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Formulation of Peel-off Gel Mask Containing Mung Bean (*Vigna radiata* (L.) Wilczek) Extract

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ABSTRACT

Mung bean (*Vigna radiata* (L.) Wilczek) is one of the plants that rich in antioxidant compound. Antioxidant is a compound that can inhibit the skin aging process because of photoaging. The aim of this study was to formulate peel-off gel mask containing mung bean (*Vigna Radiata* (L.) Wilczek) extract using polyvinyl alcohol (PVA) as a base of mask and Hydroxy Prophyl Methyl Cellulose (HPMC) as a viscosity increasing agent and to determine the antioxidant activity of the peel-off gel mask. Antioxidant activity was tested using DPPH (1,1-diphenyl-2-pycrilhidrazil) assay. Mung bean was extracted by maceration method using ethanol 96%. The concentration of mung bean extract in the peel-off mask gel was 4% w/w and variant concentration of PVA were 5% (F1), 7.5% (F2), 10% (F3) w/w. The evaluations were organoleptic, pH, viscosity, drying and film forming, and gel spreadness. The study result showed that the organoleptic of the gel was brownish yellow with pH approximately 6, 196-513 cps in viscosity, 0.0646-0.0730 cm/g in gel spreadness and 27.6-54.5 second in drying and film forming. F3 containing mung bean extract 4%, PVA 10%, HPMC 2%, propylene glycol 15%, potassium sorbate 0.2%, olive oil 0.5%, alpha-tocopherol 0.05% and distilled water ad 100% w/w was the best formula with IC_{50} value was 85.2793 µg/ml and significantly different than F1 and F2 ($p < 0.05$).

Keywords: peel-off gel mask, mung bean extract, *Vigna radiata* (L.) Wilczek, antioxidant

1. Introduction

Previous studies have reported that mung bean is one of the plants that rich in antioxidant compound. Flavonoid compounds contained in mung bean, vitexin and isovitexin, have an antioxidant effect [1]. Vitexin inhibits DPPH radicals of approximately 60% at 100 µg/ml and effectively inhibits UV rays that can stimulate skin cell death [1, 2].

The process of skin damage is showed by the appearance of wrinkles caused by free radicals. Skin aging can occur due to photoaging by UV radiation [3, 4]. Skin aging can be caused by UV radiation (photoaging) which trigger in the formation of ROS (Reactive Oxygen Species) free radical on the skin. Free radicals cause oxidative damage to the tissue known as oxidative stress [5, 6]. Antioxidants can be used to protect the skin from the free radical attack so it can inhibit aging process [7, 8].

High content of antioxidants in mung bean is potentially to be formulated into peel-off gel mask to protect our skin from UV radiation so it can be novelty of the research to develop new formula of peel-off gel mask containing mung bean extract. The use of mask has many benefits not only refreshing, repairing and tightening of facial skin but also improving blood circulation, stimulating the activity of skin cells, lifting dead skin cells, softening the skin, and providing nutrient on the skin [9]. Peel-off gel mask can be directly removed without rinsing after the mask is dry so it can remove the dead skin cell [10].

2. Method

2.1. Extraction of mung bean

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Maceration was one of the extraction methods [11]. Mung bean was extracted by maceration method using ethanol 96%. 1000 g of dried mung bean powder was weighed and extracted in 500 ml of 96% ethanol for 24 hours then filtered until filtrate is obtained. The treatment was carried out for 2 days. The filtrate was collected and evaporated using a rotary evaporator at temperature of 40-50 °C until the ethanol extract was ±50 ml.

2.2. Phytochemical screening of mung bean extract

Tests of Alkaloid, flavonoid, tannin, saponin, triterpenoids and steroid were done to screening phytochemical content [11].

