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Production Optimization of Chlorophyll Herbs Spice Powder from Tapak Liman (*Elephantopus scaber*) Leaves with Response Surface Method

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***Abstract*—Jamu is a herbal drink obtained from the processing of plant parts which are non-toxic and do not have side effects. One way to extend the shelf life of herbal medicine is by changing the form of herbal medicine into powder. The method that can be used is foam mat drying which involves an emulsifying agent in the form of maltodextrin and a foam agent in the form of tween 80. Generally, herbal medicine is made from raw materials such as ginger. Ginger contains gingerols and shogaols as phenolic antioxidant components. Improving the quality, characteristics, attractiveness of herbal spice powders can be done by adding green coloring from chlorophyll. Chlorophyll is a photosynthetic pigment in plants that can absorb blue, red and purple light and reflects green in plants. Tapak liman leave (Elephantopus scaber) is one of the weeds that has a deep green color and can be used as medicine. The characteristics of herbal spice powders with chlorophyll are influenced by factors in each process, such as the mixing and drying processes. Optimizing the final result requires process engineering with one of the methods, namely the Response Surface Methodology. This study used the Behnken Box Design with 3 factors in the form of mixing time, drying time and power with a design that produced 15 treatments. Optimization response parameters used consist of response to chlorophyll content and response to water content. Optimum treatment conditions were obtained in the R_7 treatment with 26 minutes of stirring time, 10 minutes of drying time at 400 Watt power. The chlorophyll response is 14.138 ppm and the water content response is 2.5%. Analysis of herbal powder containing chlorophyll supporting optimum treatment conditions can be carried out by measuring color, pH and TDS. The L* value owned by R_7 is 73.7 which tends to be brightness. Meanwhile, the a* value is -2.5 and the b* value is 6.5. The degree of acidity or pH at R_7 is 6.03 with a total dissolved solids value of 7.75 °Brix.**

***Keywords*— Tapak Liman, Chlorophyll, Jamu, Foam Mat Drying, RSM**

I. INTRODUCTION

Indonesia has traditional drinks that are classified as cultural heritage and are very popular among generations. Jamu is a traditional drink that is included in functional drinks that contain nutrients that can have a positive effect on the health of the body. Herbal medicine is obtained from processing natural ingredients in the form of plant parts such as rhizomes/roots, leaves, bark, and fruit which are non-toxic and do not cause side effects [9, 23]. Herbal medicine in liquid form tends to have a low shelf life so it needs to be modified into powder form. The powder form has many advantages such as long shelf life, practical in daily use, as well as ease of handling, transportation and storage [13]. Powder production can use the foam mat drying method involving an emulsifying agent in the form of maltodextrin and a foam agent in the form of tween 80.

Herbal medicine made from ginger which has the ability as a natural antioxidant derived from gingerol and shogaol compounds. Increasing the quality, usefulness and attractiveness of herbal medicine can be done by adding chlorophyll from green plants. Chlorophyll extracts from plants are obtained by involving organic solvents such as ethanol, methanol, ether, acetone, benzene and chloroform. The use of organic solvents is because chlorophyll is insoluble in water and susceptible to degradation in heat or process conditions at low pH. Plants that can be used as a source of chlorophyll are tapak liman leaves which contain alkaloids, saponins, flavonoids, tannins, triterpenoids/steroids, and polyphenols. Tapak liman leaves can be used as herbal medicine to treat astringents, dysentery, lactagogue, fever medicine, malaria, cough, mouth ulcers, etc.

The characteristic quality of herbal medicine powder is influenced by several factors in the foam mat drying process, such as the mixing and drying processes. There is a need for process engineering to produce powder with optimum conditions. Process engineering in optimizing the manufacture of chlorophyll herbal powder is carried out using the Response Surface Methodology with the factors of stirring time, drying time and power. Response Surface Methodology (RSM) is a

collection of statistical and mathematical techniques that are useful for developing, improving, and optimizing processes whose responses are influenced by several independent variables to produce a systematic model [11]. In this study, the Box Behnken Design model was used in the design of the RSM to determine the optimal conditions for the manufacture of herbal spice powders with chlorophyll using a response surface methodology. The final powder product will be subjected to further analysis to determine the characteristics, regarding color, pH and TDS of herbal spice powders with optimum treatment chlorophyll.

II. MATERIAL AND METHOD

A. Materials

The main ingredients used is tapak liman leaves, ginger, aromatic ginger [22], lemongrass, cardamom, cinnamon, and cloves. In addition, the chemicals used were 96% ethanol, maltodextrin, tween 80, bottled drinking water (AMDK), aquadest, buffer 4, buffer 7, and acetone 80%. The tools used are analytical balances, ohaus balances, stopwatches, blenders, basins, dark glass bottles, measuring cups, beaker glass, pipettes, aluminum foil, Erlenmeyer, filter cloth, Whattman filter paper, funnels, test tubes, racks test tube, pot, Rinnai stove R1-5225, gas, spoon, brown paper, mixer, refrigerator, Philips blender, spectrophotometer, vortex, General Colorimeter – AMT 507, pH meter, desiccator, micropipette, measuring pipette, rotary evaporator R -210, Getra dehydrator, labtech oven and microwave.

