

Peel-Off Mask Formulation of Red Dragon Fruit Extract (*Hylocereus lemairei* Hook.) and Corn Starch with Variation of Polyvinyl Alcohol (PVA) Concentration

Formulasi Masker *Peel-off* Ekstrak Buah Naga Merah (*Hylocereus lemairei* Hook.) dan Pati Jagung dengan Variasi Konsentrasi *Polyvinyl Alcohol* (PVA)

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Abstract

Red dragon fruit (*Hylocereus lemairei* Hook.) contains Phyto albumin and antioxidant compounds such as phenolic compounds and vitamin C. Corn contains vitamins A, B, and E as antioxidants, as well as Thiamin which can reduce black spots on acne scars and dry out wounds. Peel-off masks are cosmetic preparations for facial care. They form a thin, transparent layer on the skin's surface and are peeled off after drying, making them easy to use. Polyvinyl alcohol (PVA) is a film-forming polymer that increases viscosity and produces good physical quality peel-off masks. The study aimed to formulate peel-off masks of red dragon fruit extract and corn starch with variations in PVA concentrations, namely 2.5% (F1), 8.75% (F2), and 17.5% (F3). The physical quality of the preparation was evaluated on the organoleptic, homogeneity, pH, spreadability, adhesion, and drying time. The organoleptic preparations (F1-F3) were brownish orange, with a distinctive rose odor, with increased viscosity from F1 to F3, and remained stable for four weeks of storage. The homogeneity of preparations (F1-F3) remained homogeneous for four weeks of storage. The pH value of preparations F1 and F2 was pH 4, and F3 was pH 4.5 on day 1. From the first to the fourth week, the pH of the F1-F3 preparations was 4.5. The spreadability of F1-F3 preparations was in the 5.5-6.5 cm range. The adhesive power of the F1-F3 preparations was in the range of 5.29-40.1 seconds. The drying time of F1-F3 preparations was in the range of 20.58-30.45 minutes. The three red dragon fruit peel-off mask formulas and corn starch meet the requirements for good physical quality according to the criteria set and recommended. Increasing the concentration of PVA did not affect the pH value. However, it slightly decreased the preparation's spreadability and increased the value of adhesion and drying time.

Abstrak

Buah naga merah (*Hylocereus lemairei* Hook.) mengandung fitoalbumin dan senyawa antioksidan seperti senyawa fenolik dan vitamin C. Jagung mengandung vitamin A, B, dan E sebagai antioksidan, serta Thiamin yang mampu mengurangi flek hitam bekas jerawat dan mengeringkan luka. Masker *peel-off* adalah sediaan kosmetik perawatan wajah yang membentuk lapisan tipis transparan pada permukaan kulit dan dikelupas setelah mengering, sehingga praktis digunakan. Polivinil alkohol (PVA) merupakan polimer pembentuk film yang meningkatkan viskositas, dan berperan menghasilkan masker *peel-off* bermutu fisik baik. Penelitian bertujuan untuk memformulasikan masker *peel-off* ekstrak buah naga merah dan pati jagung dengan variasi konsentrasi PVA yaitu 2,5% (F1); 8,75% (F2); dan 17,5% (F3). Evaluasi mutu fisik yang dilakukan terhadap sediaan adalah uji organoleptik, homogenitas, pH, daya sebar, daya lekat, dan waktu mengering. Organoleptis sediaan (F1-F3) yaitu berwarna oranye kecoklatan, dengan bau khas mawar, dengan kekentalan meningkat dari F1 ke F3, dan bertahan stabil selama empat minggu penyimpanan. Homogenitas sediaan (F1-F3) bertahan homogen selama empat minggu penyimpanan. Nilai pH sediaan F1 dan F2 adalah pH 4, dan F3 pH 4,5 pada hari ke-1. Sejak minggu ke-1 sampai ke-4 pH sediaan F1-F3 adalah 4,5. Daya sebar sediaan F1-F3 berada pada rentang 5,5-6,5 cm. Daya lekat sediaan F1-F3 berada pada rentang 5,29-40,1 detik. Waktu mengering sediaan F1-F3 berada pada rentang 20,58-30,45 menit. Ketiga formula masker *peel-off* buah naga merah dan pati jagung memenuhi ketentuan mutu fisik yang baik sesuai kriteria yang ditetapkan dan disarankan. Meningkatnya konsentrasi PVA tidak mempengaruhi nilai pH, namun sedikit menurunkan daya sebar sediaan, serta meningkatkan nilai daya lekat dan waktu mengering.

