

Research Article

Formulation of Air Freshener Gel Combination of Mint Leaf Essential Oil (*Mentha piperita* L.) and Lemon (*Citrus limon* (L) Burm F.)

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Abstract

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Air freshener gel is a semi-solid fragrance product that uses carrageenan and pectin as gel-forming components to overcome unpleasant odors when in a room with high temperatures. The purpose of this study was to determine the composition of carrageenan and pectin as gel-forming materials for air fresheners and the composition of the aroma comparison of mint oil (*Mentha piperita* L.) and lemon (*Citrus limon* (L) Burm F). The gel base was made with a ratio of carrageenan: pectin concentration of 1: 2; 1.8: 1.2; 2.5: 0.5 then the base was evaluated including organoleptic examination, stability test and gel hardness. The best base was then added with mint oil and lemon with a ratio of 1: 1.5; 1.25: 1.25; 1.5: 1 and the gel preparation was evaluated with organoleptic parameters, gel stability, gel hardness, liquid evaporation, fragrance resistance and hedonic test. The results of the study showed that the best base preparation after the evaluation of the base was a ratio of carrageenan: pectin concentration of 2.5: 0.5. Evaluation of the preparation with the addition of mint leaf oil (*Mentha piperita* L.) and lemon (*Citrus limon* (L) Burm F) to the base showed a value that was not too significant in the evaluation results. In the hedonic test, the formula with the addition of 2.5%: 2.5% mint leaf oil (*Mentha piperita* L.) and lemon (*Citrus limon* (L) Burm F) was the formula preferred by the panelists. So it can be concluded that the carrageenan and pectin combination room freshener gel with a concentration ratio of 2.5: 0.5% can be formulated as a base for room freshener gel preparations, namely producing a chewy and elastic gel base. The formulation of the most preferred combination of mint leaf essential oil and lemon oil as a gel fragrance is with a concentration of 2.5: 2.5%, because it produces a refreshing aroma.

Keywords: Air freshener gel, essential oil, mint leaves, lemon

1. INTRODUCTION

Essential oils are complex mixtures of volatile alcohol compounds produced as secondary metabolites in plants. Essential oils usually determine the distinctive aroma of plants. Indonesia is one of the most important essential oil suppliers in the world. Indonesia produces 40 of the 80 types of essential oils traded on the world market. Essential oils have very promising business potential. The raw materials for this oil are obtained from various parts of plants such as leaves, flowers, fruits, seeds, seed coats, stems, roots, or rhizomes. Essential oils have been used as perfumes, cosmetics, food additives and medicines.

Air freshener gel is a semi-solid fragrance product that uses carrageenan as a gel-forming component or other types of gel-forming materials. This product functions to overcome unpleasant odors, reduce fatigue when in a room with a high temperature and provide a relaxing effect. The increasingly hot environmental conditions cause the room to become stuffy. This triggers an increasing demand for air freshener products. The type of air freshener product that is suitable for this room is the gel-shaped product type to make it more practical. Air freshener gel products are widely developed because they are elastic, more durable, and more attractive. In addition, the gel form can inhibit the release of volatile substances in air fresheners so that the fragrance lasts longer.

Air freshener gels are composed of several types of ingredients including basic gel-forming ingredients, additives, fragrances and fixatives. Commonly used natural gel formations are xanthan gum, pectin, carrageenan, agar-agar, and gelatin [7]. The use of pectin alone will create a soft gel texture in the gel making process so that other gel-forming ingredients such as carrageenan are needed. The use of hazardous chemicals in synthetic air fresheners such as formaldehyde can have side effects on humans including irritating the eyes, nose, throat, skin, causing nausea, dizziness, bleeding, memory loss, cancer and tumors, liver damage, causing mild to moderate irritation to the lungs, including asthma symptoms. Thus, the use of natural air freshener gels is a solution that can be developed through research so that it is safer to use.

