Antioxidant Activity and Development of Hair Serum Containing Essential Oils From Pomelo Peel

Rattana Panriansaen[1]*, Wichayaporn Sa-ard[2], Atittayaporn Khongwat[3] and Kitthisak Khlaeo Chansukh[4]

College of Allied Health Sciences, Suan Sunandha Rajabhat University,

Samut Songkram, Thailand

E-mail: rattana.pa@ssru.ac.th[1]*, s63122235010@ssru.ac.th[2], s63122235011@ssru.ac.th[3], kitthisak.ch@ssru.ac.th[4]

Abstract

This research aims to 1) study the antioxidant properties of essential oil of pomelo peel, 2) develop hair serum products containing essential oil from pomelo peels and 3) evaluate the satisfaction of users of hair care serum containing essential oils from pomelo peels. The results of the research are presented below: -

In testing the antioxidant activity, the free radical scavenging ability at 50 percent (IC_{50}) of Vitamin E was 133.28 ± 13.97 g/ml. while of essential oil extracts from pomelo peels was an IC_{50} value of 1.10 ± 0.26 g/ml. Development of hair in 4 formulas contained an essential oil in concentration levels of 0, 1, 3, and 5 percent. Result of stability test was examined by method Heating/Cooling cycle for 6 cycles at a temperature of 4 ºC and 45 ºC in accelerated condition. It was found that the pH values were 5.04, 5.56, 5.55 and 5.55 respectively. Formula 1 showed odorless. But the scent of essential oil from pomelo peel was found in the others. Testing for skin allergies using the closed patch test method, no allergic reactions were found in any of the volunteers. The results of testing satisfaction with the use of hair care serum in 20 volunteers, it was found that volunteers were overall satisfied with all 4 formulas at a high level. Arranged from highest to lowest, they are Formula 4, Formula 2, Formula 1, and Formula 3. The best and most satisfying formula is Formula 4. However, analyzing the results of satisfaction of hair serum had no statistically significant difference at the 0.05 level ($p>0.05$).

Keywords: Pomelo peels essential oil, Hair serum, Antioxidant activity

Introduction

Pomelo (Citrus grandis L.) belongs to the family Rutaceae. It is the largest fruit in the citrus family. The fruit is round, approximately 10 - 30 centimeters. The pomelo peel weighs 50 - 60 percent of the total weight. Pomelo has good taste and is therefore popular for consumption.[1] Pomelo is an economically significant fruit that generates income for Thailand both in the form of pomelo and peeled pomelo in packaging. Each year, over a hundred tons of waste from pomelo peels is generated. The pomelo peel contains essential oils and if the essential oil from pomelo peels can be extracted, they may be used to create value-added products. It presents an alternative solution to the problem of waste generated from pomelo peels.[2]

Pomelo peel can be divided into 3 layers. The outermost layer (Exocarp) is the colored part of the peel, also called Flavedo, where essential oils can be found. The middle layer of bark (Mesocarp) is white, thick and soft containing pectin fibers and mucous substances, including vitamins and enzymes. The innermost peel (Endocarp) has the appearance of a transparent membrane covering the petals of the pomelo flesh. The pomelo peel contains a variety of chemical compounds, with the focus of this discussion centered on its secondary metabolite content. The compounds found in the peel of pomelo consist of flavonoids, coumarins, phenylpropanoids, phenolics, steroids, and essential oils.[3] There are various chemical compounds in pomelo peel such as flavonoids, naringenin, naringin, hesperetin, hesperidin, apigenin, penciling, eriocitrin and limonene, limonin, linalool, myricetin, and nerol. Limonene is the main component and small amounts of other monoterpene substances such as alpha-pinene, sabinene, beta-pinene, beta-phellandrene.[4]

Pomelo peel extract can inhibit bacteria that cause disease in the gastrointestinal tract, such as Bacillus cereus, B. subtilis, Listeria monocytogenes, Staphylococcus aureus, Escherichia coli and Salmonella typhimurium.[5] Limonene is reported to be an active ingredient in cosmetics that have antibacterial, antifungal, and antioxidant properties. There is research on the antioxidant effects of limonene that help reduce cell damage.[6] Limonin could be developed as a useful treatment for hair loss.[7]

From the above report, pomelo peel extract has properties that can be developed into hair care products. The researcher is therefore interested in developing a hair serum product containing essential oils from pomelo peels, to create income generation for farmers/or the industrial sector and to encourage the concept of sustainable living in the country.