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INTRODUCTION

Physical appearance begins to change with age. It is one of the reasons a person becomes less confident. Unhealthy environmental conditions due

to air pollution, such as cigarette smoke, incomplete combustion of motor vehicles, pollutants, and solar radiation¹ causes the emergence of free radicals. Uneven skin tone, rough skin, wrinkles, and

pigmentation disorders can result from excessive reactive species.²

The skin consists of millions of skin cells that can undergo death and be replaced with newly grown living skin cells.³ The three main layers of the skin are: the epidermis, the dermis, and the hypodermis/subcutaneous layer.^{4,5} The skin protects from exposure to UV radiation, harmful temperatures, injuries, and infections.^{5,6} Healthy skin naturally performs skin cell turnover every 28 days. However, the growth of new skin cells often becomes abnormal, one of which is the result of dead skin cells cannot be appropriately exfoliated. As a result, signs of skin damage such as wrinkles, dull appearance, and black spots appear.⁷

Natural products, including red dragon fruit and corn starch, can be used for skin care. Red dragon fruit contains several antioxidants, such as vitamin C, E, anthocyanins, and lycopene.^{8,9} Corn starch contains thiamin compounds that can dry wounds and remove acne scars through holes in the face or dark spots. The content of vitamins B, A, and E are antioxidants that are advantageous for the skin to ward off free radicals and prevent premature aging. The content of pro-carotene helps repair damaged skin structure.^{7,10} Corn starch comes from corn where in addition to being a source of carbohydrates, it also contains tryptophan and the amino acid lysine, and essential fats omega 3 and 6, which can build collagen cross-links that function to help regenerate skin cells, maintain elasticity and skin moisture.¹¹⁻¹³ The combination of these two natural ingredients, namely red dragon fruit and corn starch, can be used in facial skin care to overcome damage caused by pollution in the environment and excessive exposure to free radicals.

Over time, technology that develops in society also advances in cosmetics. One of the existing advances is the manufacture of various types of face masks. One of the popular type of masks is the peel-off mask, a gel-shaped facial care cosmetic preparation. After being applied to the skin for a particular time, the peel-off mask will dry immediately, forming an elastic transparent film to be exfoliated. Peel-off masks can remove residual dirt and dead skin cells on the surface of facial skin and are easy to use without the need to rinse. Peel-off masks help relax facial muscles, thereby restoring freshness and reducing wrinkles.¹⁴⁻¹⁶

The composition of their constituent excipients influences the physical quality of peel-off masks. One of the excipients in peel-off mask formulations is polyvinyl alcohol (PVA) that is water-soluble, biodegradable synthetic polymer, environmentally friendly, and is often used as a viscosity-enhancing agent and film layer forming, allowing peel-off effects for face mask preparations.^{14,15,17,18} PVA has been widely used in the formulation of peel-off masks, as well as using red dragon fruit peel extract as an active ingredient in peel-off masks and ensuring its benefits through testing the antioxidant activity of preparations.^{14-16,19-21} However, it is still rare to use red dragon fruit as an active ingredient in peel-off mask preparations²²⁻²⁴ and no one has ever combined it with corn starch to enhance the benefits of the preparation, and add PVA concentration variations.

Based on the background stated above, this study is intended to formulate an innovative cosmetic product in the form of peel-off masks with variations in polyvinyl alcohol (PVA) concentrations from low concentrations of 2.5%, 8.75%, and 17.5%, as PVA had a significant impact on the physical quality of the mask. The uniqueness of the study is the preparation of peel-off masks made from active ingredients of the combination of red dragon fruit extract and corn starch to improve its function as facial skincare and the use of variations of PVA excipients in a wide concentration range to see the physical quality produced.