Based on the description above, the researcher conducted a study on making room fragrance gel using natural ingredients, such as mint leaf oil and lemon oil which are natural essential oils as fragrance ingredients. Mint leaves are used as a fragrance that provides aromatherapy, because of its nature can emit a distinctive and calming aroma. The fragrant aroma of mint leaves is caused by the content of essential oils in the form of menthol oil [12]. Lemon oil has a refreshing aroma. The combination of mint and lemon aromas is expected to provide a refreshing aroma sensation and provide a sense of relaxation for those who inhale the aroma. And, carrageenan and pectin are used as gelling agents so that the texture of the gel produced is better and is expected to have good fragrance resistance. The purpose of this study was to obtain a formulation of room fragrance gel preparations from mint leaf essential oil (*Mentha piperita* L.) and lemon oil (*Citrus limon* (L.) Burm. F.) by finding out the formula that is most preferred by panelists.

2. MATERIALS AND METHODS

2.1. Material

Mint oil, Lemon oil, Patchouli oil, Carrageenan, Pectin, Propylene glycol, Sodium benzoate, Aquadest

2.2. Instrument

Stirring rod, Evaporating dish, Gel mold, Watch glass, Beaker, Measuring cup, Hot plate, Hardness tester, Parchment paper, Water bath, Dropper pipette, Thermometer, Scale, Gel container

2.3. Method

2.3.1. Base Optimization

The procedure carried out in making this gel begins with preparing the tools and materials to be used and weighing the materials that will be needed. Aquadest is heated in a beaker to 75°C. Carrageenan is added, stirred quickly until dissolved, then pectin is added and stirred again quickly. After that, sodium benzoate is added little by little and then stirred quickly until homogeneous. The beaker is lifted from the water bath and stirred quickly until the temperature drops to 65°C After that, propylene glycol is added and stirred quickly until homogeneous. Poured into a container and left at room temperature to form a gel.

Table 1 Design of Gel Base Formula

Materials	Concentration (%)		
	F1	F2	F3
Carrageenan:pectin	1:2	1,8:1,2	2,5:0,5
Sodium benzoate	0,3	0,3	0,3
Propylene glycol	10	10	10
Aquadest	ad 100	ad 100	ad 100

2.3.2. Evaluation of Gel Base Preparations

a) Organoleptic Test

Organoleptic testing with the tested aspect being the best gel texture from the combination concentration of carrageenan and pectin as a gel base. The expected gel texture is a gel that is chewy and elastic and not brittle.

b) Gel Stability Test

Gel Stability Test Gel stability is tested by calculating and comparing the level of syneresis between samples. The gel that has been formed in a plastic container is weighed (M_0) then the gel is stored in a room with a temperature of 30°C in an open plastic container. After 24 hours, the gel is weighed for its final weight (M_i). The data calculated is the percentage of syneresis with the formula as follows:

$$\text{syneresis (\%)} = \frac{M_0 - M_i}{M_0} \times 100\%$$

c) Gel Hardness Test

Gel hardness test using a Hardness tester tool with the gel preparation installed in a vertical position then rotated on the pressing part and observed the scale until the gel preparation is destroyed. The hardness value to be obtained is entered into g/cm² units.

2.3.3. Air Freshener Gel Preparation Formulation

Table 2 Design of Air Freshener Gel Preparation Formula

Materials	Concentration (%)		
	F1	F2	F3
Carrageenan:pectin	2,5:0,5	2,5:0,5	2,5:0,5
Mint oil:lemon	1:1,5	1,25:1,25	1,5:1
Patchouli oil	1	1	1
Sodium benzoate	0,1	0,1	0,1
Propylene glycol	10	10	10
Aquadest	Ad 100	Ad 100	Ad 100

