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Optimizing Formulas of Instant Cereal Drink Based on Jali *(Coix lacryma-jobi* L.) Using Response Surface Methodology

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ABSTRACT

Instant cereal drinks mostly use imported raw materials, so there is a need for diversification using local ingredients. The aim of this research is to determine the appropriate formulation for a cereal drink based on garut, jali, and mango, in order to produce a breakfast cereal product that can meet daily nutritional needs for all segments of society and reduce dependence on imported materials. The research method consists of several stages, namely: The research method consists of several stages, namely: 1) Determining the upper and lower limits of treatment and Optimization of 14 products using RSM; 2) Determining the composition of supplementary materials and production of instant cereal beverage products; 3) Sensory testing of optimized products; 4) Data analysis. The upper limit for jaliflour is 35 gram, with a lower limit of 25 gram. For garut flour, the upper limit is 20 gram, and the lower limit is 10 gram. Sensory testing was conducted with 15 semi-trained panelists, evaluating parameters such as aroma, taste, and preference. The results showed that variations in the formulation of jali and garut flour did not have a significant effect on the responses for aroma, taste, and preference. The optimal formula for the instant cereal drink is 33.54% jali flour and 11.46% garut flour.

Keywords*: Formulas; Response Surface Methodology; Jali; Garut; Instant Creal Drink*

INTRODUCTION

Breakfast is the type of food consumed by a person before engaging in activities in the morning. Breakfast is included in the General Guidelines for Balanced Nutrition. According to (Depkes, 2014), the types of food for breakfast can be selected and arranged according to an individual's body condition. Furthermore, according to (Spence, 2017), breakfast is not merely about consuming food in the morning; it should also fulfill 15-25% of daily nutritional needs.

Instant food products like cereal have become a popular alternative favored by various segments of society in Indonesia. According to APEDA data, the global market share for breakfast cereal is projected to increase by 4.30% from 2017 to 2025. Cereals have many advantages and are enjoyed by many people, with various enriched-flavors available to suit different tastes and practical value. Cereals are expected to meet the average daily caloric needs of Indonesians, which can be derived from protein components of 10% - 15% and carbohydrates of 40% - 50% of total calories (Kemenkes, 2019). Breakfast cereals contribute to the fulfillment of macro- and micro-nutrient needs (Thomas et al., 2013).

In Indonesia, most cereal products are dominated by those made from oats and wheat. Indonesians do not cultivate wheat domestically due to unsuitable climatic conditions, making it entirely reliant on imports to fulfil its wheat demand. In 2023/24 the wheat imports reached a high record of 13.0 million metric tons (MMT). This surge volumes of imports led to a significant increase in carry-out stocks, which rose by 900,000 tons to 2.1 MMT. The wheat consumption per capita in Indonesia has been on an upward trajectory, reflecting the growing demand for wheat-based products. Forecasts indicate a continuous increase, with their consumption per capita expected to reach 29.01 kilograms by 2031, marking a 5.46% rise from current levels (U.S. Wheat Associates, 2024. This condition encourages various parties to continue efforts in food diversification through the utilization of local resources. This feels

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quite rational, considering Indonesia is rich in various types of local commodities whose use has not been optimal.These local cereal commodities are highly tolerant and easy to adapt to dry and extreme climatic conditions, and they do not require complicated care treatments, allowing them to be widely cultivated in various regions of Indonesia (Wall & Paulis, 1998). Local product a number of nutritional components such as proteins, vitamins, minerals, and dietary fiber that are beneficial for health Utilizing local product based commodities can serve as an alternative source for food products. Several potential local crops that can be used include Garut (*Maranta arundinacea*), Jali (*Coix lacryma-jobi* L.).These crops are rich in carbohydrates and dietary fiber, making them suitable for alternative food sources. Garut, found in regions such as Java, Maluku, and Sulawesi (Kementan, 2021), has significant economic value but remains underutilized (Setyaningrum & Adi, 2022). Garut flour, for instance, contains 271 kcal, 13.39 g of carbohydrates, and 4.24 g of protein per 100 g, making it a nutritious carbohydrate source (Supriyati, 2017). Similarly, Garut is known for its high carbohydrate and fiber content, as well as its low glycemic index, making it a suitable ingredient for functional foods (Lestari et al., 2017). Garut flour is particularly rich in dietary fiber, containing water-soluble polysaccharides and diosgenin, which contribute to digestive health (Yofananda & Estiasih, 2016).