RESEARCH METHOD

Tools and materials

The tools used in this research were as follows: universal pH indicator (Macherey-Nagel, Germany), analytical balance (Ohaus pioneer, PA 224C), 500 g scale (ACIS BC), rotary evaporator (BUCHI R-300), water bath (MEMMERT GmbH+Co., KG, Germany), various laboratory glassware (PYREX), and Elmasonic S 40 H (Hans Schmidbauer GmbH & Co.KG, Germany).

The material used in this study was dragon fruit extract from dragon fruit plants obtained from Banjar Batu Sari, Mengwitani Village, Badung Regency, Bali, Indonesia. Other ingredients used were as follows: ethanol 96% (PT. Brataco, Indonesia), corn starch (PT. Ega Multi Cipta, Indonesia), polyvinyl alcohol (Fadjar Kimia, Indonesia), propylene glycol

(PT. Karunia Sejahtera Abadi SABA KIMIA, Indonesia), carbomer (PT. Karunia Sejahtera Abadi SABA KIMIA, Indonesia), rose essence (Fadjar Kimia, Indonesia), methylparaben (PT. Karunia Sejahtera Abadi SABA KIMIA, Indonesia), and *aqua demineralisata* (DM) (UD. Sekawan Bali Sejahtera, Indonesia).

Research Procedure

This research is pure laboratory research with a developmental purpose, namely formulating peel-off mask cosmetic preparations using a combination of red dragon fruit extract and corn starch as active ingredients. The peel-off mask preparation formula of red dragon fruit extract and corn starch is made with three variations in PVA concentration, namely 2.5% (F1), 8.75% (F2), and 17.5% (F3), which are evaluated for physical quality through several tests including organoleptic tests, homogeneity, pH, dispersion, adhesion, and drying time. The preparation is stored for four weeks, and each physical quality test is carried out in a triple manner. Details of the research procedure are as follows.

Determination of red dragon fruit plants

Plant determination was carried out at the Characterization Laboratory of the Botanical Garden "Eka Karya"-National Research and Innovation Agency (BRIN), in Bali, Indonesia. Determination aims to discover the truth of the plant's identity, to prevent errors in plants used in research.²⁵

Collection and extraction of red dragon fruit

The selected red dragon fruit is in good condition, free from defects due to pests, and ripe, characterized by a thorough red color on the fruit's skin. The fruit that has been collected is then cleaned, then separated between the flesh of the fruit and the skin of the fruit. Then the fresh dragon fruit flesh is cut into small pieces.

The ultrasonically assisted maceration process (ultrasound-assisted extraction) produces dragon fruit extract. Red dragon fruit extract was obtained by utilizing 300 g of fresh red dragon fruit cut and mashed with a blender, soaked in 900 ml of 96% alcohol using a Beaker glass, then macerated using an Elmasonic® tool for 3 minutes. It was then stirred using a stirring rod for 5 minutes, then laid back in the Elsonic® tool. Maceration was repeated using the Elmasonic® tool three times. After that, the macerate obtained was filtered using a Buchner

funnel. The filtration results were then evaporated until a thick extract was obtained. In manufacturing peel-off mask gel preparations, a thick extract of red dragon fruit was used as an active ingredient along with corn starch.

Manufacture of peel-off mask preparations

Peel-off mask preparations were made in three formulas where F1, F2, and F3 had different concentrations in the additional ingredient of PVA. This formula adopts the peel-off gel mask formula from Pratiwi and Wahdaningsih²⁶ with modifications to the active ingredients, and each formula was made of as much as 100 g.