2.3.4. Air Freshener Gel Preparation Formulation

a) Liquid Evaporation Test

The liquid evaporation test was carried out by weighing the gel weight every 3 days for 15 days. This air freshener gel was stored in several places, namely in a room temperature room at a temperature of 26-30°C, an AC room at a temperature of 18-19°C and a fan room, to compare gels stored in different places. From this test, the amount of weight loss of the gel was obtained each week and the weight loss after 15 days of storage. The weight loss of the air freshener gel was obtained by calculating the difference in the initial gel weight (M_0) with the gel weight at the time of weighing (M_n). The amount of weight difference is the amount of liquid that evaporates. the formula for the total percentage of liquid evaporation is calculated as follows:

$$\text{total evaporation of liquid (\%)} = \frac{M_0 - M}{M_0} \times 100\%$$

The percentage weight of the remaining gel is calculated using the following formula:

$$\text{Percentage weight of remaining gel (\%)} = \frac{\text{Gel weight day to day} - n (M_n)}{\text{Gel weight day to day} - 0 (M_0)} \times 100\%$$

b) Fragrance Durability Test

The fragrance durability test of the room fragrance product was conducted to determine the usage age and fragrance durability of the room fragrance gel for 15 days of storage and will be assessed by 6 panelists [9]. The fragrance durability test of the room fragrance gel was conducted on the 3rd, 6th, 9th, 12th and 15th days of storage. During testing, the gel was positioned 45° from the nose with a distance of 10 cm and the fragrance was smelled by waving the hand towards the nose from the gel preparation that had been stored or used in each place, namely in a room with a room temperature of 26-30°C, an AC room at a temperature of 18-19°C and a fan room. The AC and fan were turned on for 8 hours a day. The room was 4x4 m in size. Each sample was tested for fragrance durability using a comparison sample, namely a newly made gel preparation.

Testing was carried out by comparing the strength of the test gel fragrance with the standard gel on a scale of 5 - 1, namely 1 (no fragrance), 2 (very less fragrance), 3 (less fragrance), 4 (slightly less fragrance), 5 (same fragrance). The data obtained from the questionnaire were tabulated and the value was determined for each preparation by finding the average result for each panelist at a 95% confidence level [4].

c) Hedonic/Like Test

The hedonic test was conducted to determine the best concentration of mint and lemon oil in the air freshener gel. Panelists were asked to express their personal impressions of the level of liking the air freshener gel preparation. The fragrance preference test was conducted by smelling it two to three times. During testing, the gel was positioned 45° from the nose at a distance of 10 cm and the fragrance was smelled by waving the hand towards the nose.

This test used a minimum of 30 panelists. Panelists were asked to express their personal impressions of liking or disliking an air freshener product with a preference scale. The scale used was 1 (dislike), 2 (less like), 3 (neutral), 4 (like), 5 (very much like). Panelists provided an assessment by filling out the questionnaire that had been given. The data obtained from the questionnaire were tabulated and the preference value was determined for each preparation by finding the average result for each panelist at a 95% confidence level [4].

3. RESULT AND DISCUSSION

In this study, the gel formulation consisted of mint leaf oil, lemon oil, patchouli oil, carrageenan, pectin, sodium benzoate, propylene glycol, and distilled water. Mint and lemon oils function as active fragrance substances. Patchouli oil functions as a binder for essential oils. Carrageenan and pectin function as basic ingredients for gelling. Sodium benzoate functions as a preservative. Propylene glycol functions as an emulsifier to help maintain the stability of the water and essential oil emulsion. Aquadest functions as a solvent. The use of mint and lemon oil with a concentration of 5% and patchouli oil 1% is based on previous research by Aqila (2018) which obtained a formula of 5% peppermint oil concentration and 1% patchouli oil as the gel preparation most preferred by panelists through the hedonic/preference test conducted.