Jali (*Coix lacryma-jobi*), is an underutilized cereal crop with significant potential for food product development. As consumer demand for functional and health-promoting foods continues to rise, alternative cereals with high nutritional value are gaining attention. Jali is rich in complex carbohydrates, dietary fiber, and high-quality protein, making it a promising ingredient for the development of cereal-based products. Additionally, it is naturally gluten-free, making it suitable for individuals with celiac disease or gluten intolerance. Beyond its nutritional profile, jali contains bioactive compounds with antioxidant, anti-inflammatory, and cholesterol-lowering properties, further enhancing its functional benefits. From an agricultural perspective, jali exhibits adaptability to various climatic conditions and demonstrates resilience against environmental stress, providing a sustainable alternative to conventional cereals. Given these advantages, this study aims to explore the potential of jali as a raw material for cereal products, focusing on its nutritional composition, processing characteristics, and market potential in the modern food industry (Nurmala, 2011).

In addition to Garut and Jali, fruits can also be incorporated into cereal products to enhance aroma, flavor, and overall sensory appeal, making them more attractive to the consumers. One promising fruit for this purpose is mango (*Mangifera indica*), which is widely available in tropical regions and has significant potential for food applications (Jahurul et al., 2015). Mango is chosen for its rich content of natural sugars, organic acids, and volatile compounds that contribute to its distinct aroma and sweet taste, which can improve the palatability of cereal-based products. Additionally, mango is a good source of vitamin C, which is providing 27.7 mg per 100 g, along with other essential vitamins and minerals that enhance the nutritional profile of the final product (Novia et al., 2015). Its high antioxidant content and fiber further contribute to the functional benefits of the cereal, making it a valuable addition to alternative food formulations aimed at improving consumer acceptance and health benefits.

METHODS

Material

The ingredients used consist of two types: primary ingredients and complementary ingredients. The primary ingredients include Jali flour *(Coix lacryma*-jobi L.*)* sourced from a local in Hanjeli Village, Sukabumi Regency, West Java, Indonesia, Garut flour *(Marantha arundinaceae),* Indonesia and sweet mangoes *(Mangifera indica* L*)* (from local farmers, Indonesia). The complementary ingredients include low-fat skim milk (NZ, New Zealand), Fiber Cream (Ellenka, Indonesia), maltodextrin (Qinhuangdao Lihua, China), low-calorie sugar (Tropicana Slim, Indonesia), vanilla (Mohler, Indonesia), mango flavoring (Koepoe,

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Indonesia), raisins (Foodmall, USA), coconut sugar (Semedo Manise, Indonesia), and mineral water (Lee Mineral, Indonesia).

Tool

The drying process was carried out using a food dehydrator with 10 trays and 650-watt power (Fomak Electric, China) until the samples reached a constant weight. The dried samples were then ground into powder using a powder grinder with a capacity of 200 g and operating power of 1200 watt, producing particle sizes between 30–300 mesh (Hans Garden, China). The weight of the samples before and after drying was measured using a digital analytical balance (SF400C, 600 g capacity, Acas SF, China). Additional utensils such as knives, spoons, plastic cups, stainless steel trays and bowls, strainers, pastry brushes, rice paper, and scissors were used during sample preparation and handling.

Research Stages

The research method consists of several stages, namely: 1) Determining the upper and lower limits of treatment and Optimization of 14 products using RSM; 2) Determining the composition of supplementary materials and production of instant cereal beverage products; 3) Sensory testing of optimized products; 4) Data analysis.

Determining The Upper and Lower Limits Treatment

The research examines the formula during cereal drink production as well as their nutritional values. The experimental design used in this study is Response Surface Methodology (RSM) with the software "Design Expert Metode Mixture D-Optimal" The optimization of the formula is carried out using the Response Surface Method (RSM) with an experimental design employing the Central Composite Design (CCD) (Astuti, et al., 2021). The workflow of the research is shown in Figure 4. The recommended treatment combinations from RSM can be seen in Figure 3. The minimum and maximum limits of the treatments are presented in Table 1. Other materials used that are not independent variables can be seen in Table 2. Fourteen formulas were tested using sensory analysis, evaluating preference, aroma, and flavor as Independent variable in this research.