Table 1. Dragon Fruit Extract and Corn Starch Peel-off Mask Formula

Material	Concentration (%)			Function
	F1	F2	F3	
Red dragon fruit extract	1.5	1.5	1.5	Active ingredient
Corn starch	1.5	1.5	1.5	Active ingredient
PVA	2.5	8.75	17.5	Film-forming agent; Viscosity-increasing agent
Propylene glycol	6	6	6	Humectant
Carbomer	2	2	2	Gelling agent
Rose essence	0.01	0.01	0.01	Fragrance
Methylparaben	0.18	0.18	0.18	Preservative
Aqua DM ad	100	100	100	Solvent, Vehicle

The manufacture of peel-off masks adopts procedures from Pratiwi and Wahdaningsih.²⁶ It started with weighing all the necessary ingredients. PVA was placed in a beaker glass, enough aqua DM was added, and heated in a water bath until it expanded for five minutes at 90°C.¹⁷ (Mixture 1). Carbomer was placed in another Beaker, sufficient Aquadest was added and heated in a water bath until homogeneously dispersed and expanded (Mixture 2). Then methylparaben was added to another Beaker, propylene glycol was added and stirred until dissolved (Mixture 3). Corn starch was mixed into the dragon fruit extract until homogeneous (Mixture 4). Mixture 1 was then added to Mixture 2 and pounded with a pestle on a mortar until a gel base was formed, then Mixture 3 was added and pounded to homogeneity, then Mixture 4 was added and pounded to homogeneity, and finally Rose Essence was added to the mixture and pounded to homogeneity.

Physical quality testing of peel-off mask preparations

Organoleptic test

The Organoleptic examination included the visually observed peel-off mask's texture, color, and scent.²⁷

Homogeneity test

The homogeneity test was carried out by taking 1 g of peel-off mask gel, then applied to a clean and dry glass object to form a thin layer. The glass object was then covered with a glass of another object. Peel-off gel masks show a homogeneous arrangement if there were no coarse particles; the texture appeared flat and did not clump.¹⁴

pH Test

The pH measurement of the preparation was carried out using a universal indicator. This test utilizes a universal indicator pH paper dipped in a peel-off mask preparation. After perfect dipping, a color change in such universal indicators was observed.²⁷

Spreadability test

The spreadability test was carried out by weighing 500 mg of gel and placed in the middle of a scaled glass, beforehand, the other glass was weighed first and sufficiently weighed to 50 g, then placing the glass on the gel and leaving for 1 minute. Then, it was to measure the diameter of the gel spread by taking the average diameter length of multiple sides. After that, 50 g of additional load was added and allowed to stand for 1 minute. Then, recorded the diameter of the gel spread and continued by adding a 50 g load, then recorded the diameter of the gel spread again for 1 minute.²⁶

Adhesion test

The adhesion test was carried out by placing 250 mg of gel on the object glass, then placing another object-glass on the gel, after that pressing with a 1 kg load for 5 minutes. The object glass was mounted on the adhesion test kit and released a weight of 80 g. In addition, the time required for the object glass to be released was recorded.²⁶

Drying time test

The drying time test was carried out by applying 0.7 g of gel and spreading it on a glass surface with an area of 5.0 x 2.5 cm to form a uniform thin layer with a thickness of approximately 1 mm. It was monitored until the drying process was

complete.²⁸ The drying time of a good peel-off mask is between 15-30 minutes.^{14,21,24}

Data Processing and Analysis

The results of the peel-off mask formulation of red dragon fruit extract and corn starch with variations in PVA concentration were obtained by evaluating the physical quality of the preparation in the form of organoleptic testing, homogeneity, pH, adhesion, dispersion, and drying time. The data obtained from the test were processed qualitatively and explained descriptively, compared to the general requirements and conditions of good peel-off mask physical quality.

RESULT AND DISCUSSION

The plant used in this study was red dragon fruit obtained in Mengwitani Village, Mengwi District, Badung Regency, Bali. Plant determination was carried out at the Characterization Laboratory of the Botanical Garden "Eka Karya"-National Research and Innovation Agency (BRIN), Bali. The determination results stated that the plant samples tested were true red dragon fruit plants with the type *Hylocereus lemairei* (Hook.) Britton & Rose, and already according to the Library. The determination of a plant aims to find out the truth of the plant's identity so that it can be ascertained that the red dragon fruit that extract was used in research comes from the right plant.²⁹

Ultrasonically assisted maceration was used to obtain red dragon fruit extract. This method is more effective and efficient than ordinary maceration due to using fewer raw materials and solvents, and in a shorter time can get more results.^{30,31} The maceration result was a purplish red liquid with a distinctive aroma. The fiber was then evaporated, and a viscous extract of dark brown color and distinctive scent was obtained. The red dragon fruit extract yield was 24.53%.