B. Method

Preparation of extraction

a. Extract Tapak Liman Leaves

Tapak liman is cleaned in running water then drained and weighed. The roots and leaves of tapak liman are cut while sorting the fresh and rotten leaves. Then it is weighed and dried in a dehydrator. The dried leaves were crushed with a blender and sifted through a 60-mesh sieve. In the maceration method, simplicia is mixed with 96% ethanol in a dark closed bottle and stored at room temperature. Soaking was carried out for 2 days with the first 6 hours of stirring and 18 hours then allowed to stand. After 24 hours, the simplicia was rinsed with 96% ethanol as much as half of the initial volume. After a total of 24 hours, the extract was evaporated using a rotary evaporator until no solvent dripped and the yield ranged from 14 to 19% of the initial volume [7].

b. Extract Spice

The spices used are ginger, aromatic ginger, lemongrass, cardamom, cloves and cinnamon. All spices are cleaned in running water and drained. Ginger, aromatic ginger, and lemongrass are blended with water for ± 8 minutes. Then the material is filtered and the filtrate is transferred to the bottle. The extraction of spices using the decantation method was carried out in the refrigerator for 2 hours. The spice extract is then filtered and poured out of the bottle to remove any precipitated starch. The spice extracts are heated for 10 minutes with the addition of cloves, cardamom and cinnamon. The spice extract was filtered and cooled at room temperature for ± 30 minutes to remove moisture. The extract is stored in a closed container covered with aluminum foil [19].

Making a Treatment Plan with Response Surface Methodology

Designing the optimum treatment and response using the application Design Expert 13. The response surface method is an experimental strategy that involves multiple factors in influencing the response. The factors used is stirring time, drying time and power used. The center point used for stirring time is 23 minutes with the middle point for drying time is 12 minutes and the power is 400 watts. The treatment plan have 15 treatmens like Table I

TABLE I. TREATMENT PLAN OF CHLOROPHYLL HERBS SPICE POWDER

Treatment	Stirring Time (Minute)	Drying Time (Minute)	Power (Watt)
R_1	20	12	600
R_2	20	14	400
R_3	23	12	400
R_4	23	14	600
R_5	23	12	400
R_6	26	12	600
R_7	26	10	400
R_8	23	*12*	400
R_9	26	12	*200*
R_{10}	26	14	400
R_{11}	23	10	200
R_{12}	20	12	200
R_{13}	23	14	200
R_{14}	23	10	600
R_{15}	20	10	400

Production of Chlorophyll Herbs Spice Powder

The composition of 9 ml extract tapak liman leaves with 21 ml extracts spice and additional ingredients in the form of 30% v/v water, 15% b/v maltodextrin and 0,5% v/v tween 80 in each treatment were mixed and stirred for a duration of stirring according to the design. Stirring is carried out for the time that has been designed with the help of a mixer then the sample is dried in the microwave. Drying is carried out at the time and power according to the design. Then the samples were cooled to room temperature and then refined using a blender. The collected powder was weighed and the response analyzed using 2 parameters. The parameters used are chlorophyll content and water content.

Analyzed Chlorophyll Herbs Spice Powder Optimum Condition

Herbal spice powder containing chlorophyll under optimal conditions was carried out further analysis in the form of analysis supporting the optimum treatment which consisted of measuring color, measuring pH, and Total Dissolved Solids (TDS).

III. PROCEDURE ANALYSIS

A. The parameters optimum Analysis

Analyzed Respon Chlorophylly

0,1 g of the formula sample was weighed using an Ohaus balance, then 10 ml of 80% acetone was added in a test tube. After that, homogenization was carried out with a vortex for one minute. The sample was filtered and continued to test for chlorophyll content using a spectrophotometer with a wavelength of 645 nm and 663 nm [1]. Chlorophyll content is calculated using the formula:

Total chlorophyll (mg/L) = 20.2 (A645 nm) + 8.02 (A663 nm)