The results of the evaluation of physical characteristics against the results of the optimization of the basis can be seen in table 3 that the formula has met the range of physical requirements pharmaceutically which includes several test parameters including organoleptic, gel stability, and gel hardness. The concentration of carrageenan and pectin used is formula F1 1: 2%, formula F2 1.8: 1.2% and formula F3 2.5: 0.5%. Based on the results of the evaluation of physical characteristics obtained the results of the base of the air freshener gel preparation formula F1, F2 and F3 have a white color, aroma of carrageenan and pectin. Variations in the concentration of carrageenan and pectin produce different consistencies, namely in shape and texture. Formulas F1 and F2 have a consistency that is more easily destroyed than formula F3 which has a denser consistency, is not easily destroyed and elastic. Based on table 3, it can be seen that formula F1 has the highest gel syneresis value of 5.21%, and formula F2 has a syneresis value of 2.86%. Meanwhile, formula F3 has the smallest syneresis value of 0.75%. According to Fitrah, (2013), a good syneresis value according to standards is below 1%, so that the F3 formula is considered a stable base concentration in binding liquids

Table 3. Results of Gel Base Preparation Evaluation

No	Evaluation	Formula		
		F1	F2	F3
1.	Organoleptic			
	Shape/Texture	Less dense, Easily Crushed, Less elastic	Solid, slightly brittle, slightly elastic	Solid, not easily broken, elastic
	Color	White	White	White
	Aroma	Typical of carrageenan and pectin	Typical of carrageenan and pectin	Typical of carrageenan and pectin
2.	Gel Stability Test	5,21%	2,86%	0,75%
3.	Gel Hardness Test	56,67 g/cm ²	246,67 g/cm ²	994,67 g/cm ²

Formula F3 is considered the best gel base to be applied based on organoleptic tests and syneresis values influenced by temperature, carrageenan concentration and pectin concentration. Syneresis indicates the stability of the gel in maintaining the water trapped in it. Syneresis is the event of water coming out of the gel caused by the formation of a gel that is increasingly hardening and shrinking due to the cooling process. If the syneresis value produced is higher, the resulting gel is more-watery and becomes easy to break, but if the syneresis value produced is lower, the resulting gel becomes elastic, not watery and not easy to break. Water syneresis in gel is a natural phenomenon, the water given will come out of the gel matrix. This event can be minimized by determining the

proportion and concentration of the right hydrocolloid components and the addition of supporting gel raw materials. Gel syneresis is influenced by temperature, humidity, salt concentration and polysaccharide concentration.

Formula F3 with a higher carrageenan composition ratio than pectin has lower syneresis than formulas F1 and F2. This is due to the nature of carrageenan which can form a matrix/net/gel framework that can absorb water. The water will be trapped in the matrix cavities formed by carrageenan, so that during the gelation process during cooling, the water that is pushed out is getting less because most of it has been trapped in the carrageenan matrix. Atmaka (2021) explained that the greater the addition of carrageenan, the stronger the double helix structure will be formed and will be able to bind the solvent so that it will reduce syneresis. Meanwhile, pectin forms a gel that is chewy and elastic and can increase gel strength, but does not have the stability of kappa carrageenan. Pectin can absorb water and thicken the liquid during the gelation process, but cannot form a solid gel. This shows that the more pectin, the higher the water content. This is because pectin is a sponge-like system filled with water so that the more pectin, the more water is bound by pectin. Estiasih and Ahmadi (2009) stated that pectin gel is a sponge-like system filled with water.

The results of the gel base hardness test can be seen in table 3 where the F3 gel base has the largest gel hardness value of 994.67 g/cm². Then the second largest gel hardness value is 246.67 g/cm² in the F2 gel base. While the lowest gel hardness value is F1 with a value of 56.67 g/cm². This can occur because the texture of the F1 gel base formula is like porridge and does not harden. The air freshener gel with F2 and F3 experienced an increase in gel because there was a synergistic effect between pectin and a greater carrageenan composition, while the decrease in gel hardness due to the strength in the chain such as the number of sulfate groups has a very important influence on gel formation, because it will inhibit the formation and collection of double helix which then reduces gel hardness. The air freshener gel will have high gel hardness if the gel-forming components and carrier substances support each other to produce good physical properties and will also have a low syneresis value [11].

