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Original Research

Facial Wash Gel Formulation from Papaya Leaf Extract (*Carica papaya* L.) With Carbopol 940 as Gelling Agent and Its Stability Study

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Abstract—*Propionibacterium acnes is a bacterium that significantly contributes to the development and progression of acne—the phenomenon of bacterial proliferation. The alkaloid carpain present in papaya leaf extract exhibits antibacterial properties against Propionibacterium acnes, a bacterium associated with the development of acne. The facial wash is a cleansing product that removes bacteria and debris from the skin. This study aims to develop a facial wash gel formulation employing papaya leaf extract to treat and inhibit acne-causing bacteria. The formulation will involve the use of different concentrations of Carbopol 940 polymer, namely FI (1%), FII (1.5%), and FIII (2%), as a gelling agent. The research conducted falls under the category of experimental research. The assessment of facial wash gel formulations encompasses various parameters, such as organoleptic evaluation, homogeneity analysis, pH determination, viscosity measurement, spreadability assessment, and foaming capacity examination. The study's findings indicate that the formulation of the FII facial wash gel successfully fulfils all criteria for preparation evaluation. FI fails to satisfy the criteria for spreadability testing, while FIII needs to fulfil the homogeneity and viscosity testing requirements. The viscosity test was significantly affected by different amounts of Carbopol 940, which was used as a gelling agent. The pH, spreadability, and foamability tests were not significantly affected (p>0.05).*

Keywords: *acne, carbopol 940, carica papaya, facial wash gel*

Abstrak—*Propionibacterium acnes* merupakan bakteri yang sangat berperan dalam patogenesis timbulnya jerawat. Pertumbuhan bakteri. Di dalam ekstrak daun pepaya terkandung alkaloid karpain yang berfungsi sebagai antibakteri penyebab jerawat (*Propionibacterium acnes*). Facial wash menjadi salah satu produk yang dapat digunakan untuk membersihkan kulit dari bakteri dan kotoran yang menempel. Penelitian ini bertujuan untuk memformulasikan sediaan facial wash gel dari ekstrak daun pepaya untuk mengobati jerawat serta mencegah pertumbuhan bakteri penyebab jerawat dengan variasi konsentrasi polimer Carbopol 940 sebagai gelling agent yaitu FI (1%), FII (1,5%), dan FIII (2%). Jenis penelitian yang dilakukan adalah penelitian eksperimental. Evaluasi sediaan facial wash gel meliputi pengujian organoleptik, homogenitas, pH, viskositas, daya sebar, dan daya busa. Hasil dari penelitian menunjukkan formulasi sediaan facial wash gel FII memenuhi semua syarat evaluasi sediaan. FI tidak memenuhi syarat uji daya sebar, sedangkan pada FIII tidak memenuhi syarat uji homogenitas dan viskositas. Variasi konsentrasi Carbopol 940 sebagai gelling agent memberikan hasil berpengaruh secara signifikan ($p<0,05$) terhadap uji viskositas tetapi tidak berpengaruh secara signifikan ($p>0,05$) terhadap uji pH, daya sebar, dan daya busa.

Kata kunci: *daun papaya, gel sabun muka, jerawat, karbopol 940*

INTRODUCTION

Indonesia, classified as a tropical nation, experiences two distinct seasons: the rainy and perpetually shifting summer seasons. This climatic condition may have an impact on the well-being of the epidermis, particularly that of the face, which is designed to adapt to its surroundings [1]. Facial skin tissue are particularly vulnerable to health disorders. These disorders can arise from various factors, including hormonal imbalances, excessive oil gland production, or daily activities both indoors and outdoors, which can impact the health of the facial skin [2].

Indonesia's tropical climate contributes to the development of moist facial skin [3] . On oily skin, the oil glands produce lubricants continuously to hydrate the surface. Acne formation is among the skin disorders that can be induced by an overabundance of sebum discharge [4] . One of acne causing microbes, scientifically known as *Acne vulgaris*, can be attributed to the accumulation of excess sebum within the pores, which promotes bacterial proliferation and inflammation [5]. Anaerobic bacterium *Propionibacterium acnes* contributes

to the pathogenesis of acne [6]. The proliferation of *Propionibacterium acnes* can be impeded by using antibacterials derived from natural or synthetic sources. Inhibitory to bacterium growth are papaya leaves, a naturally occurring substance. Previous research has determined that 96% of ethanol extracts possess antibacterial properties. Carpain, which is present in papaya leaf extract, possesses anticancer properties [6].