Red dragon fruit viscous extract and corn starch were used as active ingredients for the formulation of peel-off mask preparations. The peel-off mask formulation is made with variations in the concentration of PVA, where F1 contains 2.5%, F2 contains 8.75%, and F3 contains 17.5% PVA. The peel-off mask formulation of red dragon fruit extract and corn starch could be seen in **Table 1**. PVA is a viscosity-increasing and film-forming agent that

easily peels off after the mask preparation dries.^{17,32} Propylene glycol is a co-solvent commonly used as a humectant.^{17,33} Carbomer is a gelling agent commonly used in making gels. This gelling agent has physicochemical properties, and the concentration of gelling agent used also affects the gel preparation produced.¹⁷ Rose essence serves as a fragrance. *Aqua*

DM serves as a vehicle. Methylparaben is a preservative¹⁷, which is necessary for a peel-off gel mask formulation because it has high water content. This is because preparations containing large amounts of water quickly become overgrown with mold and bacteria, reducing the quality of the preparation.

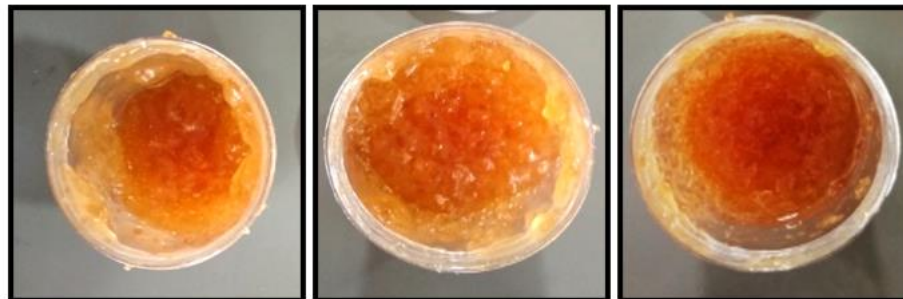


Figure 1. The Three Red Dragon Fruit Extract and Corn Starch Peel-off Mask Formulas, respectively F1, F2, and F3

The quality of peel-off mask preparations is seen from the stability of physical quality, where six kinds of tests are carried out, namely organoleptic tests, homogeneity, pH, spreadability, adhesion, and drying time. Testing was performed five times on the first day after the preparation, then weeks 1, 2, 3, and 4. The data from the physical quality evaluation was analyzed descriptively.

An organoleptic test is a test that observes the shape, color, taste, and aroma of the preparation. This test ensures that the dosage form produced follows the initial formula design. In addition, changes in color, aroma, and dosage form observed during the

four weeks in this study may indicate possible chemical, physical, or microbiological instability due to microbial activity.³⁴ The organoleptic test results of the three peel-off gel mask formulas showed that the dosage form F1 was slightly viscous, F2 was viscous, and F3 was the most viscous. The results of observing the color and aroma of the three formulas were light brown and have a distinctive aroma of rose. In the evaluation results, the three formulas remained stable. They showed no changes in texture, color, and aroma during four weeks of storage. The organoleptic test results of peel-off masks of red dragon fruit extract and corn starch can be seen in **Table 2**.