Table 1. Upper and Lower Treatment Limits (Dependent variable)

	Variable	Unit	-alpha	Low	+alpha	High
A	Jali Flour	G	25	26.4645	35	33.5355
B	Garut Flour	G	10	11.4645	20	18.5355

Table 2. Mixed flour formulas to be analyzed based on design expert

Formulations	Jali Flour	Garut Flour
1	28.5355	16.4645
2	28.5355	23.5355
3	21.4645	23.5355
4	21.4645	16.4645
5	25	20
6	25	20
7	25	20
8	30	20
9	25	20
10	25	20
11	20	20

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Formulations	Jali Flour	Garut Flour
12	25	25
13	25	20
14	25	15

Determining the Composition of Supplementary Materials and Instant Cereal Process

The process of making instant cereal includes drying mango fruit using a food dehydrator (DHY-10H, Fomak Electric, China), at a temperature of 55°C until it is dry and brittle, then grinding it using a grinder (FGD-Z100, Hans Garden, China). Next, the dry mixing with manually tool process involves combining other ingredients such as jali flour, taro flour, mango powder, milk powder, maltodextrin, Tropicana Slim sugar, vanilla, coconut sugar, fiber cream, raisins, and mango flavoring. The process of making instant cereal can be seen in Figure 1.

Table 3. Instant cereal drink of the composition of additional ingredients

No	Ingredients	Composition (g)
1	Skim milk	30
2	Sugar low calorie	2
3	Coconut sugar	8
4	Fiber cream	10
5	Jali flour	20
6	Garut flour	25
7	Maltodextrin	5
8	Vanili	1
9	Mango flour	10
10.	Raisins	2

The process of making instant cereal drinks can be seen in Figure 1.

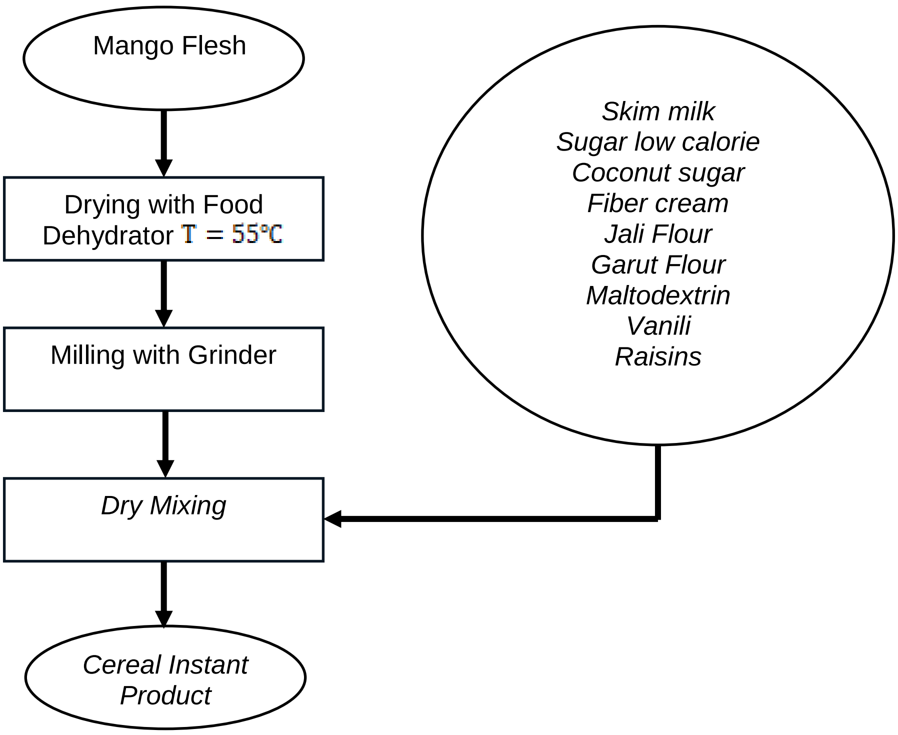

Figure 1. Procedure Instant Cereal Drink

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Sensory Analysis

Assessment of the formulas resulted from the application of RSM (In Table 2) is carried out using sensory variables namely aroma, taste and likeness. The assessment is done by as many as 15 semi-trained panelists included panelists of Agricultural Product Technology lecturers and students who had attended the Sensory Evaluation lecture. In this study, the panelists used are semi-trained panelists who meet the criteria of having prior knowledge and experience in sensory evaluation, specifically having completed a course in Sensory Evaluation. The panelists have also passed an interview selection process, ensuring they have the availability and are familiar with the type of products being tested. The formula is presented as much as 20 ml per formula with the control of commercial instant cereal beverage products. The panelists conducted tests on 14 samples, and after completing the test for each sample, they were advised to drink mineral water to neutralize their sense of taste and smell

