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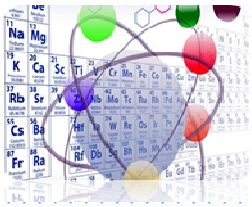

Comparison between Carboxy Methyl Cellulose and Carbomer as Viscosity Agents on the Physical Stability of Combination Shampoo Preparations of Jackfruit Leaves (*Artocarpus heterophyllus*) and Pandan Leaves (*Pandanus amarillyfolius*)

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ABSTRACT

Viscosity agents such as carboxy methyl cellulose (CMC) and carbomer are an important part of shampoo preparations because they function as regulators of the viscosity of the preparation which can affect physical stability. This study analyzes the differences between CMC and carbomer as viscosity agents on the physical stability of a combination shampoo preparation of jackfruit leaves (Artocarpus heterophyllus) and pandan leaves (Pandanus amarillyfolius). The physical stability measured by this shampoo preparation includes the density test, viscosity test, and foam test. There is a difference in specific gravity between shampoos that use the viscosity agent CMC and carbomer in F1, F2, and F3 (P value <0.05), a difference in viscosity in F1 (P value <0.05), and there is no difference in viscosity between the shampoos used. using viscosity agent CMC with carbomer on F2 and F3 (P value >0.05), as well as high foam on F1, F2, and F3 (P value >0.05).

Keywords: Carboxy Methyl Cellulose, Carbomer, Physical Stability

1. INTRODUCTION

The tropical climate, which tends to be hot, causes the skin to sweat more easily, including the scalp. In particular, the scalp is quite thick and contains many sebaceous glands, making it susceptible to fungal infections and inflammation[1]. The scalp and hair need antioxidants that can rejuvenate hair, repair damaged hair cells, and improve blood circulation so that hair becomes strong and not dull[2]. One of the problems with

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the scalp and hair is dandruff which is caused by Candida albicans and is usually called candidiasis on the human skin mucosa(3).

Dandruff treatment requires a long time, so choosing anti-dandruff products made from natural ingredients made in shampoo is better used to overcome dandruff problems[4]. The results of previous research screening on jackfruit leaves showed positive results for flavonoid compounds, phenols, steroids, and tannins. Flavonoids have antioxidant, anti-inflammatory, anti-fungal, anti-viral, anti-cancer and anti-bacterial activity[5]. Based on research conducted by Dewanti et al (2017) pandan leaves contain flavonoid, alkaloid, saponin, tannin, and polyphenol compounds. The flavonoids contained in pandan leaves are polyphenolic compounds found as secondary metabolites in plants and have various pharmacological activities[6].

Viscosity agents such as carboxy methyl cellulose (CMC) and carbomer are an important part of making shampoo preparations because they function as regulators of the viscosity of the preparation which can affect physical stability[7]. CMC is a cellulose derivative that has neutral, stable properties and is resistant to microbial growth[8]. Based on a study conducted by Mardiana et al (2019) the addition of CMC to topical preparations has the effect of increasing the spreadability when the preparation is used[9].

Carbomer as a synthetic viscosity agent is acceptable when mixed with various active substances, has an attractive organoleptic appearance, and is effective in increasing viscosity at low concentrations of active substances[10]. Carbomer also has good homogeneity as indicated by the absence of coarse grains in the preparation[11]. This study aims to analyze the differences between CMC and carbomer as viscosity agents on the physical stability of a combination shampoo preparation of jackfruit leaves (*Artocarpus heterophyllus*) and pandan leaves (*Pandanus amarillyfolius*).

2. EXPERIMENTAL

2.1. Chemicals, Equipment, and Instrumentation

The materials used were jackfruit leaf extract, pandan leaf extract, CMC, carbomer, ethanol, sodium lauryl sulfate, methylparaben, propylene glycol, menthol, and distilled water. The equipment used were dropper pipette, oven, analytical balance, stopwatch, thermometer, magnetic stirrer, separating funnel, 60 mesh sieve, viscometer, 25 ml pycnometer, measuring cup, and beaker glass.

