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Optimization of Vinegar Hand Sanitizer Gel Formula With Response Surface Methods

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Abstract Formulated handsanitizer gel needs optimization such as optimizing active substances, and supporting ingredients such as carbopol and TEA. One way to optimize is to use the Simplex lattice design (SLD) method used of Design Expert software. The aims of this study was to optimize hand sanitizer formulations that meet SNI (Indonesia National Standards) standards with the study of active ingredients and the basis of a combination of carbopol and TEA. As for the handsanitizer that will be made using a 5% vinegar and combination of carbopol 1, 2 and 3%, and TEA 1;1.5 and 2%. This active ingredient formula is made into a gel with the use of other ingredients such as methyl parabens, glycerin and aquadest. The handsanitizer gel formula is then tested for physical properties to obtain SNI standards such as organoleptic tests with five senses, pH with pH meters, viscosity with otswald viscometer dan scatter power. The results showed that the combination of carbpol and TEA had no effect on pH because it produced the same pH of 4,2. While the combination of carbopol and TEA affects viscosity and TEA with a probability value below 0,05. Optimization results using design expert software showed that the best combination of carbopol and TEA was at concentrations of 0,802% and 1.6% which produces a pH of 4,2; viscosity 10,893 cp and scatter power 5,249 cm^2.

Keywords: *Hand sanitizer, Vinegar, Formulation Optimization, Simplex lattice design*

1. Introduction

Health is an important aspect of human life. Efforts that have been made to maintain health is by maintaining the cleanliness of the body. The development of covid-19 is indeed starting to fall, but that does not mean to ignore health protocols. Awareness of hand washing still needs to be applied. In addition, the presence of bacteria will certainly aggravate health conditions. In addition to viruses, most of these diseases can come from pathogenic bacteria that cannot be seen directly by the eye. One of the most powerful mediums for the spread of bacteria on the body is through the hands [1].

Various types of bacteria, viruses and fungi will be easier to stick to and develop in the condition of unclean hands. The way to overcome the spread of these bacteria is to wash your hands using clean water. However, clean water alone is not enough to ensure that the bacteria will disappear perfectly from the hands that make direct physical contact with the bacteria every day. This can be overcome by washing hands using alcohol-based cleansers [2]. Along with the development of technology, today there are many instant products that are ready to be used for antiseptic hand sanitizers or so-called hand sanitizers [3]. Hand sanitizer products are products that are used to kill disease germs found on the hands. Hand sanitizers generally contain 62% ethyl Alcohol, softeners, and moisturizers. The active ingredient content is alcohol that has the highest effectiveness against viruses, bacteria, and fungi also does not cause resistance in bacteria. Alcohol itself can make your hands dry. Hand sanitizers should be equipped with moisturizers and emollients, which keep hands soft, not dry, unlike pure alcohol solutions that can cause dehydration of the skin. Hand sanitizers will generally evaporate [4]. So as not to leave residue or make the hands sticky [5]. In the manufacture of hand sanitizer products it is also necessary to use natural ingredients that will be developed as antiseptics

[1], [6]. Natural ingredients that can be used as a hand sanitizer that can be used vinegar as an active substance [7]. Vinegar has an organic acid content that is acetic acid. The acetic acid content of vinegar acts as an antimicrobial that can cause loss of cell integrity and is tested to inhibit the growth of *Salmonella typhi* bacteria [8].

Response surface methods has been done as much as done by Gumbara et al., (2015), who optimizes lipstick preparations from purple sweet potatoes (Ipomoea Batatas L.) with a combination of base paraffin wax and carnauba wax. Rao et al., (2016) made the development of a microemulsion-based gel formulation for antifungal preparations of *butenafine hydrocloride*. This study aims to find out the influence of active substances, carbopol bases and TEA that most affect physical properties. The use of *Response surface methods* has advantages in the efficiency of formula making by eliminating trial and error and replication.

