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Total phenolic compounds and antioxidant activity in plants and application to face mask production

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Abstract

Plant foods are rich sources of antioxidants. The objective of this study was to investigate quantities of tolal phenolic compounds and antioxidants in plants as well as applications to face mask production. There were seven selected plants, namely Indian gooseberries, torch gingers, aloe veras, cashew leaves, passion fruits, gacs, and lemongrasses. Their phenolic compound quantities were 1,028.00, 1,017.20, 1,004.40, 1,021.60, 1,014.40, 996.00, and 944.00 micrograms/liter, respectively. When each plant was boiled at 60°C for 2 minutes, it was found that the phenolic compound quantities in all plants reduced to 960.40, 948.00, 920.00, 913.00, 900.40, 897.60, and 876.80 micrograms/liter, respectively. The torch gingers were selected and used to produce face masks due to the fact that the Indian gooseberries contained too high acid quantity. If the Indian gooseberries had been selected to produce facemasks, their phenolic compounds would necessarily have been diluted, resulting in decreasing antioxidants. In terms of the torch gingers, their extract contained 58.80% of antioxidants, and their antioxidant capacity was 18.146 μmol Trolox equivalents/g. Regarding the application of the torch ginger extract for face mask production and the skin prick test of the face masks made from the extract, it was found that 10 samples did not have pricks on their forearms or they were not allergic to the torch ginger extract in the face masks. The suitable solution formula to make the face masks was 35% of the torch ginger extract and 65% of moisturizer.

Keywords: *total phenolic, antioxidant activity, face mask production*

INTRODUCTION

Free radicals are atoms, molecules or ions with unpaired electrons that are highly unstable and active towards chemical reaction with other biomolecules (Gulcin, 2020), resulting in some damage to some components of cells in a body such as wrinkles, some types of cancer, or atherosclerosis in a cardiovascular system and damage to protein and DNA. (Lobo et al., 2010) The free radicals can be destroyed by antioxidants. Antioxidants that break the chain reaction are strong electron donors and react with free radicals before major molecules are damaged which can be found in a variety of vegetables, fruits, and herbs, containing such substances as vitamin E, vitamin C, trace elements (Se, Cu, Zn, Mn) phytochemicals such as isoflavones and phenolic compounds.

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(Martemucci et al., 2022) There are also various phenolic compounds in plants, namely flavonoids, anthocyanin, and phenolic acids. The term "phenolic acids" generally describes the phenolic compounds having one carboxylic acid group. Phenolic or phenolcarboxylic acids are one of the main classes of plant phenolic compounds. (Kumar and Goel, 2019). The quantity of phenolic acids in each type of plants varies due to plant types, glowing methods, ripening levels, and storage. Therefore, the quantities of all phenolic compounds and antioxidants founds in plants were investigated in order to be beneficial for interested people. In addition, this study included applications of plants with high antioxidants for face mask production in order to slow down face skin degradation and add more value to Thai local plants in the South.

LITERATURE REVIEW

Nowadays more and more consumers realize the environment, and trends of organic cosmetics have been growing each year. It is expected by Statista in 2023 that products of organic cosmetics will be increased to 7.6%, especially facial skincare products (Revenue of the cosmetics market worldwide by country 2019, no date). This expectation was relevant to a report by the Center for Economic and Business Forecasting, the University of the Thai Chamber of Commerce. It was found that Thai cosmetic industry has been grown up to 10-20% per year and ranked number 3 of Asia, following Japan and South Korea, and organic products made from plants and herbs have been emphasized (time to get money, SME enters the herbal market, no date). Applying herbs to be ingredients of cosmetics needs to consider some factors such as raw material resources, botanical characteristics, extraction difficulty, and so on, in order to have raw materials with the most safety and effectiveness.

RESEARCH METHOD

In this study, there were seven herbal plants and some parts of these plants were used : flesh of Indian gooseberries (Phyllanthus emblica), petals of torch gingers (Etlingera elatior), leaves and gels of aloe veras (Aloe vera), cashew leaves (Anacardium occidentale), stems of lemongrasses (Cymbopogon citratus), flesh of passion fruits (Passiflora edulis), and seeds and flesh of gacs (Momordica cochinchinensis). All of these plants were gathered at Mrs. Penkhae Khunphakdee's house, no. 70/3 Moo 4, Yupo Subdistrict, Mueang District, Yala Province Thailand. Each type of plants was cut into small pieces (50 g) and mixed with 80% Acetone (450 ml). The mixture of each plant was blended in a Homogenize mixer and extracted by a centrifuge with 10,000 rounds per minute. The extract was then evaporated with acetone in a rotary evaporator at 45°C until 90% of the filtrate had been evaporator. Therefore, the concentrated extracts of each plant came out, and they were then frozen at -40°C (Chu *et al.*, 2002).

