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Optimization of Snackbar product formulation based on butterfly pea flower extract (*Clitoria Ternatea L.*) and canna tuber flour by d-optimal design expert mixture methods

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Abstract

The purpose of this study was to determine the best formulation in making Snackbar Based on Butterfly Pea Flower Extract and Canna Tuber Flour using the Design Expert program, Mixture D-Optimal method. So as to obtain Snackbar Based on Butterfly Pea Flower Extract and Canna Tuber Flour with optimal chemical and organoleptic quality. Preliminary research verifies the formulation with organoleptic responses used to determine the upper and lower limits in the design expert program in the main research. The main research conducted was to determine the optimal formulation of Snackbar Based on butterfly Pea Flower Extract and Canna Tuber Flour by considering the changing variables, namely canna tuber flour, butterfly Pea flower extract, and palm ant sugar consisting of 5 stages including the formulation design stage, formulation stage, upper and lower limits, optimization stage, and verification stage using the Design Expert program D-Optimal method. The responses used include protein content, carbohydrate content, crude fiber content, fat content, ash content, total sugar content, water content, antioxidant activity, and organoleptic test. The selected formulation of Snackbar Based on butterfly pea Flower Extract and canna tuber Flour is 13.44% canna tuber flour, 13.54% ant palm sugar, 0.38% butterfly pea flower extract. The resulting desirability value is 0.686. Based on the results of verification in the laboratory, the moisture content was 6.66%, fat content was 17.22%, total sugar content was 13.90%, protein content was 10.27%, carbohydrate content was 62.79%, crude fiber content was 5.32%, ash content was 3.06%, color attribute score was 4.27 (rather like), aroma was 4.43 (rather like), taste was 4.33 (rather like), texture was 3.37 (rather dislike), and overall 3.53 (rather dislike).

Keywords: Butterfly pea flower, Canna tuber flour, Design expert program D-optimal method, Formulation optimization, Snackbar.

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1. Introduction

Indonesia is a country located on the Pacific Ring of Fire,making it vulnerable to natural disasters such as earthquakes and volcanic eruptions. These natural disasters cause damagethat affects the limited need for food and availability of clean water. This emergency situation requires emergency food to meet the nutritional needs of disaster victims, the ideal emergency food given should contain nutrients and can meet the energy needs. The average daily energy required by Indonesians is 2150 kcal [1]. In addition, due to modern and convenient lifestyles, many people today choose ready-to-eat foods. A suitable food alternative to keepup with the times is snack bar products.

Snackbar is a snack product that is generally consumed asa hunger suppressant in between the main meals of the day. Some of the advantages of a snack bar are that it has a convenient form (bar and solid) and can be consumed by anyone. In addition, snack bars also have a relatively long shelf life and are known to be rich in nutrients, so in connection with the increasingly dynamic lifestyle of the community, food products with these characteristics are oftenneeded to support daily activities [2]. Snack bar is usually rectangular in shape,which contains nutrients needed by humans, and moreover, snack bar is a food that can be consumed ready to eat and hashigh nutritional value [3].

The use of canna tuber in Indonesia is usually still in traditional food processing such as only steamed, made into chips and other traditional foods, besides that so far people still consider canna tuber as a low class food. From the nutritional content of canna tuber, it is a source ofcarbohydrate that has the potential to be developed and has considerable prospects and opportunities as a raw material forthe food industry. Its development and utilization can be improved by applying the right cultivation technology in an effort to increase productivity and the availability of a reasonable market guarantee. The increase in production must be followed by processing technology that can grow the agro-industry. Industries that have prospects for development are the processing of semi-finished products such as flour or other finished products [4].

The nutritional content of canna flour has good prospects if it is properly processed or managed, because it is an alternative source of carbohydrates derived from local resources that can be processed according to the needs in making types of food. canna flour contains 85.20 grams of carbohydrate per 100 grams and 0.70 grams of protein per 100 grams, and the fiber content is 2.20 grams per 100 grams [5].

Butterfly pea flowers are plants that have the Latin name Clitoria ternatea L. High anthocyanins in this flower are organic compounds that act as antioxidants that function against free radicals, and antioxidants can also help provide additional nutrients to body cells, and the florets can beconsumed, and can be used as an attractive blue color [6].

The blue substance contained in butterfly pea flowers (Clitoria ternatea L.), apart from being a source of antioxidants, the crude butterfly pea extract of flowers can be
used as an alternative dye and is safe for consumption so thatanthocyanins can have potential in foodstuffs as a natural color giver [7]. Apart from being a natural colorant, anthocyanins are generally water soluble so that they can be used for food and beverage products that are safefor consumption [8]. Currently, theuse of butterfly pea flowers is still limited, so it is necessary to process modifications of butterfly pea flowers in order to obtain balanced nutrients.

Making Snackbar based on butterfly pea flower extractand canna tuber flour is expected to help increase selling value, and also as an effort to diversify local food products sothat based on the description above, it is necessary to conduct research to determine the optimization of Snackbarformulations based on butterfly pea flower extract and canna tuber flour using Design Expert Mixture D-Optimal method. Design Expert Mixture D-Optimal method is one of the software that can be used to determine the optimalformulation, which is used to optimize the main responseprocess caused by several variables, and the goal is to optimize the response. Design Expert 13 offers several design options with their respective functions, including MixtureDesign which is used to find the optimal formulation [9].

2. Materials and Methods

2.1. Materials

The ingredients used in the process of making a butterfly pea and canna tuber flour. Canna tuber flour obtained from Bantul district, Central Java. The materials in the process of production of snack bar from Butterfly pea flower extract and canna tuber flour include Butterfly Pea Flower Extract, Canna Tuber Flour, Mung Beans Flour, Oats, roasted almond, oats, sorghum puff, pumpkin seeds, sesame, Date palm, Margarine, Ant Palm Sugar, Salt, Vanilla Powder and Water. The materials used for chemical analysis were Distilled water, filter paper, charcoal band, Kjeldahl salt, concentrated H_2SO_4 solution, 0.1 N HCl solution, PP indicator, 0.1 N NaOH solution, Luff-Schoorl solution, 6 N H_2SO_4 solution, KI powder, standard sodium thiosulfate solution, Amylum solution, 10 N H_2SO_4 solution, DPPH powder, PA Methanol solution, DPPH solution, DPPH test solution, and tartaric acid.

2.2. Preparation of Snackbar Making

The process of weighing all the ingredients according to the recipe takes place, then the canna tuber flour, mung bean flour, oats and sesame are first roasted at a temperature of 140°C-180°C for 3-5 minutes. Then the caramel is made by heating ant palm sugar, margarine and water at 180°C for 15minutes. Then all the ingredients are added to the caramel and mixed until all the ingredients are mixed. After the ingredientshave been mixed, they are spread on a 24cm x 4cm x 4cm baking tray that has been covered with some baking paper for shaping. Then the cutting is done with a weight of 30 grams per square. The sliced Snackbar is then tempered at room temperature. After that, it is placed in a fridge to finish at a temperature of 5°C within 1 hour. Then it goes to the lastprocess, which is packaging.

2.3. Chemical Analysis of Snackbar

2.3.1. Moisture Content Analysis

One of the crucial laboratory chemical analysis techniques used in the food sector is moisture content analysis. Food quality and resistance to potential spoiling are assessed using this moisture content test. The oven method and the gravimetric method are two instances of testing techniques. By weighing the component after it has been separated into its pure condition, the gravimetric method, an analytical chemistry technique, can be used to calculate the amount of a known substance and component. The procedure for analyzing the water content of the gravimetric method is an empty cup heated in an oven at 105ºC for 30 minutesand then put into an applicator for 15 minutes and weighed (W0).15 minutes in an exicator and weighing (W0). Then Then 2grams of sample is put in a cup that has known weight and weighed(W1) then dried in the oven at 105ºC for 3 hours. Then put in an exicator for fifteen to thirty minutes, after which the cup and its contents are weighedand dried again for 1 hour and then put back for 1 hour and put backfor 1 hour. put back for 1 hour and put back into the applicator andweighed again (W2). then weighed again (W2). Drying was carriedout until getting a constant W2 which is constant. Moisture contentcan be calculated using:

$$\%Moisture\ Conten(\%) = \frac{(\mathrm{W1} - \mathrm{W2})}{(\mathrm{W1} - \mathrm{W0})} x100\%$$

Description:
W0 : Weight of empty cup (g)
W1 : Weight of cup + initial sample (before drying process) (g)
W2 : Weight of cup + constant sample (after drying process) (g)

2.3.2. Protein Content Analysis

Weighing the material to 0.1 to 0.5 g and then placing it in a 100 mL Kjeldhal flask allows us to determine its protein content. then disassembled (heated to a boiling point) until the solution turns bright green and the SO2 is gone. After allowing the solution to cool, it was moved to a 50 ml flask, diluted with distilled water to the appropriate level, placed in a distillation apparatus, and then distilled using 5–10 ml of 30- 33% NaOH. A few drops of indicator (0.1% bromcresol green solution and 0.1% methyl red solution in 95% alcohol separately and combined between 10 ml of bromcresol green and 2 ml of methyl red) were then added to the distillate, which was then collected in a solution of 10 ml of 3% boric acid. and used the following formula to determine the protein concentration of the material after titrating with a 0.02 N HCl solution until the solution becomes pink

$$\%Protein = \frac{(\mathrm{VA} - \mathrm{VB})\mathrm{HCl\ X\ NHCl\ x\ 14{,}007}}{\mathrm{Wsample\ x\ 1000}} x100\%$$

Description:
VA : ml *HCl* for sample titration
VB : ml *HCl* for blanket titration
N : normality of the standard *HCl* used14,007 : atomic weight of Nitrogen
W : Weight of sample (g)

2.3.3. Fat Content

The Soxhlet method involves weighing a sample up to 5 grams, wrapping it in filter paper, and placing it on a Soxhlet extraction equipment that is positioned on a condenser with a fat flask underneath. After adding enough hexane solvent to the fat flask based on the size of the Soxhlet, the mixture was refluxed for at least 16 hours until the solvent settled back into the flask. The fat flask's solvent is collected and distilled. After that, the fat flask with the extracted fat is dried for five hours at 105ºC in an oven. After 20 to 30 minutes of cooling in a desiccator, the fat flask was weighed. The following formula can be used to determine fat content using the Soxhlet method.

$$\%Fat\ Content(\%) = \frac{(\mathrm{W1} - \mathrm{W0})}{(\mathrm{Ws})} x100\%$$

Description:
W0 : Weight of empty cup (g)
W1 : Weight of cup + initial sample (before drying process) (g)

2.3.4. Wa Kash Content Analysis

Ash is an inorganic material that is left over after burning biological material [10]. This analysis's basic idea is to oxidize all organic materials at high temperatures (around 550°C) and then weigh the residue that remains after combustion. The sample is smoothed, and two grams are weighed on a porcelain chair with a known weight to complete the procedure. then dried for three to five hours at 500–6000C in a furnace. The porcelain is heated in the oven for fifteen minutes after the furnace is switched off and allowed to cool. After cooling in a desiccator, the porcelain is weighed one last time. The mathematical technique is then used to determine the amount of ash. The following appendix displays the findings from the computation of the analysis of the water, protein, fat, and ash contents.

$$\%Ash\ Conten(\%) = \frac{(W1 - W2)}{(W1 - W0)} x100\%$$

Description:

W0 : Weight of empty cup (g)
W1 : Weight of cup + initial sample (g)

W2 : Weight of cup + constant sample (after drying process)(g)

2.3.5. Antioxidant Activity Analysis by DPPH Method

The antioxidant analysis procedure with the DPPH method isas follows:

a) Preparation of 0.2 M DPPH Solution

DPPH powder weighed ± 7.88 mg and then dissolved with methanol PA as much as 100 mL The solution was stirred until homogeneous and measured absorbance using a UV-Vis spectrophotometer.

b) Preparation of Blank Solution as much as 2.0 mL

A DPPH solution of 0.2 mL was put into a test tube and methanol p.a. 2.0 mL was. The solution was homogenized and incubated in a dark place for 30 minutes. This solution was made for three repetitions.

