# Optimization of Carbopol 941 And HPMC on the Gel of the Bark of *Strychnos lucida* R.B Ethanol Extract as Hand Sanitizer

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## ABSTRACT

Some research resulted that show *Strychnos lucida* R.Br contains compound of tannin, flavonoids, phenols, alkaloids and saponins that can be used as antibacterial. Seeing the compounds contained, one csn make an antiseptic gel. An important components in the gel preparation is gelling agent. Gelling agent is widely used because it has high stability and increases the effectiveness of the use of gel as an antibacterial. This study aims to determine the optimum composition of Carbopol 941 and HPMC in the extract of *Strychnos lucida* R.Br stem using the Simplex Lattice Design method. The gel was made in three formulas with a comparison of Carbopol 941 and HPMC, 100%: 0%; 50%: 50%; 0%: 100%. Next, these were tested physicochemical properties including spreading, pH, and stickiness tests. The validity of the optimization method has done before by comparing the test result and the prediction in the optimum gel formula. The results showed that the optimum composition was obtained of Carbopol 941: HPMC by 50%: 50%. Verification results compared to the prediction results it did not show different for all tests, spreading, pH, stickiness tests and antibacterial. The optimum formula for the ethanol extract of *Strychnos lucida* R.Br stems have the potential for strong antibacterial activity with a inhibitory zone value of 13.55 mm.

**Keywords**: Gelling agent, Simplex Lattice Design, *Strychnos lucida* R.Br., Antibacteria

## ABSTRAK

Beberapa hasil penelitian menunjukkan bahwa tanaman kayu ular mengandung senyawa golongan tannin, flavonoid, fenol, alkaloid maupun saponin yang bersifat antibakteri. Melihat senyawa yang terkandung, maka dapat dibuat salah satu bahan antiseptik berupa gel. Komponen penting dalam sediaan gel adalah *gelling agent*. *Gelling agent* tersebut banyak digunakan karena memiliki stabilitas yang tinggi dan meningkatkan efektivitas penggunaan gel sebagai antibakteri. Penelitian ini bertujuan untuk mengetahui komposisi optimum Carbopol 941 dan HPMC dalam sediaan gel ekstrak batang kayu ular dengan menggunakan metode *Simplex Lattice Design.* Gel dibuat dalam tiga formula dengan perbandingan Carbopol 941 dan HPMC, (100%:0%); (50%:50%); (0%:100%). Gel yang diperoleh kemudian diuji fisikokimia meliputi uji daya sebar, pH, daya lekat dan antibakteri. Validitas metode optimasi dilakukan dengan membandingkan hasil pengujian dengan hasil prediksi pada gel formula optimum. Formula optimum gel ekstrak etanol batang kayu ular memiliki potensi aktivitas antibakteri yang kuat dengan nilai zona hambat 13,55 mm.

Kata Kunci: *Gelling agent, Simplex Lattice Design, Strychnos lucida* R.Br., Antibakteri

## INTRODUCTION

Releasing hands are contaminated with microbes when we carry out our daily activities, so the hands can be an aid in the entry of microbes into our body. One of the simplest and most common ways to clean your hands is to wash your hands with soap. (Khaerunnisa et al, 2015).

Snake wood (*Strychnos lucida* R.Br., synonym Strychnos ligustrina Blume) contains tannin, flavonoid, phenol, alkaloid and saponin compositions (Setiawan et al, 2014). The results of another report stated that this plant has an essential content such as phenol which is very potential as an antibacteria (Nazzaro et al, 2013).

Handsanitizer is an antiseptic ingredient that contains a gel that is often used by the public as a practical hand washing media. An important component in gel preparations is a gelling agent, in the formulation of a gel commonly used carbopol, xanthan gum and cellulose derivatives such as carboxymethylcellulose (CMC) and hydroxypropylmethyl cellulose (HPMC) as gelling agents and drugs because it can increase contact time with the skin increasing the use of gels as antibacterial (MOH, 1995).

