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Selection of the Best Margarine Brand in UMKM Roti Pandan Using the AHP and TOPSIS Methods

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Abstract

The selection of the best margarine brand is essential for the MSME Roti Pandan, as margarine is a key ingredient in bread production that influences both quality and taste consistency. This study aims to recommend the most suitable margarine brand based on predetermined criteria: price, quality, fat content, taste consistency, and availability. The Analytical Hierarchy Process (AHP) method is used to determine the weight of importance for each criterion, while the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method is applied to rank the alternatives. The three margarine brands considered in this study are Mother Choice, Simas, and Menara. The analysis results indicate that Mother Choice ranks highest based on the TOPSIS approach, as it has the shortest distance to the positive ideal solution and the farthest distance from the negative ideal solution. The conclusion of this research is that Mother Choice is the most suitable margarine brand for Roti Pandan, as it best meets the established criteria. These findings are expected to assist Roti Pandan in improving product quality through the optimal selection of raw materials.

Keywords: *AHP, MSME, Margarine Brand, Roti Pandan, TOPSIS*

1. Introduction

Margarine is one of the main raw materials in bread production. Therefore, it is crucial for the MSME Roti Pandan to select the appropriate margarine brand. In the bakery industry, choosing the right raw materials such as margarine greatly affects the final quality of the product. Margarine plays a key role in determining the texture, softness, taste, and appearance of the bread[1]. Thus, Roti Pandan's ability to choose the right margarine is essential to maintain the quality and consistency of its products. The results obtained from this selection process are expected to provide an alternative solution to the existing problem.
The decision-making methods used in selecting the best margarine brand for Roti Pandan are the AHP and TOPSIS methods. The AHP method is used to determine the weight value of each criterion, while the TOPSIS method is used to identify the best alternative based on the weights obtained.

The Analytical Hierarchy Process (AHP) is a decision support method developed by Dr. Thomas L. Saaty. This method determines the importance weights of criteria based on human perception using a pairwise comparison scale, followed by calculations to obtain the priority of each criterion[2]. The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a method used to determine the ideal solution based on preference values. The use of TOPSIS is based on the concept that the chosen alternative should have the shortest distance to the positive ideal solution and the farthest distance from the negative ideal solution.

By combining the AHP and TOPSIS methods, the best alternative for margarine selection can be obtained. AHP is used to rank the priority of several criteria determined by Roti Pandan through a pairwise comparison matrix to generate the relative importance of each criterion. This is then integrated with the TOPSIS method to identify the best alternative among the available options, based on the established criteria[3].

2. Theoretical Framework

2.1. Analytical hierarchy process method

The Analytical Hierarchy Process (AHP) method was developed by Dr. Thomas L. Saaty from the Wharton School of Business in the 1970s to organize information and judgments in selecting the most preferred alternative [4].

The working principle of AHP is to simplify and accelerate the decision-making process by breaking down complex problems into smaller components and arranging them into a hierarchy. After that, numerical values are assigned to indicate the relative importance of each criterion.

According to Kusrini, the steps in the Analytical Hierarchy Process (AHP) method include[5]:

1. Defining the problem and determining the desired solution, then structuring a hierarchy of the problem being addressed.
2. Determining the priorities of the elements.

Table 1: Paired comparison rating scale

Intensity of interest	Information	Explanation
1	Equally important	Both elements are equally important
3	A little more important	One element is a little more important
5	More important	One element is clearly more important
7	Very important	One element is clearly more important
9	The most important	One of the most important elements
2,4,6,8	When in doubt between two adjacent values	Values between two adjacent consideration values

3. Sintesis
4. Measuring consistency.
5. Calculate the Consistency Index (CI).

$$CI = \frac{(\lambda max - n)}{n-1} \quad (1)$$

Explanation :
λ max : Eigen value maksimum.
n : Determine the number of elements.