c) Preparation of Test Solution

A 1000 µg/mL mother solution was made in order to create the test solution. To create test solutions with concentrations of 50 µg/mL, 125 µg/mL, 200 µg/mL, 275 µg/mL, and 350 µg/mL, the parent solution was pipetted 0.5 mL, 1.25 mL, 2.0 mL, 2.75 mL, and 3.5 mL into a 10 mL volumetric flask. After pipetting 2.0 mL of each test solution into a test tube, 2 mL of 0.2 mL DPPH was added. After homogenizing the mixture, it was allowed to sit at room temperature for half an hour in the dark. Up to three repetitions of the test solution were made.

d) Measurement of Antioxidant Activity Each solution was incubated at room temperature for 30 minutes in the dark then the absorbance was measured using a UV-Vis spectrophotometer at a wavelength of 515 nm. IC50 value was determined using a linear regression equation formula with percent inhibition as ordinate (y) and concentration as abscissa (x). Percent inhibition of each solution

.

$$\%Inhibition = \frac{(\text{Absorbance of Blank} - \text{Sample Absorbance})}{\text{Absorbance of blank}} x100\%$$

2.3.6. Carbohydrate Content Analysis

Carbohydrate content is determined by the difference method, which involves water content, protein content, fat content, and ash content. The following equation is used in calculating carbohydrate content using the by-difference

$$Carbohydrate\ Content(\%) = 100\% - (\%Water + Protein + Fat + Ash)$$

2.3.7. Total Sugar Content Luff schoorl Method

- Determination of Reduced Sugar Content Before Inversion

After weighing three to five grams of the sample, it was dissolved in a 250 ml measuring flask and distilled water was added until the limit was reached. After that, give each of the two 250 ml Erlenmeyer pipettes 25 ml of the experimental sample solution, and use 10.2 ml of aqua dest as a blank. 10 ml of the luff solution was pipetted, and it was then mixed until it was uniform. After 10 minutes of refluxing with running water, add 20 schoorl ml of distilled water. Next, add 10 ml of 6 N H2SO4 and stir until it's homogenous. Finally, add 1 gram of KI and mix until it's homogenous. Add 2.5 ml of 1% amylum solution after titrating with thiosulfate standard solution till light yellow. Titrate again until the blue hue goes away.

$$Reduced\ sugar\ content\ before\ inversion = \frac{(\text{fp x mg of sugar x 0,001})}{(\text{W Sample})} x100\%$$

- Determination of Reduced Sugar Content After Inversion Piped 25 ml of experimental solution for reducing sugar,

100 ml of distilled water and 10 ml of 25% HCl were then added to a 250 ml Erlenmeyer flask, heated in a hot water bath at 70–80 °C for 10–15 minutes, quickly cooled under running water, and then five drops of phenolphthalein indicator were added. After neutralizing with a small amount of 30% NaOH solution until it turns pink, apply 1% acetic acid to restore its natural hue. After adding 10 ml of Luff Schoorl solution and 20 ml of distilled water to a 250 ml volumetric flask, the sample was refluxed for 10 minutes and cooled with cold running water. Next, 10 ml of 6 N H2SO4 was added, and it was stirred until it was homogenous. Finally, one gram of KI was added and stirred until it was homogenous. Next, a thiosulfate solution is added until it turns pale yellow, followed by two milliliters of H2SO4 6 N that is swirled until it is homogenous and one gram of KI that is also stirred until it is homogenous.

$$Reduced\ sugar\ content\ before\ inversion = \frac{(\text{fp x mg of sugar x 0,001})}{(\text{W Sample})} x100\%$$

$$Source\ Content = ((\%Recuded\ Sugar\ \ content\ before\ inversioan - \%\ Recuded\ sugar\ content\ before\ inversion)x\ 0{,}095\%)$$

$$\text{Total Sugar Content} = (\text{\% Reduced sugar content before inversion} + \text{\% Sucrose})$$

2.3.8. Crude Fiber Analysis Using the Gravimetric Method

The procedure in this Gravimetric method is that a sampleof 2-3 grams is put into an Erlenmeyer flask, added 100mL of 0,3 N H2SO4 and 2 drops of CHCI3 heat for 30 minutes. Filter and wash the residue with distilled water until acid-free (blue litmus remains blue). Transfer the residue to another Erlenmeyer. Rinse with 0.3 N NaOH then add 2-3 drops of CHCl3 heat for 30 minutes. Filter the paper residue on the previously constant (dried at 105◦C, and wash with hot distilled water until base-free (red litmus remains red). Then rinse the residue with 10 mL of 95% alcohol. Dry in the oven for 1 hour. After drying, store in an applicator and weigh, do it repeatedly until a constant weight is obtained. The formula for fiber content is as follows:

$$\%Fiber\ Content = \frac{(\text{Wfiber paper} - \text{Wconstant paper})}{\text{WSample}} x100\%$$

2.4. Statistical Analysis

The reseach design model used in this research is a Design expert mixture d-optimalizing methods. The research design was composed of two variables, which consist of the independent and dependent variables. The independent variables in this research were butterfly pea flower extract, and ant palm sugar while the dependent variables were MungBeans Flour, Oats, roasted almond, oats, sorghum puff, pumpkin seeds, sesame, Date palm, Margarine, Ant Palm Sugar, Salt, Vanilla Powder and Water. Then some formulations are offered by the Design Expert. The products based on the Design Expert formula then need to be analyzedfor chemicals, and sensory responses.

Table 1.
The independent variables.

No.	Ingredients	Low	High
1.	Canna Tuber Flour	5.42	13.56
2.	Ant Palm Sugar	13.54	20.6
3.	Butterfly Pea FlowerExtract	0.27	1.35

Table 2.
The dependent variables.

No.	Ingredients	Amount (%)
1	Mung beans flour	6.77
2	Margarine	4.07
3	*Pumkin seeds*	6.77
4	Water	13.56
5	Salt	0.41
6	Vanilla powder	0.41
7	Sorgum *puff*	6.77
8	Sesame	6.77
9	*Oats*	6.77
10	*Roasted* almond	13.56
11	Date palm	6.77

Table 3.
Snackbar formulas to be analyzed on design expert

F	Canna TuberFlour (%)	Butterfly Pea FlowerExtract (%)	Ant Palm Sugar(%)
1	6.71	1.35	19.31
2	12.48	1.35	13.54
3	9.82	0.66	16.88
4	13.56	0.27	13.54
5	6.50	0.27	20.60
6	12.13	0.30	14.92
7	10.71	1.35	15.31
8	12.48	1.35	13.54
9	5.85	0.91	20.60
10	5.85	0.91	20.60
11	9.05	0.27	18.04
12	13.56	0.27	13.54
13	7.85	0.27	19.24
14	7.94	1.33	18.09

Table 4.
Chemical Analysis of snackbar based on butterfly pea flowerextract and canna tuber flour.

F	Moisture(%)	Ash(%)	Protein(%)	Fat(%)
F1	7.30	3.32	10.09	18.37
F2	7.20	3.10	10.35	20.91
F3	7.34	2.84	10.18	18.34
F4	7.47	2.70	10.33	18.14
F5	7.96	2.72	10.21	17.79
F6	7.34	2.06	10.27	18.14
F7	7.39	3.04	10.31	20.23
F8	7.23	3.08	10.37	20.91
F9	9.98	2.95	10.28	15.66
F10	9.89	2.99	10.28	16.02
F11	7.49	2.62	10.11	17.85
F12	7.47	1.03	10.33	18.34
F13	7.53	2.68	10.08	17.70
F14	7.27	3.22	10.15	18.45
F	**CH(%)**	**TotalSugar (%)**	**Crude Fiber(%)**	
F1	60.97	23.21	5.15	
F2	52.82	15.85	10.02	
F3	61.54	21.74	5.13	
F4	61.10	13.34	5.11	
F5	62.08	24.83	4.78	
F6	62.19	16.35	4.99	
F7	58.93	16.87	8.97	
F8	52.82	15.08	10.02	
F9	63.72	26.46	4.26	
F10	63.32	26.13	4.19	
F11	62.16	17.21	4.88	
F12	62.77	14.66	5.11	
F13	62.31	23.03	4.80	
F14	60.91	22.80	5.32	

3. Results and Discussion

3.1. Moisture Content Analysis

Based on Table 4. The response of snackbar moisture content using variable change raw materials (ant palm sugar, butterfly flower extract, and canna tuber flour) was formulated. The 14 formulations show the range of moisture content of snackbar from 7.20% to 9.98% according to USDAstandards.According to USDA standards (2015), the moisture content of snackbar is 11.26%. According to Winarno [11] in Avianty [12]. The moisture content in food that issafe for storage is less than 14%, so snack bars with low moisture content are safe for storage. A moisture content of 14-15% is sufficient to prevent the growth of bacteria and mold.

Result from the ANOVA test analysis showed that the response of water content of snackbar based on butterfly pea flower extract and canna tuber flour with the cubic model recommended by the design expert showed the results of the analysis of the formulation made had a significant effect (probability <0.05) on the chemical response of water content showed that the model made was significant (probability

<0.05), at a value of p=0.0001. This means that of the 14 formulations made, the effect was significant (probability

<0.05). This means that the 14 formulations made have a realeffect on the chemical response of water content, so that the response can be used in the optimization process to obtain a product with optimum characteristics. The lack of fit value isgreater than 0.05, which is 0.1546, indicating that the lack offit is not significant to noise. The lack of fit value is not significant, indicating that there is agreement between the chemical analysis data on moisture content analysis and the model.

The equation of the mathematical model of moisturecontent analysis is the coefficient of each factor contained inthe following equation:

Y = A(7.46) + B(8.49) + C(2074.40)

Description:

A = canna tuber flourB = ant palm sugar

C = butterfly pea flower extract

Based on the equation obtained, it can be seen that the highest component contributing to the analysis of water content in snackbar products based on butterfly pea flower extract and canna tuber flour is the interaction coefficient C (Butterfly Pea Flower Extract). This is characterized by the interaction coefficient C has the highest value of 2074.40 when compared to the coefficients of other components. The optimal formulation graph for chemical analysis of moisture content can be seen in Figure 1.

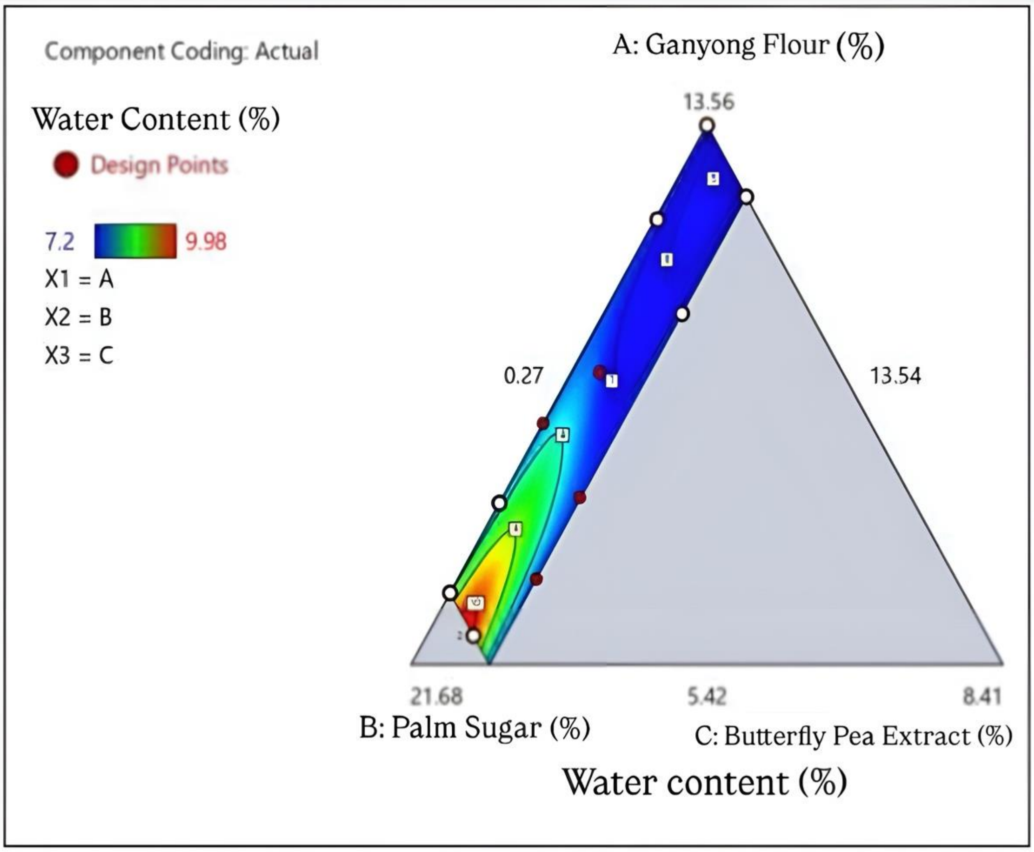

Figure 1.
Graph of Design Expert on Moisture Content Response.