1.1 Objectives

This research aims to: -

1) study the antioxidant properties of essential oil of pomelo peel,

2) develop hair serum products containing essential oil from pomelo peels and

3) evaluate the satisfaction of users of hair care serum containing essential oils from pomelo peels.

2. Methodology

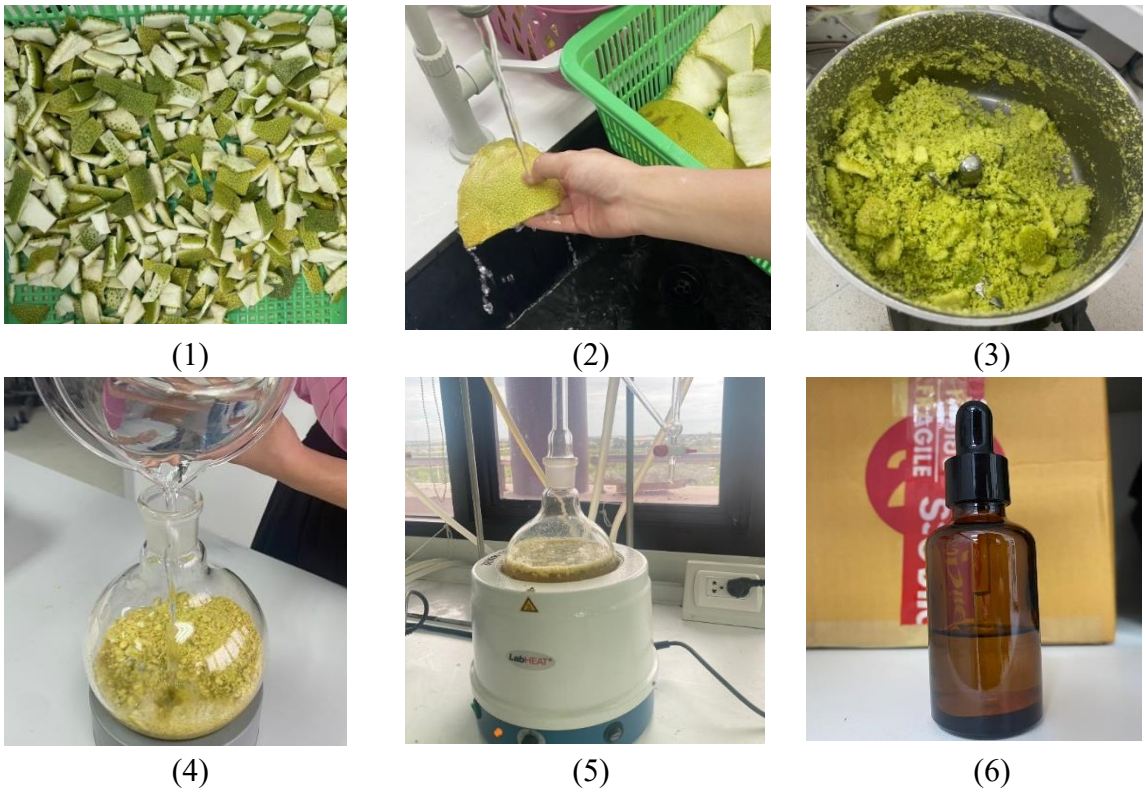
Material

2, 2-diphenyl-1-picrylhydracyl (DPPH), □-tocopherol and were from Sigma (USA). Folin-Ciocalteu reagent was from Merck (Germany) and other analytical grade chemicals were used.

