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Formulation, Physical Quality Evaluation, and Antioxidant Activity of Body Butter of Ethanol Extract of Dragon Fruit (*Hylocereus polyrhizus*) Peel

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ABSTRACT

Dragon fruit (*Hylocereus polyrhizus*) has polyphenols as an antioxidant. It has known that the antioxidant content of dragon fruit peels was more than in the flesh, so it can be used as a source of natural antioxidants to replace synthetic antioxidants. The use of dragon fruit (*Hylocereus polyrhizus*) peel, especially as topical preparations in the form of body butter, was still rarely done, whereas dragon fruit peel as an antioxidant can be used as an active ingredient of cosmetics. The purpose of this study was to obtain the body butter formula of ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel and its physical quality evaluation, to know the antioxidant activity of ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel and its body butter. This research was an experimental study with the stages of research consisting of determination of native plants, making ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel, ensuring its activity antioxidant, performing body butter formulation procedures, carrying out physical quality evaluation such as organoleptic, homogeneity, pH, spread, protection, and adhesion ability, then antioxidant activity of its body butter. The result of this research showed that the ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel has a moderate level of antioxidant (Antioxidant Activity Index / AAI = 0,88). Furthermore, body butter which has contains antioxidant content of ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel as much as 0.5% has the best physical quality evaluation during storage and the highest AAI (0,54) among other body butter formulas.

Keywords: *Hylocereus polyrhizus;* body butter; formulation; physical evaluation; antioxidant

INTRODUCTION

Dragon fruit is one type of tropical fruit that has biologically active compounds such as antioxidants (Omidizadeh *et al.,* 2011). Because of the health benefits of dragon fruit, the consumption of this fruit was increasingly high. It has an impact on the remaining dragon fruit peels that were thrown away and have not been used optimally so that its peels become food waste that was able to pollute the environment (Zain and Nazeri, 2016). Both the peel and the flesh of the dragon fruit contain polyphenols as a source of natural antioxidants replacing synthetic antioxidants (Wu *et al.,* 2006).

Natural antioxidants derived from natural materials have been developed in various studies, especially their use in cosmetics. It could happen because natural antioxidants were considered to have a higher level of security compared to synthetic antioxidants such as BHT and BHA which have the potential to have a carcinogenic effect in toxicology studies (Thorat, 2013). Dragon fruit peel with natural sources of antioxidants could be used as the main ingredients the manufacture of antioxidant cosmetics that prevent premature aging of the skin due to sun exposure by favoring the antioxidant activity of dragon fruit peels which is greater than the flesh of the fruit (Le Bellec *et al.,* 2006; Wu *et al.,* 2006). Furthermore, it also could reduce food waste from the remaining unused dragon fruit peels.

Topical preparations from the use of dragon fruit peels were still rarely done given the antioxidant activity possessed by dragon fruit peels, especially in the form of body butter. Body butter preparations are better than body lotion preparations because of their high oil content so they have a better ability to nourish and are able to hydrate the skin so skin moisture was better maintained (Sayuti, 2017).

Based on the explanation above, this research was aimed to formulate body butter preparations of ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peels, to evaluate its physical quality, and to know the antioxidant activity of ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel and its body butter in various concentrations extract, such as in a previous study it was known that antioxidant activity would increase with the increase in the amount of dragon fruit peel extract added (Manihuruk *et al.,* 2017).

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Tabel I. Body Butter Formulas of Ethanol Extract of Dragon Fruit *(Hylocereus polyrhizus)* Peel

Formula (%w/w)	**Negative control**	**I**	**II**	**III**
Active material:				
Ethanol extract of dragon fruit *(Hylocereus polyrhizus)* peel	-	0.5	1.0	2.0
Oil phase:				
Stearic acid	8.0	8.0	8.0	8.0
Cetyl alcohol	3.0	3.0	3.0	3.0
Propylparaben	0.2	0.2	0.2	0.2
Steareth-20	0.5	0.5	0.5	0.5
Formula (%w/w)	**Negative control**	**I**	**II**	**III**
Coconut oil	20.0	20.0	20.0	20.0
Cyclomethicone	2.0	2.0	2.0	2.0
Cocoa butter	10.0	10.0	10.0	10.0
Olive oil	1.0	1.0	1.0	1.0
Water phase:				
Triethanolamine	2.0	2.0	2.0	2.0
Glycerine	2.0	2.0	2.0	2.0
Methylparaben	0.3	0.3	0.3	0.3
Aqua dest	ad 100.0	ad 100.0	ad 100.0	ad 100.0

METHODOLOGY

This research was an experimental study with stage involved of determination of native plants, making ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel, ensuring its activity antioxidant, performing body butter formulation procedures, carrying out physical quality evaluation, then antioxidant activity of its body butter that contain different levels of extract addition of 0.5%, 1.0%, and 2.0%.