Analyzed Respon Water Content

Calculation of the value of water content in chlorophyll-containing herbal spice powder was carried out using the oven method. The baking sheet or container that will be used is heated in the oven at 105℃ for 15 minutes to dry the container from the water and then weighed using a digital balance to determine the weight of the container. Then the sample was weighed as much as 2 grams placed in a container and in the oven at 105°C for 3 hours. Then the sample was put into the desiccator for 15 minutes to remove the contained vapor and the weight was measured. After that, it was baked again for 1 hour until the weight was constant. The sample is then cooled in a desiccator until the temperature drops and weighed. The baking and cooling processes were repeated several times until the weight is constant. The expected constant weight is 0.002 mg [17]. In calculating the water content using the following formula:

$$\text{Water Content} = \frac{(a+b)-c}{c-a} \times 100\% \qquad (1)$$

note :

a = Baking sheet after heating

b = Baking dish containing samples before drying

c = Baking dish containing samples after drying

B. Optimum Treatment Support Analysis

Color

Color measurement is carried out using a colorimeter. The principle of the colorimeter is the measurement the different color through the reflection of light by the surface of the sample [6]

pH

pH measurement was carried out using a pH meter. The dry pH meter is calibrated by immersing it in pH 4 and 7 buffer solutions. The calibrated pH meter is ready to be tested by dipping the cathode tip into the dye solution for 2-3 minutes until the number shown on the pH meter display is stable. The measurement results can be read on the pH meter display. The herbal spice powder with chlorophyll to be tested was previously dissolved in distilled water with a ratio of 1: 10. In measuring the pH of the herbal spice powder, 1 gram was used and 10 ml distilled water [21].

Total Dissolved Solids (TDS)

Measurement of total dissolved solids used a refractometer with units of ºBrix. The measurement begins with weighing 1 gram of chlorophyll-containing herb powder and dissolving it in 10 ml of distilled water. The sample is homogenized on a vortex shaker. A homogeneous sample is taken and dripped onto a refractometer prism so that it can be read on a screen with a refractometer scale [8].

C. Data analysis

The response results are explained by regression analysis of experimental data and 3D plots of the response surface model for each treatment result in the Design Expert 13 application which includes ANOVA, lack of fit, adjusted R^2, predicted R^2, adequate Precision tests, etc.