One method that can be used to produce optimal formulas from combinations is the Simplex Lattice Design (SLD) method. The Simplex Lattice Design method is used for optimization formulas because it can produce an optimal formula with a constant amount of different materials. The SLD method is useful for predicting responses in dosage formulations (Bolton and Bon, 1997).

## RESEARCH METHODS

### Materials

The materials used are snake wood plant (Strychnos lucida R.Br), 96% Ethanol solvent, Carbopol 941, HPMC, Triethanolamine, Methyl paraben, Aquadest, Staphylococcus aureus ATCC 25923, Nutrient Agar media, nutritional gel, aluminum foil.

### Tools

Digital, oven, blender, rotary evaporator, water bath, hot plate, mortar and stamper, glass funnel, measuring cup, beaker glass, porcelain cup, dropper, erlenmeyer, stirring rod, filter paper, calipers, petri dishes, incubators, autoclaves, ose needles, bunsen, test tube racks, colony counters, tissues, paper discs (paper discs).

### Formula of Snake Wood Gel Extract (*Strychnos lucida* R.Br)

**Table 1. Formula of snake wood extract gel**

| Ingredients | Total | | |
|---|---|---|---|
| | FI (g) | FII (g) | FIII (g) |
| Extract of snake wood | 1,0 | 1,0 | 1,0 |
| Carbopol 941 | 1,75 | 0,5 | 0 |
| HPMC | 0 | 0,5 | 1,75 |
| Trietanolamine | 0,25 | 0,25 | 0,25 |
| Metyl paraben | 0,1 | 0,1 | 0,1 |
| Aquades | 76,65 | 77,40 | 76,65 |
| Gel weight | 80 | 80 | 80 |

**Gel preparations**

Carbopol 941 is added air and crushed slowly until it is homogeneous. HPMC added with water that has been heated then mixed with carbopol 941 then stir until homogeneous. Methyl paraben that has been dissolved with heated water, then mixed with a second base that has been developed, stirred until homogeneous. Triethanolamine is added little by little while continuing to stir until a homogeneous gel preparation is formed. Add the remaining air and extract the wood into the gel little by little while continuing to stir until it forms a homogeneous mass.

**Physical Testing of Gel from Snake Bark Extract (*Strychnos lucida* R.Br)**

**Organoleptic Test**

Organoleptic test is done visually and read directly changes in color, shape, texture and odor of the gel.

**Homogenity Test**

Furthermore, the gel to be discussed is applied to a clean and dry slide glass to form a thin layer, then covered with glass preparations (glass objects). Disclaimer must show a homogeneous arrangement and no visible grain.

**Scattering ability**

Weigh 0.5 grams of gel, then put the gel in the middle of a petri dish that is in an upside down position. Put another load of petri dishes on the gel then let stand for 1 minute. Add 50 grams of load then measure the diameter (Erawati et al, 2015).

***Stickiness test***

A total of 0.25 grams is placed on the glass whose area has been determined. The glass object containing the gel is affixed to the glass object which is then filled with a 1 kg load for 5 minutes. The glass object is mounted on the test kit and released a weight of 80 g. The time it takes for up to two glass objects to be removed. This test was replicated 3 times (Nurlaela et al, 2012).

**Test of pH**

Each gel weighing 1 gram made using its pH uses a pH meter (Nur. 2017).

**Determination of Physicochemical Properties of Snake Bark Extract Gel (*Strychnos lucida* R.Br)**

The profile was determined based on the Simplex Lattice Design using test data on the gel's physical properties and antibacterial activity with the equation:

$$Y = a(A) + b(B) + ab(A)(B)$$

Where :

Y = Response (experiment result)

a, b, ab = Coeficient from three experiment

(A)(B) = The amount of part A (Carbopol 941) and component B (HPMC), with the number of A + B is always one (Bolton,1997).

**Determination of Optimum Formula**

After obtaining a profile of each gel's physical properties and gel antibacterial activity, a total response is sought which is a sum of the responses of the gel's physical properties and antibacterial activity.

The total response can be calculated using the formula:

$$R_{total} = R1 + R2 + R3 + \ldots + Rn.$$

Where, R1 + R2 + R3 + ... + Rn is the response of each physical properties and antibacterial activity of the gel.

