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Optimization of Lip Balm Formulation of Cucumber Fruit Extract (*Cucumic Sativus L.)*

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ABSTRACT

Cucumber is one of the herbal plants that contains antioxidants, vitamins, and minerals that are used to overcome skin problems, so it is suitable for use in making lip balm. The purpose of this study was to obtain the results of optimization of the formulation and physical evaluation of the preparation of cucumber fruit extract lip balm (cucumic sativus l.) that meets the requirements. This type of research is experimental, with the Simplex Lattice Design approach. Then the physical evaluation test of the preparation was carried out including organoleptic, homogeneity, pH, adhesive power, and melting point. The results of the organoleptic test were bone white, peppermint oil odor, and semi-solid texture. The homogeneity test showed that there were no coarse grains. The pH test obtained results according to the requirements of 4.5 - 8. The adhesion test obtained results according to the requirements >4 seconds. And in the melting point test the results were according to the requirements of 50 -70 ^{0} C. Analysis of SPSS 25 results using one sample t-test, obtained pH test results of 0.076, adhesion test of 0.627, and melting point test of 0.410, thus showing a value (p>0.05) which means there is no significant difference between the predicted value and the experimental results.

***Keywords**: Cucumber, Lip balm, Optimization*

INTRODUCTION

Over time, cosmetics have played a significant role in today's lifestyle. The use of cosmetics has gained a certain appeal among the public over the years. Cosmetics can be applied to any external part of the human body, such as the lips (Limanda et al., 2019) . Lip balm is used to moisturize lips to prevent them from drying out and chapping. Furthermore, lip balm can also be used to brighten dull lips. Lip balm is often used in environments with low humidity or extremely cold temperatures to prevent water evaporation from the mucosal epithelial cells in the lips (Desnita et al., 2022) .

One natural ingredient that can be used in making lip balm is cucumber. Cucumbers are members of the Cucurbitaceae family and can be a source of natural antioxidants due to their vitamin C and flavonoid content (Agustin & Gunawan, 2019) . Vitamin C in cucumbers helps brighten and tighten skin, and prevent wrinkles. This is because vitamin C has a stimulating effect on collagen formation. Furthermore, the antioxidants contained in vitamin C can neutralize free radicals that damage skin cells and cause premature aging. They can also relieve skin irritation and reduce fluid retention under the skin (Kurniawan et al., 2021) . Other literature also states that cucumber extract can be used in cosmetics, with a cucumber extract concentration of 3% (Ph *et al.* , 2017) .

simplex lattice design method is used to optimize formulas for varying amounts of ingredients, while maintaining the same total amount. This method can determine the optimum formula using fewer trials, thus minimizing material usage. One of the key factors in choosing the right base for your lip balm is its ability to determine its hardness, ensuring its acceptance and effective use. The base is the primary component of lip balm. Cera alba, a key component

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of lip balm, acts as a potent oil binder, resulting in a homogeneous product. Furthermore, cera alba maintains the consistency of the base and maintains the color stability of the lip balm. Glycerin, a humectant, provides a softening effect on the lip balm.

Based on the background description above, the problem formulation in this study is "How to Optimize the Formulation of Cucumber Fruit Extract *(Cucumic Sativus L.) Lip Balm Preparations* ". The aim of this study was to obtain the results of formulation optimization and physical evaluation of lip balm preparations made from cucumber *(Cucumic sativus L.) fruit extract* that meets the requirements.

MATERIALS AND METHODS

Equipment and Materials

The tools used in this research were analytical scales, water bath, porcelain cup, beaker glass (pyrex), dropper pipette, stirring rod, spatula, watch glass, jar tube.

The materials used in this study were cucumber extract, glycerin, cera alba, nipagin, BHT *(Butylated Hydroxytoluene)*, peppermint essence, vaseline album.

Methods

Sampling and Processing

The samples used in this study were ripe cucumbers (*Cucumic sativus L) obtained from Semarang Regency, Central Java.* The cucumbers are washed to remove impurities. After that, it is cut into pieces and dried in a simple oven at a temperature of 55 ^{0}C. Sample Determination

The samples obtained were determined at Semarang State University (UNNES)

Sample Extraction

Fruit extraction using the maceration method. A 200 g cucumber fruit sample was added to 1000 ml of 70% ethanol. The sample was stirred thoroughly, then the vessel was tightly closed. The maceration process was carried out for 3 x 24 hours with several stirrings and placed in a place protected from sunlight. The resulting macerate was then filtered using filter paper with the help of a vacuum pump to separate it from the filtrate. The resulting filtrate was evaporated using a rotary evaporator at a temperature of 40°C.