The results of the gel stability evaluation of the three formulas can be seen in table 4 where the three formulas have syneresis values that fall into the range of good and stable gel stability, which is below 1%. However, there is a significant difference in the percentage value of syneresis obtained, namely in formula K1 a syneresis value of 0.33% was obtained, in formula K2 a syneresis value of 0.17% was obtained and the smallest syneresis value obtained was in formula K3, which was 0.06%. This can be caused by differences in the concentration of mint oil and lemon oil used. In formula K1, the concentration of lemon oil is greater than mint oil, compared to formula K2 which has a balanced concentration of mint and lemon oil, and formula K3 which has a higher concentration of mint oil than lemon oil. Karo (2018) explained that the value of the concentration of essential oils in the gel can affect the syneresis value in air freshener gels because essential oils, especially mint oil, have a high boiling point to further suppress the rate of evaporation. So, it can be seen that the higher the concentration of mint leaf oil used, the lower the percentage value of syneresis obtained.

The results of the gel preparation hardness evaluation can be seen in table 4, where the three formulas have high hardness values so that they are considered to meet the standards of good gel preparations. Where the results of the gel hardness test in this study have a higher gel hardness than the hardness of commercial products, that commercial products have a strength/hardness of 954.11 g/cm² slightly lower than the gel hardness obtained in this study, namely in formula K1 965.33 g/cm², formula K2 969.67 g/cm², and formula K3 969.33 g/cm². The results of the evaluation of the evaporation of the liquid substance of the gel preparation can be seen in table 4. The results of the percentage of remaining weight of the air freshener gel during 15 days of storage in an AC room were the largest in formula K1, namely 43.02% and the smallest percentage of remaining weight of the air freshener gel was in formula K2, namely 32.38%. The percentage of remaining weight of the fragrance gel in a room temperature room is the largest in the K3 formula, which is 45.71% and the percentage of the smallest remaining weight of the fragrance gel

is in the K2 formula, which is 27.41%. And the percentage of the remaining weight of the fragrance gel in a regular room with a fan is the largest in the K3 formula, which is 51.04% and the percentage of the smallest remaining weight of the fragrance gel is in the K2 formula, which is 25.04%.

Table 4. Evaluation Results of Room Fragrance Gel Preparations

No.	Evaluation	Formula		
		K1	K2	K3
1.	Organoleptic:	Solid, not easily broken, elastic	Solid, not easily broken, elastic	Solid, not easily broken, elastic
	Shape	White	White	White
	Color	Typical	Typical	Typical
2.	Aroma	0,33%	0,17%	0,06%
3.	Gel Stability Test	965,33 g/cm ²	969,67 g/cm ²	969,33 g/cm ²
4.	Liquid Evaporation Test:			
	AC	43,02%	32,38%	41,57%
	Room Temperature	34,16%	27,41%	45,71%
	Fan	32,27%	25,04%	51,04%
5.	Fragrance Durability Test:			
	AC	3,1-3,9	3	2,9-3,5
	Room Temperature	1,9-2,7	2,5-3,5	2,5-3,5
	Fan	1,9-2,5	2,1-2,9	1,9-2,7
6.	Hedonic Test	3,26-4,20	3,83-4,37	3,31-4,03