2.3. Antioxidant activity test of mung bean extract

Antioxidant activity was tested using DPPH (1,1-diphenyl-2-pycrilhidrazil) method. A stock solution was prepared by carefully weighing 10 mg extract and add methanol p.a until 100 ml in volumetric flask. A series of solutions in variant concentration was prepared (10 µg/ml, 20 µg/ml, 30 µg/ml, 40 µg/ml, and 50 µg/ml) using the stock solution. One ml of the solutions was added with 2 ml DPPH 50 µg/ml in the test tube and incubated at room temperature and avoid from light. Absorbance of the test solution was measured at maximum wavelength. The absorbance data was used to calculate the inhibition percentage of extract against DPPH free radical using the equation below.

$$\text{Inhibition percentage (\%)} = \frac{(A_o - A_1)}{A_o} \times 100\ \%$$

A_o was absorbance of blank solution while A_1 was absorbance of test solution. The IC_{50} (*inhibition concentration 50%*) was determined using the linear regression equation y = bx + a, where x is the concentration (µg/ml) and y is the percentage of inhibition (%) [12, 13].

Determination of the AAI (Antioxidant Activity Index) value was done by calculating the DPPH concentration used in the test (µg/ml) divided by the IC_{50} value obtained (µg/ml). AAI value < 0.5 is a weak antioxidant, AAI > 0.5-1 is a moderate antioxidant, AAI > 1-2 is a strong antioxidant, and AAI > 2 is a very strong antioxidant [14].

2.4. Formulation of peel-off gel mask

Formulation of peel-off gel mask containing mung bean extract was prepared using polyvinyl alcohol (PVA) as a base of mask and hydroxypropylmethyl cellulose (HPMC) as a viscosity increasing agent. All formula are listed in Table 1.

2.5. Preparation of peel-off gel mask

All ingredients were weighed carefully using analytical balance. The viscous liquid of α-tocopherol was mixed with propylene glycol while potassium sorbate dissolved in distilled water. Dispersion of PVA and HPMC was made using distilled water. The ingredients were mixed together with olive oil and mung bean extract in a beaker glass under stirring. Then distilled water was added until 100% w/w total volume.

2.6. Physical evaluation of peel-off gel mask

The physical evaluation involved were organoleptic, pH, viscosity, drying and film forming, and gel spreadness [15]. Organoleptic was observed visually, pH was measured by using pH meter, and viscosity was determined by using

Table 1. Formula of peel-off gel mask

Ingredients (% w/w)	F1	F2	F3	F4	F5	F6
Mung Bean Extract	4	4	4	-	-	-
PVA	5	7.5	10	10	10	10
HPMC	2	2	2	2	2	2
Propylene Glycol	15	15	15	15	15	15
Potassium Sorbate	0.2	0.2	0.2	0.2	0.2	0.2
Olive Oil	0.5	0.5	0.5	0.5	0.5	-
Alpha-tocopherol	0.05	0.05	0.05	0.05	-	-
Distilled water	until 100	until 100	until 100	until 100	until 100	until 100

Viscometer. Drying and film forming test was carried out 48 hours after the preparation of the mask base and formulation of the peel-off face mask. Samples (triplo) containing about 0.7 g of the base mask were weighed and spread using a brush, over an area of 5.0 x 2.5 cm above the glass object or watch glass, forming a homogeneous thin layer of about 1 mm, to mimic the film formed on the face after the use of peel-off mask. Object glass or watch glass was inserted into the oven at 36.5 ± 2.0 ° C for 1 hour. The preparation was observed every 10 minutes, until the drying process was complete and the film was completely peeled off of the object glass or watch glass [16]. Test of gel spreadness was done as a following procedure. A total of 1 g of gel mask was placed carefully on a 20x20 cm glass. Furthermore, it was covered with another glass and placed a weight on glass with a load of 1 g, 2 g, 5 g, 10 g, 15 g, 20 g, and 25 g. Diameter of spreading mask was measured after 1 minute [17].

2.7. Antioxidant activity test of peel-off gel mask

Antioxidant activity was tested using DPPH (1,1-diphenyl-2-pycrilhidrazil) method [12, 13]. Procedure of the test was as same as the procedure to determine antioxidant activity of mung bean extract.

2.8. Data analysis

Data and statistic analysis were made by using analysis of varians (one way ANOVA). A value of $p< 0.05$ was considered significant statistically.

3. Results

3.1. Extraction of mung bean

Extraction of 1000 gram of mung bean powder resulted 42.0825 g viscous greenish brown and characteristic odor extract.

3.2. Physicochemical screening of mung bean extract

The result of phytochemical screening tests is listed in Table 2.