6. Calculate the Consistency Ratio (CR)

$$CR = \frac{CI}{IR} \quad (2)$$

Explanation:
CR : Consistency Ratio.
CI : Consistency Index.
IR : Indeks Random Consistency

Table 2: Random index (IR) values

N	1	2	3	4	5	6	7	8
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41

7. Checking the consistency of the hierarchy.

2.2. Technique for order preference by similarity to ideal solution method

The TOPSIS method is a multi-criteria decision-making approach first introduced by Yoon and Hwang in 1981[6]. TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is based on the concept that the best alternative not only has the shortest distance to the positive ideal solution—which is identified as the combination of the best possible values for all attributes simultaneously—but also the farthest distance from the negative ideal solution, which consists of the worst possible values for all attributes. However, in real-world problems, the positive ideal solution is rarely achievable[7]. The basic assumption of TOPSIS is that when the positive ideal solution cannot be reached, the decision-maker seeks a solution as close as possible to the positive ideal. TOPSIS evaluates each criterion positively relative to the ideal solution, rather than requiring a truly ideal solution. The classical TOPSIS method requires knowing the weights of each criterion clearly, which reflect the importance of each criterion in the decision-making process.

According to Nofriansyah in (Sunarti, 2018), the stages in the TOPSIS method are as follows[8]:

1. Constructing the normalized decision matrix

$$rij = \frac{xij}{\sum_{i=1}^{m} x \frac{2}{ij}} \quad (3)$$

2. Constructing the weighted normalized decision matrix

$$y_{ij} = w_i r_{ij} \quad (4)$$

3. Determining the positive ideal solution matrix and the negative ideal solution matrix

$$A^+ = (y_1^+, y_2^+, \ldots, y_n^+); \quad A^- = (y_1^-, y_2^-, \ldots, y_n^-); \quad (5)$$

4. Determining the distance between each alternative and the positive ideal solution matrix as well as the negative ideal solution matrix.
For the positive ideal solution

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (y_1^+ - y_{ij})} 2 \quad (6)$$

For the negative ideal solution

$$D_i^- = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_1^-)} 2 \quad (7)$$

5. Determining the preference value for each alternative

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad (8)$$

3. Research Methodology

In this case, a series of stages or steps is required. The stages or steps are as follows:

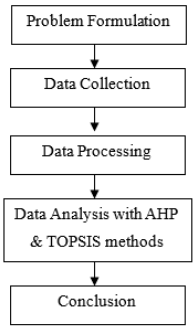

Fig. 1: Research Flow

1. Problem Formulation
   The problem identified is how to select and evaluate the best margarine brand for the MSME Roti Pandan. This stage is developed based on the problem formulation derived from the background of the issue, ensuring that the results remain aligned with the research framework.
2. Data Collection
   This stage involves collecting the necessary data to be used in solving the problem formulated in the first stage. Data is obtained through questionnaires completed by two respondents who are experts in their field: the owner and the baker of the MSME Roti Pandan.
3. Data Processing
   After data collection, the next step is data processing. In this stage, the researcher analyzes and processes the questionnaire data using a hierarchical rating scale, assisted by Microsoft Excel, to obtain the calculation results.
4. Data Analysis
   At this stage, analysis and ranking will be conducted based on the discussion of the problem. This includes the steps of calculating the available data using the AHP and TOPSIS methods.
5. Conclusion
   The conclusion is the final stage of the research, drawn based on the data analysis from the previous chapters, and it examines whether the conclusions align with the research objectives and goals.

4. Results and discussion

4.1. Criteria and alternatives

In making decisions regarding the selection of the best margarine brand for bread production, various criteria must be considered. The chosen criteria should be relevant to ensure that the decision is based on a comprehensive and accurate analysis. The criteria used to select the best margarine brand using the TOPSIS method are as follows:

Table 3: Criteria

No	Criteria code	Criteria
1	C1	Price
2	C2	Quality
3	C3	Fat content
4	C4	Taste consistency
5	C5	Availability

The alternative margarine brands to be used for bread production are as follows:

Table 4: Alternatives

No	Alternative code	Alternative
1	A1	Mother choice
2	A2	Simas
3	A3	Menara

4.2. Results of the AHP and TOPSIS calculations

The methods used in the decision-making process for selecting the best margarine brand are the Analytical Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The AHP method is employed to determine the priority

weight values of each criterion, which are obtained through interviews with the owner and the baker of MSME Roti Pandan. Meanwhile, the TOPSIS method is used to rank the available alternatives, where the best alternative is not only the one with the shortest distance to the positive ideal solution but also the farthest distance from the negative ideal solution.
Next, a decision matrix is constructed based on the preference values of each criterion for all alternatives:

Table 5: Decision Matrix

Criteria / Alternative	C1	C2	C3	C4	C5
A1	5	5	5	5	4
A2	4	4	4	2	5
A3	5	4	4	4	3

The weighting of alternative ratings for each criterion is assessed on a scale from 1 to 5, where 5 = very good, 4 = good, 3 = average, 2 = poor, and 1 = very poor.

The steps involved in the AHP method are as follows:

1. Creating the pairwise comparison matrix
   At this stage, a comparison is made between each criterion against the others. The results of the pairwise comparisons among the criteria can be seen in the table below:

Table 6: Importance level between criteria

Comparison of criteria	Definition of AHP calculation scale	Weight value
K1 – K1	K1 is as important as K1	1
K1 – K3	K1 is as important as K3	1
K1 – K5	K1 is slightly more important than K5	3
K2 – K1	K2 is slightly more important than K1	3
K2 – K2	K2 is as important as K2	1
K2 – K3	K2 is a little more important than K3	3
K2 – K4	K2 is as important as K4	1
K2 – K5	K2 is more important than K5	5
K3 – K1	K3 is as important as K1	1
K3 – K3	K3 is as important as K3	1
K3 – K5	K3 is slightly more important than K5	3
K4 – K1	K4 is slightly more important than K1	3
K4 – K2	K4 is as important as K2	1
K4 – K3	K4 is slightly more important than K3	3
K4 – K4	K4 is as important as K4	1
K4 – K5	K4 is more important than K5	5
K5 – K5	K5 is as important as K5	1

Table 7: Comparison and pairwise matrix

Criteria	C1	C2	C3	C4	C5
Price (K1)	1	1/3	1	1/3	3
Quality (K2)	3	1	3	1	5
Fat content (K3)	1	1/3	1	1/3	3
Taste consistency (K4)	3	1	3	1	5
Availability (K5)	1/3	1/5	1/3	1/5	1

2. Performing normalization on the pairwise comparison table
   At this stage, normalization is performed on the criteria that have been assigned comparison values by first converting them into decimal form. The normalization results of the comparison table can be seen in the table below:

Table 8: Decimal form of the pairwise comparison matrix

Criteria	C1	C2	C3	C4	C5
Price (K1)	1,00	0,33	1,00	0,33	3,00
Quality (K2)	3,00	1,00	3,00	1,00	5,00
Fat content (K3)	1,00	0,33	1,00	0,33	3,00
Taste consistency (K4)	3,00	1,00	3,00	1,00	5,00
Availability (K5)	0,33	0,20	0,33	0,20	1,00
Total	**8,33**	**2,87**	**8,33**	**2,87**	**17,00**

Table 9: Normalization between criteria

Normalization					Total
0,12	0,12	0,12	0,12	0,18	0,65
0,36	0,35	0,36	0,35	0,29	1,71
0,12	0,12	0,12	0,12	0,18	0,65
0,36	0,35	0,36	0,35	0,29	1,71
0,04	0,07	0,04	0,07	0,06	0,28

1,00	**1,00**	**1,00**	**1,00**	**1,00**	**5,00**

This is done by dividing each value in a row by the sum of the values in its respective column, starting from the first column and continuing through to the last row and column. Then, the sums of each row and column are calculated.