Presently, the formulation for the facial cleanser has been finalized, with one such formulation taking the form of a gel [7]. In comparison to other formulations, the gel formulation offers the following benefits: excellent penetration into the skin, non-clogging of pores, cold effect upon application, efficient drug release, and simple rinsing [8]. As a gel-forming component, a gelling agent must be incorporated into the formulation of the gel preparation [9]. Carbopol 940 is among the most frequently implemented gelling substances. It is crucial to precisely determine the concentration of the gelling agent, as it is a determining parameter that impacts both the stability of the preparation and the absorption of the active substance [10].

Based on the provided background information, the researcher aims to develop a facial wash gel containing papaya leaf extract as the active ingredient. This extract has been found to have the ability to inhibit bacteria that cause acne. The researcher intends to vary the concentration of carbopol 940, which is a gelling agent, in the formulation.

METHOD

Tools

In this study, the tools employed were: Beaker glass 250 mL, measuring cylinder 100 mL, stirring rod, analytical balance (Ohaus, USA), pH indicator (MColorpHast, Jerman), Oven (Memmert, Jerman), Magnetic stirrer (Faithful, China), Viscometer Brookfield (Brookfield Engineering Laboratories, Inc., Boston, USA), Dropping pipette (Pyrex, Jepang), and Rotary evaporator (IKA, Jerman).

Materials

The materials utilized in the study were as follows: sodium lauryl ether sulfate (KAO, Indonesia), cocamidopropyl betaine (KAO, Indonesia), carbopol 940 (Corel Pharma Chem, india), propylene glycol (Wilmar, Singapore), sodium metabisulfite, DMDM hydantoin , triethanolamine, parfume and aquadest.

Facial Wash Gel Preparation

The prepared formula of the facial wash gel can be seen in Table 1. The preparation of the facial wash gel from papaya leaf extract in this study commenced with creating a gel base. The gel base was achieved by dispersing Carbopol 940 in aquadest and mixing the mixture with a stirrer at 400–600 rpm until a base was formed. After this, sodium metabisulfite, dissolved in some aquadest, was added to the base, which was then blended with the stirrer until it became homogeneous (M1).

After adding papaya leaf extract to a chemical glass, propylene glycol and cocamidopropyl betaine are combined and stirred until homogeneous. Sodium lauryl ether sulfate and DMDM hydantoin are added, and the mixture is stirred steadily until homogeneous (M2). M2 is gradually added to M1, followed by aquadest and perfume, combined with an agitator until uniform.

Tabel 1
Papaya Leaf (*Carica papaya* L.) *Extract Facial Wash Gel Formulation*

Materials	Concentration (% w/v)			Function
	FI	FII	FIII	
Papaya Leaf Extract	1	1	1	Active ingredient
Carbopol 940	1	1,5	2	Gelling agent
Sodium Lauryl Ether Sulfate	10	10	10	Surfactant
Cocamidopropyl Betaine	5	5	5	Surfactant
Propylene Glycol	15	15	15	Humectant
DMDM Hydantoin	0,6	0,6	0,6	Preservative
Sodium Metabisulfite	0,1	0,1	0,1	Antioxidant
Triethanolamine	1,5	1,5	1,5	Alkalizing agent
Parfume	0,1	0,1	0,1	Parfume
Aquadest to	100	100	100	Solvent

Evaluation of Facial Wash Gel

The preparation is undergoes organoleptic testing, which involves evaluating its color, odor, and texture [11]. For testing the homogeneity of the face wash gel, a 0.2gram sample is applied to a piece of glass or another suitable lining material. It should have a uniform appearance with no visible rough particulates [12].

The universal pH is utilized by submerging the paper in the sample and subsequently comparing its color to that of a standard with a known pH value. The preparation's pH is modified to match the skin's pH range of 4.5–6.5; however, a pH range of 6–8 is deemed tolerable to prevent irritation during extended periods of exposure [7,13].

The procedure of viscosity test involves utilizing a Brookfield Viscometer, where the sample is introduced into a 100-mL container, affixed to the spindle, and the instrument is activated at a specific revolution per minute. The number is multiplied by the factor indicated on the gadget. An ideal viscosity ranges from 500 to 20,000 cPs [14,15].

The procedure of spreadability test included weighing up to 0.5g of the sample, which was placed on top of the glass, on a load of 150g. After one minute of waiting, the diameter of the combined force was determined using the micrometer. The required spreadability test for topical supplies is 5-7cm ([12,16].