1. Determination of total phenolic content

The total phenolics of the extracts were determined using the Folin and Ciocalteu reagent (Singleton, Orthofer and Lamuela-Raventós, 1999). Crude extract (100 µL) was mixed with distilled water until the quantity of the solution was 3 ml. After that, the solution was filled with Folin Ciocalteureagent (contained 10% (w/v) Sodium tungstate and 0.002% (w/v) Phosphomolybdic

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acid) 125 µL and rested at the room temperature for 6 minutes. Next, 1.25 ml of 7% Na_2CO_3 were added into the solution, and it was rested again at the room temperature for 90 minutes before the absorbance was measured at 760 nm. A standard curve was prepared using gallic acid with a concentration range from 20-500 µg/ml and results were expresses as mean ± SD for triplicates. Total phenolic content was expressed as mg gallic acid equivalents (GAE)/g of samples.

2. The heat affecting the remaining total phenolic content quantities of each plant

The aforementioned parts of these seven plants were boiled at 60°C for two minutes. Then the total phenolic content qualities were found out similarly to the process in step 1. Finally, the plant with the most total phenolic content were selected to test in the next step.

3. The test of antioxidant activity efficiency by DPPH radical scavenging ability

At first, 150 µL of plant extract was poured into each test tube. Then DPPH solution (3 ml, 0.6 mM) were added into each tube and shaken. After that the mixtures were kept in a dark room for 30 minutes, The absorbance of each sample read at 517 nm by UV Visible spectrophotometer. Next, % DPPH radical inhibition was measured in each sample. Distilled water was used as the blank solution instead of the crude extracts, and Trolox with 25, 50, 100, 300, and 600 µM was used as the standard solution. The results of plant extract were compared to the concentration calibration curve in order to calculate the antioxidant activity efficiency and reported in µmol/g Trolox of each plant. Percentage DPPH inhibition was calculated using the formula

$$\text{DPPH Inhibition (\%)} = [(Acl-As)/Acontrol]\times 100$$

when Ac was the absorbance value of the control dependent, and as was the absorbance value of the sample.

4. The application of the plant extract for face mask production

4.1) The skin prick test of the plant extract used to make the face masks

The plant containing the highest antioxidants was cleaned and place on a grate until it dried. After that, 250 grams of this plant was cut into small pieces and blended in a blender with level 1 speed for 3 minutes. Next, the blended plant was squeezed through a two-layer white cloth to become the plant extract. The extract was then stored in a brown glass bottle completely closed with a metal cap. A face mask was cut into a piece of 2 × 3 centimeters. In the next step, 20 grams of the plant solutions were prepared to dip into 20 pieces of face masks for 15 minutes. For the treatments in this study ; treatment 1, 100% of moisturizer. Treatment 2, 75% of moisturizer and 25% of the plant extract. Treatment 3, 65% of moisturizer and 35% of the plant extract. Finally, treatment 4 , 55% of moisturizer and 45% of the plant extract. After the preparation, these 20 face masks were tested on 10 samples' forearms. In this test, a point of placing a face mask on each sample's skin was marked with a pen, and pliers were used to hold each face mask on the forearms for 15 minutes. The allergy and pricks on the skin were then observed.

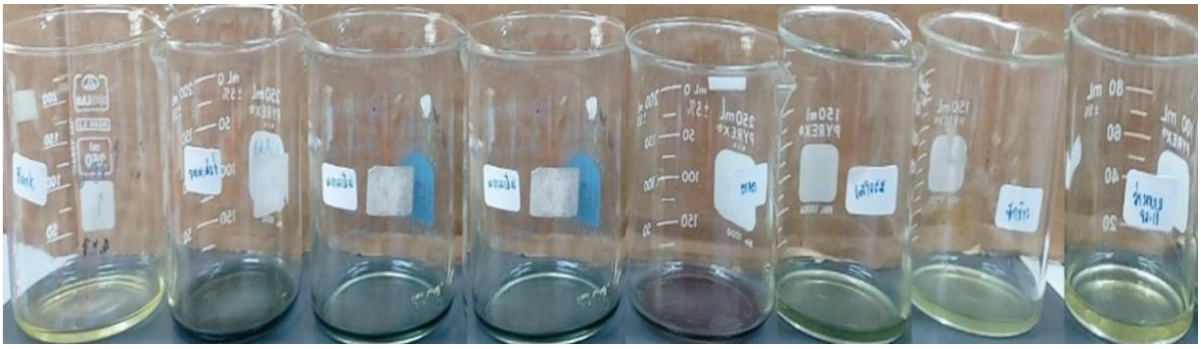
4.2) The test of the plant extract quantity in the face masks affecting skin moisture after using the face masks