3. The next step is to determine the priority weight for each criterion i by dividing the sum of each row in the normalized matrix by the total number of criteria compared, as follows:
   Priority for K1 (first row)= 0,65 : 13 = 0,13

Table 10: Priority weights

Kriteria	Priority vector
Price (K1)	0,13
Quality (K2)	0,34
Fat content (K3)	0,13
Taste consistency (K4)	0,34
Availability (K5)	0,06
Total	**1,00**

4. alculating λmax (lambda max)
   $\lambda \max = (8{,}33 \times 0{,}13) + (2{,}87 \times 0{,}34) + (8{,}33 \times 0{,}13) + (2{,}87 \times 0{,}34) + (17{,}00 \times 0{,}06) = 5{,}07$

5. Calculating the Consistency Index (CI)
   $CI = \frac{(\lambda max - n)}{n-1} = \frac{(5{,}07-5)}{5-1} = 0{,}02$

6. Calculating the Consistency Ratio (CR)
   Checking the consistency ratio, if the consistency ratio (CR) is less than or equal to 0.1 (CR ≤ 0.1), then the calculation results can be considered valid or acceptable.
   $CR = \frac{CI}{IR} = \frac{0{,}02}{1{,}12} = 0{,}02$

After determining the weights for each criterion using the Analytical Hierarchy Process (AHP), the next step is to perform ranking using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method.
The steps carried out in the TOPSIS method are as follows:

1. Constructing the normalized decision matrix.

$X1 = \sqrt{5^2 + 4^2 + 5^2} = 8{,}124$

$r11 = \frac{5}{8{,}124} = 0{,}6155$

$r21 = \frac{4}{8{,}124} = 0{,}4924$

$r31 = \frac{5}{8{,}124} = 0{,}6155$

$X2 = \sqrt{5^2 + 4^2 + 4^2} = 7{,}5498$

$r12 = \frac{5}{7{,}5498} = 0{,}6623$

$r22 = \frac{4}{7{,}5498} = 0{,}5298$

$r32 = \frac{4}{7{,}5498} = 0{,}5298$

$X3 = \sqrt{5^2 + 4^2 + 4^2} = 7{,}5498$

$r13 = \frac{5}{7{,}5498} = 0{,}6623$

$r23 = \frac{4}{7{,}5498} = 0{,}5298$

$r33 = \frac{4}{7{,}5498} = 0{,}5298$

$X4 = \sqrt{5^2 + 2^2 + 4^2} = 6{,}7082$

$r14 = \frac{5}{6{,}7082} = 0{,}7454$

$r24 = \frac{2}{6{,}7082} = 0{,}2981$

$r34 = \frac{4}{6{,}7082} = 0{,}5963$

$X5 = \sqrt{4^2 + 5^2 + 3^2} = 7{,}0711$

$r15 = \frac{4}{7{,}0711} = 0{,}5657$

$r25 = \frac{5}{7,0711}$ = 0,7071

$r35 = \frac{3}{7,0711}$ = 0,4243

Thus, the values of R are obtained as follows:

$$R = \begin{pmatrix} 0,6155 & 0,6623 & 0,6623 & 0,7454 & 0,5657 \\ 0,4924 & 0,5298 & 0,5298 & 0,2981 & 0,7071 \\ 0,6155 & 0,5298 & 0,5298 & 0,5963 & 0,4243 \end{pmatrix}$$