The contour plot graph illustrates how the combination ofA (canna tuber flour), B (ant palm sugar) and C (butterfly pea flower extract) affect each other's water content analysis. Theblue color shows the lowest moisture content analysis value of 7.20. The red color shows the highest water content analysis response value of 9.98. The dots shown on the graphshow the results of the combination of the three components with different amounts that produce water content analysis.

3.2. Ash Content Analysis

Based on Table 4. Based on the results of chemical analysis, the ash content of butterfly pea flower snackbar andcanna tuber flour can be seen in Table 4. Of the 14 formulations, the ash content ranged from 1.03%-3.32%.From these results, it can be seen that the highest result was 3.32%. The higher the addition of butterfly pea flower extractpowder, the higher the ash content in snackbar. This is because the ash content of bayang flower extract powder is high at 6.03% per 100 grams. The decrease in ash content canbe caused by the use of water in the processing process whichcan reduce the availability of minerals because minerals willdissolve in water. Ash content roughly describes the amount of minerals contained in a food material [13]. Other ingredients also affect ash content. Based on United States Department of Agriculture Nutrient Database [14] the quality requirements for ash content in snackbar productsdo not meet the standards because the high ash content exceeds 1.90%.

The results of the anova test analysis can be seen in Table 1. Linear models recommended by design experts show that the formulations made have a significant effect (probability

<0.05) on the chemical response of ash content, at a value ofp=0,0056. This means that the 14 formulations made have a significant effect on the chemical response of ash content, sothat the response can be used for the optimization process, toobtain a product with optimum characteristics. The lack of fitvalue is greater than 0,05, which is 0,9970, indicating that thelack of fit is not significant to noise. The lack of fit value is not significant, indicating that there is agreement between theash content analysis data and the model. The value of lack offit not significant is a requirement for a good model and shows that there is a match between the ash content analysis data and the model. The equation of the mathematical model of ash content analysis is the coefficient of each factor contained in the following equation:

$Y = A(2.05) + B(2.70) + C(8.73)$

Description:

A = canna tuber flourB = ant palm sugar

C = butterfly pea flower extract

Based on the equation obtained, it can be seen that the highest component contributing to the analysis of ash contentin snackbar products based on butterfly pea flower extract and canna tuber flour is the interaction coefficient C (butterfly pea Flower Extract). This is characterized by the interaction coefficient C having the highest value of 8,73 when comparedto the coefficients of other components. The optimal formulation graph for ash content analysis can be seen in Figure 2.

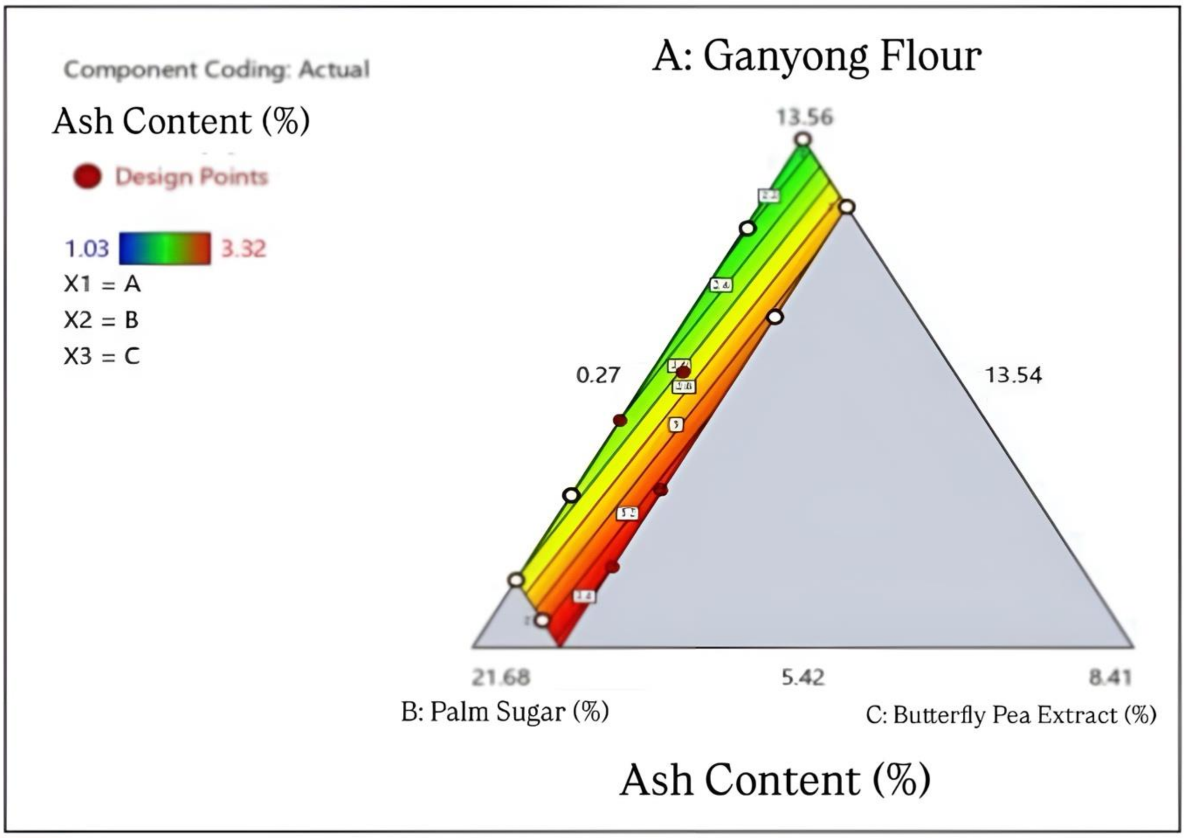

Figure 2.
Graph of Design Expert on Moisture Content Response.

The contour plot graph illustrates how the combination ofA (canna tuber flour), B (ant palm sugar) and C (butterfly pea flower extract) affect the ash content analysis. The blue colorshows the ash content analysis value of 1,03. The red color shows the highest ash content analysis response value of 3,32. The dots on the graph show the combination of the three components with different amounts that produce the ashcontent analysis response.

3.3. Carbohydrate Content Analysis

Based on Table 4. Based on the results of chemical analysis of carbohydrate content in bayang flower snackbar and canna tuber flour can be seen in Table 6. Of the 14 formulations, the results of carbohydrate content ranged from52.82%-63.72%. From these results it can be seen that the highest result is 63.72%. Based on this analysis, the higher the addition of canna tuber flour and butterfly pea flower extract powder, the higher the carbohydrate content in the snackbar. This is because canna tuber flour has a very high carbohydrate content of 83.60%. According to Wijayanti [15] carbohydrates increase due to high starch content. Other ingredients also affect the calculation of carbohydrate content. According to Subandoro, et al. [16] carbohydrate content calculated by difference is influenced by several other nutritional components, the lower the other nutritional components, the higher the resulting carbohydrate content. Vice versa, the higher the other nutritional components, the lower the carbohydrate content. Nutritional components that affect the amount of carbohydrate content include protein, fat, water and ash.

The results of the anova test analysis can be seen in Table

6. The special quartic model recommended by the design expert shows that the formulation made has a significant effect (probability <0.05) on the chemical response of carbohydrate content shows that the model made is significant (probability <0.05), at a value of p=0.0001. This means that the 14 formulations made have a significant effect on the chemical response of carbohydrate content, so that the response can be used for the optimization process, to get a product with optimum characteristics. The lack of fit value is greater than 0.05, which is 0.9703, indicating that the lack of fit is not significant to noise. The value of lack of fit not significant indicates that there is a match between the data from the analysis of fat content with the model. The value of lack of fit not significant is a requirement for a good model and indicates the existence of conformity between the data of the analysis of fat content with the model.

The equation of the mathematical model of carbohydrate content analysis is the coefficient of each factor contained in the following equation:

$Y = A(61.96) + B(61.93) - C(436.47)$

Description:

A = canna tuber flour B = ant palm sugar

C = butterfly pea flower extract

Based on the equation obtained, it can be seen that the highest component contributing to the analysis of carbohydrate content in snackbar products based on butterfly pea flower extract and canna tuber flour is the interaction coefficient A (canna tuber flour). This is indicated by the interaction coefficient A has the highest value of 61.96% when compared to the coefficients of other components. The optimal formulation graph for carbohydrate content analysis can be seen in Figure 3.

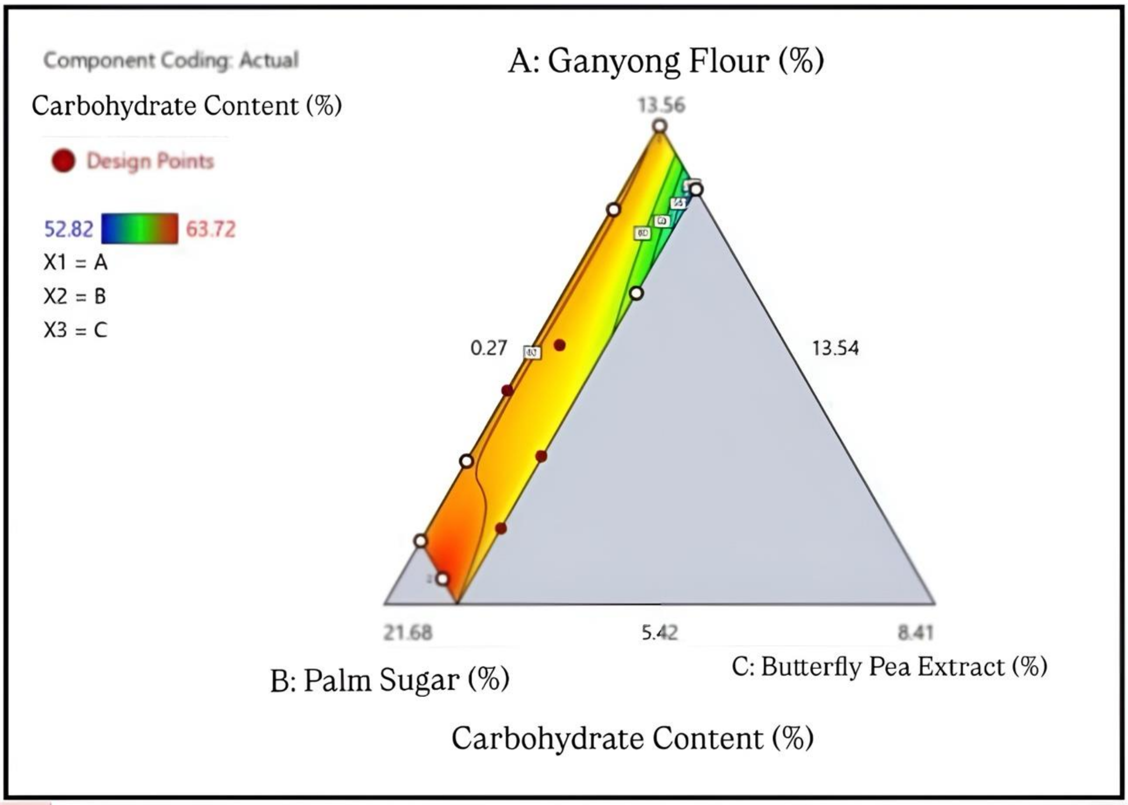

Figure 3.
Graph of Design Expert on Carbohydrate Content Response

The contour plot graph illustrates how the combination of A (canna tuber flour), B (ant palm sugar) and C (butterfly pea flower extract) affect the carbohydrate content analysis. The blue color shows the lowest carbohydrate content analysis value of 52.82%. The red color shows the highest carbohydrate content analysis value of 63.72%. The dots shown on the graph show the results of the combination of the three components with different amounts that produce the response of carbohydrate content analysis.

