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Determination of Superior Product in Cocoa Processing Industry of SMEs Scale Using Analytic Hierarchy Process

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Abstract: One of the problems in the cocoa processing industry of Small and Medium Enterprises scale (SMEs) in Palopo is not yet having the method of determining the superior product that can give profit contribution. The purpose of this study is the determination of product selection criteria to determine the superior product of cocoa processing industry of SME scale that is competitive and profitable. The method used is a combination of Delphi and analytic hierarchy process techniques involving expert respondents. The result is determined 4 criteria that become the main priority to choose the superior product that is the added value of the product, market opportunity, the availability of processing and process technology and the availability and the feasibility of cocoa seed raw material with the priority weight each 0,193. The results of the assessment and analysis based on the criteria that exist then set the choice of superior products in the form of cocoa powder with a priority weight of 0.411. The impact of this research is to contribute profits to the SME cocoa processing industry because the products produced meet the criteria of value added and market competitiveness.

Key words: Superior product, cocoa powder, cocoa processing, AHP, SMEs, OVOP industry

INTRODUCTION

Indonesia is the world's third-largest cocoa producer (Anonymous, 2015). In Indonesia, one of the largest cocoa producing regions in the province of South Sulawesi. Cocoa production center in South Sulawesi is Luwu Raya area covering Palopo, East Luwu, Luwu Utara and Luwu with the cocoa production of 60222 tons (Anonymous, 2012). Based on the real condition in the area of Palopo city has been developed cocoa processing industry based One Village One Product (OVOP) program. This OVOP industry of cocoa processing is the first developed in Indonesia. The cocoa processing industry focuses on one of the basic principles of OVOP namely local yet global. The development of the industry is a form of cooperation program of the local government of Palopo city, Sulawesi Selatan Provincial Office of Industry and Ministry of Cooperative Micro Small and Medium Enterprises of the Republic of Indonesia. The cocoa processing industry through the Palopo city OVOP program was established to increase the added value of cocoa beans. The process of increasing the added value is done through the processing of cocoa beans into cocoa powder products, cocoa paste, cocoa butter and various derivative products. Based on the existing condition of OVOP cocoa processing industry in Palopo, it has not applied the method of determining the criteria for selecting superior products. This is a cause, so that, the industry has not set a superior product that can be competitive and profitable.

Although, processed cocoa beans can produce several types of products but it requires the establishment and selection of superior products. It aims to decide what kind of superior product can be profitable. To determine the superior product of the value-added processing industry is needed the strategy of increasing value-added products through diversification and innovation (Lamatinulu, *et al*., 2017). The process of diversification of processed cocoa products aims to establish superior products that have quality eligibility and be able to compete on local, national and international market share.

Based on the problems faced by the cocoa processing industry in Palopo OVOP then required analysis of priority setting of criteria for selecting superior products. The purpose of this study was to find the criteria on which to choose the best product to produce. The criteria identification approach used to select a superior product is determined based on stakeholder

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relationship (Kustanto, 1999). Other aspects that may be considered factors of superior product selection criteria include industrial strategy, demand conditions, production factors, related industries and supporting industries. To define the criteria for the selection of superior processed food products, cocoa processing is closely related to the characteristics of products, raw materials and auxiliaries, the ease of technology and equipment, market opportunities and the availability of capital (Anonymous, 2005). With regard to some of the above description, the selection of cocoa processing industry products on the scale of SMEs based on consideration of added value, market opportunities, human resources availability, availability of raw materials and process technology.

The method approach in determining the priority of product selection criteria and the priority of the main product determination is the combination of Delphi method and Analytic Hierarchy Process (AHP). The Delphi method is applied to identify the criteria required for the assessment of product selection based on feedback from expert respondents (Habibi *et al*., 2014). The AHP method can be applied to make decisions on key choices and priorities (Saaty, 1980; Huang *et al*., 2015; Lamatinulu, 2016). AHP can also be applied in terms of making decisions in setting options related to the product (Lamaakchaoui *et al*., 2015).