IV. RESULT

a. Response Analysis

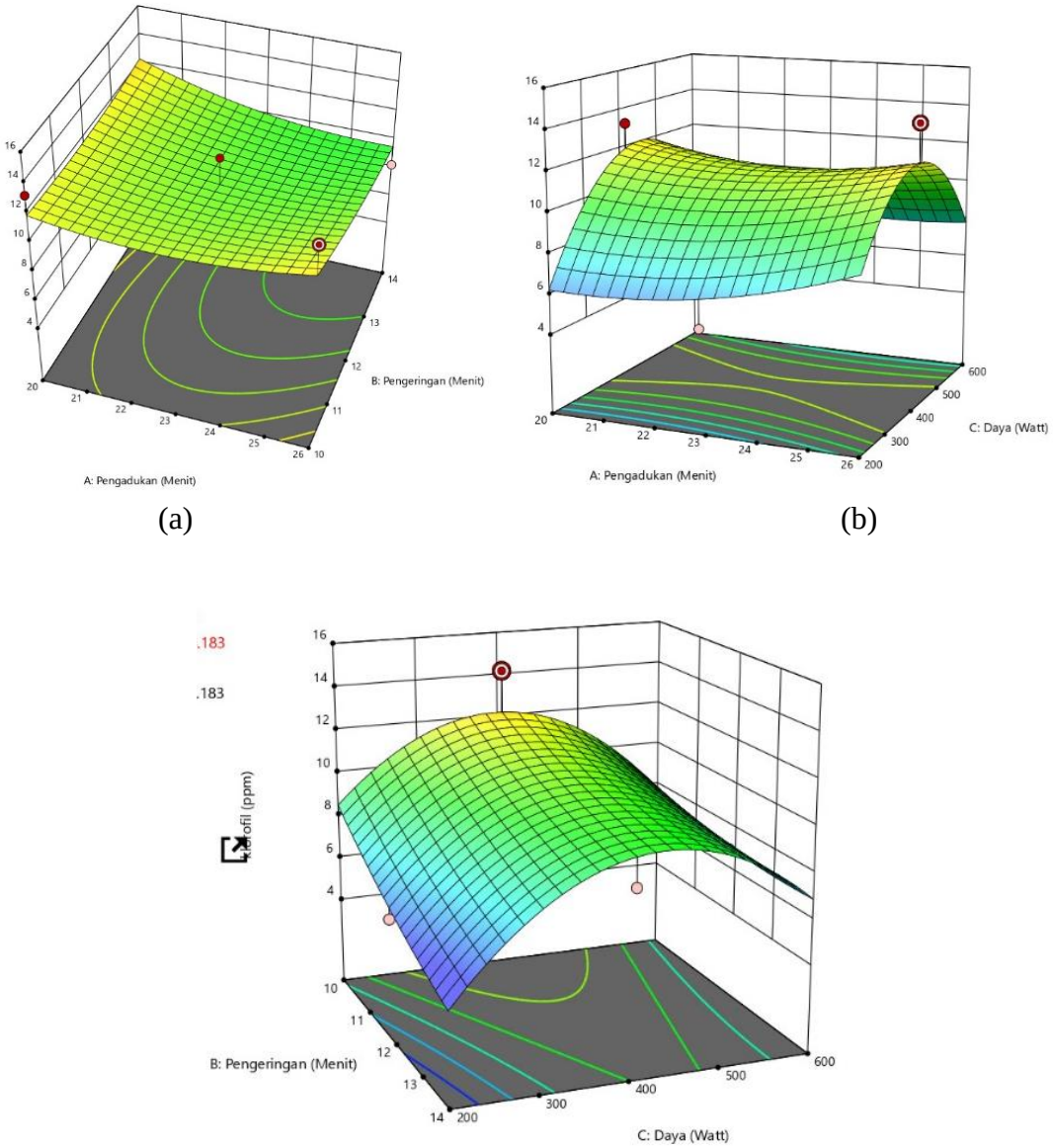
Chlorophyll Response Analysis

The highest absorbance owned by sample R_7 of 0.349 and 0.929 on the waves 645 nm and 663 nm. The value obtained on the absorbance depends on the substance contained therein. The absorbance value is directly proportional to the substances contained in the sample. If the substance contained in a sample increase, the light that will be absorbed at a certain wavelength by a molecule also increases [12]. The 645 – 663 nm wave is in the 610 – 800 nm wavelength category which absorbs red and the complementary color which looks bluish green. The absorbance value is used in the calculation of chlorophyll content so that the highest total chlorophyll content is owned by R_7 with value of 14.183 ppm. High chlorophyll will help green coloring in products, especially food or beverage products. In addition, chlorophyll can provide medicinal benefits when added to a product. However, this addition also pays attention to the characteristics of chlorophyll which is easily damaged at high temperatures. One of the physical signs of chlorophyll damage that can be seen in a product is that the green color that appears has faded or disappeared. BPOM No 32 of 2019 concerning Safety and Quality Requirements for Traditional Medicines regarding natural dyes derived from Chlorophyll CI. No. 75810 (Chlorophyll), Chlorophyll and copper chlorophyllin complex CI. No. 75810 (Chlorophylls and chlorophyllins, copper complexes) has a maximum limit on powdered drinks of 500 mg/kg of product. Therefore, R_7 becomes a product with a maximum green color which is proportional to the chlorophyll content selected for the desired sample.

Analysis of the adequacy of the model through the expert design of the chlorophyll response is suggested in the quadratic model with a p-value of 0.2272. However, a p-value that is > 0.0500 indicates an insignificant model indication, so a recommendation is needed in the form of reducing the model in each factor. In addition, the H_0 hypothesis is rejected, which means that the independent variable does not really affect the value of the fixed variable. In the ANOVA calculation on the chlorophyll response, there is 1 model factor that satisfies

$p<0.0500$, namely the C^2 model with a value of 0.0206. The C^2 factor makes a significant difference in chlorophyll content. This can be seen in the power used resulting in a change in color and chlorophyll content in the powder. The higher the power used will damage the chlorophyll. Chlorophyll damage can be characterized by the unrelated physical color of the product and chlorophyll content [15].

The lack of fit test obtained an F-value of 3.03 which implies a lack of fit is not significant relative to pure error. The lack of fit test is used to detect whether the first orde linear model is correct or not. If the lack of fit is not significant then the first linear model is correct [4]. The R^2 prediction was obtained -1.9177 which implies that the average response predictor is better than the current model. The adequate precision value is 4.499 which indicates an adequate signal for a model that can navigate the design space. This is because the adequate precision value is a signal-to-noise ratio that compares the range of predicted values at the design point with the average prediction error. The value obtained is expected to be above 4. The VIF or Variance Inflation Factor value is obtained within the limits of <10 with an average of 1 for each factor.



(a) (b)

(c)

Fig. 1. Surface Response 3D Design on R_7 with the Highest Chlorophyll Content ((a) Effect of stirring and drying variables; (b) Effect of stirring and power; (c) Effect of drying and power variables)

Analysis of the chlorophyll response to R_7 as the powder with the highest chlorophyll content had the highest point compared to the others. The highest point will be in a slightly orange yellow color in the contour and surface area. The

maximum value is in an area with a slightly orange yellow color as shown in Figure I. The colors in the contour and surface areas range from dark blue to red. The dark blue color indicates the area with the smallest value response. One of the runs in the dark blue area is R_{11} with a chlorophyll content of 5.145 ppm. Contour visualizes a colored area with a curved outline that adjusts the distribution of color on the surface. Both are related to each other in visualizing the range of distribution of responses obtained.