For measured foam stability, 1g of the weighed sample was transferred into the reaction tube, 10 mL of aquadest was added, the tube was folded, and the height of the froth produced was measured. Foam stability was determined by allowing an object to occupy it for ten minutes, while foam formation was computed by measuring foam height and the point at which foam began to decompose. Conditions affected foam height by 1.3–22 cm [17].

Statistic Analysis

The normality of the data in this study is ascertained through the application of the Shapiro-Wilk method, with a confidence level of 95%. If the p-value is more significant than 0.05, which suggests that the data follows a normal distribution, the one-way parametric statistical test Anova is applied; otherwise, the non-parametric analytical test Kruskal-Wallis is utilized. The treatment is considered significantly altered if *p* is less than 0.05; otherwise, it is not significantly altered [18]. The Post Hoc test (Tukey HSD) is used to determine the smallest difference [19].

RESULT

Evaluation of Facial Wash Gel

This study categorized the preparation of facial wash gel into three formulations (FI, FII, and FIII), adding gelling agent concentrations of 1%, 1.5%, and 2%, respectively. In order to

determine the compatibility of the polymer Carbopol 940 with the outcomes of an assessment of a facial wash gel formulated with pepper leaf extract, various quality attributes were evaluated in addition to organoleptic testing, including froth strength, homogeneity, and pH. Concentration variations were conducted for this purpose.

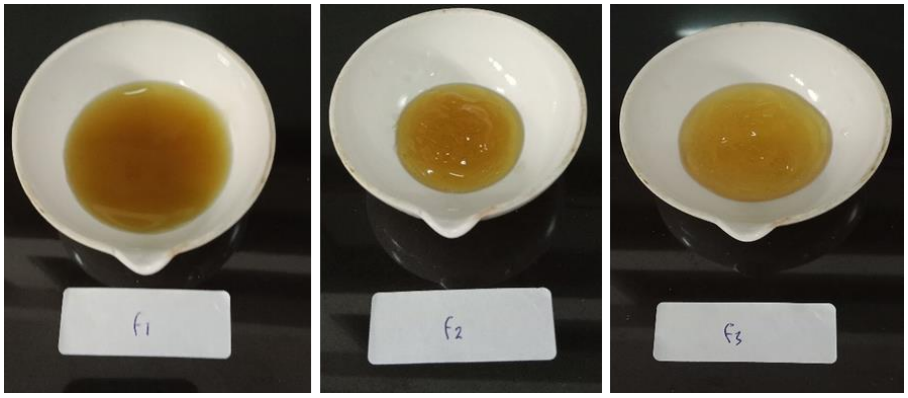

*Figure 1.*Appearance of papaya extract facial wash gel.

Tabel 2
Evaluation Results of the Facial Wash Gel Formula for Papaya Leaf Extract

Day	Formula	Homogeneity	pH	Viscosity (cPs)	Spreadability (cm)	Foam Power (cm)
0	I	Homogenous	6	7.320	6,73	8,1
	II	Homogenous	6	18.000	4,01	7,0
	III	Homogenous	6	22.080	3,88	7,5
1	I	Homogenous	6	7.440	6,91	6,6
	II	Homogenous	6	18.000	4,98	8,0
	III	Homogenous	6	22.080	3,94	9,0
7	I	Homogenous	6	7.200	7,25	7,6
	II	Homogenous	6	16.000	5,98	7,0
	III	Homogenous	6	21.580	5,98	8,0
14	I	Homogenous	6	7.000	7.00	8,1
	II	Homogenous	6	15.400	5,96	8,0
	III	Inhomogenous	6	21.280	5,71	9,0
21	I	Homogenous	6	6.720	7,13	8,4
	II	Homogenous	6	15.320	5,91	7,5
	III	Inhomogenous	6	21.200	5,66	9,0
28	I	Homogenous	6	6.440	7,11	8,0
	II	Homogenous	5	15.200	5,78	7,5
	III	Inhomogenous	5	21.120	5,45	9,0

Initially, all formulas exhibited distinct properties as a result of variations in the concentration of carbopol 940. From an organoleptic perspective, the three preparations exhibited distinct hues. Specifically, the FI formula had a darker hue in comparison to the other formulas (Figure 1). The preparations exhibited varying consistencies, with FIII being notably thicker than the other formulations.