Plant Material and Extraction

Dragon fruit (*Hylocereus polyrhizus*) obtained from Organic Dragon Fruit Garden, Sayoga Land located in Banjar Batur Sari, Mengwitani Village, Mengwi District, Badung Regency, Bali, Indonesia. The specimen determined at the Bali "Eka Karya" Botanical Garden Conservation Center, Indonesian Research Institute, Candikuning, Baturiti, Tabanan Regency, Bali, Indonesia. This research used dragon fruit peels as a main material. Dragon fruit was cleaned and peeled manually, then the peels were cut in small size (3-5 mm), dried in the oven for about three days at 50°C, and powdered. Simplicia powder was macerated by 96% ethanol (1:5) for three days, with solvent replacement every 24 hours (Selvamuthukumaran and Shi, 2017; Suena *et al.,* 2017; Wahyuningtyas, 2017). The macerated solution evaporated at a rotary evaporator at 50°C to remove the solvents contained in the extract until it became a thick extract.

Production of Body Butter

Body butter of ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peels was prepared by following procedure conducted previously by Suena (2017). The production of body butter used the fusion method, where the oil components were melted first, and the water-resistant components were heated separately in different places or containers, but with the same temperature. Then, the water phase was added to the oil phase by mixing. Components that were not resistant to heating were added at the end of mixing when the temperature was low, thick mass formed and homogeneous, then packaged in a suitable pot (Jasti, Abraham & Ghosh, 2004). Body butter formulation showed in table I.

Physical Quality Evaluation of Body Butter

Organoleptic

Observed dosage forms, colors, textures and odor preparations (Juwita *et al.,* 2013).

Homogeneity

500mg of body butter took on the top, middle, and bottom then applied to a piece of transparent glass. Observe the presence of particles if phase separation occurs (Juwita *et al.,* 2013).

pH

Apply body butter to the universal pH indicator paper to find out the pH of the

preparation, wait a while for the color to appear. The colors that arise were matched or compared to the standard colors available on the pH indicator universal packaging (Juwita *et al.,* 2013).

Spreadability

500mg body butter placed on the glass measuring 10 x 10 cm^2. Furthermore, covered with a cover glass of the same size and given a weight on it until the weight reaches 150 grams, then measured the diameter formed after 1 minute at each additional weight (Arikumalasari *et al.,* 2013).

Protection ability

Filter paper (10x10 cm) moistened with phenolphthalein and dried. 500mg of body butter applied to the paper. On other filter paper, made an area (2.5x2.5 cm). On the edge of the area, applied melted solid paraffin. Paste this filter paper on the previous paper, then 1 drop of 0.1 N NaOH solution dripped into the area, recorded the time until a reddish stain occurs (Indrayudha *et al.,* 2010).

Adhesion ability

500mg body butter placed between 2 glass objects, then pressed with a load of 1 kg for 5 minutes. The load lifted from the glass object and then mounted on the test equipment, given a load of 100 grams and then recorded at the time of release the preparation from the glass object (Arikumalasari *et al.,* 2013).

Analysis Antioxidant Activity of Extract and Its Body Butter with DPPH Method

Analysis of antioxidant activity of extract and its body butter was conducted by measuring free radical inhibition against 1,1-diphenyl-2-picrylhydrazyl (DPPH) using UV-Vis spectrophotometer (Adnan *et al.,* 2011; Kedare and Singh, 2011).

Sample Preparation

Extract

50mg extract dissolved by 50ml of 96% ethanol, then a concentration of 1000 ppm was obtained, then made a series solution by adding 96% ethanol to a concentration of 100, 70, 50, 40, 30, 20, 10 ppm.

Body Butter

grams from each body butter formulation dissolved by 1.5 ml of 96% ethanol into a centrifuge tube (replicated 8 times), then centrifuged at a speed of 6000 rpm within 15 minutes then take a clear solution phase and made series solutions of concentrations of 100, 70, 50, 40, 30, 20, 10 ppm.

Determination of Maximum Wavelength

40 ppm of DPPH solution pipetted as much as 4 ml, incubated for 30 minutes in a dark room, then filled with UV-Vis spectrophotometer and added absorbance at a wavelength of 400-800 nm. From the spectrum determined the maximum wavelength.