Water Content Response Analysis

Moisture content is one of the test methods to determine the quality and resistance of food to damage that may occur. Based on the SNI 01-4320-1996 concerning powdered traditional drinks, powdered traditional drinks are drink product ingredients in the form of powder or granules made from a mixture of sugar and spices with or without the addition of other food ingredients and permitted food additives. One of the quality requirements related to these products is a moisture content with a maximum of 3.0% of w/w. The water content in accordance with SNI 01-4320-1996 is in the range of 2.2-2.8% with the drying process at 200 Watts and 400 Watts with a drying time range of 10-14 minutes. The water content in powdered drinks depends on the drying temperature during processing. The higher the drying temperature, the lower the water content of the powder drink. The factors that influence the drying of food products include drying temperature, drying time, drying method and the nature and shape of the materials used [10].

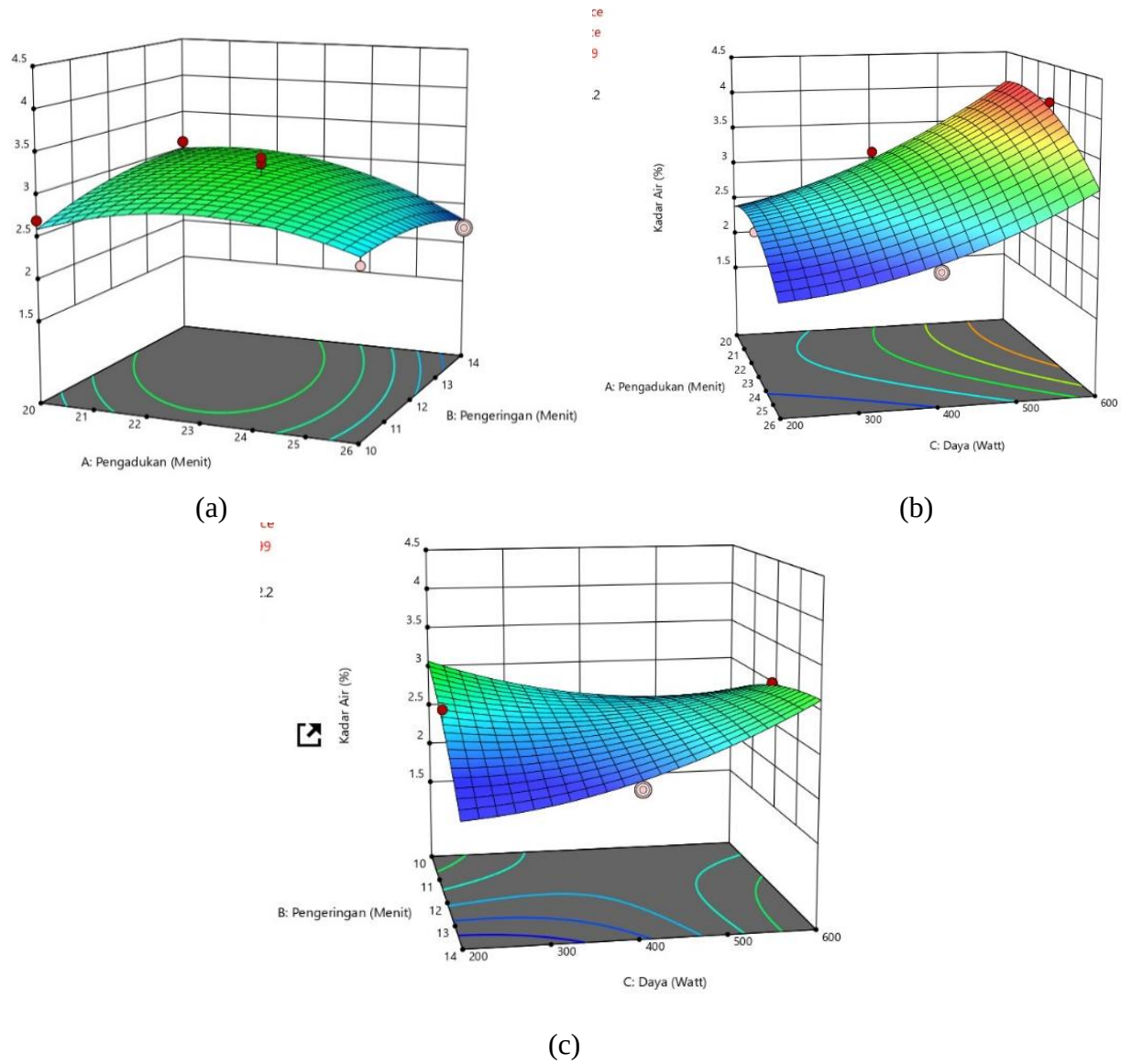


Fig. 2. Response of Surface 3D Design on R_{10} with the Smallest Moisture Content ((a) Effect of stirring and drying variables; (b) Effect of Stirring and power; (c) Effect of drying and power variables)