Data Analysis

Data analysis of all responses on all formula combinations were performed using ANOVA. Furthermore, a normal plot of residuals analysis is conducted. Residuals refer to the difference between the predicted RSM response and the actual measured response (Kumari et al., 2008). Design Expert displays the outcomes of the ANOVA (analysis of variance). A response variable is considered significantly different at the 5% significance level if the p-value from the F-Test ("Prob>F") is less than or equal to 0.05. Conversely, if the p-value exceeds 0.05, the response variable is deemed not significantly different. These response variables are subsequently utilized for model predictions to identify the optimal formula. The best conditions that meet all objective functions in RSM are described by the desirability value (0 - 1). The higher the desirability value (closer to 1), the more perfect the program is in predicting the optimal conditions based on the designed response targets (Astuti et al, 2021).

The Version 11.0 of Design Expert processes all response variables according to the established criteria and offers solutions for various selected optimal formulas. The target value for optimization, referred to as the desirability value, ranges from 0 to 1. A desirability value closer to 1 indicates that a formula is more likely to achieve the optimal point based on the response variable.

RESULT AND DISCUSSIONS

Aroma Responses

Optimization using RSM indicates that the mathematical equation obtained for the optimized aroma response follows a linear model. The results of the ANOVA analysis in Table 4 show that the treatment of Jali flour and Garut flour does not have a significant effect ($p > 0.05$) on the product aroma response. The target for the aroma response is to maximize it with an importance level of 5. This result indicates that the use of jali flour and garut flour, as desired, does not affect the aroma, specifically the rancid peanut aroma. is consistent with previous research conducted by Damayanti dan Indrawati, (2016) which found that the addition of jali flour to semprong cake did not significantly affect the final aroma of the cake. Research by Zafira and Farida (2023) revealed that increasing the addition of taro flour results in a more pronounced taro aroma in dry noodles, although the effect is not significant.

The R-square (R^2) value indicates the percentage of the influence of independent variables on the dependent variable. Based on the data obtained in Table 4, the R^2 value is 0.4857, indicating that the independent variables, in this case jali flour and garut flour, account for 48% of the influence on the dependent variable, which is the aroma response, while the remaining influence is attributed to other factors outside the independent variablesIn addition to the ANOVA table, RSM optimization also displays three-dimensional contour graphs. In

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Figure 2, the scattered dots represent the position of each formula based on the aroma response using a quadratic model. Formulas with the highest aroma are placed in the red area of the graph, followed by orange, yellow, green, light blue, and dark blue, indicating decreasing product aroma response. In testing by panelists, a scale of 1-4 was given, including; 1) really smells like peanuts, 2) smells like peanuts, 3) slightly smells like peanuts, 4) doesn't smell like peanuts. This research wants maximum value, namely a product that does not taste like peanuts, with an importance value of 5 in the RSM application. The average panelist aroma response was 2.89, or around 3, which indicates that the panelists interpreted the instant cereal drink product as having a nutty aroma that was not too strong, indicating that the product had minimal rancidity.

Jali seed flour has a rancid aroma caused by the activity of the enzyme lipoxygenase (Adha *et al*., 2024). The lipoxygenase enzyme hydrolyzes the fats in peanuts, producing hexanol compounds that create the rancid taste and aroma. Jali is a group of cereals that contains a high fat content of 7.90% (Grubben and Partohardjono, 1996; Nurmala, 2011). This also affects the aroma of bran flour, where a high formulation of bran flour can lead to rancidity, making the aroma less preferred by the panelists. The rancidity reaction is caused by the enzymatic hydrolysis of lipase and oxidative rancidity. Free fatty acids are oxidized by the enzyme lipoxygenase into peroxides, ketones, and aldehydes, resulting in rancidity (Gianto et al., 2022) In addition to being caused by the fat content in jali and garut flour, the rancid aroma is also caused by the addition of milk in the formulation, as also mentioned in the research Santoso et al., (2013).