Table 2. Organoleptic and Homogeneity Testing Results of Dragon Fruit Extract and Corn Starch Peel-off Mask

Formula	Testing	Time					
		Day 1	Week 1	Week 2	Week 3	Week 4	
F1	Organoleptic	Shape	Slightly viscous	Slightly viscous	Slightly viscous	Slightly viscous	Slightly viscous
		Color	Light brown	Light brown	Light brown	Light brown	Light brown
		Aroma	Rose scent	Rose scent	Rose scent	Rose scent	Rose scent
	Homogeneity	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous	
	F2	Organoleptic	Shape	Viscous	Viscous	Viscous	Viscous
Color			Light brown	Light brown	Light brown	Light brown	Light brown
Aroma			Rose scent	Rose scent	Rose scent	Rose scent	Rose scent
Homogeneity		Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous	
F3		Organoleptic	Shape	Most viscous	Most viscous	Most viscous	Most viscous
	Color		Light brown	Light brown	Light brown	Light brown	Light brown
	Aroma		Rose scent	Rose scent	Rose scent	Rose scent	Rose scent
	Homogeneity	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous	

Information:

F1, F2, F3: Dragon fruit extract and corn starch peel-off mask formula with PVA concentration variations, 2.5%, 8.75%, and 17.5%, respectively

The homogeneity test was carried out to see whether the preparation that has been made was homogeneous or not. The preparation is considered

homogeneous if there are no coarse particles at the testing time; the texture looks flat and does not clump.¹⁴ The homogeneity test results of the three

peel-off gel mask formulas with evaluation for four weeks showed that the three formulas were homogeneous, shown by the absence of coarse particles on the object glass at the testing time. It also showed that the stirring method of making peel-off masks of red dragon fruit extract and corn starch was correct, and variations in PVA concentration did not affect the homogeneity of the three formulas. The homogeneity test results of peel-off masks of red dragon fruit extract and corn starch can be seen in **Table 2**. A homogeneous preparation will give good results as well, this is because the active substances contained in a preparation can be evenly dispersed in the carrier so that the gel preparation has the same amount of active ingredients in each part, thus providing a sustainable effect.²⁹

The pH test aimed to determine the suitability of the pH value of peel-off mask preparations with the physiological pH of the skin. Hence, it is safe to use on the skin. The pH value should not be overly acidic because it can cause irritation to the skin, while if the pH is overly alkaline, it can cause dry and scaly skin³⁵. A pH range of 4.1 to 7.4 is appropriate for the skin.³⁶⁻³⁸ The pH value in the peel-off mask preparations of red dragon fruit extract and corn starch increased in F1 and F2 during storage in week 1, from pH 4 to 4.5. The higher the concentration of PVA, the higher the pH of the peel-off gel mask preparation, because PVA belongs to the synthetic polymer group, which has a pH of 5-8.³⁹ It indicates that variations in PVA concentration affect the pH of peel-off mask preparations. Changes in pH may indicate a formula that is less stable during storage caused by environmental factors such as temperature or poor storage.⁴⁰ Another reason was that the preparation was tested the very day after its production, when it should have been at least 24 hours before the physical tests could be done. However, from week 1 to the end of the observation week 4, the pH of all three formulas remained stable at pH of 4.5. Although there was a change in pH in storage in week 1 in formulas F1 and F2, the results still met the requirements, therefore it was safe for use on the skin. These pH results were similar to research from Fauziah et al.³⁵, which obtained the pH value of peel-off mask preparations that tend to be acidic in the range of 4 to 5. The pH test results of the peel-off mask of red dragon fruit extract and corn starch can be seen in **Table 3**.

Table 3. pH test results of Dragon Fruit Extract and Corn Starch Peel-off Mask

Form ula	pH value				
	Day 1	Week 1	Week 2	Week 3	Week 4
F1	4	4.5	4.5	4.5	4.5
F2	4	4.5	4.5	4.5	4.5
F3	4.5	4.5	4.5	4.5	4.5

Information:

F1, F2, F3: Dragon fruit extract and corn starch peel-off mask formula with PVA concentration variations, 2.5%, 8.75%, and 17.5%, respectively