3.4. Protein Content Analysis

Based on Table 4. Based on the results of chemical analysis of protein content in snackbar from 14 formulations, the results of protein content ranged from 10.08%-10.37%. From these results it can be seen that the highest result is 10.37%. Based on this analysis, the more the addition of canna tuber flour and butterfly pea flower extract powder, thehigher the protein content in the snackbar. This is because butterfly pea flower extract powder has a high protein contentof 19% and canna tuber flour of 0.80%. So that the more the addition of butterfly pea flower extract powder and canna tuber flour to the snackbar, the more the protein content in thesnackbar increases. Heating can affect protein levels where the longer the heating, the lower the protein content, these changes depend on the time and temperature conditions during processing [17]. Other ingredients also affectprotein levels. Badan Standardisasi Nasional [18] the quality requirementsfor protein content in snackbar products have met the standards due to the high protein content entering the averageof 9-25%.

The results of the anova test analysis can be seen in Table 4 the cubic model recommended by the design expert shows that the formulation made has a significant effect (probability<0.05) on the chemical response of protein content, at a value of p = 0.0001. This means that the 14 formulations made havea significant effect on the chemical response of protein content, so that the response can be used for the optimizationprocess, to get a product with optimum characteristics. The lack of fit value is greater than 0.05, which is 0.1911, indicating that the lack of fit is not significant to noise. The value of lack of fit not significant indicates that there is a match between the data from the analysis of protein levels with the model. The value of lack of fit not significant is a requirement for a good model and shows the suitability between the data from the analysis of protein levels with the model.

The equation of the mathematical model of protein content analysis is the coefficient of each factor contained inthe following equation:

$Y = A(10.33) + B(10.45) - C(2091.24)$

Description:

A = canna tuber flourB = ant palm sugar

C =butterfly pea flower extract

Based on the equation obtained, it can be seen that the highest component contributing to the analysis of protein content in snackbar products based on butterfly pea flower extract and canna tuber flour is the interaction of coefficient B (ant palm sugar). This is characterized by the interaction coefficient B has the highest value of 10,45 when compared to the coefficients of other components. The optimal formulation graph for protein content analysis can be seen in Figure 4.

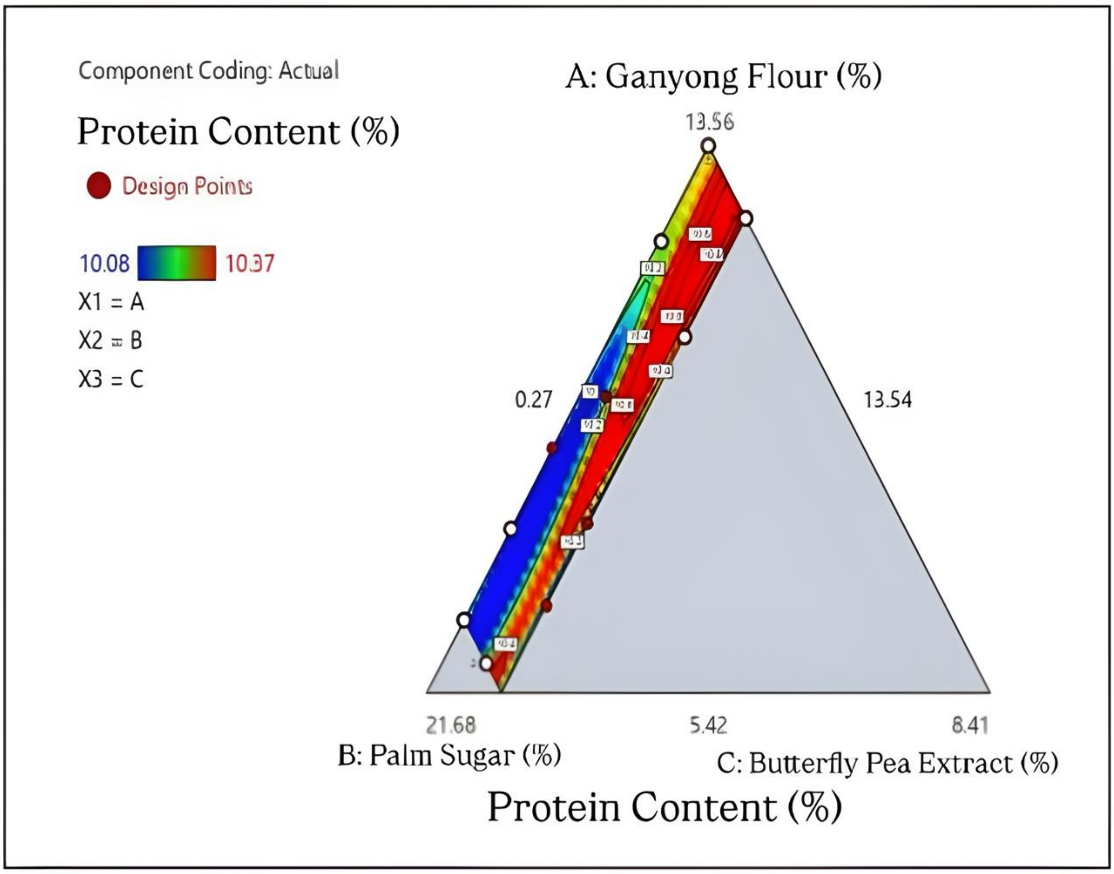

Figure 4.
Graph of Design Expert on Protein ContentResponse.

The contour plot graph illustrates how the combination of A (canna tuber flour), B (ant palm sugar) andC (butterfly pea flower extract) affect each other's fat contentanalysis. The blue color shows the lowest protein content analysis value of 10,08%. The red color shows the highest protein content analysis value of 10,37%. The dots shown onthe graph show the results of the combination of the three components with different amounts that produce a protein content analysis response.

3.5. Fat Content Analysis

Based on Table 4. Based on the results of chemical analysis of fat content in snackbars from 14 formulations, the results of fat content ranged from 15,66% - 20,91%. From these results it can be seen that the highest result is 20,91%. Based on this analysis, the more the addition of canna tuber flour and butterfly pea flower extract powder, the higher the fat content of the snackbar. This is because the fat content ofbutterfly pea flower extract powder is 2,50% and canna tuber flour is 1,70%. Other ingredients also affect fat content. Badan Standardisasi Nasional [18] the quality requirements for fat content in snackbar products have met the standards because it is not less than 1,40 and the quality requirements for fat content arenot more than 14%.

The results of the anova test analysis can be seen in Table 4. The quartic model recommended by the design expert shows that the formulation made has a significant effect (probability <0.05) on the chemical response of fat content, the model made is significant (probability <0.05), at a value of $p=0.0001$. This means that the 14 formulations made have a significant effect on the chemical response of protein content, so that the response can be used for the optimization process, to obtain products with optimum characteristics. The lack of fit value is greater than 0.05, which is 0.5391, indicating that the lack of fit is not significant to noise. The lack of fit value is not significant, indicating that there is a match between the data from the fat content analysis and themodel. The value of lack of fit not significant is a requirementfor a good model and shows that there is a match between thedata from the analysis of fat content with the model.

The equation of the mathematical model of fat content analysis is the coefficient of each factor contained in the following equation:

$Y = A(18.18) + B(17.67) + C(652.26)$

Description:

A = canna tuber flour

B = ant palm sugar

C= Butterfly pea flower abstract

Based on the equation obtained, it can be seen that the highest component contributing to the analysis of fat content in snackbar products based on butterfly flower extract and canna tuber flour is the interaction coefficient C (butterfly pea Flower Extract). This is characterized by the interaction coefficient C has the highest value of 652,26 when compared to the coefficients of other components. The optimal formulation graph for fat content analysis can be seen in Figure 5.

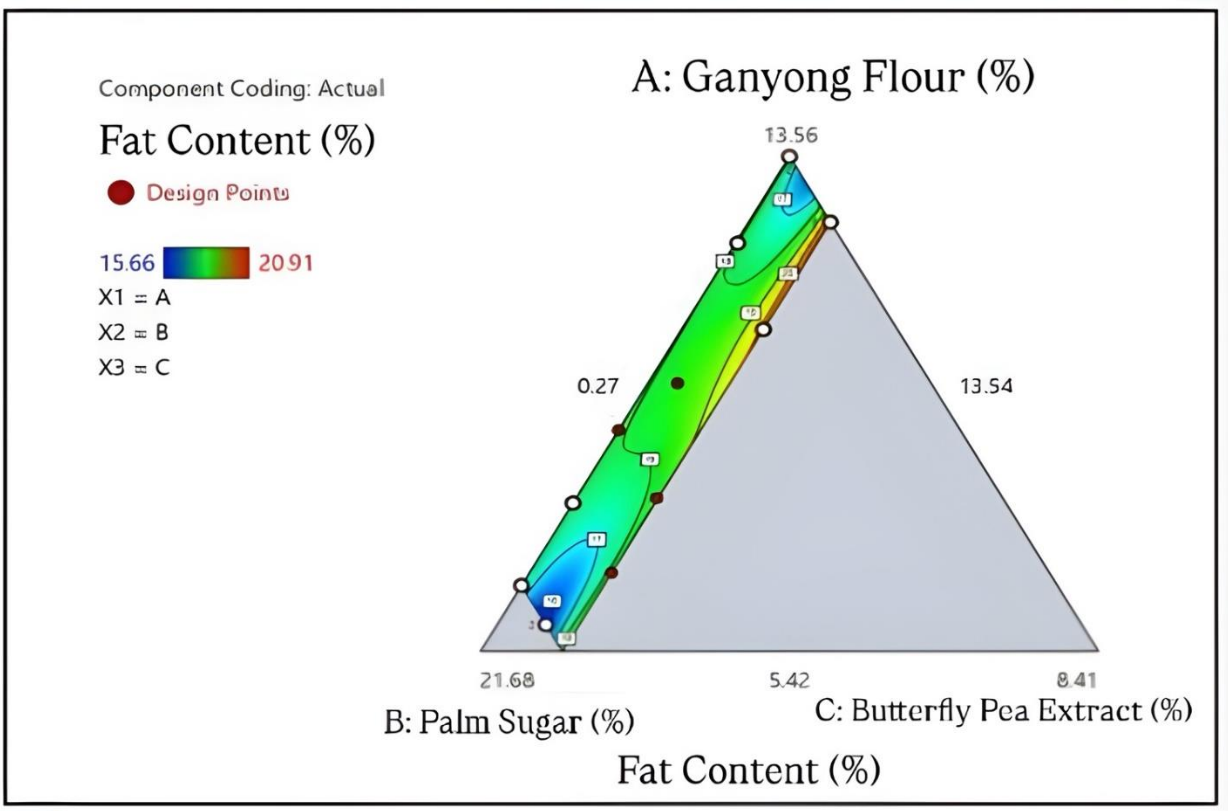

Figure 5.
Graph of Design Expert on Fat Content Response

The contour plot graph illustrates how the combination of A (canna tuber flour), B (ant palm sugar) and C (butterfly pea flower extract) influences the fat content analysis. The blue color shows the lowest fat content analysis value of 15,66%. The red color shows the highest fat content analysis value of 20,91%. The dots shown on the graph show the results of the combination of the three components with different amounts that produce a fat content analysis response.