2. Materials and methods

This study uses this type of laboratory experimental research by making a hand sanitizer gel formulation from vinegar. The free variables of this study are the concentration of carbopol and TEA from the pharmaceutical laboratory (p.a Merck) used, then for bound variables, namely the response of optimization results, namely pH, viscosity and scatter power and controlled variables namely vinegar concentration (5%), glycerin (20%), nipagin (0.18%) and nipasol (0.02%) used. Composite designs on surface response methods are used to optimize the effect of independent variables on responses and analyzed by Design Expert. Based on the response of the design of the software will provide three experimental solutions with the given response. The design form is shown in table 1 below.

Table 1. The variables and levels in experimental design

	Factors	Level				
		-α	-1	0	1	+α
Karbopol	X1	0,6	1	2	3	3,6
TEA	X2	0,6	1	1,5	2	2,6

Viscosity measurements were performed on gel preparations using ostwald viscometers. A good viscosity test is that the liquid does not flow easily and is clear [11]. Formula done by weighing 5 grams of preparation dissolved in 20 mL aquadest in beaker glass, Measure with pH meters and record pH shown [12]. The scatter power test is conducted to ensure the distribution of gel when applied to the skin as soon as the gel is made. The gel is weighed as much as 0.5 g and then placed in the middle of a round glass scale. On the gel is placed another round glass or other transparent material and ballast so that the weight of the glass is round and ballast 150 g, let stand 1 minute, then recorded the diameter of the spread. Good gel scattering power between 5-7 cm [13].

3. Results and discussion

The experimental results were shown from the results of the software analysis presented in Table 2. Modeling with significant values R2 and lack of fit values of each response with a specific pattern suggested software. After that, the model is optimized with a target.

Table 2. The experimental design for optimizing the formula.

STD	Run	Variables	Responses

		Code	Actual (Karbopol %)	Code	Actual (TEA %)	pH	Viscocity (Cp)	Scatter power (cm)
1	1	-1	1	-1	0,6	4,2	10,279	5,25
11	2	0	2	0	1,5	4,2	11,002	5,3
10	3	0	2	0	1,5	4,2	10,809	5,25
7	4	0	2	-1,41421	0,6	4,2	10,935	5,25
8	5	0	2	1,41421	2,6	4,2	9,638	5,2
5	6	-1,41421	0,6	0	1,5	4,2	10,71	5,17
13	7	0	2	0	1,5	4,2	10,968	5,25
12	8	0	2	0	1,5	4,2	10,214	5,32
6	9	1,41421	3,6	0	1,5	4,2	10,935	5,25
3	10	-1	0,6	1	2	4,2	11,002	5,31
4	11	1	3	1	2	4,2	11,079	5,25
2	12	1	3	-1	1	4,2	9,638	5,21
9	13	0	2	0	1,5	4,2	10,809	5,25

Hand sanitizer gel preparations are made by means of gelling agents (carbopol and TEA) developed by aquadesting 70 °C in a chemical glass, stirring it until it expands. Then TEA was mixed into the base of the gel and then homogenized. Add nipagin and nipasol that have previously been dissolved with 3 ml of aquadest at 90 °C, homogenizing. Dissolve the vinegar into glycerin, then put it into a little base at a time, homogenizing. Then add the rest of the aquadest after it homogenizes [14].

In the research that has been done, the preparation consists of thirteen formulas of gel hand sanitizer with base concentration (carbopol and TEA) in accordance with the results of running the software. The physical evaluation response of hand sanitizer gel preparations includes pH, viscosity, and scatter power to be analyzed for modeling. The response of these physical properties is shown in table 3 as follows:

Table 3. The analysis of variance from the analysis showing the effect of all factors ($p \leq 0.05$)

Factors	p-value dependent variables		
	pH	Viscosity	Scatter power
Model	Mean	Quadratic	2FI
A-Carbopol	0,000	0,1572	0,8676
B-TEA	0,000	0,0096	0,1773
AB		0,0958	0,2561
A2		0,1518	
B2		0,1988	
Lack-of-fit	0,000	0,615	0,9844