MATERIALS AND METHODS

Analysis of this research begins with the application of Delphi method to explore the assessment of expert respondents (Habibi *et al*., 2014). The Delphi method is a procedure technique in research surveys (Sharkey and Sharples, 2001; Skulmoski *et al*., 2007). Implementation of Delphi method to identify the criteria needed in determining the superior product of OVOP industry of cocoa processing of SME scale. The results of the criteria identified in the selection of priority of superior products were analyzed using AHP method. This is done to obtain a priority scale order of the elements of the assessment criteria to determine the selection of superior products.

The result of the priority sequence of product selection criteria becomes the basis of consideration to perform an analysis of the importance and priority of the products to be selected as the pre-eminent product. The data collected is sourced from the assessment of expert respondents. The criteria of expert respondents are cocoa industry practitioners, researchers and agro-industry experts, researchers about the product cocoa processing. The application of AHP uses nine assessment scales in designing 1, 3, 5, 7 and 9 questionnaires which are consecutively clarified with meanings 1 = equally important, 3 = slightly more important, 5 = very important, 7 = proved to be more important and 9 = really more important while the value 2, 4, 6, 8 is intermediate value (Saaty, 1980). As for the steps applied to perform analysis with AHP method can be described as follows:

Preparation of pairwise comparison matrix. Matrix A is an n×n matrix in which n is a comparison criterion. Equation 1 shows the parameters in the matrix A, a_{ij} is between the criteria in the row and the criterion in the column with the result equal to $1/a_{ij}$:

$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \quad (1)$$

Calculate the normalized value of the decision matrix for the selection criteria:

$$a_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}},\ i = 1, 2, 3, ..., n,\ j = 1, 2, 3, ..., n \quad (2)$$

Calculate the weighted value of the normalized decision matrix to determine the priority scale of the criteria:

$$Wi = \frac{1}{n}\sum_{j=1}^{n} a_{ij} \quad (3)$$

Calculate the value of Consistency Ratio (CR) by comparing the Consistency Index (CI) with Random Index (RI). This stage is a consistency test of matrix A, Saaty (1980) recommend to use eigenvalue λ_{max} by using equation 3 to calculate eigenvector. The eigenvalue calculation of λ_{max} is shown in Eq. 4:

$$\lambda_{max} = \frac{1}{n}\sum_{j=1}^{n} a_{ij}\frac{Wj}{Wi} \quad (4)$$

The result of calculating eigenvalue value λ max is used to get the value of Consistency Index (CR) and confirm consistency of matrix A by applying Eq. 5 and 6:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (5)$$

$$CR = \frac{CI}{RI} \quad (6)$$

The value of RI is determined based on the number of matrix order (n). This value is used in calculating CR accordingly as shown in Table 1 (Saaty, 1980).

Table 1: Random inconsistency indices

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

RESULTS AND DISCUSSION

In the determination of superior products in the cocoa processing industry based on OVOP SME scale has identified the criteria under consideration. The criteria for the selection of excellent products in Table 2 were obtained based on perceptions of stakeholders justified by expert opinion. To support the accuracy of the assessment of the criteria for selecting the superior product then is determined the ranking priority of scale which is the criteria for the assessment of the product selection of the processed cocoa. Based on 7 proposed criteria that can be an indicator of consideration of assessment in product selection then compiled pairwise questionnaires as a basis for compiling the comparison matrix. The result of priority analysis of the criteria of the assessment of the selection of the superior product with the AHP method is obtained based on the pairwise matrix value, the normalization of the decision matrix value, the determination of the priority weight value, the value of λ_{max}, the CI value, the CR value as shown in Table 3.

The results of AHP analysis in Table 3 show that there are three priority levels of election assessment criteria to define a superior product. The first priority with the weight of 0.193 includes the criteria of value-added factors (C_1), market opportunities (C_2), availability of equipment and process technology (C_4) and availability of raw materials and auxiliary materials (C_5). The second priority with the weight of 0.105 is human resource (C_3). The third priority with the weight of 0.062 includes the ease factor in the use of technology and production process equipment (C_6) and the typical taste of processed cocoa products (C_7).