Preparation of plant extracts

Pomelo peel was collected from Ban Bang Phlap, Bang Phrom subdistrict, Muang district, Samut Songkhram province, Thailand. Essential oil of pomelo peel was extracted by water distillation method. The extracts were kept at 4°C until used.

Figure 1. The process of water distilling essential oils from pomelo peels.



(1) (2) (3)

(4) (5) (6)

Determination of total phenolic content

The total phenolic content was determined by the Folin-Ciocalteu method. The extracts were dissolved in methanol at various concentrations (0.1- 5.0 mg/ml), then the extract solution (0.5 ml) was mixed with the Folin-Ciocalteu reagent (0.25 ml) and 20% sodium carbonate (1.25 ml). After mixing and standing at room temperature for 30 min, the absorbance was measured at 765 nm. The total phenolic content was expressed as a mg of gallic acid equivalent/g dried extract.

Determination of DPPH Radical scavenging activity

The extract was dissolved in methanol at various concentrations (0.1-5 mg/ml), then 2.8 ml of each extract solution was mixed with 0.2 ml of DPPH solution (1 mM in methanol). After incubation at room temperature for 30 min, the absorbance was measured at 517 nm. The negative (methanol) and positive (vitamin E) controls were run in parallel. The scavenging activity was calculated.

Formulation of hair serum

The hair serum formula used in this study was shown in Table 1.

Table 1 Formulation of hair serum containing essential oil from pomelo peel

Phase	Ingredient (%w/w)	F1	F2	F3	F4	Function
A	Di-Water	q.s.	q.s.	q.s.	q.s.	Diluent
	Propylene Glycol	5.0	5.0	5.0	5.0	Moisturizers
	Carbopol 940	0.4	0.4	0.4	0.4	Thickening agent
	Tween 20	0.6	0.6	0.6	0.6	Surfactant, Emulsifier
B	Liquid paraffin	2.0	2.0	2.0	2.0	Conditioner agent
	Span 20	4.3	4.3	4.3	4.3	Emulsifier
	Isopropyl myristate	2.0	2.0	2.0	2.0	Emollient
	Silicone oil	4.0	4.0	4.0	4.0	Viscosity decreasing agent
C	Pomelo peel essential oil	0	1.0	3.0	5.0	Antioxidant
D	Phenoxyethanol	0.5	0.5	0.5	0.5	Preservative
	Total	100	100	100	100	

Hair serum stability test

When preparing hair serum products containing essential oils from pomelo peels, all 4 formulas by adding essential oils from pomelo peels at 0, 1, 3, and 5 percent respectively. The stability was tested by the heating-cooling cycle, temperature at 4□ and 45□ for 24 hours), 6 cycles.

Evaluation of hair serum

Hair serum hypoallergenic test was determined in the arm area of 15 subjects by closed patch test method. Product satisfaction was assessed in the number of 20 volunteers who were selected for the age of 20-30. Volunteers were divided into 4 groups. Each volunteer group will receive a hair serum formula product to use for 4 weeks.

To assess the level of satisfaction with the hair serum formula among the volunteers the researcher will distribute a questionnaire to be completed by them.

3. Research Results

Antioxidant activity of essential oils from pomelo peels

It was found that the free radical scavenging ability was the average IC_{50} of vitamin E equal to 133.28±13.97 □g/ml. While essential oil from pomelo peel, the IC_{50} value was 1.10±0.21 g/ml.

Development of a hair care serum containing essential oils from pomelo peels

Hair serum products containing essential oils from pomelo peels under accelerated condition. The pH value of 4 formulas were 5.04, 5.56, 5.55 and 5.55, respectively. The texture of all 4 product formulas is serum. The color of the product is white in all 4 formulas. The odor of formula 1 is odorless. Formulas 2, 3, and 4 have the scent of essential oil from pomelo peel. No separation occurred in all 4 formulas. No redness was observed in the closed patch test conducted on the volunteers. No irritation or swelling was observed in the volunteers.