*Significantly different at 95% confidence level

The equations for the model on each parameter are presented below:

pH = + 4,20

Viscosity = 10,60 – 0,18A + 0,40B + 0,31AB + 0,19A^2 – 0,17B^2

Scatter power = 5,25+ 2,500E-003A + 0,021B + 0,025AB

Based on the equations that (A) was carbopol response, (B)TEA response and combination of carbopol and TEA (AB), and the value is double carbopol (A2) and TEA (B2). Synergistic effect represented with positive marks in front of the equation and representatives [15].

Instead for antagonistic effect.The results of pH observations of hand sanitizer gel preparations on the basis of a combination of carbpol and TEA for thirteen formulas in table 2 showed a pH yield of 4,2. These results showed that the combination of carbpol and TEA had no effect on the pH of the preparation.

The scatter power shown in table 2 showed that of the thirteen formulas with a combination of carbopol base and TEA has the highest scatter power of 5,32 cm^2. Furthermore, statistical processing is carried out with the Response Surface Method with a composite design that aims to find out the influence of both factors (carbpol and TEA) on the power response of the hand sanitizer gel spread. Calculations based on 2FI modeling obtained from the software showed that the combination of carbopol and TEA shown from the equation with the highest coefficient value of 0.025 exerted the most influence on the results of the scatter power test when compared to the more dominant concentration of either TEA or carbopol.

The above results show that the combination of carbopol and TEA is modeled with quadratic with the equation result has the largest coefficient value of 0.4B which means the concentration of carbopol exerts the most influence on the viscosity test results when compared to one of tea and combination of both.

The effect of free variables against each solution based on modeling is presented in table 4. Modeling results provide three solutions based on validation in the laboratory. Optimization validation results using design expert software show that the best combination of carbopol and TEA is at concentrations of 0.802% and 1.6% which produces a pH of 4.2; viscosity 10,893 cp and scatter power 5,249 cm^2.

Table 4. The three solutions obtained from the software

Solutions	Independent Variables		Dependent Variables		
	Carbopol (%)	TEA (%)	pH	Viscosity	Scatter power
Solution 1	0,802	1,6	4,2	10,893	5,249
Solution 2	3	2	4,2	11,148	5,300
Solution 3	2	1,5	4,2	10,603	5,251