2.2. Research Procedure

2.2.1. Preparation of Sample

The CMC as a viscosity agent is put into a hot container, stirred until it expands, and mixed with methylparaben and sodium lauryl sulfate which have been dissolved in water and stirred until homogeneous (Part 1). Menthol mixed with propylene glycol (Part 2). Part 1 is mixed with part 2 and stirred until homogeneous, then add pandan leaf extract and jackfruit leaf extract, add the remaining distilled water to the mixture, and stir until homogeneous. The same treatment for making shampoo preparations uses carbomer as a viscosity agent. The shampoo formula is shown in Table 1.

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Table 1. The Shampoo Formula of Jackfruit Leaves and Pandan Leaves Extract

Material	Ccarboxy Methyl Cellulose			Carbomer		
	F1	F2	F3	F1	F2	F3
Jackfruit leaves extract	5 %	5 %	5 %	5 %	5 %	5 %
Pandan leaves extract	5 %	5 %	5 %	5 %	5 %	5 %
Ccarboxy methyl cellulose	0,25 %	0,50 %	0,75 %	-	-	-
Carbomer	-	-	-	0,1 %	0,3 %	0,5 %
Sodium lauryl sulfate	10%	10%	10%	10%	10%	10%
Methylparaben	0,2%	0,2 %	0,2 %	0,2%	0,2 %	0,2 %
Propylene glycol	6 %	6 %	6 %	6 %	6 %	6 %
Menthol	0,2 %	0,2 %	0,2 %	0,2 %	0,2 %	0,2 %
Aquadest ad	100 ml	100 ml	100 ml	100 ml	100 ml	100 ml

F1 : Formula 1
F2 : Formula II
F3 : Formula III

2.2.2. Density Test

Density was measured using a 25 ml pycnometer at 25°C. The empty pycnometer is weighed (A), then the pycnometer containing distilled water is weighed (B), then the pycnometer containing the shampoo preparation is weighed carefully (C). The results are recorded and the density is calculated.

2.2.3. Viscosity Test

The viscosity test aims to measure the viscosity of a shampoo preparation using a viscometer. The viscosity of each formula was measured 3 times using an Ostwald viscometer.

2.2.4. Foam Test

The height of the foam is tested by dissolving 10 ml of shampoo in a measuring cup, and then shaking it for 5 minutes. The foam formed is left for 10 – 15 minutes, then the height of the foam formed is measured.

2.3. Data Analysis

Data were analyzed using the t-test method.

3. RESULTS AND DISCUSSION

3.1. Analysis of Density

The density test aims to determine the stability of the shampoo preparation. Based on the results of the t-test analysis, in F1, F2, and F3 there was a difference between the shampoo preparation that used the viscosity agent CMC and the shampoo preparation that used the viscosity agent carbomer (P value <0.05) (Table 2). Shampoo preparations that use CMC, in F1, F2, and F3 have different CMC concentrations. However, the data from the density test results show that the shampoo preparation using CMC has the same density values as F1, F2, and F3 of 1.03 g/ml. This is different from the study conducted by Fitriana (2020),

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which showed that the greater the CMC concentration used in each formula affected the density value of the cosmetic preparation[12]. Shampoo preparations that use carbomer in F1, F2, and F3 have increasing carbomer concentrations in the formula. The largest carbomer concentration is in F3, so the density of F3 shows the highest value. When Carbopol is dispersed in water, it hydrates and forms cross-links, resulting in a very thick gel quickly. Therefore, the more carbopol polymer used, the more cross-links will be formed increasing the consistency of the shampoo preparation's specific gravity[13].