3.6. Total Sugar Content Analysis

Based on the results of chemical analysis of total sugar content in snack bars from 14 formulations, the results of total sugar content ranged from 13,34%-26,46%. From these results it can be seen that the highest result is 26,46%. Basedon this analysis, the more the addition of ant palm sugar, the higher the total sugar content in the snackbar. This is because palm ant sugar has a very high sugar content of 84,21%. Other ingredients also affect the total sugar content.

The anova test analysis results can be seen in Table 4. Thequbic model recommended by the design expert shows that the formulation made has a significant effect (probability

<0.05) on the chemical response of total sugar content, at a value of p = 0.0001. This means that the 14 formulations made have a real effect on the chemical response of total sugar content, so that the response can be used for the optimization process, to get a product with optimum characteristics. The lack of fit value is greater than 0.05, which is 0.0741, which indicates that the lack of fit is not significant to noise. The value of lack of fit not significant indicates that there is a match between the data from the analysis of total sugar content with the model. The value of lack of fit not significant is a requirement for a good model and shows that there is a match between the data from the analysis of total sugar levels with the model.

The equation of the mathematical model of total sugar content analysis is the coefficient of each factor contained in the following equation:

$Y = A(13.77) + B(26.30) + C(25.84)$

Description:

A = canna tuber flourB = ant Palm sugar

C = butterfly pea flower extract

Based on the equation obtained, it can be seen that the highest component contributing to the analysis of total sugar content in snackbar products based on butterfly pea flower extract and canna tuber flour is the interaction coefficient B (Ant Palm Sugar). This is characterized by the interaction coefficient B has the highest value of 26.30% when comparedto the coefficients of other components. The optimal formulation graph for total sugar content analysis can be seenin Figure 6.

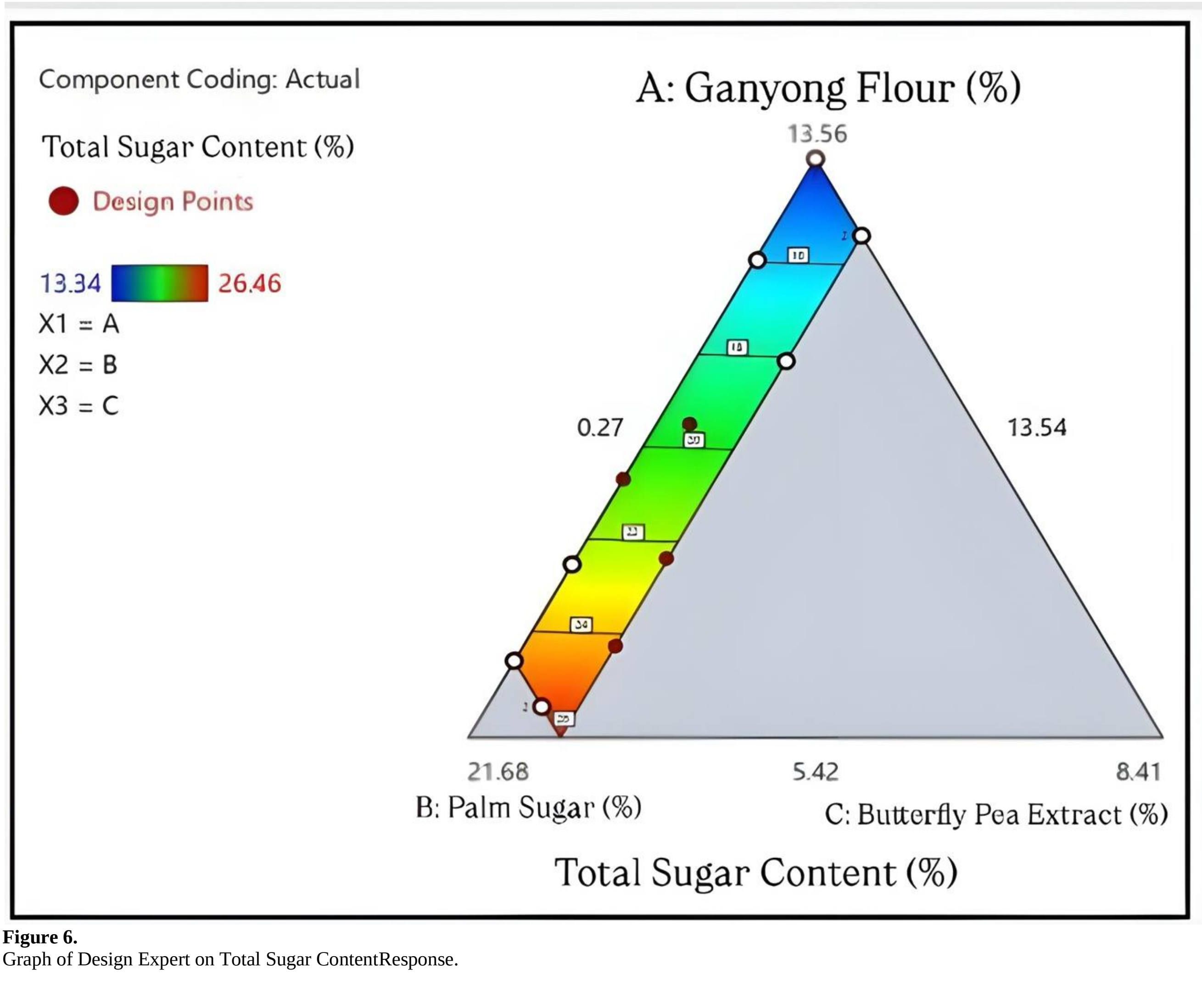

Figure 6.
Graph of Design Expert on Total Sugar ContentResponse.

The contour plot graph illustrates how the combination of A (canna tuber flour), B (ant palm sugar) and C (butterfly pea flower extract) affect the total sugar content analysis. The blue color shows the lowest total sugar content analysis value of 13,34%. The red color shows the highest total sugar content analysis value of 26,46%. The dots shown on the graph show the results of the combination of the three components with different amounts that produce a total sugar content analysis response.

3.7. Crude Fiber Content Analysis

Beside on Table 4. Based on the results of chemical analysis of crude fiber content in snackbars from 14 formulations, the results of crude fiber content ranged from 4.19%-10.02%. From these results it can be seen that the highest result is 10.02%.

Based on this analysis, the more canna tuber flour and butterfly pea flower extract powder, the higher the fiber content in the snackbar. This is because the fiber content contained in canna tuber flour is very high at 5,64% and butterfly pea flower extract powder is 14%. Other ingredients can also affect fiber content. According to Atmaka, et al. [19] the heating process can damage fiber components. Heating can cause the components of the fiber to degrade, so that when crude fiber analysis is carried out using acids and bases the fiber components will be hydrolyzed so that the levels can decrease. According to United States Department of Agriculture Nutrient Database [14] the fiber in snackbar is 3,4%. Based on the results of all samples in this study, it exceeds the USDA standard. Meanwhile, this states that the nutritional content is high in fiber if there is dietary fiber of not less than 6 grams per 100 grams [20]. So that snackbar products in 14 formulations can be categorized as high in fiber because they have met BPOM standards.

The results of the anova test analysis can be seen in Table 4, the quartic model recommended by the design expert shows that the formulation made has a significant effect (probability <0.05) on the chemical response of crude fiber content, at a value of p=0.0001. This means that of the 14 formulations made, the effect is significant (probability <0.05). This means that the 14 formulations made have a significant effect on the chemical response of crude fiber content, so that the response can be used for the optimization process, to obtain products with optimum characteristics. The lack of fit value is greater than 0.05, which is 0.7086, indicating that the lack of fit is not significant to noise. The value of lack of fit not significant indicates that there is a match between the data from the analysis of crude fiber content with the model. The value of lack of fit not significant is a requirement for a good model and shows that there is a match between the data from the analysis of crude fiber content with the model.

The equation of the mathematical model of crude fiber analysis is the coefficient of each factor contained in the following equation:

$Y = A(5.10) + B(4.79) + C(318.53)$

Description:

A = canna tuber flourB = ant palm sugar

C = butterfly pea flower extract

Based on the equation obtained, it can be seen that the highest component contributing to the analysis of crude fiber content in snack bar products based on butterfly pea flower extract and canna tuber flour is the interaction coefficient C (butterfly pea Flower Extract). This is indicated by the interaction coefficient C has the highest value of 318.53 when compared to the coefficients of other components. The optimal.

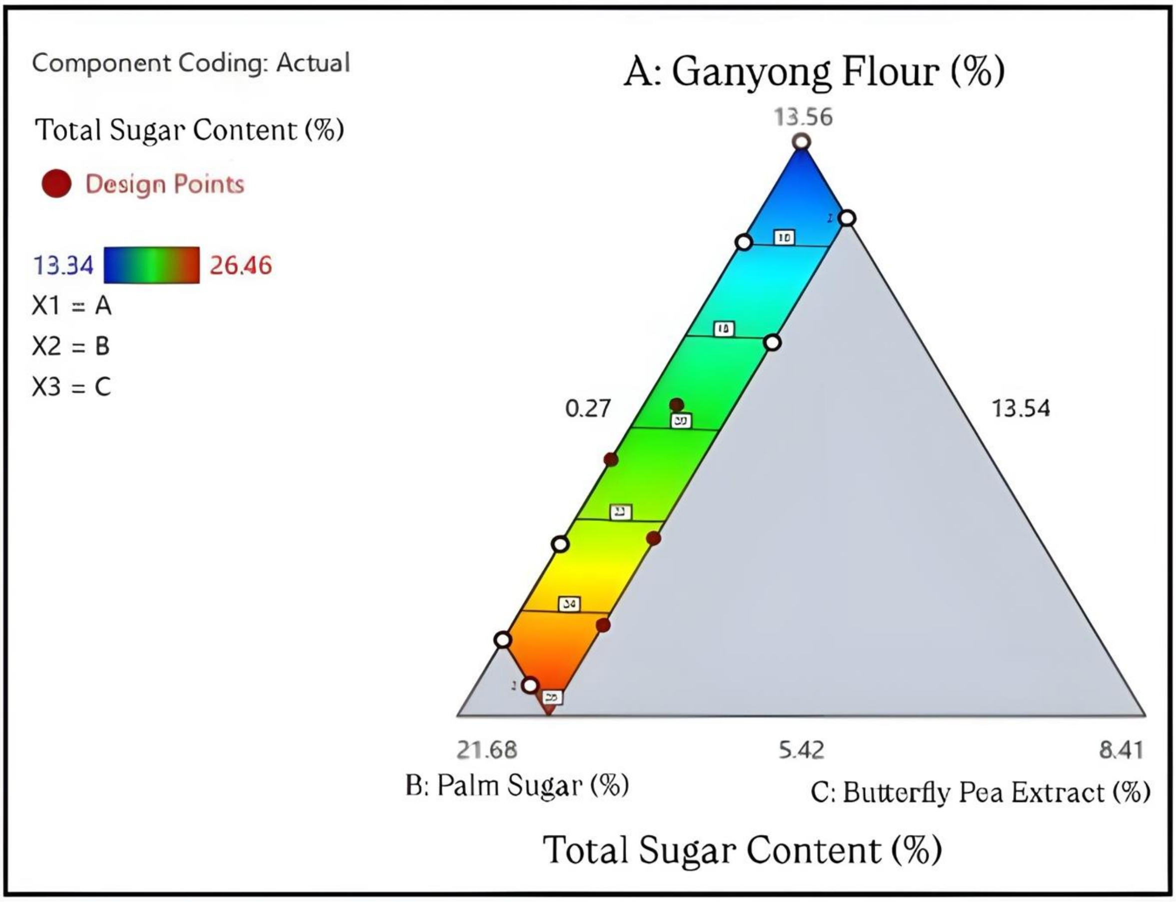

Figure 7.
Graph of Design Expert on Crude Fiber ContentResponse.

The contour plot graph illustrates how the combination ofA (canna tuber flour), B (and palm sugar), and C (butterfly pea flower extract) affect the analysis of crude fiber content. The blue color shows the lowest crude fiber analysis value of 4,19%. The red color shows the highest crude fiber analysis value of 10,02%. The dots shown on the graph show the results of the combination of the three components withdifferent amounts that produce the crude fiber analysis response.