Table 2. Phytochemical screening result of mung bean extract

Test	Result
Alkaloid	-
Flavonoid	+
Steroid	+
Saponin	-
Tanin	+

3.3. Antioxidant activity test of mung bean extract

The results of antioxidant testing on mung bean extract proved that mung bean extract had IC_{50} = 37.205 µg/ml.

3.4. Formulation and preparation of peel-off gel mask

The organoleptic of peel-off gel mask preparation was homogenous brownish yellow gel and characteristic odor.

3.5. Physical evaluation of peel-off gel mask

The result of physical evaluation of peel-off gel mask was shown in Table 3 and Table 4.

3.6. Antioxidant activity test of peel-off gel mask

The result of antioxidant activity test was shown in Table 5.

Table 3. Organoleptic and pH (n=3)

Formula	Color	Odor	Consistency	Homogeneity	pH
F1	Brownish yellow	Characteristic mung bean odor	Gel	Homogeneous	6.239 ± 0.01
F2	Brownish yellow	Characteristic mung bean odor	Gel	Homogeneous	6.274 ± 0.02
F3	Brownish yellow	Characteristic mung bean odor	Gel	Homogeneous	6.264 ± 0.02
F4	Clear	Characteristic PVA odor	Gel	Homogeneous	6.182 ± 0.01
F5	Clear	Characteristic PVA odor	Gel	Homogeneous	6.138 ± 0.02
F6	Clear	Characteristic PVA odor	Gel	Homogeneous	6.149 ± 0.03

Table 4. Viscosity, gel spreadness and time of drying and film forming (n=3)

Formula	Viscosity (Cps)	Gel spreadness (cm/g)	Time of drying and film forming (Sec)
F1	196.7 ± 15.3	0.0646 ± 0.003	54.5 ± 13.90
F2	330.0 ± 26.5	0.0727 ± 0.010	45.3 ± 0.61
F3	513.3 ± 35.1	0.0730 ± 0.009	27.6 ± 7.40
F4	180.0 ± 20.0	0.0691 ± 0.010	25.4 ± 8.30
F5	200.0 ± 20.0	0.0825 ± 0.004	27.1 ± 10.00
F6	163.3 ± 15.3	0.0844 ± 0.006	25.4 ± 12.70

Table 5. IC_{50} and antioxidant activity index (AAI)

Formula	IC_{50} (µg/ml)	Antioxidant activity index (AAI)	Antioxidant properties
F3	85.4793	0.585	Medium
F4	105.3105	0.475	Weak
F5	159.316	0.314	Weak

4. Discussion

4.1. Extraction of mung bean

Extraction of mung bean powder was done by maceration method using ethanol 96%. The method is chosen to avoid damage of active substances due to heating. Ethanol 96% was used to extract polar substance like flavonoid. Active substances taken from mung bean powder are flavonoids which has an antioxidant effect [2]. The extraction process will produce a liquid extract which is then concentrated by using a rotary evaporator at 40-50 °C. The viscous extract obtained has characteristic odor of mung bean and greenish brown in color. Extraction of 1000 gram of mung bean powder resulted 42.0825 g (4.2083%) viscous extract.

4.2. Physicochemical screening of mung bean extract

Phytochemical screening tests include alkaloid, flavonoid, tannin, steroid and saponin tests. Mung bean extract positively contains tannins, flavonoids and steroids. Data are listed in Table 2.

4.3. Antioxidant activity test of mung bean extract

Test of antioxidant activity was the main parameter of this research and conducted on mung bean extract using DPPH method. This method was chosen because it was a simple, quick method, using samples and chemicals in small amounts and most commonly used for in vitro antioxidant testing [12, 13]. The principle of DPPH method is that when the DPPH solution is mixed with a sample that has antioxidant activity, it causes a reduction form with the change of purple to yellow color. The results of antioxidant testing on mung bean extract proved that the IC_{50} of mung bean extract is 37.205 µg/ml. An antioxidant agent which has high antioxidant activity will have low IC_{50} value. Mung bean extract was able to inhibit 50% DPPH at concentration 37 µg/ml. Based on the calculation of the value of AAI (Antioxidant Activity Index), mung bean extract had AAI value 1.34 or a potent antioxidant properties. In this study, quercetin was used as a positive control. The IC_{50} value was 4.825 µg/ml which mean quercetin had antioxidant activity stronger than mung bean extract.