Analysis of the adequacy of the model through expert design, the response to water content is suggested in the quadratic model with a p-value of 0.0647. The p-value which is > 0.0500 indicates an insignificant model indication so it is predicted that there are some internal errors. The results of ANOVA on water content obtained 2 model factors that fulfilled the value of p <0.0500, namely in the C and BC models with values of 0.0223 and 0.0220 respectively. Factor C in the form of power gives a significant difference to the resulting water content response. In addition, the BC factor in the form of continuity between drying time and the power used in making powder has a significant effect on the response of water content. The longer the drying time and the higher the power used, the greater the evaporation of water. This can be seen in R_{10} which was dried for 14 minutes at a power of 400 Watt which had a moisture content of 2.2%. In addition, R_{10} is also a sample with the smallest response to water content from the treatment that has been designed.

The lack of fit test obtained an F-value of 0.41 which implies a lack of fit is not significant relative to pure error. The significance shown in the lack of fit indicates that the model is good. The predicted R^2 in response to water content was 0.119 which implies that the predicted value is not as close to the expected R^2. The difference obtained is more than 0.2 which indicates a block effect, a problem with the model used, or the data obtained. Anticipation that can be done, namely model reduction, transformation, response, outliers or empirical models must be tested. In addition, it is necessary to carry out a confirmation process in order to obtain a difference that does not exceed the limit of 0.2. At the value of adequate precision which indicates an adequate signal for a model that can navigate the design space, the value is 7.6594. This ratio is better than the value of 4 so that the model used can navigate the design space. The VIF value for each factor was obtained within the limits of <10 with an average of each factor obtained 1. The factor of stirring time, drying time and drying power had no significant effect on the water content of chlorophyll-containing herb powder with the quadratic model.

Analysis of the response to water content is aimed at R_{10} with the lowest water content having a point that is in the dark blue area in the contour and surface areas. The area with a yellow-orange color indicates that the water content response is maximal and will be filled with runs that have the highest water content such as R_4. The surface (surface) and contour are composed of dark blue to red. The dark blue color indicates the area with the smallest value response such as the area belonging to R_{10}. Vice versa, the red color indicates the area with the largest moisture content response such as R_4.

b. Totality Response Analysis

The parameters used in the Response Surface are the chlorophyll and water content of the chlorophyll-containing herb powder. The solution obtained from the measurement results of the two parameters is 57. The optimum solution is determined from the criteria for chlorophyll content at the maximum value and the water content is in the minimum area in the range of 2.5% - 2.99%. Each solution will contain a value different desirability. The desirability value given in each solution gets the highest score in solution 1 of 57 solutions of 0.816.

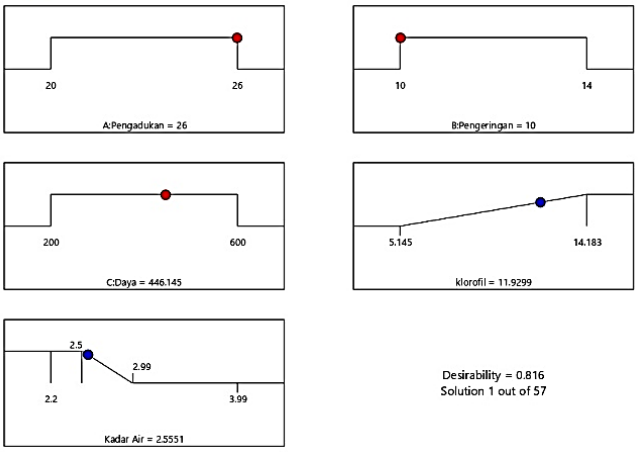


Fig.3 Solution of range optimum

The expected value of the two desired responses is offered at the highest desirability value. Run with a desirability value close to 0.816, namely at R_7. The R_7 treatment has a desirability of 0.789 which is a difference of 0.027 with the maximum desirability value offered. The power used in the manufacture of R_7 has power is 400 Watt with a drying time of 10 minutes. Treatment R_7. has physical characteristics in the form of the best green color which is directly proportional to the chlorophyll content of 14.183 ppm. The green color is maintained due to the presence of foam which is formed from the use of maltodextrin and tween 80 as foam agents in a stirring time of 26 minutes so that maximum foam is formed which can shorten drying time but still produce maximum product. The use of tween 80 has foaming properties that can maintain color and minimize damage when heated [16].

The water content obtained at R_7 is 2.5% which is quite good obtained from the use of power of 400 Watt which is related to the use of power in drying which has an effect on determining the water content. In addition, the surface area in the form of foam and material particles during drying also have an influence on the sample results. The smaller the size of the material, the better the surface that can be in contact with the heating medium and the easier it is for water to diffuse or evaporate from the material and the resulting lower water content [4]. In addition, the water content is also affected by the addition of tween 80 which easily binds to water and evaporates easily. This process occurs during stirring and foam formation.