2. Weighted normalization.
Where the criterion weights from the AHP process are multiplied by the normalized values.

$y_{11} = w_1 \text{ x } r_{11}$ = 0,13 x 0,6155 = 0,08

$y_{21} = w_1 \text{ x } r_{21}$ = 0,13 x 0,4924 = 0,064

$y_{31} = w_1 \text{ x } r_{31}$ = 0,13 x 0,6155 = 0,08

$y_{12} = w_2 \text{ x } r_{12}$ = 0,34 x 0,6623 = 0,2252

$y_{22} = w_2 \text{ x } r_{22}$ = 0,34 x 0,5298 = 0.1801

$y_{32} = w_2 \text{ x } r_{32}$ = 0,34 x 0,5298 = 0.1801

$y_{13} = w_3 \text{ x } r_{13}$ = 0,13 x 0,6623 = 0.08609

$y_{23} = w_3 \text{ x } r_{23}$ = 0,13 x 0,5298 = 0.06888

$y_{33} = w_3 \text{ x } r_{33}$ = 0,13 x 0,5298 = 0.06888

$y_{14} = w_4 \text{ x } r_{14}$ = 0,34 x 0,7454 = 0.2534

$y_{24} = w_4 \text{ x } r_{24}$ = 0,34 x 0,2981 = 0.1014

$y_{34} = w_4 \text{ x } r_{34}$ = 0,34 x 0,5963 = 0.2027

$y_{15} = w_5 \text{ x } r_{15}$ = 0,06 x 0,5657 = 0.0339

$y_{25} = w_5 \text{ x } r_{25}$ = 0,06 x 0,7071 = 0.0424

$y_{35} = w_5 \text{ x } r_{35}$ = 0,06 x 0,4243 = 0.0255

Thus, the matrix Y is obtained as follows:

$$Y = \begin{pmatrix} 0,08 & 0,2252 & 0,0861 & 0,2534 & 0,0339 \\ 0,064 & 0,1801 & 0,0689 & 0,1014 & 0,0424 \\ 0,08 & 0,1801 & 0,0689 & 0,2027 & 0,0255 \end{pmatrix}$$

3. Determining the positive ideal matrix $A^+$and the negative ideal matrixA^-
The positive ideal matrix A^+

Y_1^+ = max {0,08 ; 0,064 ; 0,08} = 0,08

Y_2^+ = max {0,2252 ; 0,1801 ; 0,1801} = 0,2252

Y_3^+ = max {0,0861 ; 0,0689 ; 0,0689} = 0,0861

Y_4^+ = max {0,2534 ; 0,1014 ; 0,2027} = 0,2534

Y_5^+ = max {0,0339 ; 0,0424 ; 0,0255} = 0,0424

The negative ideal matrix A^-

Y_1^- = min {0,08 ; 0,064 ; 0,08} = 0,064

Y_2^- = min {0,2252 ; 0,1801 ; 0,1801} = 0,1801

Y_3^- = min {0,0861 ; 0,0689 ; 0,0689} = 0,0689

Y_4^- = min {0,2534 ; 0,1014 ; 0,2027} = 0,1014

Y_5^- = min {0,0339 ; 0,0424 ; 0,0255} = 0,0255

4. Determining the distance between the weighted value of each alternative and the positive ideal solution.
D_1^+

$$= \sqrt{(0,08 - 0,08)^2 + (0,2252 - 0,2252)^2} + (0,0861 - 0,0861)^2 + (0,2534 - 0,2534)^2 + (0,0424 - 0,0339)^2$$

= 0,0085

D_2^+

$$= \sqrt{(0,08 - 0,064)^2 + (0,2252 - 0,1801)^2} + (0,0861 - 0,0689)^2 + (0,2534 - 0,1014)^2 + (0,0424 - 0,0424)^2$$

= 0,1603

D_3^+

$$= \sqrt{(0{,}08 - 0{,}08)^2 + (0{,}2252 - 1801)^2} + (0{,}0861 - 0{,}0689)^2 + (0{,}2534 - 0{,}2027)^2 + (0{,}0424 - 0{,}0255)^2$$

$$= 0{,}072$$

5. Determining the distance between the weighted value of each alternative and the negative ideal solution.

D_1^-

$$= \sqrt{(0{,}064 - 0{,}08)^2 + (0{,}1801 - 0{,}2252)^2} + (0{,}0689 - 0{,}0861)^2 + (0{,}1014 - 0{,}2534)^2 + (0{,}0255 - 0{,}0339)^2$$

$$= 0{,}1605$$

D_1^-

$$= \sqrt{(0{,}064 - 0{,}064)^2 + (0{,}1801 - 0{,}1801)^2} + (0{,}0689 - 0{,}0689)^2 + (0{,}1014 - 0{,}1014)^2 + (0{,}0255 - 0{,}0424)^2$$