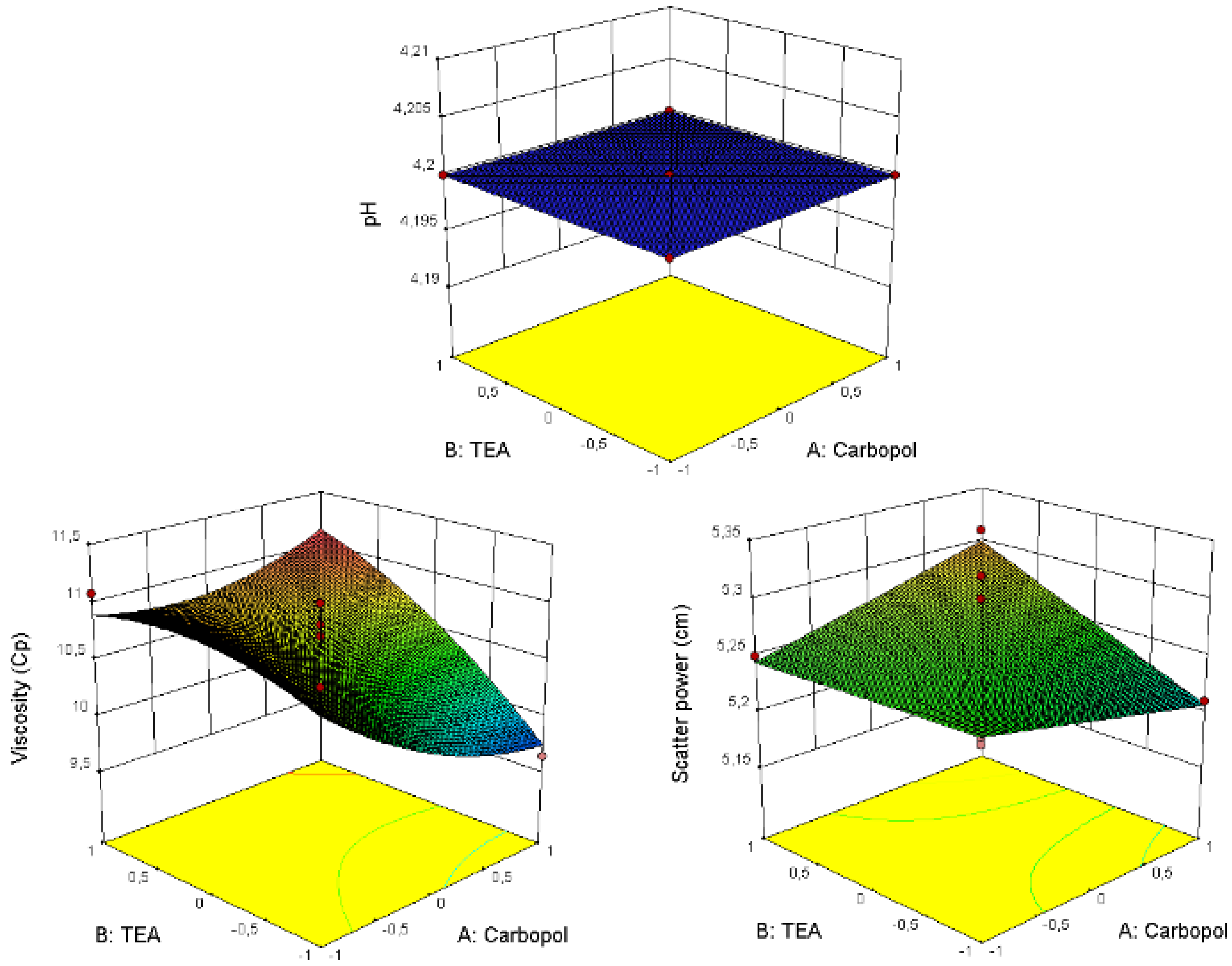

Figure 1. All 3D graphs showing the influence of carbopol and TEA concentration (a) pH, (b) viscosity, (c) scatter power

4. Conclusion

The combination of carbpol and TEA had no effect on pH because it produced the same pH of 4,2. While the combination of carbopol and TEA affects viscosity and TEA with a probability value below 0,05. Optimization results using design expert software showed that the best combination of carbopol and TEA was at concentrations of 0,802% and 1,6% which produces a pH of 4,2; viscosity 10,893 cp and scatter power 5,249 cm^2.

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6. Reference

[1] A. L. Larasati, D. Gozali, and C. Haribowo, “Penggunaan Desinfektan dan Antiseptik Pada Pencegahan Penularan Covid-19 di Masyarakat,” *Maj. Farmasetika*, vol. 5, no. 3, pp. 137–145, 2020, doi: 10.24198/mfarmasetika.v5i3.27066.

[2] Y. R. Natanael, “Laporan Resmi Praktikum Mikrobiologi Industri,” Surabaya, 2015.

[3] Sutrisno, R. D. Assyfah, R. Retnosari, I. B. Rachman, and H. W. Wijaya, “Antibacterial activity of potassium salt, fatty acids, and methyl esters of candlenut seed oil against staphylococcus aureus and Escherichia coli,” *AIP Conf. Proc.*, vol. 2231, 2020, doi: 10.1063/5.0002553.

[4] J. I. Wijaya, "Formulation of Hand Sanitizer Gel Formulation with Triclosan 1.5% and 2% Active Ingredients. University of Surabaya Student Scientific Journal," vol. 2, no. 1, pp. 1–14, 2013.

