DECISION SUPPORT SYSTEM BY USING MULTIPLE ATTRIBUTE DECISION MAKING WITH SIMPLE ADDITIVE WEIGHTING METHOD (MADM-SAW) METHOD IN SELECTING THE BEST BROMELAIN

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ABSTRACT

Bromelain is a protease enzyme obtained from pineapple. In choosing bromelain only pay attention to its chemical analysis and there is no rank yet. Therefore, research has been carried out in making the best bromelain decision using the Multiple Attribute Decision Making with Simple Additive Weighting Method (MADM-SAW) method based on the shelf life of pineapples. The basic concept of this method is to find the weighted sum of the performance branches for each alternative (treatment) of all attributes so that the best alternative will be obtained in the selection of crude bromelain enzymes based on pineapple storage.The results showed that the best pineapple fruit was with a storage of day 0 as rank 1, with total value was 0.9025.

Keywords: *Bromelain, pineapple storage, MADM-SAW*

INTRODUCTION

Pineapple (*Ananas comosus,* L. Merr) is the number four most widely produced fruit in the world after banana, mango, and orange (L. Zhou *et al.*, 2015 and P. E. Wiranthi and F. Mubarok, 2017). Indonesia has a comparative advantage as the largest pineapple exporter in the world. Most of the pineapples are exported in the form of canned pineapples (P. E. Wiranthi and F. Mubarok, 2017). 33.65% of pineapple production in Indonesia is carried out by the Great Giant Foods Company, located in Lampung Province, Indonesia. The tropical climate supports the mass pineapple cultivation process, encouraging Indonesia to become the world's third-largest producer after Thailand and the Philippines (A. N. Putra *et al.*, 2021).

Pineapple contains beneficial compounds such as the bromelain. Bromelain is one of the protease enzymes found in pineapple that has great potential in its application in the food industry, pharmaceuticals, and cosmetics (R. F. Nanda *et al.*, 2020; S. Abbas *et al.*, 2021; H. M. Maher *et al*, 2021). It can be extracted on the fruit, peel, stem, tuber and leaves. In this research, bromelain has been extracted from the fruit. Generally, the selection of bromelain quality is seen from its chemical analysis, such as enzyme

activity. but no one has done the selection of the best bromelain by using a tool to assist researchers in making the best decisions. The one of the tools than can be used for decision making system is Multiple Attribute Decision Making with Simple Additive Weighting Methode (MADM-SAW).

Compared to other methods, this method has the ability to carry out an assessment with more accurate results because the determination of the value is based on a criterion and based on a predetermined preference weight (Lismardiana, 2018). The basic concept of this method is to find the weighted sum of the performance branches for each alternative (treatment) of all attributes so that the best alternative will be obtained in the selection of crude bromelain enzymes based on pineapple storage (B. Prasetiyo and A. R. Suryani, 2016). This research is expected to be able to obtain grades from bromelain even though the pineapple fruit is rotting.

EXPERIMENTALSECTION

Method of Research

Simple Additive Weighting (SAW) Method

The basic concept of the MADM-SAW method or the weighted sum method is to find the weighted sum of the performance branches on each alternative of all attributes. The MADM-SAW method requires the process of normalizing the decision matrix (X) to a scale that can be compared with all available alternative branches. The steps for the MADM-SAW method can be detailed as follows: Determine the criteria that will be used as a reference in decision making, namely Ci. After that, make a decision matrix (X) based on the criteria (Ci), then normalize the matrix based on the equation that is adjusted to the type of attribute (profit or cost attribute) so that a normalized matrix (r) is obtained.

$$r = \begin{cases} \dfrac{xij}{Max\ xij} \ ; if\ j\ is\ profit\ attribute\ (benefit) \\ \dfrac{Min\ xij}{xij} \ ; if\ j\ is\ a\ cost\ attribute\ (cost) \end{cases}$$

Note:

rij	= Normalized performance rating
xij	= Attribute values that have criteria
Max xij	= The highest score of each criterion
Max xij	= The lowest score of each criterion

