ASIAN JOURNAL OF PHARMACEUTICAL SCIENCES 12 (2017) 386–393

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/ajps

Original Research Paper

Stability and solubility improvement of Sompoi (*Acacia concinna* Linn.) pod extract by topical microemulsion

Worrapan Poomanee [a], *Wantida Chaiyana* [a], R. Randall Wickett [b], *Pimporn Leelapornpisid* [a,*]

[a] *Faculty of Pharmacy, Chiang Mai University, Chiang Mai, Thailand*
[b] *James L. Winkle College of Pharmacy, University of Cincinnati, Cincinnati, USA*

ARTICLE INFO

Article history:
Received 4 November 2016
Received in revised form 15 February 2017
Accepted 7 March 2017
Available online 8 March 2017

Keywords:
Microemulsions
Stability
Acacia concinna Linn
Antioxidant activity
Lipid peroxidation
Antityrosinase activity

ABSTRACT

The aim of this study was to enhance the solubility and stability of *Acacia concinna* extract by loading in a microemulsion for topical application. Both physical appearance and biological activities of the extract-loaded microemulsion were determined in comparison with the extract solution. Pseudoternary phase diagrams of three oil types including tea seed oil, grape seed oil, and sesame oil, together with polysorbate 85 or the mixture of polysorbate 85 and sorbitan oleate as surfactants, and absolute ethanol as a co-surfactant were constructed to optimize the microemulsion area. The selected microemulsion was then characterized for droplet size, polydispersity index, and viscosity. Tea seed oil exhibited the highest microemulsion area in the phase diagram because it had the highest unsaturated fatty acid content. The microemulsion composed of tea seed oil (5%), polysorbate 85 (40%), ethanol (20%), and water (35%) exhibited Newtonian flow behavior with the droplet size and polydispersity index of 68.03 ± 1.09 nm and 0.44 ± 0.04, respectively. After 4% w/w of the extract was incorporated into the microemulsion, larger droplets size was observed (239.77 ± 12.69 nm) with a lower polydispersity index (0.37 ± 0.02). After storage in various conditions, both physical appearances and the stability of biological activity of the extract-loaded microemulsion were improved compared to the solution. Therefore, the *A. concinna* loaded microemulsion may be a promising carrier for further development into a topical formulation and clinical trials for pharmaceutical and cosmeceutical applications are also suggested.

* *Corresponding author.* Department of Pharmaceutical Science, Faculty of Pharmacy, Chiang Mai University, Chiang Mai 50200, Thailand. Fax: +66 53 944 390.

E-mail address: pim_leela@hotmail.com (P. Leelapornpisid).

Peer review under responsibility of Shenyang Pharmaceutical University.
http://dx.doi.org/10.1016/j.ajps.2017.03.001

1. Introduction

Acacia concinna Linn. or Sompoi, belonging to the family *Fabaceae*, is widely grown in Southern and Southeast Asia for medicinal purposes [1,2]. Its pod has been recognized as a component in holy water used for paying respect to elderly people in many special festivals in Thailand, especially the Songkran festival [3]. The Indian Ayurvedic pharmacopeia stated that *A. concinna* pod has been used as an active ingredient in anti-dandruff shampoos [1]. The main chemical constituent of the pod is saponin (20.8%) which was responsible for antidermatophyte and antimicrobial properties [2]. An ointment containing *A. concinna* pod extract has been widely used as an antimicrobial for skin disorders. The ethanolic, ethyl acetate, and hexane extracts of the pod showed fungicidal activity against several dermatophytes including *Trichophyton rubrum*, *Trichophyton mentagrophyte*, *Microsporum nanum*, and *Epidermophyton floccosum* [2,4].