The normality calculated using the formula:

$$N = \frac{X - Xmin}{Xmax - Xmin}$$

Where :
X = The response obtained from the experiment
Xmin = Minimum desired response
Xmax = Maximum response desired
N = Standardized response value (Bolton, S, 1997)

The formula with the highest response was chosen as the optimal formula.

## RESULTS AND DISCUSSIONS

### Profile of Physicochemical Properties of Snake Trunks (*Strychnos lucida* R.Br)

Tests on the physical properties of cashew leaf extract consisting of a mixture of carbopol 941 and HPMC in various formulas including: adhesion test, dispersion test, pH test, and antibacterial test. The results of each test of the physical properties of the mixture will produce a profile of the physical properties of the mixture of materials from the equation and calculations using simplex lattice design. Select will be used to determine the optimal formula.

**Table 2.** Results of examination of the physicochemical properties of snake wood extract gel

| Formula | Stickiness (seconds) | Scattering Power (cm) | pH | Anti bactery (mm) |
|---|---|---|---|---|
| I | 10,06 | 6,04 | 7,25 | 13,89 |
| II | 12,17 | 6,89 | 7,60 | 13,55 |
| III | 10,11 | 5,84 | 7,52 | 13,11 |

**Stickiness Test (seconds)**

From the test results on gel adhesion, log extract based on simplex, lattice design, obtained the following equation:

$$Y= 10,06(A)+10,11(B)+8,34(A)(B)$$

Information:
Y = Sticky response
A = Component A (Carbopol 941)
B = Component B (HPMC)

The equation obtained Y = 10.06 (A) +10,11 (B) +8,34 (A) (B), determines the various compositions of Carbopol 941: HPMC while HPMC (coefficient value = 10.11) gives a big influence Although not much different from Carbopol 941 (coefficient value = 10.06) to the adhesion. While the interaction between the two materials has a greater influence on its adhesion (coefficient value = 12.17). So when the joint use of the coefficient values obtained are relatively large compared with the coefficients issued by each material (single use), in general will increase its adhesion.

The adhesion profile obtained from the study using the simplex lattice design equation, is described as follows:

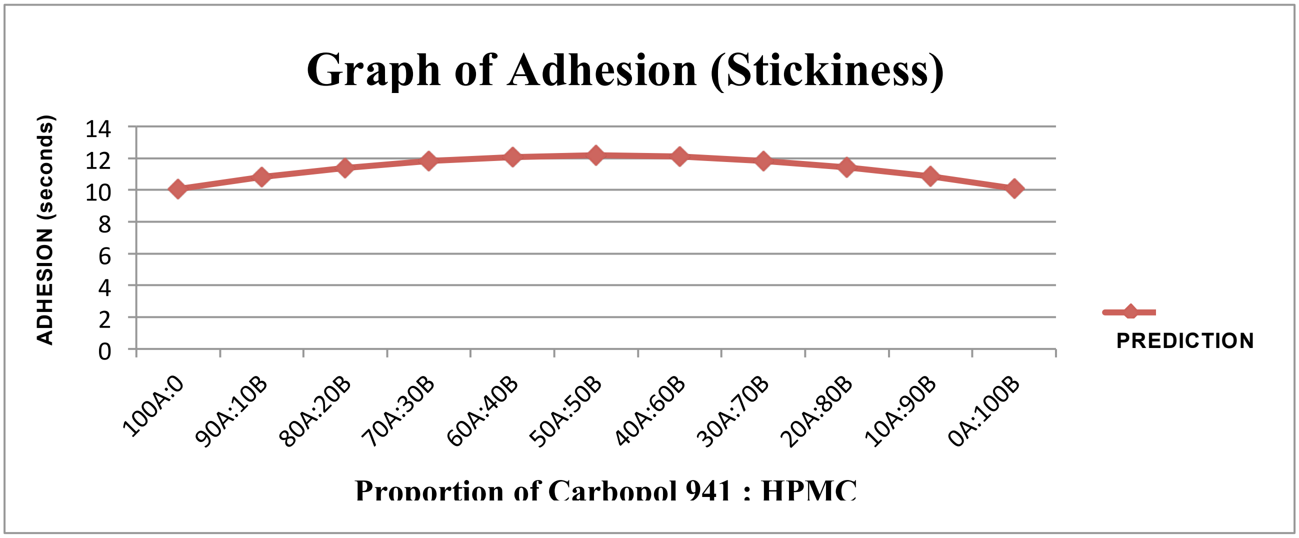


**Figure 1.** Adhesion profile using simple lattice design equation

**Scattering Power (cm)**
From the test results on the gel dispersion, log extract based on simplex, lattice design, obtained the following equation:

Y = 6.04 (A) +5.84 (B) +3.80 (A) (B)

Information:
Y = Sticky response
A = Component A (Carbopol 941)
B = Component B (HPMC)

The equation obtained Y = 6.04 (A) +5.84 (B) +3.80 (A) (B), determines the acquisition of various compositions of Carbopol 941: HPMC while Carbopol 941 (coefficient value = 6.04) is large on the spreadability compared to HPMC (coefficient value = 5.84). This shows that the increase in the proportion of Carbopol 941 used in the formula will increase the spread response. While the interaction between the two materials has a greater influence on the spreadability (coefficient value = 6.89) which means the difference between these two ingredients in general will increase the spreadability. The scatter power profile obtained from the study using the simplex lattice design equation, is described as follows:

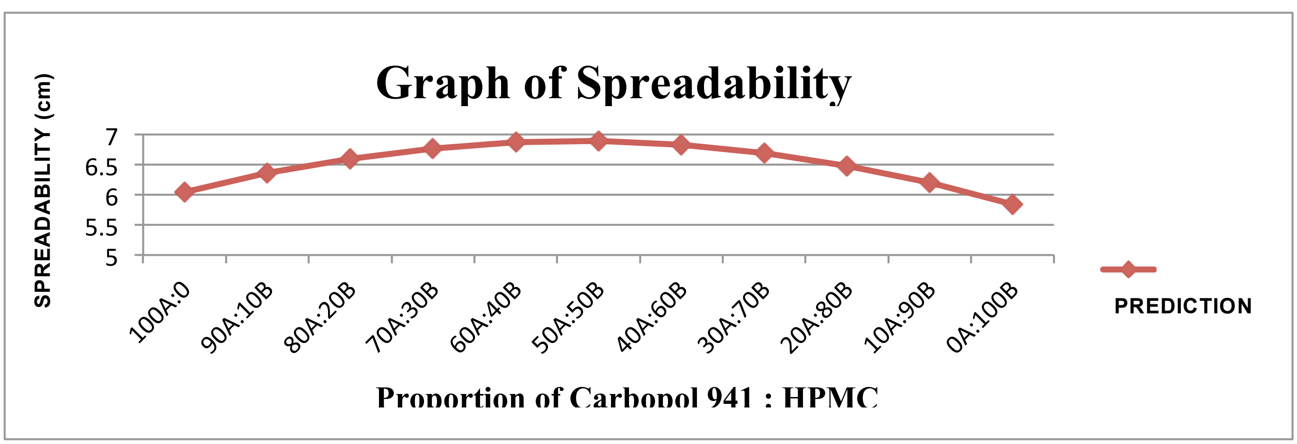


**Figure 2.** Spreadability profile using SLD

**Test of pH**
From the test results on the pH gel, wood stem extract based on simplex, lattice design, obtained the following equation:

Y = 7.25 (A) +7.52 (B) +0.86 (A) (B)

Information:
Y = Sticky response
A = Component A (Carbopol 941)
B = Component B (HPMC)

