/ 8°C for 6 cycles was carried out. The results showed that the major chemical ingredients in the volatile oil were ethyl-*p*-methoxycinnamate (43.35%) and ethyl cinnamate (29.56%). The preparations showed good appearance and good physical stability. The sun protection factor (SPF) of the 7% volatile oil containing sunscreen product was 0.67 unit / 1% volatile oil which is comparable to the sunscreening agents used in the marketed sunscreen products.

Keywords: *Kaempferia galanga*, sunscreen, SPF, ethyl-*p*-methoxycinnamate

INTRODUCTION: Ultraviolet radiation (UV) is responsible for the growing epidemic of skin cancer in the countries where are located in tropical zone including Thailand. Humans are increasingly exposed to it as the ozone is depleted and/or global warming intensifies reflection. Ultraviolet is a description of the band of sunrays that fall in the middle of the magnetic spectrum. The lengths of these rays is shorter than visible light but longer than X rays, and include UVA, UVB and UVC.

It has become increasingly evident that exposure to ultraviolet radiation, UVB and UVA, is potentially lethal to humans. It is especially important to use effective sun protection to protect high levels of UV radiation[1]. In this report, authors focus on a natural product, *Kaempferia galanga* Linn. (Zingiberaceae), that appeared to have an antimicrobial effect[2]. The volatile oil extracted from the rhizomes of *Kaempferia galanga* Linn. is an all-natural source of cinnamate derivatives shown to have enhancement of sun protection.

Therefore, the aim of this study is to prepare sunscreen oil-in-water cream incorporated with volatile oil isolated from dry rhizome of *Kaempferia galanga* Linn. Furthermore, accelerated stability testing by storing the preparations at 45°C/ 8°C for 6 cycles was carried out and sun protection factor (SPF) was determined using Optometrics' SPF-290 Analyzer.

MATERIALS AND METHODS:

Plant Materials and Chemicals

Dried rhizomes of *Kaempferia galanga* Linn. were purchased from medicinal plants drug store in Bangkok and authenticated by one of us (NR). The voucher specimens (SWU 26117) were deposited in the herbarium at Faculty of Pharmacy, Srinakharinwirot University, Nakhon-nayok. Chemicals, Tween® 80, Span® 80, mineral oil, stearic acid, cetyl alcohol, propylene glycol, EDTA, vitamin E acetate, and Germaben® II were received from Namsiang trading CO., LTD.

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Extraction and Identifiction of volatile oil

Plant materials were cut into small pieces. They were extracted by hydrodistillation with clevenger apparatus. The volatile oil was collected and stored at 2-4 °C until being used. The UV absorption spectrum of the essential oil was obtained on Shimadzu UV-2100S UV/vis spectrophotometer. The chemical analysis was done by gas chromatography-mass spectrometry (GC/MS) on a Finnigan Trace GC ultra (Thermo Electron Corpo-ration, USA) with quadrupole mass spectrometer. The column was ZB-5 fused silica linked methyl silicon capillary column (30 m. x 0.22 mm. i.d.; 0.25 μM); oven temperature programming was 50-250 °C at 7 °C/min; injector and detector temperature were 250 and 280 °C, respectively; sample volume injected was 1 μl; split ratio was 100:1; and the carrier gas was He (2 ml/min).

Compounds were identified by comparing the Kovats gas chromatographic retention indices of the peaks on the HP-5MS column with literature values, computer matching using the Masslynx database, and comparison of the fragmentation patterns of the mass spectra with those reported in the literature[3-4].

Preparation of Sunscreen Cream (Oil in Water)

An o/w cream was prepared by addition of the pre-melted lipophilic parts to the aqueous phase components. Emulsification was achieved by low shear homogenization with a lab scale mixer (T25 basic S2, Ika Labortechnik, Staufen, Germany). The qualitative composition of the basic cream is given in Table 1. The preparations were contained 3, 5 and 7% w/w of volatile oil from *Kaempferia galanga* Linn. The physical properties including emulsion type, pH (ORION Model 320, MA, USA), and viscosity (Brookfield viscometer Model LVDV-II+, MA, USA) were evaluated.

Accelerated Stability Testing

The stability of products was determined after six freeze and thaw cycles. Products were stored at 8°C for 48 hours and then thawed at 40°C for 48 hours. When completely freezed and thawed in the sixth cycle, the separation of cream was observed.

Determination of SPF

The SPF value was determined using Optometrics' SPF-290 Analyzer.