Table 4. Summary of statistical analysis results of aroma response

Analyzed components	Result
Mean	2.89
Standard Deviation	0.1756
P prop > F	0.098
R – Square (R^2)	0.4857
Adjusted R^2	0.3142
Predicted R^2	-0.4466
Mathematical Model Equations	Y = 0.0995 A - 0.2174 B - 0.1667 AB

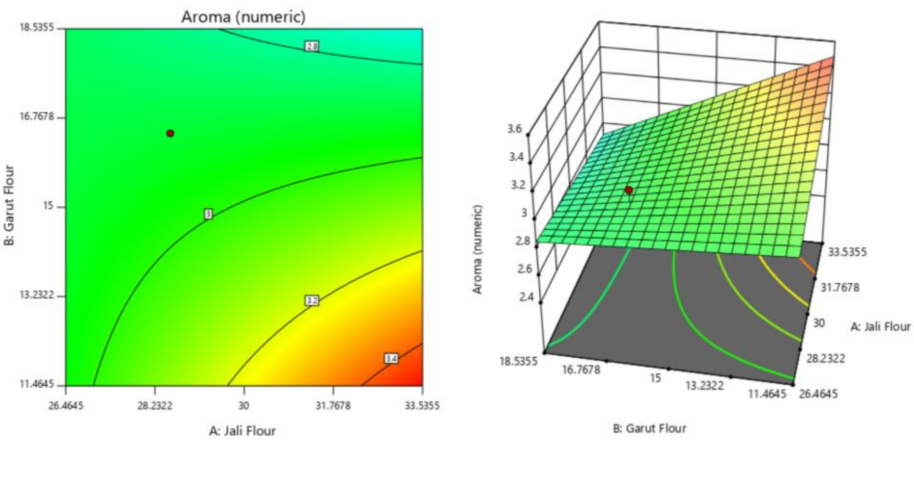

Figure 2. Aroma Response Contour Plot Graph

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Flavor Responses

Flavor and aroma are complex mixes of natural and/or synthetic components that are used to create flavors (Reshna et al., 2022). Taste primarily involves the sense of taste. Foods with distinctive and delicious flavors will be favored by consumers. The target for the response of pleasant taste is to maximize it, with an importance level of 5.

The optimization process utilizing Response Surface Methodology (RSM) reveals that the mathematical equation derived for the enhanced flavor response adheres to a linear model. This finding underscores the effectiveness of RSM in identifying relationships within the data, leading to a clearer understanding of how various factors influence taste optimization. The results of the ANOVA analysis in Table 4 indicate that the treatment of Jali flour and Garut flour does not have a significant effect ($p > 0.05$) on the taste response of the product. The target for the taste response is to maximize it, with an importance level of 5.

The R-squared (R^2) value indicates the percentage of the influence of the independent variables on the dependent variable. Based on the data obtained in Table 4, the R^2 value is 0.4054, which indicates that the independent variables, in this case, Jali flour and Garut flour, have an influence of 40% on the dependent variable, which is the taste response, while the remaining percentage is influenced by other factors outside the independent variables.

RSM optimization also displays a three-dimensional contour graph. In Figure 3, the scattered points indicate the position of each formula from 14 formulations based on the aroma response using a quadratic order model. The formula with the highest flavor is located in the red area, while the subsequent colors orange, yellow, green, light blue, and dark blue represent progressively lower taste responses for the product. The mean taste response is 2.91, or approximately 3, which indicates that the panelists interpret the instant cereal drink product as having a pleasant taste.

