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**The effect of concentration variation of ethanolic extract from potato peels (*Solanum tuberosum* L.) on the physical properties and antibacterial activity of gels against *Propionibacterium acnes***

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**ABSTRACT**

Gel is a semisolid dosage form that consumers prefer because of its cool sensation. This research aimed to identify the effect of different concentrations of ethanolic extract from potato peels on the physical properties and the antibacterial activities of the resultant gels against *Propionibacterium acnes*. The gel was prepared with three formulas using a variety of potato peel concentrations, namely 50%, 60% and 70%. Its physical properties were analyzed based on organoleptic observation, homogeneity, pH, and spreadability. The results showed that the ethanolic extract of potato peels affected the color and viscosity of the gel. However, no effects were detected on shape, smell, pH, and spreadability. All formulas showed strong inhibitory capacity against *Propionibacterium acnes*.

**Keywords:** *acne, Propionibacterium acnes, gel, potato*

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## INTRODUCTION

Acne is a chronic inflammation on pilosebaceous follicles characterized by the appearance of blackheads, papules, pustules, and nodules (Arikumalasari *et al.*, 2013). It is one of the most common skin diseases that people suffer (Kumesan, 2013). The most vulnerable area to acne is the face. Nevertheless, it does not close the possibility of acne affecting other body parts, such as chest, back, and shoulders (Movita, 2013). Acne can occur due to oily skins, which are commonly prevalent in the tropics. It is also caused by dust and dirt accumulation in the skin pores. When the pores are clogged, it creates a pile-up of dead skin cells and forms a good growing medium for bacteria. Acne-causing bacteria, namely *Propionibacterium acnes*, contribute to the pathogenesis of acne by secreting the enzyme lipase that breaks free fatty acids from skin lipids. These fatty acids can lead to inflammation on tissues and induce the formation of acne (Mayuna, 2013).

Many techniques exist to treat acne, including the use of expensive anti-acne medication, visits to aesthetic clinics, and natural remedies. Some of the natural ingredients commonly used to deal with acne problems are lemons, egg white, and potato peels. Potato (*Solanum tuberosum* L.) is a tuber plant used as food ingredients and consumed worldwide (Ovchinnikova *et al.*, 2011). Potato peels are mostly disposed of before consumption. Studies focusing on the ethanolic extract of potato peels prove that this rarely used part of tuber exhibit antibacterial activities against *Propionibacterium acnes*. The compounds suspected behind these activities are polyphenols (Miratunnisa *et al.*, 2015).

Gel is a semisolid system containing a suspension made of small inorganic particles or large organic molecules penetrated in liquid (Depkes RI, 1995). Gel dosage form is highly preferable because it delivers a cool sensation when applied to the skin and is easily dried and washable (Astuti *et al.*, 2017).

This study aimed to identify the effects of ethanolic extracts of potato peels on the physical properties and the antibacterial activities of gels against *Propionibacterium acnes*. The gels were prepared using several formulas with different levels of ethanolic extract of potato peels to see their effects on gels' antibacterial activities against *Propionibacterium acnes*. These gels were then tested for their physical properties and antibacterial activities.

## MATERIALS AND METHODS

### Materials

The materials used in this research were potatoes (obtained from Tanjung Market, Jember), CMC Na (Handan Yaxiang Chemicals), Glycerin (Ecogreen Oleo Chemicals), Propylene glycol (Dow Chemical Pacific Singapore), Na EDTA (Arrow Fine Chemicals), nipagin (Clariant), distilled water, ethanol (Fagron), and *Propionibacterium acnes* bacteria.

### Preparation of the ethanolic extract of potato peels

The dried and ground potato peels were macerated with 96% ethanol solvent and left overnight. Afterward, they were filtered to separate the solids (residues) from the filtrate. The residues were re-macerated three times. Meanwhile, the filtrate was collected, and the extract mixture was concentrated using a rotary evaporator. It was evaporated at 60°C on a water bath until a constant weight was obtained (Susanti *et al.*, 2015; Miratunnisa *et al.*, 2015)

### Preparation of gel dosage form

The gel dosage form was prepared using the three formulas presented in Table I. Each formula produced 100 g. The extract was dissolved in water then heated and added with mucilage CMC-Na and EDTA. Glycerin, propylene glycol, nipagin, and water were added to it. This mixture was stirred continuously until a gelatinous texture was formed. This gel was then stored overnight in a dark and cold place (10-15°C).

**Table I. The formulas of gels prepared from potato peel extract**

Ingredients	Functions	Negative Control (%)	F1 (%)	F2 (%)	F3 (%)
Potato peel extract	Active ingredient	0	50	60	70
CMC Na	Thickener	5	5	5	5
Nipagin	Preservative	0.2	0.2	0.2	0.2
Glycerin	Plasticizer	10	10	10	10
EDTA	Chelating agent	0.1	0.1	0.1	0.1
Propylene glycol	Plasticizer	5	5	5	5
Distilled water	Solvent	79.7	29.7	19.7	9.7

**Organoleptic evaluation**

This analysis included direct observation of the shape, color, and smell of the gel prepared in the previous step.

**Test of homogeneity**

The gel samples were applied on a piece of glass or other suitable transparent material. The dosage form had to show a homogeneous arrangement without any visible coarse grains.

**Test for viscosity**

This test was performed by observing the viscosity of the dosage form using a viscometer.

**pH measurement**

The pH of the dosage form was measured by dipping a pH meter stick in the diluted sample. The pH values displayed on the device were then recorded for further analysis.