Table 1 The excipients in the cream base

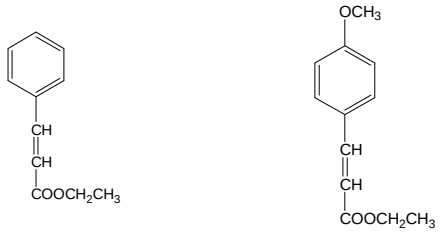
Excipients	Amount (% w/w)
Tween® 80	4
Span® 80	1
Mineral oil	10
Stearic acid	8
Cetyl alcohol	5
Propylene glycol	7
EDTA	0.1
Vitamin E acetate	0.1
Germaben® II	1
DI water	q.s. 100

RESULTS AND DISCUSSION: The extraction from the dried rhizomes of *Kaempferia galanga* Linn yields 1.4% volatile oil. It is clear-yellow oil with an average pH value of 5.12 and characteristic odor. The maximum UV absorbance value of 0.436, measuring the volatile oil at concentration of 0.008 μl/mL (n=3), were observed at a wavelength value of 281.2 nm, related to UV-B (290-320 nm). This result indicated that the extracted volatile oil can absorb some of the UV-B radiation.

The GC/MS results showed that the major compounds in the volatile oil from the rhizomes of *Kaempferia galanga* Linn were cinnamate derivatives such as ethyl-*p*-methoxycinnamate (43.35%) and ethyl cinnamate (29.56%) (Table 2 and Figure 1). Synthetic cinnamates are one of the active ingredients used in the marketed sunscreen products[5]. In this study, we found natural cinnamate derivatives that could be a promising UV absorber in sunscreen product.

Table 2 Chemical constituents of *Kaempferia galanga* Linn. volatile oil from hydrodistillation

Compounds	%Area	Retention Time
Monoterpenes		
α -Pinene	0.70	5.62
Camphene	1.87	6.02
3-Carene	7.46	7.74
Oxygenated monoterpenes		
Eucalyptol	10.44	8.42
Isoborneol	4.09	13.26
p-Cymen-8-ol	0.84	13.91
Aliphatic hydrocarbon		
Pentadecane	1.69	25.77
Cinnamate derivatives		
Ethyl cinnamate	29.56	24.65
Ethyl *p*-methoxycinnamate	0.94	31.40
Ethyl *p*-methoxycinnamate	42.41	34.55



Ethyl cinnamate Ethyl *p*-methoxycinnamate

Figure 1 Chemical structure of main components of *K. galanga* volatile oil

The preparations of volatile oil from *Kaempferia galanga* Linn. showed good appearance and good physical stability for all products as shown in Table 3. The w/o emulsion cream was found to be appropriate for the cosmetic products due to shear thinning behavior, low yield stress, and predominately elastic behavior. In addition, there was no separation observed after accelerated stability testing.

The average value of sun protection factor (SPF) of the 7% volatile oil containing sunscreen product was 4.69 (n=3), not including a SPF value of basic cream. Hence, the sun protection factor (SPF) of the 7% volatile oil containing sunscreen product was 0.67 units per 1% volatile oil which is comparable to the sun screening agents used in the marketed sunscreen products[6-7].

Table 3 Viscosity and pH of the preparations*

Preparations	Speed (rpm)	Viscosity (cps)	pH
3% w/w of volatile oil cream	2.0	37980	6.26
5% w/w of volatile oil cream	5.0	17400	6.35
7% w/w of volatile oil cream	3.0	25800	6.61
Cream base	1.5	69320	5.69

*n=3

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การพัฒนาตำรับผลิตภัณฑ์กันแดดจากเปราะหอม

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บทคัดย่อ: การวิจัยนี้มีวัตถุประสงค์เพื่อพัฒนาผลิตภัณฑ์กันแดดจากเปราะหอม (*Kaempferia galanga* Linn.) โดยสกัดน้ำมันหอมระเหยจากเหง้าแห้งของเปราะหอมโดยวิธี hydrodistillation และนำมาวิเคราะห์หาองค์ประกอบทางเคมีด้วย GC/MS จากนั้นนำน้ำมันหอมระเหยมาตั้งตำรับเพื่อพัฒนาผลิตภัณฑ์กันแดด (มีน้ำมันหอมระเหย ร้อยละ 3, 5 หรือ 7 โดยน้ำหนัก) ในรูปแบบครีมชนิดน้ำมันในน้ำ และนำผลิตภัณฑ์ที่ได้ไปทดสอบเสถียรภาพในสภาวะเร่งโดยเก็บที่อุณหภูมิ 8°C สลับกับ 45°C จำนวน 6 รอบ จากผลการศึกษาพบว่าองค์ประกอบหลักที่พบในน้ำมันหอมระเหยได้แก่ ethyl-*p*-methoxycinnamate (43.35%) รองลงมา คือ ethyl cinnamate (29.56%) ผลิตภัณฑ์ที่ได้มีลักษณะที่ดี มีเสถียรภาพ และเมื่อศึกษาประสิทธิภาพในการป้องกันแดดพบว่ามีค่า SPF เท่ากับ 0.67 หน่วยต่อน้ำมันหอมระเหยเปราะหอม 1% ซึ่งนับว่ามีประสิทธิภาพใกล้เคียงกับสารออกฤทธิ์ที่ใช้ในผลิตภัณฑ์กันแดดในปัจจุบัน

คำสำคัญ: เปราะหอม ผลิตภัณฑ์กันแดด เอทิล-พารา-เมท็อกซีซินนาเมต

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