The concentration range of the ingredients used in the research can be seen in *the Handbook of Pharmaceutical Excipients,* as follows:

Table 1Range of Material Concentrations

Material	Concentration Range
Cucumber Extract	3%
Glycerin	≤ 30%
Cera Alba	20-25%
Nipagin	0.02-0.3%
BHT	0.0075-0.1%
Peppermint Essence	0.05-10%
Vaseline Album	10-30%

Formula Design

Formula	Extract	Glycerin	Cera Alba	Nipagin	BHT	Essence	Vaseline Album
F1	3%	1%	25%	0.2%	0.02%	1 drop	Add 50 g
F2	3%	15.5%	22.5%	0.2%	0.02%	1 drop	Add 50 g
F3	3%	15.5%	22.5%	0.2%	0.02%	1 drop	Add 50 g
F4	3%	1%	25%	0.2%	0.02%	1 drop	Add 50 g

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Formula	Extract	Glycerin	Cera Alba	Nipagin	BHT	Essence	Vaseline Album
F5	3%	8.25%	23.75%	0.2%	0.02%	1 drop	Add 50 g
F6	3%	22.75%	21.25%	0.2%	0.02%	1 drop	Add 50 g
F7	3%	30%	20%	0.2%	0.02%	1 drop	Add 50 g
F8	3%	30%	20%	0.2%	0.02%	1 drop	Add 50 g

Preparation of Lip Balm Preparation from Cucumber Fruit Extract (*Cucumic Sativus L)*

The method of making lip balm is to dissolve the vaseline album base, and melt the cera alba at its melting temperature of 62-65 ^{o}C, as mixture A. Mix nipagin, BHT, and glycerin, then make it into mixture B. Add mixture B to the melted base while continuing to stir, then when the temperature is not too hot, add the cucumber extract while stirring. After that, the lip balm mixture is put into a mold that has been smeared with glycerin, add peppermint essence and let it stand until it solidifies at room temperature (Hayati et al., 2024)

Physical evaluation tests of lip balm preparations include organoleptic tests, homogeneity, pH, adhesive power, and melting point.

Organoleptic Test

Organoleptic testing was carried out by observing the shape, smell, color, and texture of the lip balm preparation (Hayati et al., 2024) .

Homogeneity Test

The homogeneity test was performed using a glass slide. A 0.5 g sample was smeared onto a transparent slide, then covered with another transparent slide. Homogeneity was indicated by the absence of coarse grains in the preparation (Hayati et al., 2024) .

pH test

The pH test was performed using a calibrated pH meter. The electrode on the pH meter was washed with distilled water and dried with a tissue. The sample was prepared at a 1% concentration, i.e., 1 gram of the preparation was weighed and dissolved in 100 ml of distilled water, then heated. After the solution temperature equaled room temperature, the electrode was dipped into the solution. The instrument was allowed to display a constant pH value. The value indicated by the pH meter represents the pH of the preparation. This test also ensures that the preparation remains within the physiological pH range of the skin of the lips. It is hoped that the appropriate pH will make the preparation non-irritating and very safe for use.

Adhesion Test

The adhesive strength test is carried out by weighing 0.5 grams of the preparation, then applying the preparation to a glass plate and placing another glass plate on top of it. Then the plate is placed on the test apparatus, by applying a load of 500 grams for 60 seconds, then releasing the load and recording the time until the two plates are released/separated. Then repeat the experiment on each plate 3 times. Adhesiveness is related to the absorption of the active ingredients contained in the preparation. The longer the adhesiveness of a preparation, the more active ingredients are absorbed, thus optimizing the therapeutic effect (Hayati et al., 2024) .