Free Radicals Inhibition Test toward DPPH

2 mL DPPH 40 ppm solution put into 7 different vial bottles and 2 ml of the sample solution of each concentration was added into it. The whole vial is covered with aluminum foil, shaken and allowed to stand for 30 minutes in a dark room. After that, the absorbance observed at the maximum wavelength.

IC_{50} Value Determination and Calibration Curve Making

From each concentration level tested, the percentage of free-radical inhibition calculated based on the following formula:

% inhibition = (Absorbance of control - Absorbance of sample) x 100 / Absorbance of control).

Then, subsequently plotted on the linear regression graph so that an equation y = bx + a obtained to find out of IC_{50} value.

Statistical Analysis

Quantitative data of spread, protection, and adhesion ability in physical quality evaluation of body butter were analyzed by using SPSS 16.0 for windows with one way-ANOVA post hoc Tukey HSD to determine the difference between the average of spread / protection/ adhesion ability between storage time and formulas. Besides that, Paired T-Test method also used to determine their effect on the stability of spread / protection/ adhesion ability of each formula at each different storage time. Significance range was set at 0.05.

RESULT AND DISCUSSION

The peel of dragon fruit (*Hylocereus polyrhizus*) were taken to be used as a sample in this research. A total of 6089 kg of dragon fruit peel made into powder as much as 358 grams and, produced as much as 13.9 grams of thick extract.

Activity Antioxidant of Extract

The analysis of the antioxidant activity of ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel aimed to ensure the presence of antioxidant activity on the extract. Its antioxidant activity was determined by DPPH (1,1-diphenyl-2-picrylhydrazyl) method measured using a UV-Vis

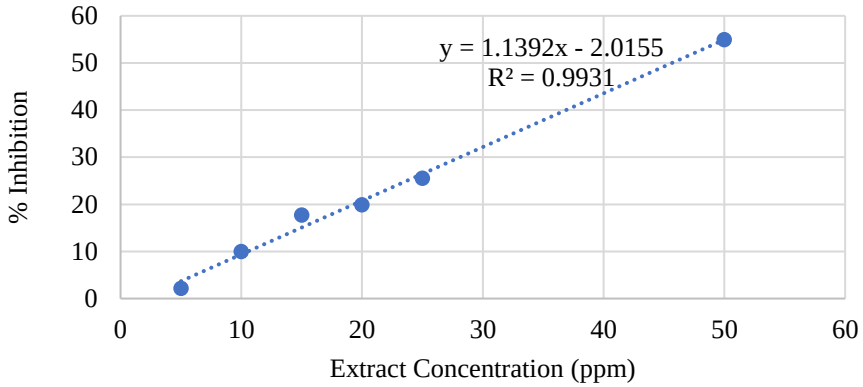

Figure 1. Curve of DPPH Free Radical Inhibition Percentage by Ethanol Extract of Dragon Fruit (*Hylocereus polyrhizus*) Peel

Figure 2. Body Butter of Ethanol Extract of Dragon Fruit (*Hylocereus polyrhizus*) Peel

spectrophotometer (Adnan *et al.,* 2011; Kedare and Singh, 2011).

The maximum wavelength of DPPH used for analyzing the antioxidant activity of the extract was 517 nm. Then at that wavelength, the absorbance of each free radical reduction was measured by each concentration of the sample solution, so that a linear regression equation (y = bx+a) obtained to calculate IC_{50} (Figure 1).

Based on the linear regression equation obtained IC_{50} value of 45.66 ppm which means that the ethanol extract of dragon fruit peels (*Hylocereus polyrhizus*) could inhibit 50% of free radical activity (DPPH) at concentration of 45.66 ppm. Then, the IC_{50} value used to calculate the AAI value. Antioxidant activity of the extract assessed based on the Antioxidant Activity Index (AAI) where AAI was obtained by calculating the final concentration of DPPH solution divided by the IC_{50} value of antioxidant tested compounds in the reaction. The ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel has a moderate level of antioxidant activity (the AAI range between 0.5 and 1.0) with AAI value of 0.88 (Scherer and Godoy, 2009).

Body Butter Formulation

In this research, body butter formulation was carried out by combining the antioxidant potential contained in the peel of dragon fruit (*Hylocereus polyrhizus*). Based on the results of the analysis of the antioxidant activity of extracts that have been done previously, showed that the ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel has antioxidant activity, so that it could be used to be a natural antioxidant active ingredient in body butter preparations. Different levels of extract consisting of 0.5%, 1.0%, and 2.0% were added in body butter production. Body butter made based on oil in water (O/W) emulsion, components in the body butter formula were adapted from previous research (Suena *et al.,* 2017) consist of the oil phase, the water phase, and the emulsifying agent and production of body butter using the fusion method (Jasti, Abraham, & Ghosh, 2004). Body butter has made then packaged in a suitable pot (Figure 2).