20 grams of each solution were prepared to dip into 20 face mask pieces for 15 minutes. The solutions were prepared as similarly as the solutions in item 4.1. The face mask pieces were tested for moisture on six samples' forearms for 7 days. A point of placing a face mask on each sample's skin was marked with a pen. Before the test, a moisture content tester was used at the center of the point marked on each sample's skin, and the results were noted. After that, pliers were used to hold each face mask on the pointed forearms for 15 minutes. After the pliers and the face masks were removed, tissue pieces were employed to absorb some liquids left on the forearms of the samples. After two minutes and the skin was dry, a moisture content tester was applied to record the moisture data. Finally, the differences of skin moisture content after using the face masks were found out.

FINDINGS AND DISCUSSION

1. Determination of Total phenolic content

Determination of Total phenolic content and crude extracts as shown in Figure 1.



Blank Indian gooseberries torch gingers aloe veras cashew leaves passion fruits gac lemongrasse

Figure 1. Seven types of plant extracts

According to the calculation of total phenolic compounds, it was found that the colors of the finished crude extracts were darker than the color of the prepared concentration standard curve. Therefore, these crude extracts were required to dilute by adding two times of the distill water quantity. Then, the absorbance values of the extracts were measured again and resulted in Table 1. After that, the concentration of the phenolic acids in these extracts was measured and compared to the concentration calibration curve again, with the equation Y = 0.0025X, when Y was absorbance value and X was the concentration of the phenolic acids (µg/ml). The phenolic acid quantities of Indian gooseberries, torch gingers, aloe veras, cashew leaves, passion fruits, gacs, and lemongrasses were 1,028.00, 1,017.20, 1,004.40, 1,021.60, 1,014.40, 996.00, and 944.00 µg/ml, respectively. The phenolic acid quantities found in each plant were different due to types of plants, degree of maturity at harvest, pre-harvest environmental conditions, growing methods, post-harvest storage conditions and processing (Mahmood *et al.*, 2012). The phenolic acid quantity found in the Indian gooseberries were the most similar to that in the torch gingers as shown in Table 2.

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Table 1. Absorbance values of seven herbal plants

Herbal plants	Absorbance values at 760 nanometers of wave length ± SD	
	Extracts	2-time diluted extracts
Blank	0.000	0.000
Indian gooseberries	2.570±0.30	1.285±0.30
Torch gingers	2.543±0.52	1.272±0.52
aloe veras	2.511±0.30	1.256±0.30
cashew leaves	2.554±0.41	1.277±0.41
passion fruits	2.536±0.10	1.268±0.10
gacs	2.490±0.57	1.245±0.57
lemongrasses	2.360±0.02	1.180±0.02

Table 2. Phenolic acid quantities of seven plants

Herbal plants	Phenolic acid concentration ± SD	
	Micrograms/milliliter	Milligrams/milliliter
Indian gooseberries	1,028.00±0.30	1.028±0.30
Torch gingers	1,017.20±0.52	1.017±0.52
aloe veras	1,004.40±0.30	1.004±0.30
cashew leaves	1,021.60±0.41	1.021±0.41
passion fruits	1,014.40±0.10	1.014±0.10
gacs	996.00±0.57	0.996±0.57
lemongrasses	944.00±0.02	0.944±0.02

2. The results of heat affecting the remaining total phenolic quantities in plants

These seven plants were boiled at 60°C for 2 minutes, so the colors of the crude extracts were darker that the standard curve . The extracts were then diluted with two times of distilled water before their absorbance values were measured and shown in Table 3. The concentration of the phenolic acids in these plants were calculated in the next step. The results revealed that the quantities of phenolic acids in all of the plants contained were reduced after heated. The phenolic acid quantities of Indian gooseberries, torch gingers, aloe veras, cashew leaves, passion fruits, gacs, and lemongrasses were 960.40, 948.00, 920.00, 913.00, 900.40, 897.60, and 876.80 µg/ml, respectively and shown in Table 4. Their phenolic acids were reduced due to the fact that the phenolic acids can be degraded by heat (Maghsoudlou, Asghari Ghajari and Tavasoli, 2019). Regarding the results, it was found that the phenolic acid quantity in the Indian gooseberries was the highest. However, this plant contained too many acids, so the extract was necessary to be diluted before it was mixed with moisturizer in order for the samples not to be allergic. Importantly, the extract's phenolic acids were also diluted; thereby, the torch gingers were selected and used to make face masks since their extract contained the equivalent phenolic acid quantity to the Indian

gooseberries' extract. In addition, the torch ginger extract could directly be filled in face masks without dilution. During the extraction process, the torch gingers only needed to be cleaned without heating because their phenolic acid quantity could be reduced. Moreover, torch ginger extract could easily be made in households, and a preservative might be used to extend the extract's life span instead of using heat.