The spreadability test aimed to discover the ability to peel-off masks to spread on the skin. The spreadability of a good topical preparation is between 5-7 cm.³³ The spreadability is critical in applying the preparation on the skin, where preparation with good spreadability will provide an even distribution of doses on the skin.²⁹ The results of the spreadability test of peel-off mask preparations of red dragon fruit extract and corn starch of the three formulas were in the range of 5.5-6.5 cm (**Table 4**), where there were differences in spreadability between F1, F2, and F3 during four weeks of storage but still in the range between 5-7 cm. It can be concluded that F1, F2, and F3 meet the requirements of good spreadability for topical preparations. The difference in spreadability between the three formulas could be caused by variations in PVA concentration in each formula that affect the viscosity of the preparation.¹⁷ Increasing the concentration of PVA from F1 to F3 caused an increase in viscosity of the preparations, so that the preparations became more difficult to spread. The test results indicated that PVA affects the spreadability of peel-off masks, where the higher the concentration of PVA from F1 to F3, the smaller the diameter of the spread. This result is in line with Pratiwi and Wahdaningsih's research, which stated that the spreadability will decrease as the concentration of PVA increases.²⁶

Table 4. Spreadability test results of Dragon Fruit Extract and Corn Starch Peel-off Mask

Form ula	Average Spreadability (cm)				
	Day 1	Week 1	Week 2	Week 3	Week 4
F1	6.0	6.1	6.4	6.4	6.5
F2	5.5	5.8	6.1	5.6	6.0
F3	5.9	5.7	5.9	5.8	5.9

Information:

F1, F2, F3: Dragon fruit extract and corn starch peel-off mask formula with PVA concentration variations, 2.5%, 8.75%, and 17.5%, respectively

The adhesion test aimed to determine the ability of peel-off masks to adhere to the skin's surface. Good adhesion of the gel is recommended not less than 1 second.^{33,39} The results of adhesion

testing of peel-off gel mask preparations of red dragon fruit extract and corn starch can be seen in **Table 5**, in terms of adhesion calculated with time parameters, F1, F2, and F3 preparations had adhesion that increases with increasing PVA concentration, ranging from 5-40 seconds.

Table 5. Adhesion test results of Dragon Fruit Extract and Corn Starch Peel-off Mask

Form ula	Average Adhesion (seconds)				
	Day 1	Week 1	Week 2	Week 3	Week 4
F1	5.29	8.25	5.50	7.12	5.37
F2	25.53	28.12	22.09	35.29	40.01
F3	35.19	33.39	38.48	37.39	39.52

Information:

F1, F2, F3: Dragon fruit extract and corn starch peel-off mask formula with PVA concentration variations, 2.5%, 8.75%, and 17.5% respectively.

This could be caused by differences in viscosity between formulas. The higher the PVA concentration, the higher the viscosity, and the higher the adhesion value, as the high molecular weight will increase the adhesion properties.^{17,39} This result showed that variations in PVA concentration affect the adhesion of peel-off mask preparations. The adhesion test results of the three formulas meet the requirements of good gel adhesion, which is not less than 1 second. Increased adhesion because of the increasing PVA concentrations was also produced in

research from Pratiwi & Wahdaningsih²⁶ and Arinjani & Ariani³⁹.

The drying time test aimed to determine the time required for the peel-off gel to dry and form a film on the skin. The shorter the peel-off gel's drying time, the better it will be because it could affect comfort when using the peel-off mask. The drying speed could be affected by the amount of water content in each formula which slows down the evaporation and formation of a film on the peel-off mask.³⁵ The results of drying time tests of peel-off mask preparations of red dragon fruit extract and corn starch could be seen in **Table 6**, where F1 and F2 on week 4 met the good drying time for peel-off gel masks, namely 15-30 minutes, whereas F3 did not yet meet drying time results because of more than 30 minutes..^{14,21,24}

Table 6. Test results Drying Time of Dragon Fruit Extract and Corn Starch Peel-off Mask

Formula	Average Drying time (minutes)				
	Day 1	Week 1	Week 2	Week 3	Week 4
F1	21.53	20.58	29.12	21.53	27.33
F2	25.48	26.00	26.17	30.05	25.13
F3	29.51	29.15	30.45	29.36	30.27

Information:

F1, F2, F3: Dragon fruit extract and corn starch peel-off mask formula with PVA concentration variations, 2.5%, 8.75%, and 17.5% respectively.