Our previous study indicated that *A. concinna* pod extracted by hydroethanolic maceration exhibited the highest antioxidant and antityrosinase activities among all the extracts due to its highest phenolic content [3]. Moreover, the safety profile on human peripheral blood mononuclear cells (PBMCs) of the extract was comparable to ascorbic acid [3]. Thus, the *A. concinna* extract is suggested to be a promising compound for topical treatment of microbial infections and UV-induced skin disorders as well as melasma [3,5]. However, our preliminary study found that the antioxidant and antityrosinase activities of the extract declined at ambient temperature and especially at high temperature with sedimentation occurring in various solvents after a period of storage. Therefore, microemulsions which possess several advantages such as increasing solubility of both lipophilic and hydrophilic compounds, higher stability, and efficacy enhancement over conventional formulations were investigated for loading the *A. concinna* extract for topical application [6–8].

Microemulsions can be defined as optically isotropic and transparent oil or water dispersions with diameters a bit greater than swollen micelles. Their particles sizes are in the range of 20–200 nm. Dinielsson and Lindman (1981) gave the definition of microemulsions as the systems of water, oil and amphiphile that are thermodynamically stable with low viscosity and Newtonian behavior [9,10]. Microemulsion components are usually optimized by using pseudoternary phase diagrams which present the suitable amount of oil, water and surfactant mixtures. The microemulsion region can be identified in the phase diagram [10]. Microemulsions are categorized into 3 types: oil in water (O/W), water in oil (W/O) and bicontinuous microemulsions. Microemulsions have been reported to enhance the solubility and oxidation stability of Silymarin and ascorbyl palmitate [11,12]. Therefore, microemulsion systems are attractive topical formulations to investigate for not only improving the stability of *A. concinna* extract but also delivering its active compounds through the skin barrier for better biological results [13].

The purposes of this study were to develop and characterize the microemulsions loaded with the *A. concinna* extract. Both physical stability and biological activities of the extract-loaded microemulsion (MES) were also determined in comparison with the extract solution (HES solution).

2. Materials and methods

2.1. *Plant material*

A. concinna pods were collected at maturity between May and September 2014 in Chiang Mai Province, Thailand. The seeds were removed, then the remaining pods were dried in a hot-air oven at 45 °C for 24 h and ground into fine powder.

2.2. *Chemical materials*

Polysorbate 85 (Tween 85®), sorbitan oleate (Span 80®), 2,2-diphenyl-1-picrylhydrazyl (DPPH), and 2,2′-azobis(2-amidinopropane) dihydrochloride (AAPH) were purchased from Sigma-Aldrich Inc., USA. Absolute ethanol was purchased from Labscan Asia Co., Ltd., Thailand. Linoleic acid was purchased from Fluka Buchs, Switzerland. Tea seed oil (TO) was purchased from Naturel Organic Inc. Thailand. Grape seed (GO) was purchased from United Chemical & Trading CO., Ltd., Thailand. Sesame oil (SO) was purchased from Kuanw brand, Thailand.

2.3. *Extraction*

Pod powder was extracted according to the method of Poomanee et al. using 50% ethanol in water by a maceration technique for 48 h each time [3]. The extractant was filtered through Whatman® Qualitative filter paper No.1 and the marc was then re-extracted by the same process twice. The solvent in collected filtrate was then evaporated and dried to powder by spray drier. The obtained extract was named as HES.

2.4. *Pseudoternary phase diagram construction*

Three different oil phases, TO, SO, and GO, which have the same required hydrophilic–lipophilic balance (rHLB) value of 7.0, were used for the construction of pseudoternary phase diagrams. Polysorbate 85 and sorbitan oleate were used as surfactants, and absolute ethanol was used as a co-surfactant. The pseudoternary phase diagram of each oil was constructed using various surfactants including polysorbate 85 and the mixture of polysorbate 85 and sorbitan oleate (2:3 and 1:1). The ratios of surfactant to co-surfactant were 1:1, 2:1, or 4:1. The effect of pH of the aqueous phase on microemulsion area was also studied. The pH values were adjusted using 1% citric acid solution to pH 3.0, 5.0, and 7.0.

The Origin 8.0 program was used for the construction of the pseudoternary phase diagrams. Percentage microemulsion area was calculated by Image J version 1.45.

2.5. *Preparation of microemulsions*

The composition of the microemulsion was selected from the pseudoternary phase diagram that gave the largest microemulsion area. The selected microemulsion (ME) was com-