Table 3. Absorbance values of seven plants after boiled at 60°C for 2 minutes

Herbal plants	**Absorbance values at 760 nanometers of wave length ± SD**	
	Extracts	**2-time diluted extracts**
Indian gooseberries	2.401±0.34	1.201±0.34
Torch gingers	2.370±0.23	1.185±0.23
aloe veras	2.300±0.14	1.150±0.14
cashew leaves	2.284±0.27	1.142±0.27
passion fruits	2.251±0.23	1.125±0.23
gacs	2.244±0.23	1.122±0.23
lemongrasses	2.192±0.02	1.096±0.02

Table 4.Phenolic acid quantities before and after heated at 60°C for 2 minutes

Herbal plants	**Phenolic acid concentration (micrograms/milliliter)**	
	Before heated	**After heated**
Indian gooseberries	1,028.00±0.34	960.40±0.34
Torch gingers	1,017.20±0.23	948.00±0.23
aloe veras	1,004.40±0.14	920.00±0.14
cashew leaves	1,021.60±0.27	913.00±0.27
passion fruits	1,014.40±0.23	900.40±0.23
gacs	996.00±0.23	897.60±0.23
lemongrasses	944.00±0.02	876.80±0.02

3. The results of antioxidant activity efficiency by DPPH radical scavenging ability

According to the equation of % Inhibition = [(Ac-As)/Ac]×100 when Ac was 0.017 of the absorbance value of the control dependent, and as was 0.007 of the absorbance value of the sample, % DPPH radical inhibition was 58.80. Regarding the antioxidant activity efficiency when compared to Trolox as the standard solution with the equation of y = -0.0342x + 0.6276 and R^2 = 0.999, it was found that the antioxidant activity efficiency of the torch ginger extract was 18.128 μmol Trolox equivalents/g. An antioxidant is a molecule capable of inhibiting the oxidation of other molecules. Antioxidants can also protect the human body from free radical. There were various types of antioxidants with their various functions such as radical scavenging, singlet oxygen quenching, metal chelation, chain-breaking, synergism, and enzyme inhibition. Some antioxidants could be made by synthesis and some could be found in the nature such as plants. The common antioxidants

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found in plants were phenolic acid, flavonoids, carotenoids, stilbens, coumarins, lignans and tannins (Gulcin, 2020). The DPPH is a free radical that can accept an electron or hydrogen radical to become a stable diamagnetic molecule. It has deep blue color and absorption band at 517 nm. When the DPPH radical solution is mixed with an antioxidant molecule, which can donate a hydrogen atom, it gives rise to the reduced form with the loss of violet color (Nimse and Pal, 2015; Gulcin, 2020).

4. The application of the torch ginger extract for face mask production

4.1) The skin prick test of the torch ginger extract for face mask production

In this study, the face masks were tested on the forearms of 10 samples for 15 minutes. The findings revealed that all of 10 samples had no pricks or allergy to the torch ginger extract and shown in Table 5.

Table 5. The skin prick test in the samples having the face masks on their forearms for 15 minutes

No.	Gender	Occupation	Age	The torch ginger extract quantities used for face mask production			
				Control	25 %	35 %	45 %
1	Female	University student	21	No pricks	No pricks	No pricks	No pricks
2	Female	University student	22	No pricks	No pricks	No pricks	No pricks
3	Female	University student	21	No pricks	No pricks	No pricks	No pricks
4	Female	University student	22	No pricks	No pricks	No pricks	No pricks
5	Female	School student	15	No pricks	No pricks	No pricks	No pricks
6	Female	School student	15	No pricks	No pricks	No pricks	No pricks
7	Female	University student	22	No pricks	No pricks	No pricks	No pricks
8	Female	University student	19	No pricks	No pricks	No pricks	No pricks
9	Female	School student	14	No pricks	No pricks	No pricks	No pricks
10	Female	School student	14	No pricks	No pricks	No pricks	No pricks

4.2) The results of the extract quantity in the face masks affecting skin moisture after using the face masks