The equation obtained Y = 7.25 (A) +7.52 (B) +0.86 (A) (B), shows various compositions of carbopol 941: HPMC while HPMC (coefficient value = 7.52) provides a large compared Carbopol 941 (coefficient = 7.25) with respect to pH. While the interaction between the two materials has more values (coefficient value = 7.60) with the coefficients owned by each material (single use). Because both materials are used to reduce deficiencies in the nature of Carbopol which, if raised, the concentration of Carbopol will increase the pH of the acid. The pH profile obtained from the study using the lattice design equation, is arranged as follows:

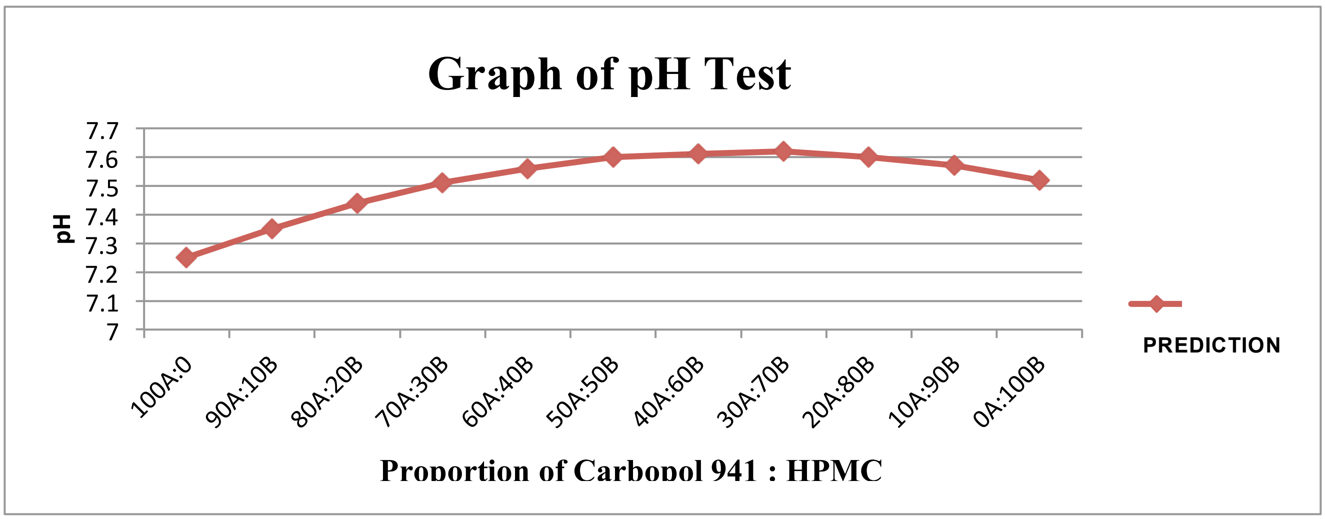


**Figure 3.** Graph of pH Test profile

**Antibacterial Test (mm)**
From the results of the test on antibacterial gel, log extract, based on simplex, lattice design, obtained the following equation:

Y = 13.89 (A) +13.11 (B) +0.20 (A) (B)

Information:
Y = Sticky response
A = Component A (Carbopol 941)
B = Component B (HPMC)

The equation obtained Y = 13.89 (A) + 13.11 (B) +0.20 (A) (B), starting with various compositions of Carbopol 941: HPMC while Carbopol 941 (coefficient value = 13.89) compared to HPMC (coefficient value = 13.11), in increasing antibacterial competence. While the interaction between the two materials provides a far greater difference compared to the efficiency comparison, this is evident from (coefficient value = 13.55). The antibacterial profile obtained from the study using the simplex design lattice equation, is described as follows:

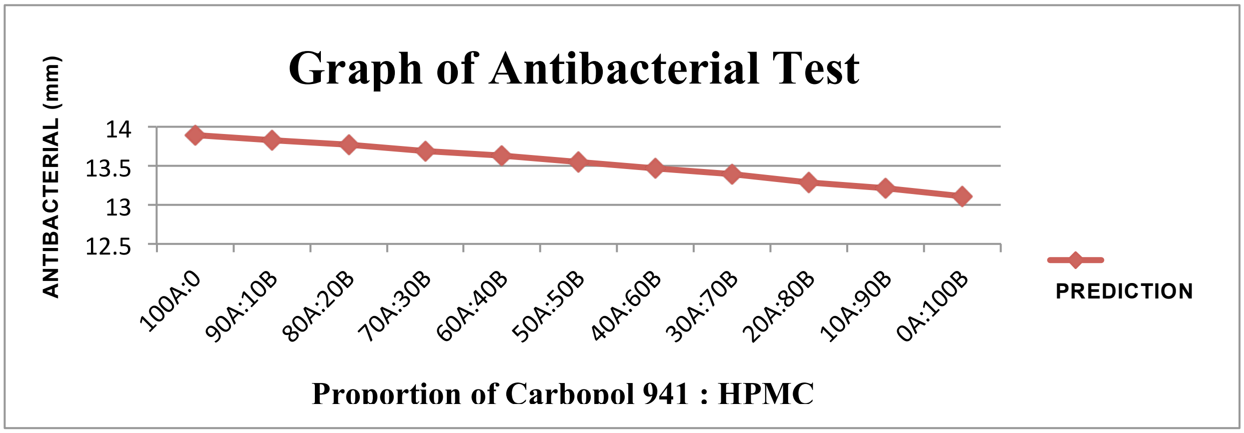


**Figure 4.** Graph of anti bacterial test profile

**Optimal Formula Determination Profile**

The optimal formula is obtained from the largest total response, which can be seen in the table below:

**Table 3**. Total response of various proportion of Carbopol 941 and HPMC

| Proportion (%) | | R stickiness | R antibacterial | R spreadability | R pH test | R total |
|---|---|---|---|---|---|---|
| Carbopol 941 | HPMC | | | | | |
| 100 | 0 | 0,8080 | 0,1356 | 0,1040 | 0,2750 | 1,3226 |
| 90 | 10 | 0,9080 | 0,1350 | 0,1360 | 0,2850 | 1,4640 |
| 80 | 20 | 0,9868 | 0,1344 | 0,1600 | 0,2940 | 1,5752 |
| 70 | 30 | 1,0440 | 0,13,36 | 0,1770 | 0,3010 | 1,6556 |
| 60 | 40 | 1,0772 | 0,1330 | 0,1870 | 0,3060 | 1,7032 |
| 50 | 50 | 1,0892 | 0,1322 | 0,1890 | 0,3100 | 1,7204 |
| 40 | 60 | 1,0788 | 0,1312 | 0,1830 | 0,3110 | 1,7040 |
| 30 | 70 | 1,0452 | 0,1304 | 0,1690 | 0,3120 | 1,6566 |
| 20 | 80 | 0,9908 | 0,1294 | 0,1480 | 0,3100 | 1,5782 |
| 10 | 90 | 0,9132 | 0,1286 | 0,1200 | 0.3070 | 1,4688 |
| 0 | 100 | 0,8148 | 0,1274 | 0,0840 | 0,3020 | 1,3282 |

The total R value is obtained from the contribution:

Rtotal = (0.4 x N adhesion) + (0.2 x N antibacterial) + (0.2 x N spreadability) + (0.2 x N pH test).

From the above calculation, the result of wood extract gel gel from a mixture of carbopol 941 and HPMC with a ratio of 50% Carbopol 941 and 50% HPMC has the highest total response.

**Results of verification and prediction of antibacterial activity and physical properties**

**Table 4.** Verification and prediction of antibacterial activity and physical properties

| Parameters | Prediction | Verification | Conclusion |
|---|---|---|---|
| Spreadability (cm) | 6,89 | 6,89 | Not different |
| Stickiness (detik) | 12,17 | 12,17 | Not different |
| pH | 7,60 | 7,60 | Not different |
| Antibacterial (mm) | 13,55 | 13,55 | Not different |

Verification results will not be different from the predicted results obtained, because the optimal formula obtained has been done before. Therefore, a re-experiment will produce the data that is issued or the same as the predicted results.

**CONCLUSION**

The results showed that the results of 50% carbopol 941 and 50% HPMC as the optimal formula for the preparation of snake wood extract gel.

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