The result of priority determination is used as the basis for determining the superior product produced by the cocoa processing industry of small-scale industry based in OVOP. The types of products that become an alternative choice of superior products are cocoa powder (P_1), cocoa butter (P_2) and cocoa pasta (P_3). Product selection criteria are used as the basis for defining superior product selection. The composition of the AHP analysis hierarchy in determining the superior product of SMEs cocoa processing industry as shown in Fig. 1.

Based on the results of the criteria weight analysis in Table 3 and the hierarchical arrangement in Fig. 1 then set alternative superior product selection. The results of priority assessment analysis of the selection of superior products based on every 7 subcriteria as shown in Table 4.

Table 2: Results of the identification of proposed criteria in the selection of superior products

Description of the criteria to be considered	Codes
The potential value added of this type of processed cocoa products	C_1
Market opportunities for cocoa processing products	C_2
Availability of human resources in the manufacturing process	C_3
Availability of equipment and production process technology	C_4
Availability and feasibility of raw materials and auxiliaries	C_5
Ease of use of technology and production equipment	C_6
The unique taste of cocoa processed products	C_7

The result of calculation with AHP method in Table 4 shows the result of the priority value of selected alternative products in the form of cocoa powder (P_1), cocoa butter (P_2) and cocoa pasta (P_3). The priority weight is determined based on consideration of assessment criteria. The priority weight values generated in Table 3 and 4 are all acceptable because they have a Consitency Ratio (CR) value smaller than 0.1 (Saaty, 1980). The value of the priority weighting of assessment criteria in Table 3 and the value of the alternative priority weighting of product selection in Table 4 provides the basis for determining the global priority weighting value. To get global priority value then done by multiplying the weight value of each assessment criterion in Table 3 with the priority weight value of each product that becomes an alternative choice. The results of the analysis of the determination of global priority weighting to determine the choice of superior products as shown in Table 5.

Based on a series of AHP analyzes in Table 5 shows the result that the selected product alternatives into the superior product are the cocoa powder (P_1) because it has the largest weight value of 0.411. In the selection of product priority, the most influential criteria are the criteria C_1, C_2, C_4 and C_5 with each weight of 0.193. This shows that the value-added factor of the product is a criterion that is very important to produce superior products. The superior product is expected to be a strategy to increase profit through the value-added process. Product-added value is a strategy related to profitability income generation and an asset of organizational wealth (Brege *et al*., 2010; Lawal *et al*., 2011; Velnampy, 2011). The criteria of market opportunity is also a factor that has a major influence in determining the determination of superior products. Marketing factors are important because market-oriented products have an impact on industry performance (Protcko and Dornberger, 2014). The selection of superior products is also determined based on technological process considerations, this is very important because it can have an impact on the knowledge management of industrial production (Hosseini *et al*., 2014).

The criteria of process technology in the selection of superior products in the cocoa processing industry are related to technology adoption and innovation. This is