Table 5. Summary of statistical analysis results of flavor response

Analyzed components	**Result**
Mean	2.91
Standard Deviation	0.2355
P prop > F	0.1780
R – Square (R^2)	0.4054
Adjusted R^2	0.2072
Predicted R^2	-0.6365
Mathematical Model Equations	$Y = 0.1524\ A – 0.2702\ B – 0.2083\ AB$

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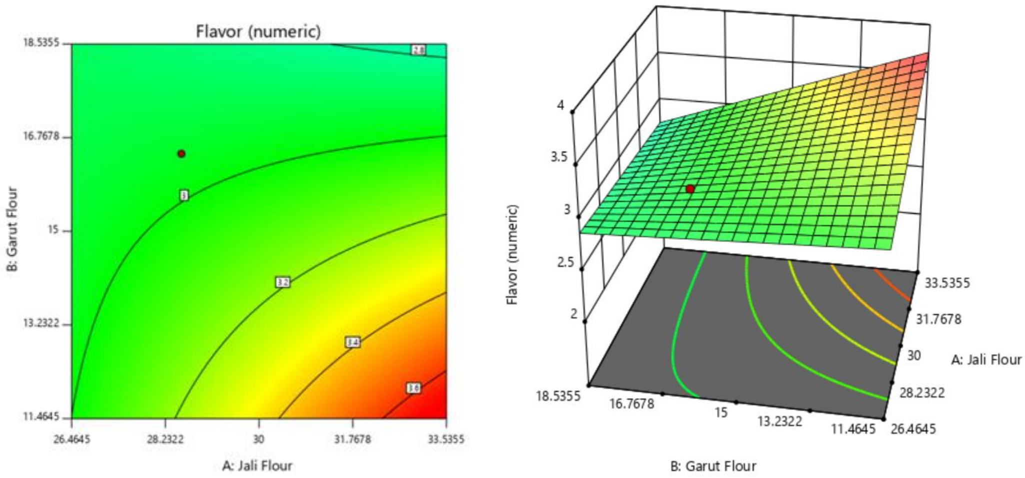

Figure 3. Flavor Response Contour Plot Graph

Overall Acceptability Responses

The description of the liking response in this study refers to the overall acceptance of the instant cereal beverage product based on quality attributes such as appearance, texture, aroma, and overall impression (Astuti et al., 2021). The target for the liked or disliked response is to maximize it with an importance level of 5. The results of the ANOVA analysis in Table 4 indicate that the treatment of Jali flour and Garut flour does not have a significant effect ($p > 0.05$) on the product liking response. This result suggests that the use of jali flour and garut flour does not influence the liking of the instant cereal beverage among the panelists.

The R-square (R^2) value indicates the percentage of the influence of independent variables on the dependent variable. Based on the data obtained in Table 4, the R^2 value is 0.2659, indicating that the independent variables, in this case, jali flour and garut flour, account for 27% of the influence on the dependent variable, which is the liking response, while the remaining influence is attributed to other factors outside the independent variables

The instant cereal beverage, several complementary ingredients such as mango flour, skim milk, and fiber cream were added, which can affect panelits' likeness toward the instant cereal drink. This is reflected in the average score from the panelists, which is 2.86 (liked). Therefore, the instant cereal beverage product based on jali and garut flour is expected to be easily accepted by consumers.

Besides the ANOVA table, in RSM optimization, a three-dimensional contour graph is also displayed. In Figure 4, the scattered points represent the positions of each formula from 14 formulations based on the liking response with a quadratic model. The formula with the highest aroma is placed in the red area of the graph, followed by orange, yellow, green, which indicate a decreasing liking response of the product. From the graph, it can be observed that the addition of more jali flour increases the panelis preference, while the addition of more garut flour decreases the panelists' preference.

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Table 6. Summary of statistical analysis results of Overall Acceptability response

Analyzed components	Result
Mean	2.86
Standard Deviation	0.4699
P prop > F	0.4031
R – Square (R^2)	0.2659
Adjusted R^2	0.0213
Predicted R^2	-1.5381
Mathematical Model Equations	Y = 0.5458 A – 0.5458 B - 0.2708 AB