Melting Point Test

The melting point test is carried out by inserting the lip balm into an oven with an initial temperature of 50 ^{0}C for 15 minutes, observing whether it melts or not, after that it is increased by 1 ^{0}C every 15 minutes and observing at what temperature the lip balm starts to melt (Hanifa et al., 2024)

Data analysis

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The research design used was experimental with the determination of the optimum formula using the *Design Expert 13 application*. Analysis of the results using *SPSS statistics 25* with normality test and one sample T Test.

RESULTS AND DISCUSSION

Results

Cucumber Extract Lip Balm Formulation

After making the 8 formulas with optimized ingredients, namely Glycerin and Cera Alba, a physical evaluation test was carried out on the preparations and entered into the *Simplex Lattice Design data* , as follows:

Table 2Physical Evaluation Test Results

Run	Glycerin	Cera Alba	pH test	Adhesion Test (seconds)	Melting Point Test (^{0}C)
1	1	25	6.06	36	61.5
2	15.5	22.5	6.19	15	58.3
3	15.5	22.5	5.56	7	61.1
4	1	25	5.54	30	62.1
5	8.25	23.75	6.27	10	63.7
6	22.75	21.25	6.1	8	56.4
7	30	20	5.76	22	61.8
8	30	20	5.85	7	63.1

Each response from the evaluation test results then obtained the results of the ANOVA *(Analysis of Variance) test* to determine the significance of the response analysis between variables, as follows:

Table 3Response, Adhesiveness, and Melting Point with Design Expert software

Parameter	ANOVA			
	pH	Adhesive (seconds)	Power	Melting point (^{0}C)
Model: linear mixture	0.7282	0.0303		0.0255
Residual: Lack of fit	0.5792	0.6364		0.8374

The ANOVA results in Table 4 show that the variable component values have a significant effect on the response if *the Lack of Fit (F-Value)* is < 0.05) and if >0.05 indicates an insignificant *Lack of Fit. An insignificant Lack of Fit* value is a requirement for a good model because it indicates that the response data matches the model.

Table 4Prediction Results

Composition (%)		Evaluation Test			Desirability
Glycerin	Cera Alba	pH test	Adhesion Test (seconds)	Melting Point Test (^{0} C)	
19,647	21,785	6,008	7,353	57,212	0.898

After all responses were entered into *the Simplex Lattice Design software*, 1 solution was obtained, namely desirability 0.898. The desirability value indicates the possibility or

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tendency of the results or responses to be achieved in accordance with the desired optimization target, the most optimal formula is with a desirability value close to one. Predictions of the physical properties of the optimum formula from the solution are presented in table 5.

The optimum formula from the prediction results, was made and replicated three times, and the following results were obtained:

Table 5Optimum Formula Evaluation Results

Parameter	R1	R2	R3	Average
Organoleptic	**White Scent: Peppermint Texture: Semi-solid**	**White Scent: Peppermint Texture: Semi-solid**	**White Scent: Peppermint Texture: Semi-solid**	
Homogeneity	**Homogeneous**	**Homogeneous**	**Homogeneous**	
pH	5.55	5.56	5.56	5.55
Adhesive Power (seconds)	7.18	7.4	7.69	7.42
Melting Point (^{0}C)	57.7	57.3	57.1	57.3

Verify Optimization Results

The predicted response results from *the Simplex Latice Design* are then compared with the response results from the experiment. Statistical analysis using one sample t-test.

Table 6. Verification of Optimization Results Using One Sample T Test

Response	Prediction	Test	Significance	Conclusion
pH test	6,008	5.55	0.076	No difference
Adhesion Test	7,353	7.42	0.627	No difference
Melting Point Test	57,212	57.3	0.410	No difference

Based on table 7, it shows that the values obtained in the three responses are significant values of p>0.05, so that the tests carried out between the prediction formula and the experiment do not have a significant difference, meaning that the prediction value from *the software* is correct and can be trusted.

Discussion

Optimization of the cucumber extract lip balm preparation formula was carried out using the *Simplex Lattice Design method* using *software. Design Expert 13.* This research began with preformulation, namely determining the active ingredient to be used, the additional ingredients used, the optimized ingredients, and the dosage form. Optimization was carried out to obtain the optimum combination of glycerin (A) and cera alba (B) to formulate a lip balm preparation with the desired criteria. Table 1 states that the concentration *range* for glycerin is ≤ 30%, while for cera alba it is 20–25% (Goel, et al., 2023) .