Physical Quality Evaluation of Body Butter
Organoleptic

Organoleptic evaluation intended to see the qualitative or physical appearance of a preparation, including the shape, color, odor, and texture so that it matches the extract used. Each week of storage (4 weeks) showed no changes in the organoleptic of each body butter formulation. The form of body butter was semi-solid, have brown color, and its texture was soft (Figure 2).

Homogeneity

The homogeneity evaluation aimed to see and know the mixing of preparations. Homogeneity in pharmaceutical preparations was very important because it reflects an even distribution of active substances into preparations so that it was expected that the dosage has met according to the purpose of its use (Juwita *et al.,* 2013). Homogeneity evaluation showed that body butter products remain homogeneous at storage time (4 weeks). This was evidenced by the absence of particle grains or lumps and phase drops that appear to be separate from the glass of object. Therefore, body butter products made with each different formula give good results.

pH

The evaluation of pH in topical preparations aimed to evaluate the safety of the preparations, so that the skin was not irritated. Topical preparations should have a pH close to the normal pH of the skin, it was about 4.0-7.0 (Lambers *et al.,* 2006). Body butter produced in each formula met the skin's pH value requirements. Body butter containing the extract could reduce the pH value of the preparation (5.0 – 6.0). *Hylocereus polyrhizus* contains organic acids such as malic acid and could reduce the pH value of body butter product (Jamilah *et al.,* 2011).

Spreadability

The spreadability evaluation aimed to determine the ability of a preparation to spread widely on the surface of the skin. The therapeutic efficacy of a formulation depends on its distribution (Deuschle *et al.,* 2015; Singh *et al.,* 2015). Based on statistical analyze, there were differences in the average spreadability between the formula I with formula III and formula II with formula III at the storage time of the second week ($p<0.05$). In relation to the stability of the spreadability, there were no differences in the spreadability with each different storage time in body butter of negative control formula, formula I and formula II ($p>0.05$). It could be said those formulas have a stable spreadability at a storage time for 4 weeks.

Protection ability

The protection ability evaluation aimed to know the ability of body butter protection against external influences which could reduce the effectiveness of applying body butter. The external influence was given by NaOH, where a purplish red stain would arise on filter paper that has been previously dripped with phenolphthalein and applied with body butter (Indrayudha *et al.,* 2010). Based on statistical analyze, there was no difference in the average of protection ability between storage time and each formula ($p>0.05$). The stability of the protection ability showed there were no differences in the protection ability with each different storage time in body butter of negative control formula, formula I and formula III ($p>0.05$). It could be said those formulas have a stable protection ability at a storage time for 4 weeks. Nevertheless, purplish-red stains that arise quickly, which was less than 2 seconds so it was known that the protection ability of body butter for other compounds (alkalis) was relatively low.

Adhesion ability

The adhesion ability evaluation aimed to determine the ability of an inherent attachment to the skin. Adhesion ability of the preparation will affect the effect of longer therapy (Arikumalasari *et al.,* 2013). Based on statistical analyze, there were differences in the average adhesion ability between the negative control formula with formula II and formula II with formula III at the storage time of the second week ($p<0.05$). Furthermore, there was also a difference in the average adhesion ability between formula I with formula III and formula II with III at the time of storage of the fourth week ($p<0.05$). Related to the stability of the adhesive ability showed there were no differences in the adhesion ability with each different storage time in body butter of negative control formula, formula I and formula III ($p>0.05$). It could be said those formulas have a stable adhesion at a storage time for 4 weeks.

Activity Antioxidant of Body Butter

Analysis of antioxidant activity in body butter of ethanol extract of dragon fruit (*Hylocereus polyrhizus*) peel aimed to know the antioxidant activity of the extract after it was combined by other components in body butter. Based on previous research showed that