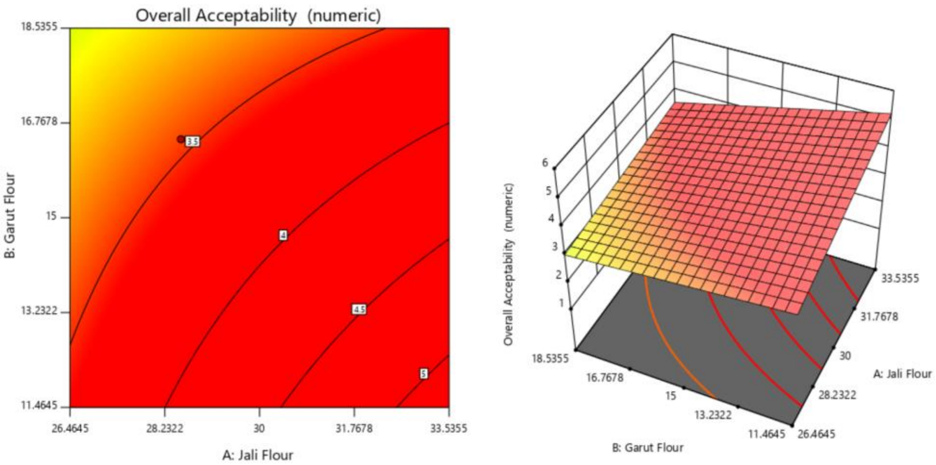

Figure 4. Overall Acceptability Response Contour Plot Graph

Optimum Product Instant Cereal Drink

The Program Design Expert will subsequently process all response variables based on the established criteria and provide several formula solutions as the chosen instant cereal drink formula. The product criteria with the best formula have a maximum acceptance value with an importance of 5, a delicious taste with a maximum importance value of 5, and a maximum importance of 5 for the aroma. The optimization target value that can be achieved is called desirability. Desirability has a value of 0 to 1. The optimization activity is the effort to achieve the maximum desirability value. A desirability value approaching one indicates that the formula can achieve the optimal formula according to the desired response variables. The optimization process produces 5 formula combination recommendations as seen in the Table 7. The formula combination with the highest desirability value (0.996) is selected to be followed up in the verification stage. The optimum formula composition consists of 33.536% of Jali and 11.464% of garut flour.

Table 7. Formula solutions and selected formulas result from design expert optimization

No	Jali flour	Garut Flour	Desirability
1.	33.536	11.464	0.996
2.	33.536	11.531	0.993
3.	33.334	11.464	0.989
4.	33.536	11.659	0.986
5.	31.992	11.464	0.941

CONCLUSION

The RSM application shows that it is possible to produce more optimal products because RSM is an analysis and modelling of the relationship between input and output variables, allowing for the identification of the best conditions according to the desired product criteria, which are products with no off-flavor, good taste, and high preference. The optimal formulation recommended by the Design Expert ver. 11 Mixture D-Optimal methods was obtained with a desirability value of 0.996. The optimal formula for instant cereal drink is 33.536% of Jali and 11.464% of garut flour. This serve an attractive alternative in efforts to diversify foods that well accepted by consumers. Further research will be conducted to determine the nutritional content of this product.

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REFERENCES

Adha, S.H, Novidahlia N, Nurlaela R.S. (2024). Karakteristik fisikokimia dan sensori flakes tepung biji jali (*Coix Lacryma Jobi* L.) dengan penambahan susu bubuk skim. *Karimah Tauhid*. *3*(10). https://doi.org/10.30997/karimahtauhid.v3i10.15540

Ambarsari, E. Retno, R. Hidayah. (2020). Kandungan nutrisi dan kualitas sensoris produk minuman sereal sarapan berbasis flakes jagung, jali, dan sorgum. *Jurnal Penelitian Pascapanen Pertanian*, 17(2),108–111. http://doi.org/10.21082/jpasca.v17n2.2020.108-116

AOAC. (2016). Official Methods of Analysis of The Association of The Official Analytical Chemist (20th ed.). Washington, D.C.: AOAC International.

Astuti S.D, Erminawati, Suri A, El kiyat W. (2021). Optimasi formula dan uji deksriptif kuantitatif jelly drink carica rendah kalori. *Jurnal Teknologi Industri Pertanian*. *15*(3), 865–875. https://doi.org/10.21107/agrointek.v15i3.9198

Badan Pusat Statistik. (2020). *Impor biji gandum menurut negara asal utama 2010–2019*. Jakarta: Badan Pusat Statistik Indonesia.

Damayanti, E. D., & Indrawati, V. (2016). Pengaruh substitusi tepung jali (*Coix lacryma-jobi* L.) dan penambahan puree labu kuning (*Cucurbita*) terhadap sifat organoleptik kue semprong. *E-Journal Boga*, *5*(1), 11–16.