All formulations showed uniform preparation results with a consistent pH level of 6. The three formulations exhibited variations in several physical attributes, including viscosity, spreadability, and foamability, which measured between 7,320 and 22,080 cPs, 3.88 and 6.73 cm, and 7.0 and 8.1 cm, respectively.

DISCUSSION

It was found that after 28 days of storage, the organoleptic test showed that the active ingredients in each formulation mixed evenly and had a fragrant quality, like fresh flowers (Figure 1). Formula FI generated a liquid gel, Formula FII generated a slightly thick gel, and Formula FIII generated a thick gel. The third formula yielded variously coloured preparations, specifically dark brown for FI, which diminishes in hue as the concentration increases. Based on studies conducted by Hasriyani *et al.* [20] and Mursal, Kusumawati and Puspasari, [10], it has been established that elevated concentrations of Carbopol 940 may impact the appearance and colour intensity of organoleptic preparations.

The storage homogeneity test was done over 28 days, and the results showed that preparations FI and FII gave uniform results. However, preparations FIII gave uneven results because their consistency changed into two layers on day 14, and particles formed. The findings of this investigation corroborate those of Kartikasari and Anggraini [21], which demonstrated that the gel formulation lacked homogeneity on the fourteenth day. According to this study, the alteration happened due to the preparation going through syneresis. Based on the observations, it is possible to conclude that FI and FII satisfy the evaluation criteria for the homogeneity test.

The pH test results obtained after 28 days of storage indicated that FI maintained a stable pH on a scale of 6. In contrast, FII and FIII exhibited a decrease in pH, resulting in a scale of 5. Variations in the pH value of Carbopol 940-based preparations may result from inadequate storage and temperature conditions. Progressively generates more H_3O^+ (acid) through a chemical reaction between the carboxylate groups in Carbopol 940 and water, thereby increasing the acidity of the gel [22]. Based on observations, it is possible to conclude that every formula satisfies the criteria for pH test evaluation.

The findings from the viscosity test evaluation (Table 2) over 28 days of storage indicated that a reduction in viscosity was observed in all formulations. Based on a study by Akmal, Tanjung and Nurlaela [13], variations in viscosity outcomes may be attributed to several factors. Among these is the polymer's response to temperature fluctuations during storage. Additionally, hygroscopic formula components that induce the gel to absorb water vapour from the environment may also have an impact. Furthermore, this is supported by a study conducted by Zakaria, Febrina and Rusli [23], which demonstrates that the viscosity of the resulting gel preparation decreases as water vapour is introduced, leading to an increase in the preparation's water content and a subsequent runniness. Based on the observations, it is possible to conclude that FI and FII satisfy the evaluation criteria for the viscosity test.

The spreadability values of all formulations exhibited an upward trend over 28 days of storage, as indicated by the spreadability test evaluation results (Table 2). Both FII and FIII exhibited favourable spreadability as they fulfilled the criteria of the spreadability test. However, FI needed to meet the test requirements as the obtained results surpassed the specified range of 5-7 cm [12]. The enhanced spreadability observed in FI can likely be attributed to the more liquid consistency of the formulation than FII and FIII. As stated in a study by Husnani and Al Muazham, [24], distinct distribution diameters can be obtained when applying the same load using various preparation formulations. With preparations having a reduced viscosity, the diameter of the distribution will be enlarged.

The findings of the foam power assessment (Table 2) over 28 days of storage indicated that the foam power values of all formulations fluctuated. This is consistent with prior investigations conducted by Yuniarsih *et al.*, [25], which suggest that this fluctuation was likely attributable to the shaking technique employed during manual testing instead of utilizing a tool with adjustable standard speed and duration. Based on the observations, each formula satisfies the criteria for evaluating foam power.

The results of the post hoc test using Tukey HSD showed that in the pH test the results were not significantly different (p>0.05) between test groups. For viscosity, all formulas showed significantly different results (p<0.05). F1 showed a significant difference (p<0.05) with

F2 and F3 in the spreadability test, but F2 and F3 were not significantly different. The results of the F2 foam power test were significantly different from F3 (p<0.05).

CONCLUSION

Based on the research findings, it is possible to incorporate papaya leaf extract into a facial cleanser gel formulation utilizing Carbopol 940 polymer. The formulation for a facial wash gel preparation containing papaya leaf extract and Carbopol 940 (1.5%), as shown in FII, satisfies all preparation evaluation criteria, including foaming power, spreadability, homogeneity and viscosity tests. In contrast, FI fails to meet the spreadability test requirement, and FIII fails to meet the homogeneity and viscosity test requirements.

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