In table 2, this is done by entering the concentration range data for the material into *the software. Design Expert 13* and obtained eight formula runs to be created. From these eight formula designs, glycerin and cera alba were obtained with varying concentrations. Then, calculations were performed using the formula % concentration = fx (upper limit - lower limit) + lower limit.

In table 3, physical evaluation tests were carried out on the preparations of the 8 formulas made, including pH tests, adhesion tests, and melting point tests. The results of the

physical evaluation test showed that the results met the requirements. Table 4 shows the results of the ANOVA *(Analysis of Variance) analysis* to determine the significance of the response analysis between variables. The results of the linear mixture model in the pH test were 0.076, in the adhesion test 0.627 seconds, and in the melting point test 0.410 ^{0}C. Therefore, the pH test showed an insignificant value ($p>0.05$). This indicates that the model cannot explain the effect of glycerin and cera alba on pH. This model remains in use due to its insignificant *lack of fit value.* The resulting *lack of fit* for all three responses was insignificant. An insignificant *lack of fit* value is a prerequisite for a good model because it indicates a good fit between the response data and the model (Widyartha et al., 2020) .

Table 5 shows the results of the desirability value, which indicates the possibility or tendency of the results or responses to be achieved according to the desired optimization target. The study obtained one solution with a desirability value of 0.898. A desirability value that is closer to 1 indicates a program's ability to produce the desired product more perfectly (Pratami, et al., 2017) .

Table 6 shows the results of the physical evaluation test of the optimum formula . The organoleptic test evaluated the preparation for factors such as color, odor, and texture. The lip balm was found to be off-white in color, with a peppermint oil scent, and a semi-solid texture. A homogeneity test was then performed to evaluate the absence of coarse grains in the lip balm. The results obtained were that there were no coarse grains on the transparent glass, thus meeting the requirements. Then a pH test was conducted to determine the acidity or alkalinity of the lip balm made. If the preparation is too acidic it will cause irritation to the lips, while if the preparation is too alkaline it will cause the skin on the lips to dry and crack. The results of the pH test in formula 1 were 5.55; formula 2 was 5.56; formula 3 was 5.56, with an average pH test value of 5.55. The pH test results that met the requirements were 4.5 - 8. Then an adhesion test was conducted to determine the ability of the preparation to adhere to the skin of the lips. The literature states that the greater the adhesive power of the preparation, the longer the preparation will be in contact with the skin so that it is more effective in delivering the active substance. However, if the adhesive power is too long, it will cause an uncomfortable feeling when applied. The results obtained in formula 1 were 7.18 seconds; formula 2 was 7.4 seconds; Formula 3 was 7.69 seconds, with an average adhesion test of 7.42 seconds. This meets the requirements for a good adhesion test of more than 4 seconds. Then the melting point test to determine the melting point which is stated as a range that indicates the temperature at which all materials melt completely. The results obtained in formula 1 were 57.7; formula 2 was 57.3; formula 3 was 57.1. The average melting point test was 57,3. Based on SNI 16-4769-1998 the melting point requirements range from 50-70 ^{0}C, thus meeting the requirements (Hayati, et al., 2024) .

Table 7 shows the verification of the optimization results. Formula verification aims to test the accuracy of the formula solution obtained through *Simplex Lattice Design*. The verification results are then analyzed statistically, aiming to determine the average difference between the experimental results and the predicted data. The statistical analysis used is the *one-sample t- test*. The *one-sample t-* test is used to test the significance of the average difference between each value of the experimental results that have been carried out with the theoretical value of the predicted results from *Simplex Lattice Design*. The experimental results and predictions show no significant difference. This can be seen from the significance value of each response obtained which is more than 0.05. There is no significant difference between the *Simplex Lattice Design predictions* and the experimental results so it can be concluded that the *software* is valid for use in optimizing cucumber extract lip balm preparations (Suryani, et al., 2017).

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CONCLUSION

Based on the results of research in making lip balm preparations, it can be concluded that:

The optimum formula results for the lip balm preparation were with a concentration of 0.643% Glycerin and 0.357% Cera Alba obtained using the *Simplex Lattice Design method.* The results of the physical evaluation of the lip balm preparation produced test values that met the standards or requirements.

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