Departemen Kesehatan Republik Indonesia. (2014). *Pedoman gizi seimbang*. Jakarta: Kementerian Kesehatan Republik Indonesia. Diakses dari https://www.bing.com/search?q=kalori+harian+masyarakat+indonesia+pdf

Departemen Pertanian Republik Indonesia. (2009). *Standar operasional prosedur pengolahan mangga*. Jakarta: Direktorat Jenderal Pengolahan dan Pemasaran Hasil Pertanian, Kementerian Pertanian RI.

Gionte, F., & Limonu, M. (2022). Karakteristik dan daya terima flakes berbahan dasar tepung ubi jalar ungu yang diformulasi dengan tepung bekatul. *Jambura Journal of Food Technology*, *4*(1), 34–42. https://doi.org/10.37905/jjft.v4i1.13896

Jahurul, M. H. A., Zaidul, I. S. M., & Ghafoor, K. (2015). Mango (*Mangifera indica* L.) by-products and their valuable components: A review. *Food Chemistry*, *183*, 173–180. https://doi.org/10.1016/j.foodchem.2015.03.046

Kementerian Kesehatan Republik Indonesia. (2019). *Angka kecukupan gizi yang dianjurkan untuk masyarakat Indonesia*. Jakarta: Kementerian Kesehatan RI.

Novia, C., Syaiful, & Utomo, D. (2015). Diversifikasi mangga *off-grade* menjadi selai dan dodol. *Jurnal Teknologi Pangan*, *6*(2), 76–79. https://doi.org/10.35891/tp.v6i2.471

Nurmala, T. (2011). Potensi dan prospek pengembangan hanjeli (*Coix lacryma-jobi* L.) sebagai pangan bergizi kaya lemak untuk mendukung diversifikasi pangan menuju ketahanan pangan mandiri. *Jurnal Pangan*, *20*(1), 41–48. https://doi.org/10.33964/jp.v20i1.10

Reshna, K. R., Gopi, S., & Balakrishnan, P. (2022). Introduction to flavor and fragrance in food processing. In *Center for Innovations and Technology (CIT)*. ADSO Naturals Private Limited, American Chemical Society, Washington, DC, 1–19. https://doi.org/10.1021/bk-2022-1433.ch001

Santoso, B., Basito, & Rahadian, D. A. M. (2013). Pengaruh penambahan berbagai jenis dan konsentrasi susu terhadap sifat sensoris dan sifat fisikokimia puree labu kuning (*Cucurbita moschata*). *Jurnal Teknosains Pangan*, *2*(3), 15–26.

Setyaningrum, N. M. A., & Adi, A. C. (2022). Kajian literatur: Potensi umbi garut sebagai pangan alternatif untuk penderita diabetes melitus. *Media Gizi Kesmas*, *11*(2), 591–599.

Spence, C. (2017). Breakfast: The most important meal of the day? *International Journal of Gastronomy and Food Science*, *8*, 1–6. https://doi.org/10.1016/j.ijgfs.2017.01.003

Supriyati, R. T. (2017). Tanaman garut (*Maranta arundinacea* L.) sebagai potensi sumber genetik untuk ketahanan pangan dan kesehatan. Dalam *Prosiding Seminar Nasional Biodiversitas*, Jakarta, April.

Thomas, R. G., Perhsson, P. R., Ahuja, J. K. C., Smieja, E., & Miller, K. B. (2013). Recent trends in ready-to-eat breakfast cereals in the U.S. *Procedia Food Science*, *2*, 20–26. https://doi.org/10.1016/j.profoo.2013.04.005

U.S. Wheat Associates. (2024). *Grain market report: Global wheat consumption and trade trends*. Retrieved from https://www.uswheat.org

Wall, J. S., & Paulis, J. W. (1998). Corn and sorghum grain proteins. In *Advances in Cereal Science and Technology* (Vol. 2, pp. 135–219). St. Paul, MN: American Association of Cereal Chemists.

Yofananda, G., & Estiasih, T. (2016). Potensi senyawa bioaktif umbi-umbian lokal sebagai penurun kadar glukosa darah. *Jurnal Pangan dan Industri*, *4*(1).

Zafira, A. S., & Saputra, E. (2023). Pengaruh tepung umbi garut terhadap kandungan gizi dan sifat organoleptik mie kering. *Indonesian Journal of Public Health and Nutrition*, *3*(3), 296–305. https://doi.org/10.15294/ijphn.v3i3.60990