**Spreadability test**

The gels were sampled by 0.5 g and placed on a round glass with a diameter of 15 cm. Another glass was placed on top of it, and the spread diameter was measured after 1 minute. Then, another mass of 150 g was added to it. The constant spread diameter was measured after 1 minute.

**Antibacterial activity test**

The test for detecting the antibacterial activity in this study employed paper disc-diffusion method. Approximately 10 mL of warm NA was added to 100 µl of *Propionibacterium acnes* suspension, then homogenized, poured into a Petri dish, and allowed to solidify evenly. Afterward, the agar surface was placed on a paper disc (diameter= 6 mm) that had been dripped with 20 µl of potato peel extract with various concentrations. The positive control used in this test was Tetracycline, while the negative one was DMSO, both of which were dripped onto the paper disc as much as 20 µl. The paper discs were then incubated at 37° C for 18-24 hours. The same procedure was performed on the resultant gel dosage form.

**Data Analysis**

The organoleptic properties and the homogeneity data were compared visually. Meanwhile, consistency, pH, spreadability, and antibacterial activity were analyzed using Kolmogorov-Smirnov test. The pH and viscosity were further analyzed using the Kruskal-Wallis test, while the spreadability was using One-way ANOVA.

**RESULTS AND DISCUSSION**

The results of the organoleptic analysis showed that formulas 1, 2, and 3 created gels with different colors, namely pale yellow, brownish yellow, and light brown, respectively. Each of them

produced fine gels with a whiff of potato. In other words, the concentration variation of potato peels extract affects the color but not the smell nor the shape of the gel. The color difference occurred because a higher extract concentration intensified the brown color of the gel. The homogeneity test results showed that all of the gel dosage forms were homogeneous, as characterized by the absence of coarse grains. The results of organoleptic observation and homogeneity test are summarized in Table II.

**Table II. The results of organoleptic evaluation and homogeneity test**

Formulas	Shapes	Odors	Colors	Homogeneity
F1	Fine	A whiff of potato	Pale yellow	Homogeneous
F2	Fine	A whiff of potato	Brownish yellow	Homogeneous
F3	Fine	A whiff of potato	Light brown	Homogeneous

The pH of the gels were within the interval of 4.5-6.5. This range of pH is compliant with the regulation because it corresponds to the pH of the skin (Mappa *et al.*, 2013). Acne can occur when the skin's pH is in alkaline condition. The gel from the potato peel extract can control alkaline pH and create acidic pH, as well as prevent the formation of acne (Mayuna, 2013). The Kruskal-Wallis Test resulted in a significance value of 0.18, indicating an insignificant difference between the pH values of the three formulas, as seen in Table III. This table also shows that pH tends to decrease with the increase of extract concentration. Such acidity can create an environment in which *P. acnes* bacteria cannot survive (Mayuna, 2013).

The test for viscosity revealed that formulas 1, 2, and 3 produced gels with viscosities of 30 dPas, 40 dPas, and 37 dPas. The Kruskal-Wallis test resulted in a significance value of 0.029, meaning that there is a significant difference in gel viscosities. The viscosity of formula 2 was higher than formula 1, because the former had a higher content of potato peel extract than the later. The increased concentration created more viscous gels; hence, the higher viscosity. The results of the viscosity testing are presented in Table III.

The spreadability test revealed that each formula created gels with a good spreadability parameter. According to Mappa *et al.* (2013), a good spreadability is in the range of 5-7 cm. The test results showed that a higher concentration of potato peel extract reduced gel spreadability because it formed thicker or more viscous gel. Gel dosage form with low viscosity (thinner or more dilute gel) creates a wider spread diameter because it flows much easily. The one-way ANOVA resulted in a significance value of 0.951, indicating the absence of significant difference in gel spreadability. The results of the spreadability test are shown in Table III.

**Table III. The results of pH measurement, spreadability test, and viscosity test**

Formulas	pH	Spreadability (cm)	Viscosity (dPas)
F1	5.0 ± 0	5.13 ± 0.321	30.0 ± 0
F2	4.8 ± 0	5.17 ± 0.076	40.0 ± 0
F3	4.8 ± 0	5.12 ± 0.076	37.0 ± 0

The analysis found that the inhibitory capacity of the potato peel extract against *Propionibacterium acnes* increased linearly with the extract concentration. The same case applied to the inhibitory capacity of the resultant gels against *P. acnes*. In other words, the higher the potato peel extract concentration, the stronger the inhibitory capacity of the resultant gel. Potato skin contains phenolic compounds that have antibacterial effects. Therefore, a higher level of potato

peel extract leads to more phenolic compounds and, subsequently, higher inhibitory capacity (Miratunnisa, 2015). The inhibitory capacities of the gels produced with different formulas of potato peel extract are categorized as strong (Pan *et al.*, 2009; Detha and Datta, 2015). The results of the inhibitory capacity test of both potato peel extract and gel are summarized in Table IV.

**Table IV. The results of the inhibitory capacity test of the potato peel extract and gel**

Samples	Extracts		Gels	
	Average inhibitory zone (mm)	Categories	Average inhibitory zone (mm)	Categories
Negative control	0	-	0	-
Positive control	11.5 ± 4.26	Strong	14.8 ± 0.68	Strong
Concentration 50%	4.9 ± 1.19	Medium	8.3 ± 3.16	Strong
Concentration 60%	6.3 ± 1.48	Strong	8.2 ± 0.75	Strong
Concentration 70%	7.7 ± 2.01	Strong	7.3 ± 0.89	Strong

## CONCLUSIONS

The variation of extract concentration affects the color and viscosity but not the shape, odor, pH, and spreadability of the resultant gels. The inhibitory capacities of the gels prepared with three formulas of potato peel extract are categorized as strong.

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