Fig. 4 Characteristics of chlorophyll herbal spice powder of R_7 treatment

The position of point R_7 in the contour area shows that the point is in the yellow area which is among the best areas. Desirability is 0.789 in the yellow area for both stirring, drying and power factors. The yellow area is a visual area that shows the optimum position. Likewise, the chlorophyll content is in an area close to the maximum because the maximum target for chlorophyll content is owned by R_7. However, at water content, the R_7point is in a slightly bluish green area which is between blue and green. This color area shows that the value of 2.5 owned by $R_7$is still in a safe and middle area. The shape of the contour shown comes from the range of values for each desirability, chlorophyll, and water content. The relationship of the three factors.

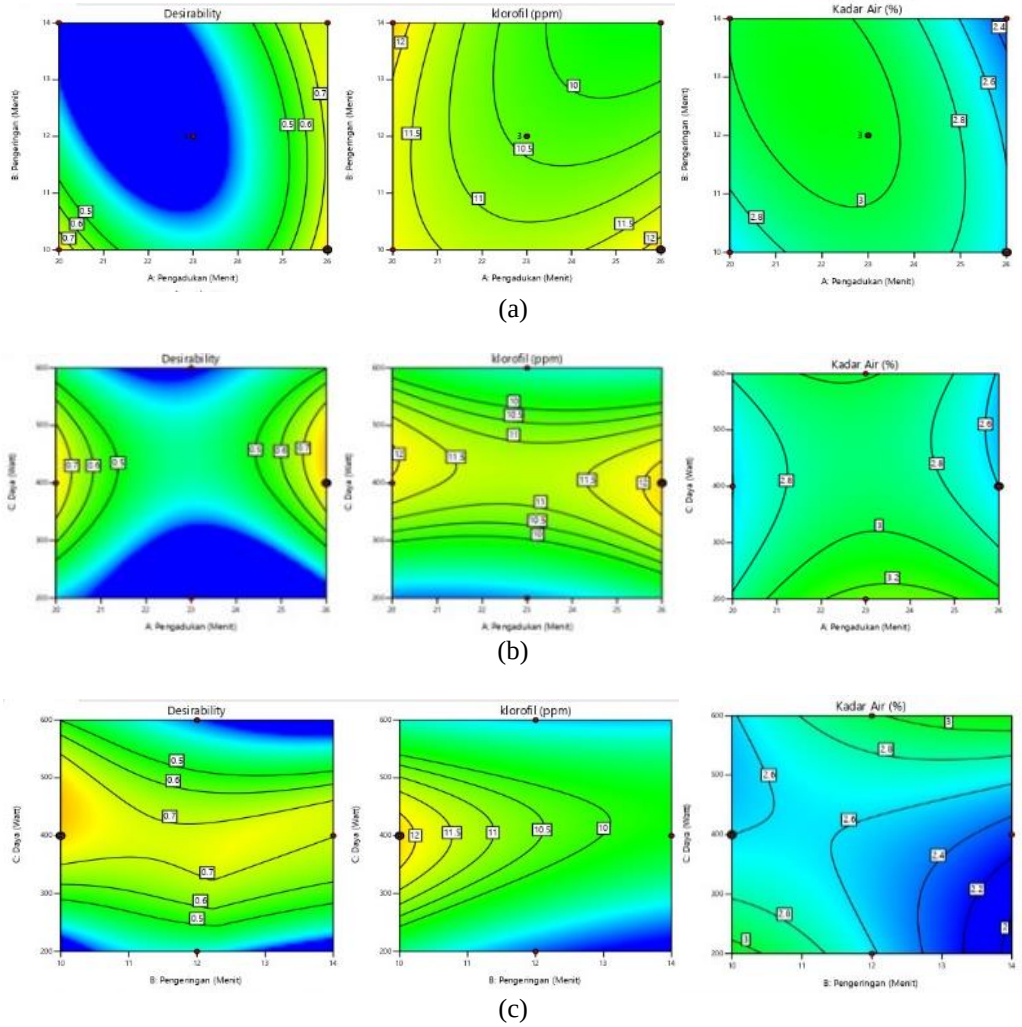


Fig. 5 Effect of all factors on desirability, chlorophyll and water content in the contour at R_7 ((a) Effect of stirring and drying variables; (b) Effect of stirring and power; (c) Effect of drying and power variables)