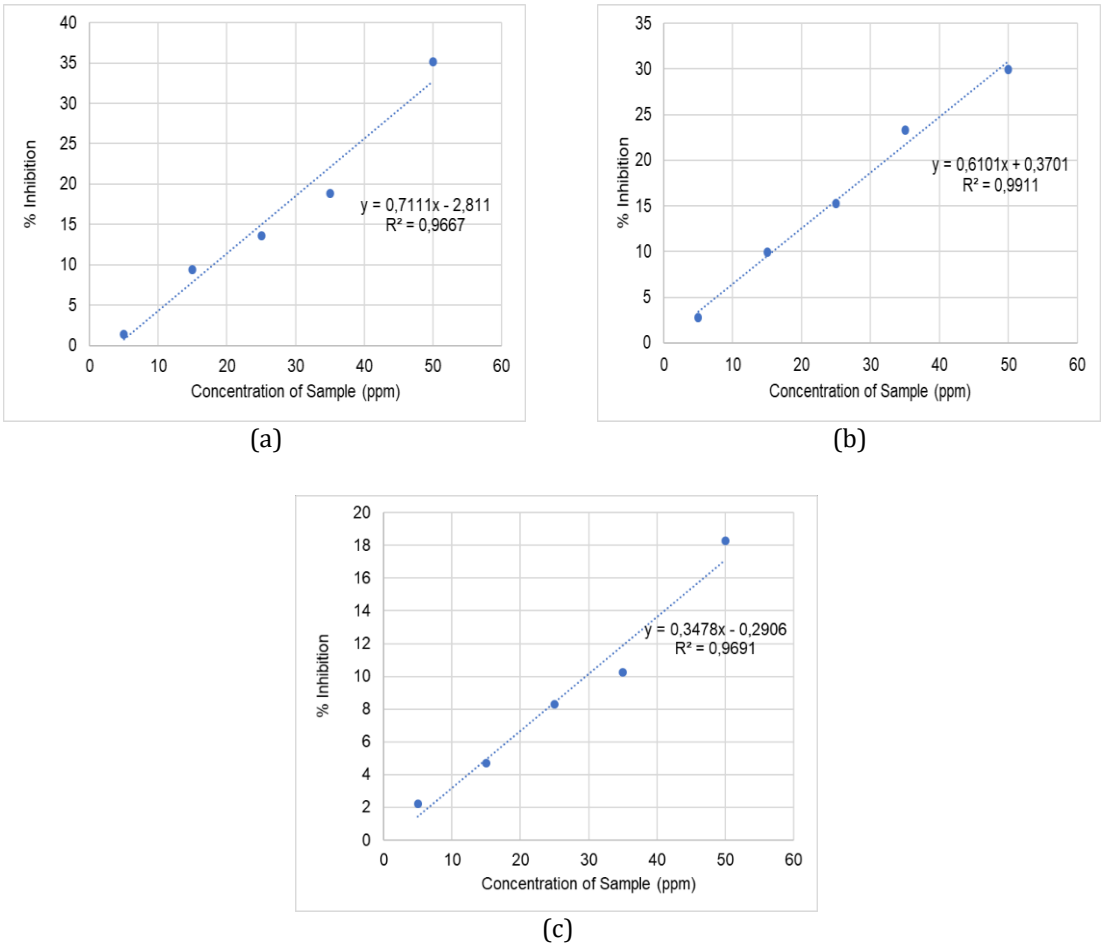

Figure 3. Curve of DPPH Free Radical Inhibition Percentage by Body Butter Ethanol Extract of Dragon Fruit (Hylocereus polyrhizus) Peel Formula I (a), Formula II (b), and Formula III (c)

Table II. Antioxidant Activity of Budy Butter of Ethanol Extract of Dragon Fruit (*Hylocereus polyrhizus*) Peel

Formula	Concentration of DPPH (ppm)	IC_{50} Value (ppm)	AAI
I	40	74.27	0.54
II	40	82.56	0.48
III	40	144.60	0.28

antioxidant activity was influenced by the increasing number of antioxidants used (Purwanto *et al.,* 2013). The results of the analysis of antioxidant activity on each body butter formula were shown in Figure 3.

Based on Figure 3 showed that the IC_{50} value obtained was greater along with the large amount of antioxidants added in body butter so the AAI value obtained was getting smaller (Table II).

Some factors could affect reducing of antioxidant activity in body butter, consisting of dual roles of antioxidant in body butter as a protective agent in the preparation from oxidation caused by emulsifying agent and free-radical scavengers on the environment, other factors were duration of storage, high temperature, and contact with light. The longer of storage time, contact with light and exposed to high temperatures, the more antioxidant activity can be drastically decreased (Del-Toro-Sánchez *et al.,* 2015; Hamzah *et al.,* 2014; Kusumawati and Indrayanto, 2013; Rompis *et al.,* 2019; Xu *et al.,* 2019).

CONCLUSION

Ethanol extract of dragon fruit (*Hylocereus polyrhizus)* peel has a moderate level of antioxidant (AAI = 0,88). Body butter containing 0,5% of ethanol extract of dragon fruit *(Hylocereus polyrhizus)* peel has the best physical quality evaluation during storage (4 weeks) and the highest AAI (0.54) among other body butter formulas.

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