Based on the test room where the fragrance gel is stored, the largest percentage of total liquid evaporation is in the fan room, then the room temperature room and the smallest total liquid evaporation is in the AC room. The weight of the preparation lost is essential oil and water that evaporates from the gel. The greater the weight loss of the remaining gel means that the less essential oil has evaporated, which means that of the three different rooms, the room that experiences the largest total liquid evaporation is the room using a fan. Then, the room with AC experiences the smallest total liquid evaporation. While in the room with room temperature, the total liquid evaporation is between the two. This happens because the room that uses a fan produces strong wind and is directly exposed to the gel preparation, resulting in contact between the gel and the air produced by the wind, so that the evaporation rate is greater than the gel placed in other test rooms. Then, other factors that also affect are air circulation and room size. Karo (2018) explained that room temperature and the value of the essential oil concentration in the gel can affect the total evaporation value of the liquid in the fragrance gel. Also, it is necessary to add a binding agent, namely patchouli oil, as a compound that has a lower evaporation power than the fragrance component and has the function of suppressing the evaporation rate of the fragrance substance. Although the combination of carrageenan and pectin in the fragrance gel can act as a binder, essential oils that have a high boiling point are still needed to further suppress the evaporation rate in the fragrance gel to maintain the fragrance or aroma of the gel.

The results of the evaluation of the fragrance resistance of the gel preparation can be seen in table 4. In a room temperature room, AC and fan, the results obtained are rounded off from the fragrance resistance test values, where 1 (not fragrant), 2 (very less fragrant), 3 (less fragrant), 4 (slightly less fragrant) and 5 (equally fragrant). The air freshener

gel placed in a room temperature room and an AC room has a longer fragrance resistance compared to the air freshener gel placed in a fan room. The air freshener gel placed in a room temperature room and AC can last for 15 days or more. The results of the fragrance resistance test from the assessment of respondents as many as 6 panelists obtained the highest value on the 15th day in the AC room, namely in formula K1 and K2 with a value of 3 (less fragrant) compared to the room temperature room and fan where the value obtained was 2 (very less fragrant). According to Fitrah (2013), the strength of the fragrance that is still in good condition is the one that has a value above 2, namely the same fragrance to less fragrant. Fragrance resistance is the duration of use of the air freshener gel until it reaches a value of 2, which is very less fragrant. Fragrance resistance is influenced by the amount of evaporated material, storage time, because the longer the storage time, the more evaporated material so that the fragrance resistance decreases. It can also be caused by differences in the test room environment, room temperature and room circulation. In addition, the fragrance resistance of air freshener gel products is also influenced by the remaining weight of the gel and the evaporation of the liquid. The smaller the weight lost or the greater the remaining weight means that the less essential oil and water have evaporated, meaning the greater the fragrance resistance of the gel [7].

The results of the preference test can be seen in table 4 above, it is known that the concentration of the combination of mint and lemon oils that is most preferred by the panelists is formula K2 with a value of 3.83-4.37 rounded to 4 (like) has a ratio of mint and lemon essential oil concentrations of 1:1 or 1.25:1.25% respectively, while formulas K1 and K3 are a comparison of mint and lemon essential oil concentrations that are quite preferred by the panelists, formula K1 with a concentration of 1:1.5 has a value of 3.26-4.20 (Neutral) and formula K3 with a concentration ratio of 1.5:1 has a value of 3.31-4.03 (Neutral). Formula K2 was chosen as the best concentration of essential oil combination because at this concentration it produces a balanced mint and lemon aroma between the aroma of mint and lemon, resulting in a fresh and soft aroma. While in formula K1 the aroma of mint leaves is less noticeable and is more dominated by the aroma of lemon, so the aroma is felt to be very pungent. Then, for the K3 formula, the aroma of the lemon produced is less noticeable, and is more dominated by the aroma of mint leaves which is considered very pungent, therefore many panelists do not like the formula. the fragrance of air freshener gel can be greatly influenced by the concentration value of the fragrance ingredient. The greater the concentration of essential oil, the better the fragrance of the gel produced [1]. However, if the essential oil added is too excessive, it can produce a sharp and very pungent aroma.

4. CONCLUSION

The carrageenan and pectin combination room freshener gel with a concentration ratio of 2.5: 0.5% can be formulated as a base for room freshener gel preparations, namely producing a chewy and elastic gel base. The formulation of the most preferred combination of mint leaf essential oil and lemon oil as a gel fragrance is with a concentration of 2.5: 2.5%, because it produces a refreshing aroma.

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