c. Optimum Treatment Support Analysis

Color

Herbal herb powder has chlorophyll on R_7 has an L* value of 73.7 which tends to be light. The a* value indicates a value of -2.5 which belongs to the -a category in the range 0 – (-80). This negative value indicates the tendency of the green color of the chlorophyll-containing herb powder. A positive value of 6.5 is displayed on the b* value which indicates the powder tends to be yellow. The green color comes from the chlorophyll content it contains of 14.183 ppm. The stirring time factor for 26 minutes in the R_7 treatment had an effect on the color characteristics. Stirring time affects Tween 80 in producing stable foam and increasing the rate of product

dissolution [14]. Tween 80 binds to maltodextrin to form a protective layer in the foam system so that it can protect bioactive components such as chlorophyll from damage and oxidation during processing and storage. The longer the stirring, the more stable the foam formed from the role of tween 80 so that the chlorophyll content is maintained. Chlorophyll in R_7 is maintained in the drying process for 10 minutes with 400 Watt power because the foam that is formed is quite stable and bonds to each other in protecting the components remain green. The drying time factor and the power used affect the quality of the color. The higher the power and drying time, the more physical damage the powder will cause. If the power used is in standard conditions such as R_7 which uses 400 watts of power, then the chlorophyll is still safe and not damaged.

pH

Herbal herb powder containing R_7 chlorophyll has a pH value of 6.03. It is classified as acidic because it is below the value of 7. The magnitude of the pH value can be influenced by the compounds contained or mixed ingredients that are intentionally added in the manufacture of powder due to the treatment given in each process. The manufacture of instant powder drink is influenced by several factors, such as sample selection, cooking technique, and crystallization process. This factor will also affect the pH of the product. Sample selection can be seen from the acidity level of the sample used. Tapak liman is an herbal plant that contains quite high levels of flavonoids. Flavonoids are polyphenols that have chemical properties like phenols and are slightly acidic. Treatment on R_7which involved 400 Watt power with 10 minutes of drying time had little effect on the flavonoid content [20]. The content of flavonoid compounds will decrease with increasing and high temperatures used because phenol decomposition will occur. Flavonoids have compound properties that are not resistant to temperature. If the levels of flavonoids decrease due to the drying process, the pH of the product will be close to neutral. The stirring time factor at R_7 for 26 minutes had an effect on the foam agent in the form of tween 80 which is easily soluble in water. The tendency to dissolve in water in tween 80 is due to the Hydrophilic Lipophilic Balance (HLB) value that tween 80 has of 15.

Total Dissolved Solids (TDS)

Herbal herb powder containing chlorophyll in tapak liman leaves in the R_7 treatment had a TDS value of 7.75°Brix. The TDS value is 7.75°Brix indicating that the dissolved solids of the components of sugar, salt, protein and pigment in the R_7 powder are 7.75 grams/100 grams of solution. The dissolved components cannot be ascertained as to what type. In herbal and spice powders with chlorophyll, the sugar component comes from the addition of a stabilizer in the form of maltodextrin. Maltodextrin contains reducing sugars, so the more maltodextrin is added, the total dissolved solids value increases[2]. Fractions or derivatives of maltodextrin caused by the stirring process. The process of stirring the material with the addition of maltodextrin for 26 minutes causes the compounds contained in maltodextrin to dissolve in water and break down more and more maltodextrin derivatives so that they bind to each other with the foam agent to form a stable layer. The longer the stirring of the ingredients will cause more derivative compounds to be formed. This is consistent with the many particles bound by the stabilizer which causes the total dissolved solids to increase and reduces the precipitate formed. Power of 400 Watt and drying time of 10 minutes in making R_7 powder had no effect on the determination of total dissolved solids. However, the stirring time affects the determination of total dissolved solids due to the effectiveness of maltodextrin as an emulsifier. The more free hydroxyl groups that are formed from the fraction of the filler, the higher the solubility level. The hydroxyl groups are formed from the stirring of all the ingredients, especially maltodextrin with tween 80.

V. CONCLUSION

The process of making optimum chlorophyll herb powder using a surface methodology response obtained optimum treatment conditions R_7 with a stirring time of 26 minutes, drying time of 10 minutes at a power of 400 Watt. The desirability value obtained is 0.789 which has a difference of 0.027 with the desirability value of the solution. The chlorophyll content in the optimum treatment was 14.183 ppm with a water content of 2.50%. The use of power units has a significant effect on chlorophyll content as the main parameter in the manufacture of chlorophyll-containing herbal spice powders. The higher the power, the easier it is for chlorophyll to be degraded. Parameters of water content in chlorophyll herbal powders are influenced by the use of power and the relationship between drying & power in the final product. The optimum chlorophyll powder for herbal medicine was selected under the R_7 treatment conditions which had an L* value of 73.7 with a tendency towards brightness. The a* value shows a value of -2.5 and a b* value of 6.5. The degree of acidity of the herb powder with chlorophyll treatment R_7 was 6.03 and the Total Dissolved Solids (TDS) value was 7.75°Brix.

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