According to the preparation of the 20-gram torch ginger extract dipped on each of the 20 pieces of face masks for 15 minutes, the moisture of face masks was tested on the forearms of six samples for seven days (Figure 2). The different moisture results before and after using the face masks with the torch ginger extract were measured. It was found that the samples' skin contained 17.7% of moisture after they used the face masks with 35% of the torch ginger extract. Followed by the face masks with 25%, 35%, and the control quantity of the torch ginger extract, the samples' skin contained 16.73%, 14.50, and 14.12% of moisture, respectively and shown in Figure 2. The antioxidants in torch gingers included bioactive compounds to inhibit wrinkles educe the redness of skin, accelerating the natural regeneration of the epidermis, stabilizing the capillaries, improving microcirculation and elasticity in the skin, and protecting against harmful external factors, including UV radiation (Michalak *et al.*, 2021). The solution mixed with 35% of the torch ginger extract and 65% of moisturizer was shown in Figure 5. In conclusion, torch gingers have been

considered the identity of three deep southern provinces. In terms of the application of the torch ginger extract for face mask production, the products were made by plant utilization in three deep southern provinces, and the products can help skin have more moisture and be in good health. In addition, the moisturizer used in this face mask production was certified by Halal, and the torch ginger extract contained no alcohol.

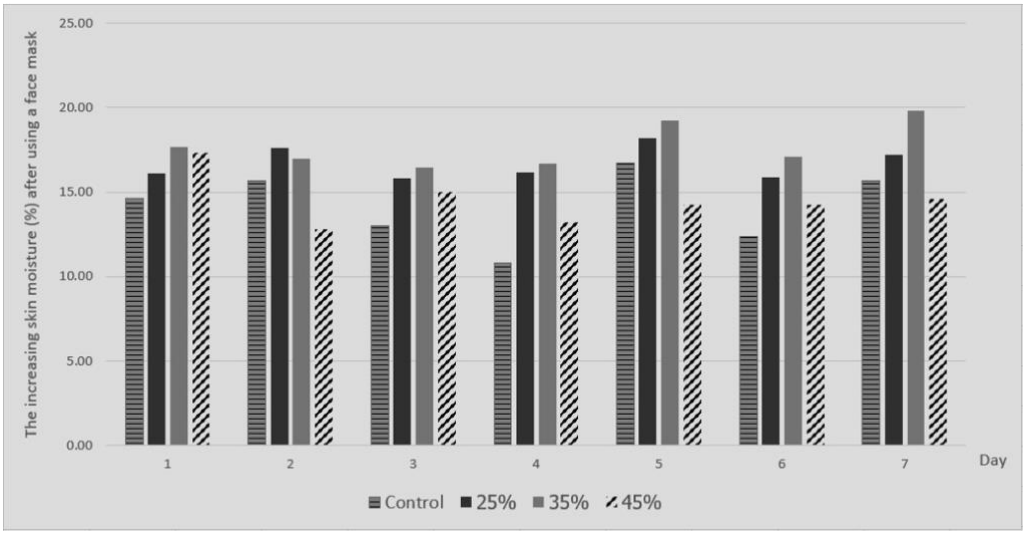

Figure 2. The moisture test of the torch ginger extract quantities dipped into the face masks on the samples

CONCLUSION AND FURTHER RESEARCH

The Covid-19 pandemic has been addressed in order to submit and obey and worship Allah SWT for the happiness of the world and the hereafter. And all these activities must be accounted for in addition to fellow humans as well as accountability to Allah SWT. Moreover, 87 percent of the vaccine users in Indonesia are Muslim citizens. Of course, the issue of Halal is important to pay attention to.

Indonesia as a large country with the world's largest Muslim population should use its Islamic philanthropic instruments for the benefit of the ummah. The instrument is cash waqf which is developed to support the government's task of providing social infrastructure (public benefits). In the model that has been made, it is possible for the government to obtain financing funds from waqf which are placed in sukuk, so that the Cash Waqf linked Sukuk (CWLS) instrument appears as social investment financing Halal Vaccine R&D. Waqf funds collected through CWLS can be beneficial in two ways. Firstly, waqf is used to finance the development of the Halal Vaccine R&D infrastructure through sukuk waqf. Secondly, the funds from the use of waqf which are placed in the sukuk instrument which can be distributed to the beneficiaries.

With the funding that comes from generous people, it is hoped that this halal vaccine R&D will focus on the tradition of developing knowledge that has been exemplified by Muslim scholars in the golden age of Islam. The discovery and development of vaccine which is halal according to

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sharia principles is an urgent need at this time. This can be done by utilizing medicinal plant resources as the strength of the Indonesian nation as a gift from Allah SWT to this country.

In this study, the source of waqf funding was taken from CWLS. In the future, other sources of waqf need to be considered to finance this halal vaccine. That requires further research.

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