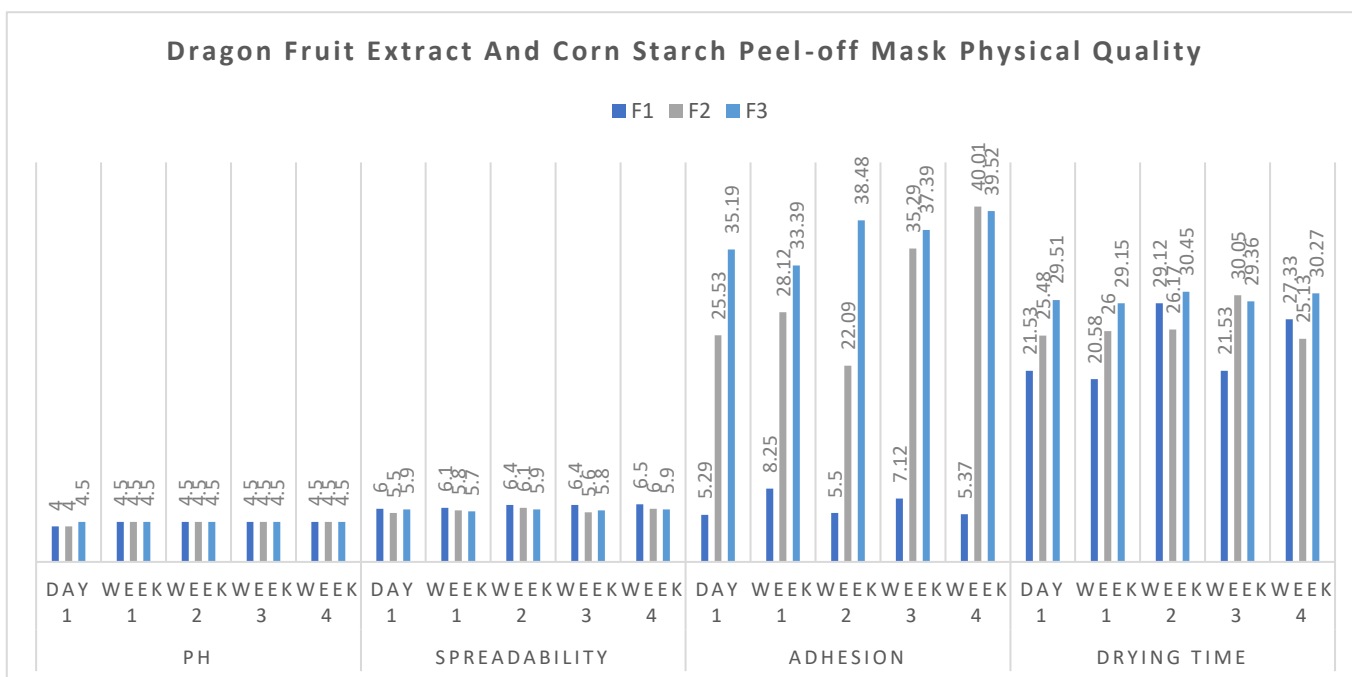


Figure 2. The overall physical quality of peel-off mask of red dragon fruit extract and corn starch with variation of PVA concentrations.

From the overall evaluation of the physical quality (Figure 2) of dragon fruit extract peel-off

masks and corn starch with variations in the concentration of PVA as a viscosity enhancer and film

former, it could be seen that the three formulas met the general provisions for the physical quality of good peel off mask preparations.

CONCLUSION

Based on the research results, it can be concluded that the three peel-off mask formulas of red dragon fruit and corn starch meet the requirements of good physical quality according to the criteria set and recommended. Increasing the concentration of PVA did not affect the pH value. However, it slightly decreases the spreadability of the preparation, as well as increases the value of adhesion and drying time. Of the three formulas, the 2.5% PVA (F1) is suitable for skin pH, has good adhesion, and is the best in terms of spreadability and drying time. The dragon fruit extract and cornstarch peel-off mask formula requires further research to determine its potential for development into innovative cosmetic products with added antioxidant value.

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CONFLICT OF INTEREST

The authors state that there is no conflict of interest between the authors in this manuscript.

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