3.8. Antioxidant Activity Analysis

The following are the results of the antioxidant activity test analysis that has been carried out on the 14 snack bar formulations based on butterfly pea flower extract and cannatuber flour can be seen in Table 5 and Table 6.

Table 5.
Antioxidant Activity Analysis Results for the WholeFormulation.

F	Antioxidant Activity IC50 (ppm)
F2	882.5326
F4	751.5166
F5	739.1338
F14	802.8514

Table 6.
IC50 Measurement of the Antioxidant Activity of the DPPHMethod.

Mark IC50	Information
>50 ppm	Very strong
50-100 ppm	Strong
101-150 ppm	Currently
151-200 ppm	Weak
200-1000 ppm	Very weak

Source: Yuslianti [21].

Based on the results of the chemical analysis of the antioxidant activity in butterfly pea flower snack bar and canna tuber flour can be seen in Table 5. Selected 4 of 14 formulations with F2 with IC50 of 882.53 ppm, F4 with IC50of 751,51 ppm, F5 with IC50 of 739,13 ppm. From these results, it can be seen that the highest result obtained is F5 at739.,3 ppm. This is due to the high antioxidant content of 126,80 ppm. The higher the addition of concentration inbutterfly pea flower extract, the higher the antioxidant activity. Based on IC50 measurements, antioxidant activity isvery weak, namely 200 - 1000 ppm due to the many other components that affect antioxidants and heating. The value of antioxidant activity written with a large IC50 value is influenced by temperature. Too high a temperature can reduce antioxidant activity [6]. Weak antioxidant activity can be caused by high water content. The high water content in the sample is easily damaged so antioxidant activity cannot be seen [22].

Antioxidants are chemical components that in certain levels or amounts can inhibit or slow down damage due to the oxidation process. Antioxidants work by donating one electron to compounds that are oxidants so that they can block the activity of these oxidant compounds [23]. Antioxidants are needed to protect the body from free radicals.

The IC50 value is the concentration of the substrate solution or sample that can reduce DPPH activity by 50% orcan be said to be a number that shows the concentration of extracts (ppm) that can inhibit the oxidation process by 50%. A compound is said to have very strong antioxidant activity if the IC50 value is

3.9. Organoleptic on Color

Table 7.
Organoleptic Response Results Color Attributes.

F	Color
1	3.53
2	3.93
3	3.60
4	3.93
5	3.27
6	3.13
7	3.93
8	4.00
9	3.87
10	3.87
11	3.13
12	4.10
13	3.67
14	3.03

Based on Table 9. the results of the analysis of organoleptic responses to color from 14 formulations of snackbar products based on telling butterfly pea extract and canna tuber flour, which are between 3.03 - 4.10. The highest color attribute value is in formulation 12 while the lowest is in formulation 14. The average value of the organoleptic response to the color attribute is 3.61.

The results of the analysis of variance or anova test can beseen in the cubic model table recommended by the design expert, which shows that the formulation made has a significant effect (probability <0.05) on the organoleptic response to color attributes, indicating that the model made issignificant (probability <0.05), at a value of p = 0.0014. Thismeans that the 14 formulations made have a significant effecton the organoleptic response to the color attribute so that theresponse can be used for the optimization process, to obtain aproduct with optimum characteristics. The lack of fit value isgreater than 0.05, which is 0.6278, which indicates that the lack of fit is not significant to noise. The lack of fit value is not significant, indicating that there is a match between the data from the organoleptic response to the color attribute withthe model. The value of lack of fit not significant is a requirement for a good model and indicates a match betweenthe data from the organoleptic analysis of color attributes withthe model. The optimal formulation graph for organoleptic response to color can be seen in Figure 8.

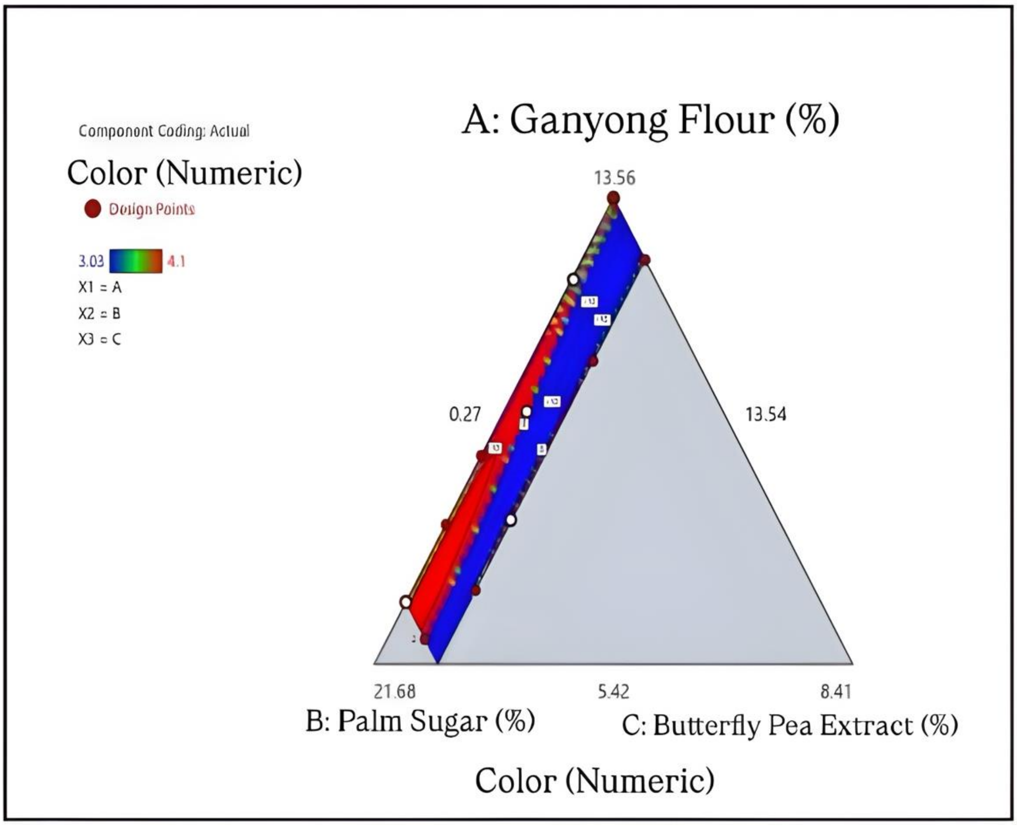

Figure 8.
Contour Plot Graph of Organoleptic Response to ColorAttributes.

The contour plot graph illustrates how the combination ofA (Canna tuber flour), B (ant palm sugar), and C (butterfly pea flower extract) influences the organoleptic response to

color attributes. The blue color shows the organoleptic response value to the lowest color attribute of 3.03. The red color shows the value of the organoleptic response to the highest color attribute of 4,10. The dots shown on the graph show the results of the combination of the three components with different amounts that produce organoleptic responses to color attributes.

3.10. Organoleptic on Odor

Table 8.
Organoleptic Response Result Odor Attributes.

F	Odor
1	3.83
2	2.93
3	3.27
4	3.87
5	3.97
6	3.40
7	3.07
8	2.90
9	4.20
10	4.17
11	3.37
12	3.30
13	3.33
14	3.13

Based on Table 8. The results of the analysis of organoleptic responses to the odor of 14 formulations of snackbar products based on butterfly pea flower extract and canna tuber flour are between 2,90 - 4,20. The highest odor attribute value is in formulation 9 while the lowest is in formulation 8. The average value of the organoleptic responseto the aroma attribute is 3,48.

The results of the analysis of variance or ANOVA test can be seen in Table 8, the quadratic model recommended by the design expert shows that the formulation made has a significant effect (probability <0.05) on the organoleptic response to the odor attribute. Shows the model made is significant (probability <0.05), at a value of p=0.0015. This means that the 14 formulations made have a significant effecton the organoleptic response to the odor attribute so that the response can be used for the optimization process, to obtain a product with optimum characteristics. The result of the lack of fit value greater than 0.05 is obtained, which is 0.7635, which indicates that the lack of fit is not significant to noise. The value of lack of fit not significant indicates that there is a match between the data from the organoleptic response to the aroma attribute with the model. The value of lack of fit not significant is a requirement for a good model and indicates a match between the data from the organoleptic analysis of aroma attributes with the model. The optimal formulation graph for organoleptic response to aroma can be seen in Figure 9.

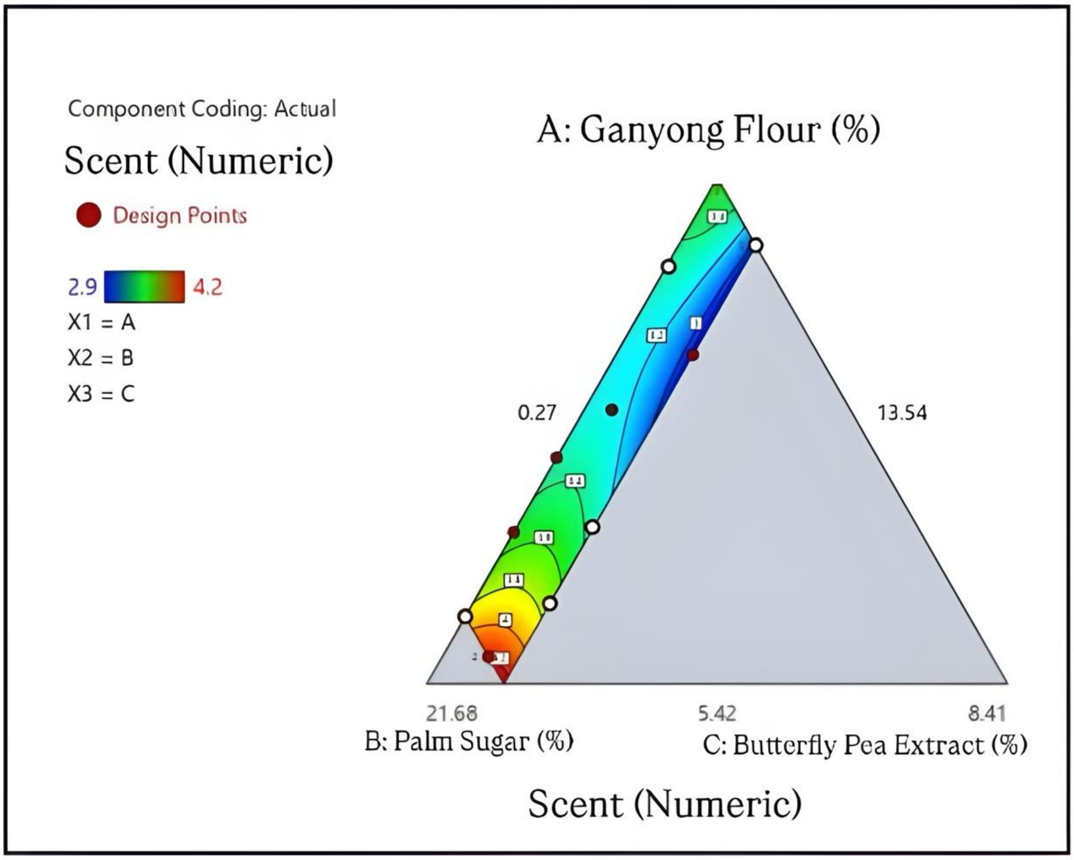

Figure 9.
Contour Plot Graph of Organoleptic Response to OdorAttributes.

The contour plot graph illustrates how the combination of A (canna tuber flour), B (ant palm sugar), and C (butterfly pea flower extract) influences the organoleptic response to the odor attribute. The blue color shows the organoleptic response value to the lowest odor attribute, which is 2,90. Thered color shows the value of the organoleptic response to the highest aroma attribute, namely 4,20. The dots shown on the graph show the results of the combination of the three components with different amounts that produce organolepticresponses to aroma attributes.

3.11. Organoleptic on Flavor

Table 9.
Organoleptic Response Result Taste Attributes.