Satisfaction evaluation of hair care serum containing essential oil from pomelo peel

The volunteers were 20 - 29 years old. Most of them have damaged hair, dry and damaged hair, split ends (85%). Most of them have used hair serum (90%). Most of the volunteers intended to use it to reduce dryness, damage, and split ends (40%).

The results of the evaluation of product satisfaction in various aspects of the product found that volunteers were satisfied with Formula 4, with a mean of 4.15±0.64. Second, it was found that Formula 2 had a mean of 4.08±0.89. Formula 1 and Formula 3 has an average value of 3.75±0.84, 3.60±0.74, respectively. The overall level of satisfaction with all 4 product formulas is at a high level. All formulas of hair serum containing essential oils from pomelo peel were found to be significantly different at the 0.05 level. The results of considering each item found that Formula 4 had the highest level of satisfaction, namely soft, shiny, smooth hair, and ease of use of hair serum products. The mean and standard deviation were 4.60±0.48**,** 4.80**±**0.40**,** respectively.

Table 2 Average satisfaction score for nourishing serum products containing essential oils from 4 formulas of pomelo peel.

Topic	Mean ± S.D.			
	F1	F2	F3	F4
1. Smell of hair serum products	3.40±1.01	4.00±1.26	2.80±0.97	4.00±0.63
2. Color of hair serum product	3.80±0.74	4.00±0.89	3.60±0.80	4.00±0.63
3. Stickiness of hair serum products	3.40±1.01	3.60±1.01	2.20±0.74	3.60±0.80
4. Absorption time of the hair serum	3.80±0.74	4.20±0.74	4.20±0.74	4.20±0.40
5. No irritation to the scalp when using hair serum products	4.20±0.74	4.40±0.80	4.40±0.48	4.40±0.80
6. Solving the problems; dryness, damaged hair, split ends, fizziness, and lack of weight	3.60±0.80	3.80±097	3.80±0.74	3.80±0.74
7. Reduce hair tangling problems	3.80±0.74	4.20±0.74	3.80±1.16	4.00±0.89
8. Hair is soft, shiny, smooth.	3.20±0.97	3.80±1.16	3.60±0.48	4.60±0.48
9. Ease of use of hair serum products	4.60±0.80	4.80±0.40	4.40±0.48	4.80±0.40
Total	3.75±0.84	4.08±0.89	3.60±0.74	4.15±0.64
Level of satisfaction	High	High	High	High

4. Discussion

Extraction of essential oil from fresh pomelo peel by water distillation method. The extract was found to be a light-yellow liquid with the odor of essential oil from pomelo peel. When calculated as percentage yield equals was 0.97.

In testing the antioxidant activity, the free radical scavenging ability at 50 percent (IC_{50}) of Vitamin E was 133.28 ± 13.97□g/ml. While essential oil extracts from pomelo peels were an IC_{50} value of 1.10 ± 0.26□ g/ml. It can be concluded that essential oil from pomelo peel has an antioxidant capacity 100 times better than vitamin E.

From testing using the closed patch test method on 20 volunteers for 24 hours. No redness was found in the volunteers and the area tested with hair serum were no found symptoms of irritation, swelling and redness.

Satisfaction evaluated in 20 volunteers. Volunteers were most satisfied with Formula 4 with an average of 4.15±0.64. It was found that the volunteers were satisfied with all 4 formulas, arrange in order of mean value from highest to lowest were formula 4 (4.15±0.64), 2 (4.08±0.89, 3 (3.75±0.84) and 1 (3.64±0.74). Analyzing the results of satisfaction of hair serum had no statistically significant difference at the 0.05 level ($p>0.05$).

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