Table 2. CMC and Carbomer Density Test Results

Formulas	CMC			Carbomer			P
	Replication 1 (g/ml)	Replication 2 (g/ml)	Replication 3 (g/ml)	Replication 1 (g/ml)	Replication 2 (g/ml)	Replication 3 (g/ml)	
F1	1,03	1,03	1,03	47,64	47,63	47,62	0,00
F2	1,03	1,03	1,03	47,51	47,52	47,54	0,00
F3	1,03	1,03	1,03	47,86	47,88	47,90	0,00

F1 : Formula 1
F2 : Formula II
F3 : Formula III

3.2. Analysis of Viscosity

Based on the t-test analysis, there was a difference in viscosity in F1 between shampoo that used the viscosity agent CMC and shampoo that used the viscosity agent carbomer (P value <0.05). In F2 and F3 there was no difference in viscosity between the shampoo using the CMC viscosity agent and the shampoo using the carbomer viscosity agent, respectively P value 0.91 and 0.08 (Table 3). In general, for shampoos that use CMC, there is an increase in viscosity in F1, F2, and F3, proportional to the increase in CMC concentration used in each formula. The results of this analysis are in line with studies conducted by Kamal (2010), that this occurs because cross-links and immobilization have formed. The higher the solvent molecules, the higher the viscosity increase[14]. In shampoos that use carbomer, the higher the concentration of carbomer used in F1, F2, and F3, the lower the viscosity. The results of this study are different from those of Mikhania (2022) and Smaniyah (2024) which showed that the viscosity of shampoo increased as the concentration of carbopol used increased[15,16] .

Table 3. CMC and Carbomer Viscosity Test Results

Formulas	CMC			Carbomer			P
	Replication 1 (cP)	Replication 2 (cP)	Replication 3 (cP)	Replication 1 (cP)	Replication 2 (cP)	Replication 3 (cP)	
F1	4,56	6,01	5,67	7,92	8,37	8,14	0,00
F2	5,87	7,78	7,00	7,55	7,13	*5,68*	0,91
F3	6,22	7,76	10,81	5,11	5,12	5,28	0,08

F1 : Formula 1
F2 : Formula II
F3 : Formula III

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3.3. Analysis of Foam

The foam test results of the shampoo preparations showed that in F1, F2, and F3, there was no difference between shampoos using viscosity agents CMC and carbomer, with a P value >0.05 (Table 4). This is because the shampoo preparations F1, F2, and F3 contain sodium lauryl sulfate (SLS) at the same concentration (10%). Sodium lauryl sulfate is often used in shampoo preparations, and functions as a surfactant[17]. Surfactants are useful in shampoo preparations for cleaning the scalp and hair from dirt and oil, because they have a hydrophilic and lipophilic structure, so they can reduce surface tension[18]. A part from cleaning dirt and oil, SLS functions as a foaming agent. Long-term use of SLS in cosmetics and in high doses can cause the skin to become dry and irritated[19]. Foam in shampoo preparations is formed due to the length of the shaking process, the type of surfactant used, and the room temperature at the time of measurement[20].

Table 4. CMC and Carbomer Foam Test Results

Formulas	CMC			Carbomer			P
	Replication 1 (cm)	Replication 2 (cm)	Replication 3 (cm)	Replication 1 (cm)	Replication 2 (cm)	Replication 3 (cm)	
F1	9,00	10,00	10,50	7,00	6,40	9,50	0,10
F2	10,00	10,50	11,00	10,00	11,00	11,70	0,52
F3	8,00	10,00	12,00	11,00	11,70	11,30	0,32

F1 : Formula 1
F2 : Formula II
F3 : Formula III

4. CONCLUSION

There is a difference in specific gravity between shampoos that use the viscosity agent CMC and carbomer in F1, F2, and F3 (P value <0.05), a difference in viscosity in F1 (P value <0.05), and there is no difference in viscosity between the shampoos used. using viscosity agent CMC with carbomer on F2 and F3 (P value >0.05), as well as high foam on F1, F2, and F3 (P value >0.05).

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