F	Taste
1	4.20
2	4.13
3	3.60
4	3.53
5	3.27
6	3.33
7	3.47
8	4.17
9	4.10
10	4.13
11	3.40
12	3.63
13	3.67
14	3.03

Based on Table 9. the results of the analysis of organoleptic responses to the taste of 14 formulations of snackbar products based on butterfly pea flower extract and canna tuber flour are between 3,03-4,20. The highest value of taste attributes is in formulation 4 while the lowest is in formulation 14. The average value of the organoleptic response to the taste attribute is 4,20.

The results of the analysis of variance or ANOVA test can be seen in the cubic model table recommended by the design expert, which shows that the formulation made has a significant effect (probability <0.05) on the organoleptic response to the taste attributes, indicating that the model made is significant (probability <0.05), at a value of p = 0.0003. This means that the 14 formulations made have a significant effect on the organoleptic response to the taste attribute so that

the response can be used for the optimization process, to obtain a product with optimum characteristics. The lack of fitvalue is greater than 0.05, which is 0.2682, which indicates that the lack of fit is not significant to noise. The lack of fit value is not significant, indicating that there is a match between the data from the organoleptic response to the flavor attribute and the model. The lack of fit value obtained, which is not significant, is a requirement for a good model and shows that there is a match between the data from the organoleptic analysis of the taste attributes and the model. The optimal formulation graph for organoleptic response to taste can be seen in Figure 10.

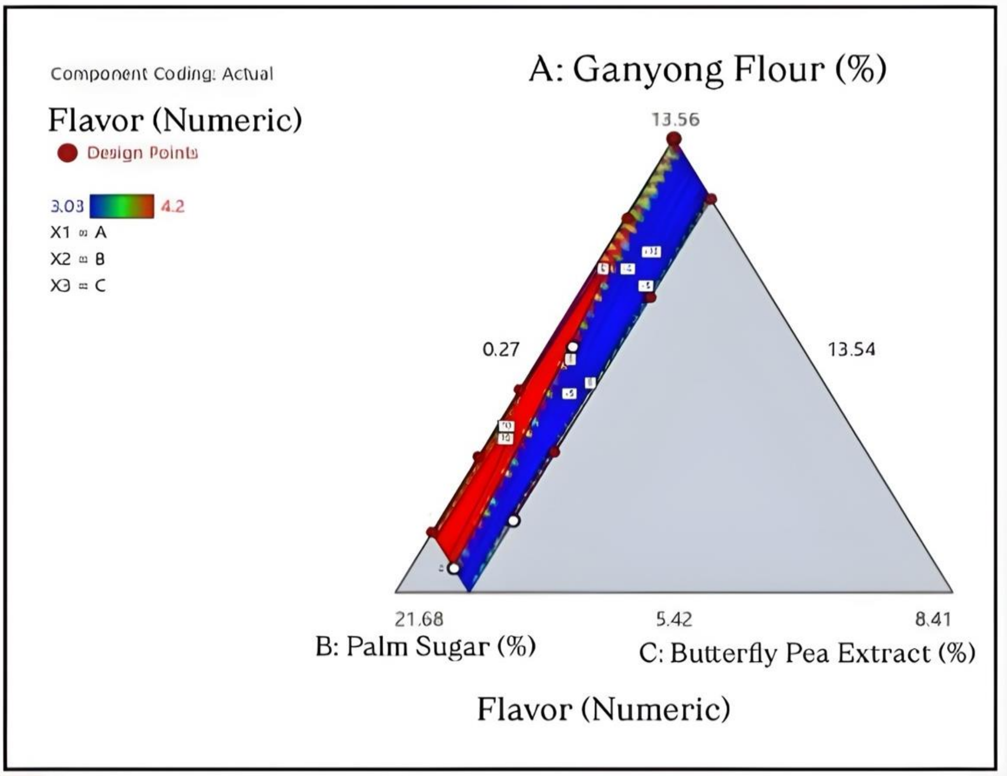

Figure 10.
Contour Plot Graph of Organoleptic Response to TasteAttributes.

The contour plot graph illustrates how the combination ofA (canna tuber flour), B (ant palm sugar), and C (butterfly pea flower extract) influences the organoleptic response to the taste attribute. The blue color shows the organoleptic response value to the lowest taste attribute of 3,03. The red color shows the value of the organoleptic response to the highest taste attribute of 4,20. The dots shown on the graph show the results of the combination of the three components with different amounts that produce organoleptic responses totaste attributes.

3.12. Organoleptic on Texture

Table 10.
Organoleptic Response Result Texture Attributes

F	Texture
1	3.73
2	3.00
3	3.20
4	2.93
5	3.37
6	3.13
j7	3.10
8	3.20
9	3.90
10	3.90
11	2.30
12	3.93
13	3.47
14	3.57

Based on Table 10. The results of the analysis of organoleptic responses to the texture of 14 formulations of snackbar products based on butterfly pea flower extract and canna tuber flour are between 2.30-3.93. The highest texture attribute value is formulation 12 while the lowest is formulation 11. The average value of the organoleptic response to the texture attribute is 3.34. Based on the above research, formulation F12 is most preferred because the highaddition of canna flour makes the texture of the snackbar nottoo hard so F12 is most favored by panelists.

The results of the analysis of variance or ANOVA test can be seen in the cubic model table recommended by the design expert, which shows that the formulation made has no significant effect (probability <0.05) on the organoleptic response to the texture attribute, indicating that the model made is not significant (probability> 0.05) greater than 0.05,at a p-value = 0.1508. This means that of the 14 formulationsmade, there is no significant effect (probability> 0.05). This means that the 14 formulations made have no significant effect on the organoleptic response to the texture attribute, sothe response is not good enough to be used for the optimization process, to get a product with optimum characteristics. The lack of fit value is greater than 0.05, which is 0.6586, which indicates that the lack of fit is not significant to noise. The value of lack of fit not significant indicates that there is a match between the data from the organoleptic response to the texture attribute with the model.The value of lack of fit not significant is a requirement for a good model and indicates a match between the data from theorganoleptic analysis of texture attributes with the model. The optimal formulation graph for organoleptic response to texture can be seen in Figure 11.

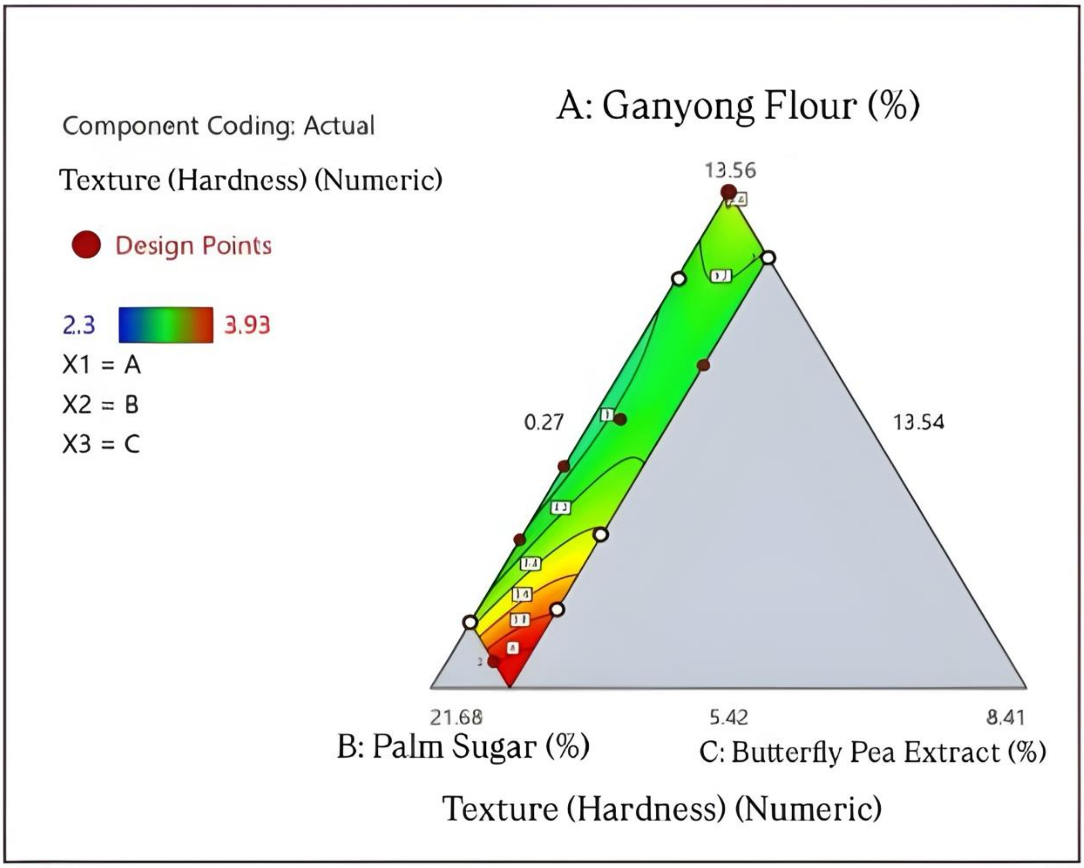

Figure 11.
Contour Plot Graph of Organoleptic Response toTexture Attributes.

The contour plot graph illustrates how the combination of A (canna tuber flour), B (ant palm sugar), and C (butterfly pea flower extract) influence the organoleptic response to texture attributes. The blue color shows the organoleptic response value to the lowest taste attribute of 2,30. The red color shows the value of the organoleptic response to the highest texture attribute of 3,93. The dots shown on the graph show the results of the combination of the three components withdifferent amounts that produce organoleptic responses totexture attributes.

3.13. Organoleptic on Overall

Table 11.
Organoleptic Response Result Overall Attributes.

F	Overall
1	3.53
2	3.67
3	4.53
4	3.47
5	3.37
6	3.40
7	3.33
8	3.67
9	4.17
10	4.17
11	3.53
12	3.30
13	3.37
14	3.20

Based on Table 11. The results of the analysis of organoleptic responses to the overall attributes of 14 formulations of snackbar products based on butterfly pea flower extract and canna tuber flour are between 3,20-4,53. The highest overall attribute value is in formulation 3 while the lowest is in formulation 14. The average value of the organoleptic response to the overall attribute is 3.00.

The results of the analysis of variance or ANOVA test can be seen in Table 11. The special quartic model recommendedby the design expert shows the formulation made has no significant effect (probability <0.05) on the organoleptic response to the overall attribute showing the model made is significant (probability <0.05), at a value of p= 0.0007. This means that the 14 formulations made have a significant effecton the overall attribute organoleptic response so that the response can be used for the optimization process, to get a product with optimum characteristics. The lack of fit value isgreater than 0.05, which is 0.2210, which indicates that the lack of fit is not significant to noise. The lack of fit value is not significant, indicating that there is a match between the organoleptic response data and the overall attributes. The optimal formulation graph for organoleptic response Overallcan be seen in Figure 12.