$$= 0{,}017$$

D_1^-

$$= \sqrt{(0{,}064 - 0{,}08)^2 + (0{,}1801 - 01801)^2} + (0{,}0689 - 0{,}0689)^2 + (0{,}1014 - 0{,}2027)^2 + (0{,}0255 - 0{,}0255)^2$$

$$= 0{,}1026$$

6. Determining the preference value for each alternative.

$$V_1 = \frac{0{,}1605}{0{,}1605 + 0{,}0085} = \frac{0{,}1605}{0{,}169} = 0{,}9498$$

$$V_2 = \frac{0{,}017}{0{,}017 + 0{,}1603} = \frac{0{,}017}{0{,}1773} = 0{,}0957$$

$$V_3 = \frac{0{,}1026}{0{,}1026 + 0{,}072} = \frac{0{,}1026}{0{,}1746} = 0{,}5877$$

5. Conclusion

This research aims to determine the best margarine brand used by the Roti Pandan MSME in the bread production process by using the Analytical Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. The AHP method is used to determine the importance weight of each criterion based on interviews with the owner and the bread maker. Meanwhile, the TOPSIS method is used to rank the alternative margarine brands based on their closeness to the positive ideal solution and their distance from the negative ideal solution.

The criteria used in the selection include price, quality, fat content, taste consistency, and availability. Three alternative margarine brands analyzed are Mother Choice, Simas, and Menara. Based on the calculation results, the Mother Choice margarine brand ranked highest as the best alternative with a preference value of 0.9498, because it meets most of the criteria expected by the Roti Pandan MSME.

References

[1] F. J. Sandy and E. Setyowati, "Peningkatan Mutu dan Kualitas Roti dengan Manajemen Produksi di Papa Cookies Kartasura," vol. 2, no. 2, 2024.

[2] Azhar Zulfi, "Seminar Nasional Teknologi Komputer & Sains (SAINTEKS) Faktor Analisis Prioritas Dalam Pemilihan Bibit Jagung Unggul Menggunakan Metode AHP," pp. 347–350, 2020.

[3] I. M. Khusna and N. Mariana, "Jurnal SISFOKOM (Sistem Informasi dan Komputer), Volume 10, Nomor 02, PP 162 -169 Sistem," *Sist. Pendukung Keputusan Pemilihan Bibit Padi Berkualitas Dengan Metod. AHP Dan Topsis*, vol. 10, no. 2, pp. 162–169, 2021.

[4] A. N. Shabrina, N. Nurfadilla, and D. R. Ramadhani, "Implementasi Analytic Hierarchy Process dalam Penentuan Supplier pada Toko Obat Shafira," *MALCOM Indones. J. Mach. Learn. Comput. Sci.*, vol. 2, no. 1, pp. 37–46, 2022.

[5] D. S. Lestari, A. Hidayat, and J. M. Tengah, "Jurnal Informatika dan Rekayasa Perangkat Lunak Penerapan Metode AHP (Analitycal Hierarchy Process) dalam Menentukan Mahasiswa Lulusan Terbaik," *J. Inform. dan Rekayasa Perangkat Lunak*, vol. 4, no. 1, pp. 51–60, 2022.

[6] I. Mutmainah and Y. Yunita, "Penerapan Metode Topsis Dalam Pemilihan Jasa Ekspedisi," *J. Sisfokom (Sistem Inf. dan Komputer)*, vol. 10, no. 1, pp. 86–92, 2021.

[7] R. R. Purba, M. Mesran, M. T. A. Zaen, S. Setiawansyah, D. Siregar, and E. W. Ambarsari, "Decision Support System in the Best Selection Coffee Shop with TOPSIS Method," *IJICS (International J. Informatics Comput. Sci.*, vol. 7, no. 1, p. 28, 2023.

[8] Normah, B. Rifai, S. Vambudi, and R. Maulana, "Analisa Sentimen Perkembangan Vtuber Dengan Metode Support Vector Machine Berbasis SMOTE," *J. Tek. Komput. AMIK BSI*, vol. 8, no. 2, pp. 174–180, 2022.