[5] R. Nakoe, N. A. S Lalu, and Y. A. Mohamad, "Perbedaan Efektivitas Hand-Sanitizer Dengan Cuci Tangan Menggunakan Sabun Sebagai Bentuk Pencegahan Covid-19," *Jambura J. Heal. Sci. Res.*, vol. 2, no. 2, pp. 65–70, 2020, doi: 10.35971/jjhsr.v2i2.6563.

[6] S. Aprilia and W. Yanti, "Pemanfaatan Kulit Jeruk Nipis Sebagai Alternatif," *Pemanfaat. Kulit Jeruk Nipis Sebagai Altern. Hand Sanitize*, vol. 4, no. 1, pp. 227–232, 2019.

[7] R. I. Pratama, U. A. Husin, and S. A. D. Trusda, "Efek Antibakteri Cuka Sari Apel Terhadap Salmonella Typhi," *Pros. Pendidik. Dr.*, pp. 694–699, 2015.

[8] R. Djuanda, V. A. Helmika, F. Christabella, N. Praata, and V. K. Sugiaman, "Potensi Herbal Antibakteri Cuka Sari Apel terhadap Enterococcus faecalis sebagai Bahan Irigasi Saluran Akar," *Sonde (Sound Dent.*, vol. 4, no. 2, pp. 24–40, 2019.

[9] Y. T. Gumbara, M. Murrukmihadi, and S. Mulyani, "Optimasi Formula Sediaan Lipstik Eekstrak Etanolik Umbi Ubi Jalar Ungu (Ipomoea Batatas L.) Dengan Kombinasi Basis Carnauba Wax Dan Paraffin Wax Menggunakan Metode SLD (Simplex Lattice Design)," *Maj. Farm.*, vol. 11, no. 3, pp. 336–345, 2015.

[10] S. Rao, T. Barot, K. S. Rajes, and L. L. Jha, "Formulation , optimization and evaluation of microemulsion based gel of Butenafine Hydrochloride for topical delivery by using simplex lattice mixture design," *J. Pharm. Investig.*, vol. 46, no. 1, pp. 1–12, 2016, doi: 10.1007/s40005-015-0207-y.

[11] R. Voight, *Buku Pelajaran Teknologi Farmasi edisi 5*. Yogyakarta: Gadjah Mada University Press, 1995.

[12] D. P. Astuti, P. Husni, and K. Hartono, "Formulasi Dan Uji Stabilitas Fisik Sediaan Gel Antiseptik Tangan Minyak Atsiri Bunga Lavender (Lavandula angustifolia Miller)," *Farmaka*, vol. 15, no. 1, pp. 176–184, 2017.

[13] T. Mappa, H. J. Edy, and N. Kojong, "(Oryctolagus Cuniculus) Tiara Mappa, Hosea Jaya Edy, NovelFORMULASI GEL EKSTRAK DAUN SASALADAHAN (Peperomia pellucida (L.) H.B.K)DAN UJI EFEKTIVITASNYA TERHADAP LUKA BAKAR PADA KELINCI Kojong," *PHARMACON J. Ilm. Farm. – UNSRAT Vol. 2 No. 02 HAL 49-55*, vol. 2, no. 02, pp. 49–56, 2013.

[14] S. D. Syaiful, "Formulasi Dan Uji Stabilitas Fisik Gel Ekstrak Etanol Daun Kemangi (Ocimum Sanctum L.) Sebagai Sediaan Hand Sanitizer," Universitas Islam Negeri Alauddin, 2016.

[15] G. M. Ulfa, W. D. R. Putri, K. Fibrianto, and S. B. Widjanarko, "Optimization studies on pre-gelatinized sweet potato starch influenced by temperature and time," *Food Res.*, vol. 5, no. S2, pp. 25–30, 2021, doi: 10.26656/fr.2017.5(s2).017.