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See next page for additional authors

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Sitthiphong Soradech[1], Buppachart Potduang[1,*], Itsara Keeta[1], Wanlapha Saisin[2], Suchipha Wannaphatchaiyong[2] and Cholticha Niwaspragrit[3]

[1]*Pharmaceutical and Natural Products Department, Thailand Institute of Scientific and Technological Research (TISTR), Technopolis, Klong 5, Klong Luang, Pathumthani, 12120, Thailand.*
[2]*Department of pharmaceutical sciences, Prince of Songkla University, Hatyai, Songkhla, 90110, Thailand.*
[3]*Agricultural Technology Department, Thailand Institute of Scientific and Technological Research (TISTR), Technopolis, Klong 5, Klong Luang, Pathumthani, 12120, Thailand.*

KEYWORDS: Hair conditioner, *Phyllanthus emblica, Zanthoxylum limonella*, Product stability

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INTRODUCTION

Hair conditioner is a hair care product that is applied after shampooing in order to condition the hair and is then rinsed out. The product is beneficial to dry or damaged hair. It works by restoring moisture, and smoothing the cuticles of the hair follicles[1]. Hair conditioner comprising of powerful antioxidants can reduce UV damage to the hair including hair color changes and protein damage[2].

Fruits of Ma-khampom (*Phyllanthus emblica* L., EUPHORBIACEAE) and Ma-khwaen (*Zanthoxylum limonella* Alston, RUTACEAE) are edible and common in Thailand with various reports on their biological activities[3-11]. The patented mixed fruit extract from the fruits of *P. emblica* and *Z. limonella* is effective as an anti-oxidant (EC_{50} 7.9 µg/ml), *in vitro* anti-microbial (MIC 4.5 mg/ml against *P. acne*, *S. aureus*, *S. epidermidis* and *S. pyogenes*) and anti-inflammatory extract[12, 13]. The biological activities of the mixed extract are beneficial to various cosmeceutical products. TISTR have developed a hair conditioner from the mixed extract to be an alternative to commercial products.

In the present study, the physical stability of the patented hair conditioner was evaluated under accelerated conditions using heating and cooling method at 45° C 24 hrs and 4° C for 24 hrs for 6 cycles, and then the physical and chemical properties of samples were observed.

MATERIALS AND METHODS

Plant material The dry, powdered fruits of *P. emblica* and *Z. limonella* were provided by the Sakaerat Biosphere Research Center, Agricultural Technology Department of TISTR.

Preparation of the mix extract The water-ethanol crude extracts from dry fruits of *P. emblica* and *Z. limonella* were mixed in a patented proportion for the best anti-microbial activity.

Formulation of hair conditioner The ingredients of hair conditioner included polyquaternium-7, cetyl alcohol, stearyl alcohol, mineral oil, beeswax, polyquaternium-11, Span 80, propylene glycol, preservative, active mixed extract, NaOH solution (5%), fragrance and water. The cream was prepared in two phases: Oil Phase A and Water Phase B, both heated at 75-80 °C. Phase B was added into phase A and homogenized to make cream base. A water solution of the mixed extract was added into the cream base while stirring, and then adjusted the pH to 8.5.

Stability testing of hair conditioner The stability in accelerated conditions of sample was assessed using heating and cooling method (45° C, 24 hrs and 4° C, 24 hrs for 6 cycles) as shown in **Figure 1**. The physical and chemical stability such as appearance, texture, color, odor, viscosity, pH and phase separation were observed. The evaluation of physical and chemical properties of sample was performed in triplicate. The appearance, odor and separation were evaluated by visual method. The viscosity was evaluated using a Brookfield viscometer (MLVT115, USA). The pH was evaluated using a pH meter (ph 700, German). The color of sample was investigated by color measurement (Miniscan EZ, USA).

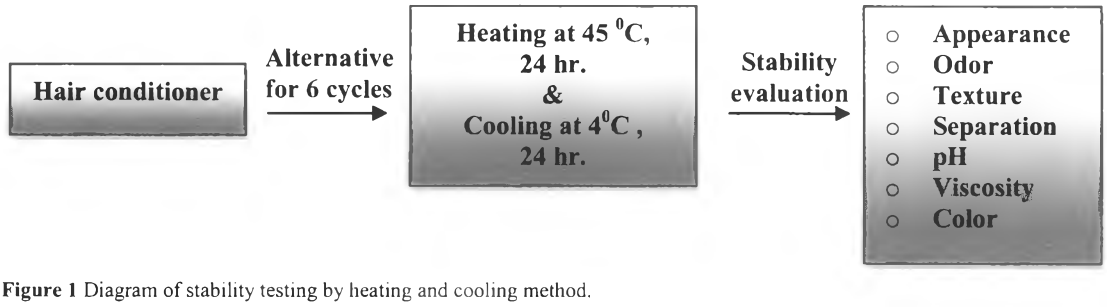

Figure 1 Diagram of stability testing by heating and cooling method.

RESULTS AND DISCUSSION

Stability assessment of the patented hair conditioner comprising the mixed extract from the fruits of *P. emblica* and *Z. limonella* was performed using heating and cooling test, at 45 °C 24 hrs and 4 °C 24 hrs for 6 cycles. The results revealed that the appearance, odor and texture of this product did not change and no separation occurred whereas pH, viscosity and color were slightly changed after 6 cycles of storage in accelerated conditions. This formulation showed high initial viscosity (1.67×10^4 CPs.) and the viscosity slightly decreased during the test (from1.67×10^4 to 1.65×10^4 CPs). The pH of the product was slightly increased from 5.13 to 5.26 due to the change in acidity of the extract. The color of the product was investigated based on three parameters including: L*, a*, b*. These values slightly changed from 78.93, 1.57 and 9.21 to 82.74, 1.68 and 9.55, respectively.

Table 1 Physical and chemical changes of the hair conditioner during heating and cooling test (45 °C 24 hrs and 4 °C 24 hrs, 6 cycles).

Properties	**0 cycle**	**3 cycles**	**6 cycles**
Appearance	White cream	White cream	White cream
Separation	None	None	None
Odor	Good volatile oil	Good volatile oil	Good volatile oil
Texture	Good	Good	Good
pH	5.13 ± 0.01	5.23 ± 0.05	5.26 ± 0.02
Viscosity (CPs.)	$1.67 \times 10^4 \pm 4.06 \times 10^2$	$1.67 \times 10^4 \pm 4.30 \times 10^2$	$1.65 \times 10^4 \pm 4.93 \times 10^2$
Color			
L*	78.93 ± 1.25	80.33 ± 1.61	82.74 ± 1.71
a*	1.57 ± 0.02	1.62 ± 0.03	1.68 ± 0.03
b*	9.21 ± 0.06	9.38 ± 0.11	9.55 ± 0.10

Note L = 100 (Reflecting diffuser, White), L* = 0 (Black)
a* = Positive a (red), Negative a (green)
b* = Positive b (yellow), Negative b (blue)

CONCLUSION

The addition of patented mixed extract from the fruits of *P. emblica* and *Z. limonella* did not affect the physical and chemical properties of the hair conditioner. The product exhibited no change in appearances, odor and color and no separation, whereas pH, viscosity and color were slightly changed after storage for 6 cycles in accelerated conditions. The slight changes in pH, viscosity and color resulted from temperature and humidity. Stability of the patented hair conditioner indicated that the product was suitably formulated and could maintain its intended properties during appropriate shelf life.

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