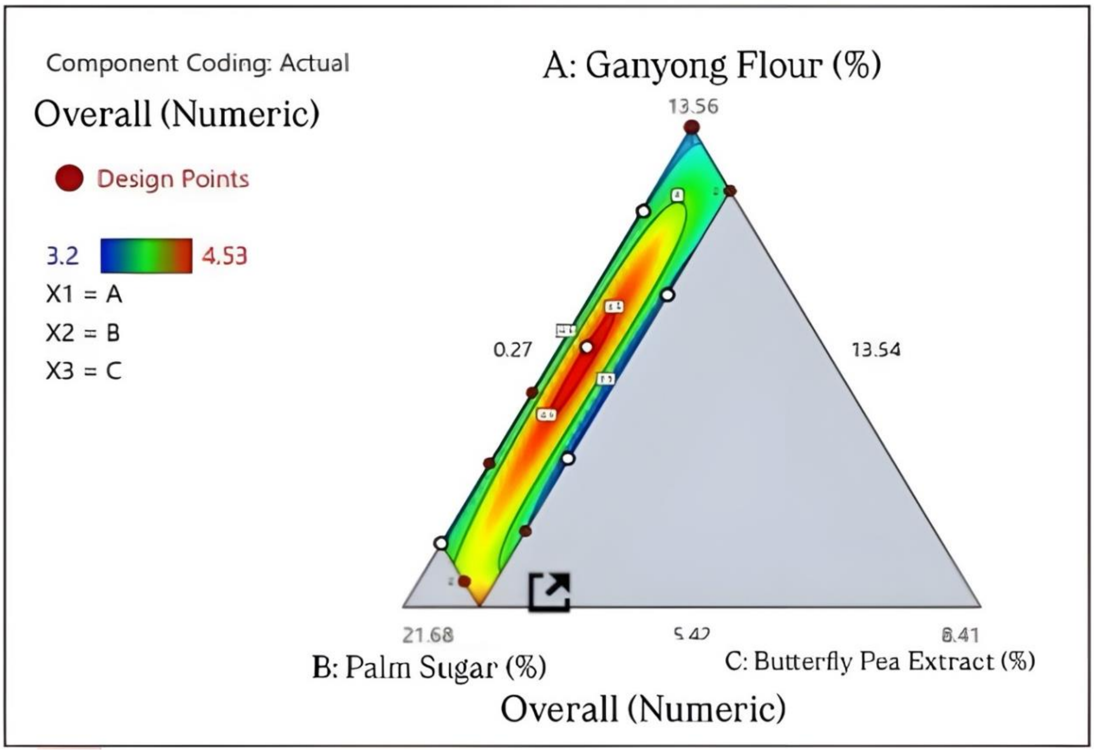

Figure 12.
Contour Plot Graph of Organoleptic Response toOverall Attributes.

The contour plot graph illustrates how the combination ofA (canna tuber flour), B (ant palm sugar), and C (butterfly pea flower extract) influence the organoleptic response to the overall attribute. The blue color shows the organoleptic response value to the lowest color attribute of 3,20. The red color shows the value of the organoleptic response to the highest color attribute of 4,53. The dots shown on the graph show the results of the combination of the three components with different amounts that produce organoleptic responses tothe overall attributes.

3.14. Selected results of optimization of formulations

The selected formulation is the optimal solution or formulation predicted by the d-optimal mixture design expert method based on the analysis of chemical responses (moisture content, ash content, protein content, fat content, carbohydrate content, total sugar content, and crude fiber content, and organoleptic responses (color, aroma taste, texture, and overall). This design expert program processes all responses from each formulation and provides solutions to the formulation of snackbar products based on butterfly pea flower extract and canna tuber flour according to the desired optimization.

Goal setting is chosen based on the desired value of eachvariable change and the responses that can be selected include minimize, in range, and maximize. The weighting or importance value is selected based on the level of importancein each variable change and the response that can be selectedis 1 (+) to 5 (+++++). The higher the importance value, the more important the weighting level. A large importance value will get the most optimum product, but it is difficult to get a high desirability value [24]. The desirabilitygraph on the snackbar product formulation can be seen in thefigure.

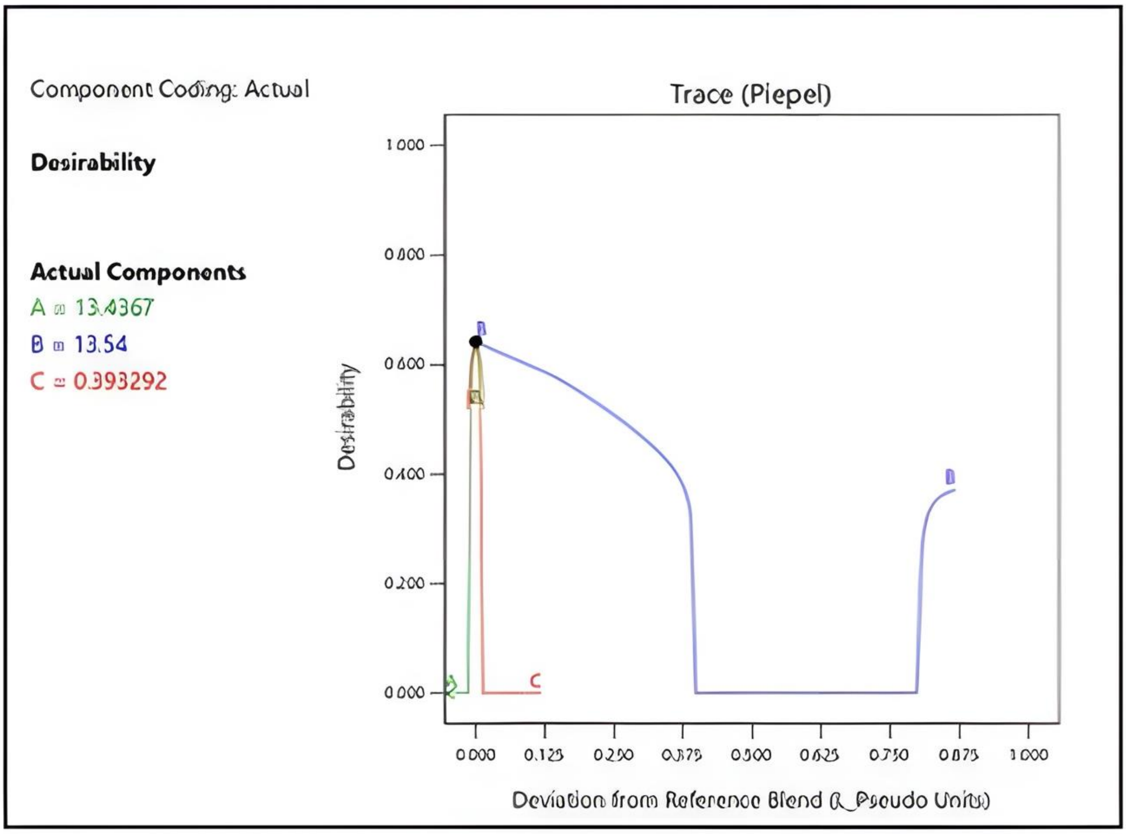

Figure 13.
Desirability Graph of Snackbar Based on Butterfly PeaFlower Extract and Canna Tuber Flour.

The most optimal snackbar based on butterfly pea flowerextract and canna tuber flour is selected based on the largest desirability value and close to 1. The desirability value of theoptimal formula is 0.686. The selected explanation shows that based on the optimization results that have been carried out, the optimal formulation 1 best meets the desired optimization target. The resulting desirability value is strongly influenced by the complexity of the components, the range used in the components, the number of components and responses, and the target to be achieved in obtaining the optimum formula. The number of components and responses affects the desirability value of the optimum formula. The more the number of components and responses, the more difficult it will be to achieve the optimum state so the desirability value that will be achieved is likely to be low [24]. The following is a comparison of the analysis results from the design expert program with the results of the Snackbar formulation laboratory analysis in the following table.

Table 12.
Comparison of Optimal Formulation Results of Design Expert Analysis of Mixture D-Optimal Method with Laboratory Analysis Results and Organoleptic Tests.

Response	Predicted Mean	Optimal Formulation Verification Results
Moisturecontent	6.61	6.66
Fat content	17.30	17.22
Proteincontent	10.28	10.27
Carbohydratecontent	61.81	62.79
Cruide fibercontent	5.09	5.32
Ash content	2.13	3.06
Total sugarcontent	13.93	13.90
Color	4.32	4.27
Odor	3.57	3.43
Taste	4.20	4.33
Texture (Hardness)	3.40	3.37
Overall	3.42	3.53

Comparison of program results with laboratory analysis and organoleptic tests aims to measure the desirability value produced by the program which has an almost appropriate accuracy value. Based on the data generated, the difference inresults of the two do not differ too much. This is because theapplication can only predict the results of the optimal formula produced based on the response from the analysis results.

Based on the optimal formula verification table that has been carried out, it can be seen that the verification results are still the predictions determined by the design expert version 13 program. This is indicated by the results of laboratory analysis of the entire response having a value that meets the 95% Prediction Interval (PI). This result indicates that the formulation predicted by the design expert 13 application is correct.

3.15. Calorie Calculation Result of Selected Optimal

The caloric value of food products is the result of the conversion of carbohydrate, protein, and fat levels into calories after multiplying by each calorie per gram producedby each nutrient [25].

Based on the results of calorie calculations which are theresult of the conversion of protein, fat, carbohydrate, total sugar, and crude fiber levels. Per 100 grams, the result is 524.15 Kcal and per 30 grams, the result is 157.23 Kcal. The higher the carbohydrate, protein and fat content in food products, the higher the total calories produced [26]. According to the United States Department of Agriculture Nutrient Database [14] the calories in food bar products (or similar snackbar products) in 100 grams of product must meet 403 kcal of energy. In this calorie calculation, 524.15 Kcal is obtained in 100 grams, meaning that it meets the calories in snackbar products. The need for energy can be referred to as the level of nutritional adequacy expressed in the Nutritional Adequacy Rate (NAR), which is the average daily nutritional intake that is sufficient to meet the nutritional needs of a person both in certain age groups, gender, and physiology [27].

3.16. Calculation Result of Nutrient Adequacy Rate (NAR)

Food consumption patterns are the composition of the type, and amount of food consumed and the frequency of consumption of a person or group of people at a certain timeinterval [28].

Based on the research of snackbars based on butterfly peaflower extract and canna tuber flour, in calculating the NAR,it looks at the BPOM [20] regarding the Nutrition Label Reference Nutrition Requirements (NAR) forthe general category. The following is a comparison of the nutritional content of the selected snackbar formulation with commercial Snackbar products in the following table.

Table 13.
Comparison of the Nutritional Content of Selected Formulation Snackbars to the Nutritional Requirements of commercial Fitbars.

NutritionalContent	Snackbar NutritionalContent per 30 grams(g)	%NAR *fitbar fruits delight* 26 grams(%)	NAR (%)
Protein	3.08	4	5.13
Carbohydrates	18.83	5	12.15
Fat	5.16	5	7.71
Crude Fiber	1.59	3.33	5.32
Calories	157.23 kkal	90 kkal	13.98 kkal

Based on the optimal formula verification table that has been carried out, it can be seen that the verification results are still the predictions determined by the design expert version 13 program. This is indicated by the results of laboratory analysis of the entire response having a value that meets the 95% Prediction Interval (PI). This result indicates that the formulation predicted by the design expert 13 application is correct.

4. Conclusion

It can be concluded that the optimal formulation aims to produce a snackbar product formulation based onbutterfly pea flower extract and canna tuber flour that hasthe best characteristics, namely with variable changes in canna tuber flour with 13,44%, ant palm sugar with 13,54%, butterfly pea flower extract with 0,38%. Fixed variables of mung bean flour at 67,77%, butter at 4,07%, pumpkin seeds at 6,77%, water at 13,56%, salt at 0,41%, vanilla powder at 0,41%, sorghum puff at 6,77%, white sesame with 6,77%, oats with 6,77%, roasted almonds with 13,56%, and dates with 6,77%.

Prediction results in the Design Expert program on the optimal formulation of snackbar products based on butterfly pea flower extract and canna tuber flour in each response have a moisture content of 6,66%, fat content of17,22%, protein content of 10,27%, the carbohydrate content of 62,79%, crude fiber content of 5,32%, ash content of 3,06%, total sugar content of 13,90%, on organoleptic color attributes 4,27, organoleptic aroma attributes 3,43, organoleptic texture attributes 3,37,organoleptic taste attributes 4,33 and organoleptic overallattributes 3,53. The formulation has a desirability value of0,686.

Prediction results in the optimal formulation analysis in the laboratory of snackbar products based on butterfly pea flower extract and canna tuber flour in each response havea moisture content of 6,61%, fat content of 17,30%, protein content of 10,28%, carbohydrate content of 61,81%, fiber content of 5,09%, ash content of 2,13%, total sugar content of 13, 93%, on organoleptic color attributes 4,32, organoleptic odor attributes 3,57, organoleptic taste attributes 4,20, organoleptic textureattributes 3,40, and organoleptic overall attributes 3,42 and calorie count per 100 grams of snackbar of 448,08 kcal, calorie count per 30 g snackbar of 13,442,4 kcal.

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