4.4. Formulation and preparation of peel-off gel mask

The peel-off gel mask was formulated into three variance concentration of PVA. The function of PVA is a film forming agent while the function of HPMC, propylene glycol, potassium sorbate, olive oil, alpha-tocopherol and distilled water is viscosity-increasing agent, humectant agent, antimicrobial preservative, humectant agent, antioxidant agent and solvent, respectively. Based on the calculation using IC_{50} of mung bean extract, the concentration of mung bean extract used in the peel-off mask gel was 4% w/w. Varian of PVA

concentrations in the formula were 5% (F1), 7.5% (F2), 10% (F3) w/w. The various concentration of PVA was aimed to get the concentration of PVA resulted the best time of drying and film forming. Formula without mung bean extract, olive oil and alpha-tocopherol was used as a control (F4, F5, F6). The reason of F5 did not contain alpha-tocopherol was to know affect of the alpha-tocopherol on antioxidant activity test result.

4.5. Physical evaluation of peel-off gel mask

The physical evaluation of peel-off gel mask were organoleptic, pH, viscosity, drying and film forming, and gel spreadness. Detail of the results was listed in Table 3 and Table 4.

Organoleptic test was carried out to see the physical appearance of the preparation by observing the color, smell, consistency and homogeneity of the preparation. The consistency of all formulas was gel. F1, F2 and F3 were yellowish brown and characteristic odor of mung bean. Whereas F4, F5, and F6, which were control formula and base mask, had the appearance of clear white and PVA odor. Based on the tests performed, all of formulas were a homogeneous preparation. The pH of gel mask preparations was approximately 6. The pH of the gel mask preparations was within the normal pH range of the skin (4.5-6.5).

The viscosity test was carried out using the DV-02 viscometer using a Spindle 2. The results of the viscosity test showed that each formula had different viscosity. There was a difference in the average viscosity value due to the effect of PVA concentration in F1 to F3. The higher concentration of PVA was used in the formula, the higher viscosity was obtained. Based on the results of testing the spreadness of gel mask, it was concluded that the increasing of PVA concentration affected the gel spreadness.

Formula without extracts (F4, F5, and F6) were faster in dry time than the other three formula containing extract. The drying test of the film showed that F3 dried faster than F1 and F2, this might be caused by the high concentration of PVA in the formula. The fastest drying time for the film layer was F3 (27.2 minutes). Based on the data obtained only F3 which meets requirement of the drying time of the peel-off gel mask (15-30 minutes) [16]. Analysis of varians (one way ANOVA) were used to analyze data. Based on the physical evaluation, statistic calculation result showed that F3 was significantly different than F1 and F2 ($p < 0.05$).

4.6. Physical evaluation of peel-off gel mask

Antioxidant activity tests of the peel-off gel mask containing mung bean extract were performed on F3, F4, and F5. Testing on F4 and F5 was done to determine whether additional ingredients such as α-tocopherol and olive oil in the preparation might affect the results of antioxidant activity test. Based on the antioxidant activity test, F3 was the best formula. F3 had an average value of IC_{50} 85.4793 µg/ml and had a medium antioxidant properties with an AAI value 0.585.

Average IC_{50} value of F4 was 105.3105 µg/ml and had a weak antioxidant properties with an AAI value 0.475 while F5 had an average IC_{50} value 159.316 µg/ml and had a weak antioxidant properties with an AAI value 0.314. The addition of α-tocopherol and olive oil did not affect the antioxidant activity test on peel-off gel mask containing mung bean extract.

5. Conclusion

Based on physical evaluation and antioxidant activity, formula containing mung bean extract 4%, PVA 10%, HPMC 2%, propylene glycol 15%, potassium sorbate 0.2%, olive oil 0.5%, alpha-tocopherol 0.05% and distilled water ad 100% w/w was the best formula with IC_{50} value was 85.2793 µg/ml and significantly different to other formula ($p < 0.05$).

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