Rating the Suitability of Each Alternative on Each Criterion

The determination of the priority value of the weight vector (w) is carried out according to the manager's policy which provides the value of the weight vector directly. There are 3 approaches to find the attribute weight value, namely the subjective approach, the objective approach, the weight value is determined based on the subjectivity of the decision makers. The final result is obtained from each ranking

process, namely the addition of the normalized matrix multiplication r with the weight vector (w) so that the largest value is chosen as the best alternative (Ai) as the solution.

$$Vi = \sum_{j=1}^{n} wjrij$$

Note:

Vi = Final and alternative values

wj = predetermined weight

rij = matrix normalization

RESULTANDDISCUSSION

Determination of the optimum shelf life of pineapple fruit was carried out after all analyzes for each treatment were carried out using the Multiple Attribute Decision Making method with the Simple Additive Weighting Method (MADM-SAW). In the MADM-SAW method, several alternatives will be selected. Then set the criteria that will be used in selecting the best alternative. The application of the MADM-SAW method in the selection of the best crude bromelain enzyme is carried out with alternatives according to the shelf life of pineapple fruit as follows:

1. Storage of pineapple on day 0 (A1)

2. Storage of pineapple on day 3 (A2)

3. Storage of pineapple on day 6 (A3)

4. Storage of pineapple on day 9 (A4)

Furthermore, several criteria are set for selecting the best processing process. The criteria are:

1. Amount of raw materials used (K1)

2. Availability of raw materials for extraction of crude bromelain enzyme (K2)

3. The amount of crude bromelain enzyme produced (K3)

4. The activity of the resulting bromelain enzyme (K4)

Table 1. shown the decision matrix. Each attribute value for each criterion is obtained from the results of laboratory analysis, literature studies and field surveys. In the bromelain value criterion variable, the alternative suitability value on this criterion is assessed from 1 to 5 (C. Surya, 2015). After making the decision matrix, proceed with normalized matrix with weight (Table 2.).

Table 1. Decision Matrix

Alternative	Criteria			
	K1	K2	K3	K4
A (Storage of pineapple on day 0)	4	5	73.73	5
B (Storage of pineapple on day 3)	5	4	33.58	4
C (Storage of pineapple on day 6)	4	3	30.89	3
D (Storage of pineapple on day 9)	3	3	27.6	3

Table 2. Normalized Matrix with Weights

Weight	15%	20%	50%	15%
Alternative	K1	K2	K3	K4
A (Storage of pineapple on day 0)	0.75	1	1	1
B (Storage of pineapple on day 3)	0.6	0.8	0.455	0.8
C (Storage of pineapple on day 6)	0.75	0.6	0.419	0.6
D (Storage of pineapple on day 9)	1	0.6	0.374	0.6

From the decision matrix, a normalized matrix is made. The normalized matrix is multiplied by the weight of the criteria so that the preferences of each alternative are obtained, later the total value of each alternative and the ranking of each alternative will be obtained (Table 3.). The best crude enzyme isolation process with storage day 0 ranks 1 (Table 4.).

Table 3. Assessment Criteria for Alternative Bromelain Enzyme Crude Extraction Process

Criteria	wj				alternative	Rank
K1	0.11	0.2	0.5	0.15	0.9625	1
K2	0.09	0.16	0.228	0.12	0.597723	2
K3	0.11	0.12	0.209	0.09	0.531981	4
K4	0.15	0.12	0.187	0.09	0.547169	3

Tabel 3. Rate and Rank each Alternative

Alternative	Sum of Value	Rank
A1	0,9025	1
A2	0,5902	4
A3	0,5919	3
A4	0,6071	2

Then the pineapple fruit treatment was taken with storage on day 0 (without storage) to extract the bromelain and apply it to food products because it was in the first ranking position (I. Widaningrum, 2013).

CONCLUSION

The length of storage in pineapple affects the characteristics of the crude bromelain enzyme produced. Based on the results of data processing using the MADM-SAW decision-making method, the shelf life treatment without storage treatment is ranked first with a total value of 0.9025. This can be used as a reference for the future in determining the best other components. This research can also be developed for the needs of the parties involved.

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