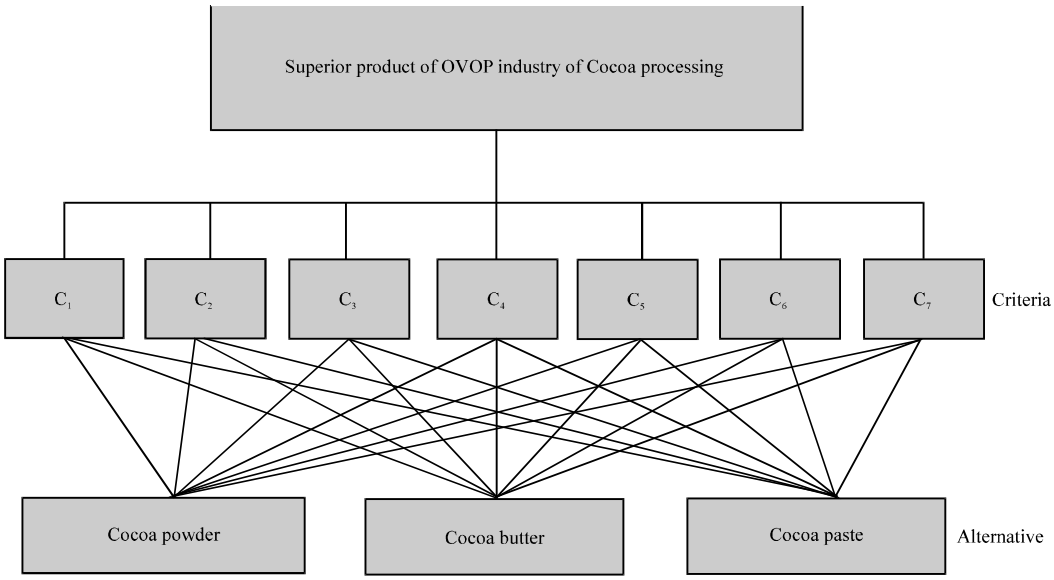

Fig. 1: Hierarchy of the AHP in determining the superior product

Table 3: Pairwise comparison matrix, weights and priority of criteria

SC	C_1	C_2	C_3	C_4	C_5	C_6	C_7	Weights values	Level of priority
C_1	1	1	2	1	1	3	3	0.193	1
C_2	1	1	2	1	1	3	3	0.193	1
C_3	0.5	0.5	1	0.5	0.5	2	2	0.105	2
C_4	1	1	2	1	1	3	3	0.193	1
C_5	1	1	2	1	1	3	3	0.193	1
C_6	0.333	0.333	0.5	0.333	0.333	1	1	0.062	3
C_7	0.333	0.333	0.5	0.333	0.333	1	1	0.062	3

$n = 7$, $\lambda_{max} = 7.0123$, RI = 1.32, CI = 0.00206, CR = 0.0015

Table 4: Priority rating of selected superior products based on criteria

Criteria	Product	P_1	P_2	P_3	Priority
C_1	P_1	1	1	3	0.429
	P_2	1	1	3	0.429
	P_3	0.333	0.333	1	0.143
C_2	P_1	1	2	4	0.571
	P_2	0.5	1	2	0.286
	P_3	0.25	0.5	1	0.143
C_3	P_1	1	1	2	0.400
	P_2	1	1	2	0.400
	P_3	0.5	0.5	1	0.200
C_4	P_1	1	1	3	0.429
	P_2	1	1	3	0.429
	P_3	0.333	0.333	1	0.143
C_5	P_1	1	1	1	0.333
	P_2	1	1	1	0.333
	P_3	1	1	1	0.333
C_6	P_1	1	1	2	0.400
	P_2	1	1	2	0.400
	P_3	0.5	0.5	1	0.200
C_7	P_1	1	2	4	0.571
	P_2	0.5	1	2	0.286
	P_3	0.25	0.5	1	0.143

$n = 3$, $\lambda_{max} = 3$, RI = 0.58, CI = 0.000, CR = 0.000

very important to be a consideration of product determination because innovation and adoption of process technology can increase profitability and market share (Al-Mubaraki and Aruna, 2013). The fourth criterion which becomes the priority of the main consideration in the selection of superior products is the availability and feasibility of raw materials. The raw material factor is an important factor in determining the superior product because the raw materials greatly affect the performance of the production process. This is supported by the results of research which states that the availability of raw materials has significant impact on industrial performance and continuity of production processing (Suryaningrat, 2016). Specifically based on the results of AHP analysis shows that to produce superior products that have been established in the processing industry of OVOP cocoa of SMEs scale should be supported by innovation factors to increase the added value, the magnitude of market opportunities, adoption and technological innovation and the availability and feasibility of cocoa seeds. Based on the results of the analysis of global priority value determination then the choice of superior product is the cocoa powder with a weight value of 0.411 priority.

Tabel 5: The value of global priority weighting of superior product determination

Criteria	Alternative products Code	Weight	Global priority	Total global priority
C_1 (0.193)				
	P_1	0.429	0.083	$P_1 = 0.411$
	P_2	0.429	0.083	$P_2 = 0.370$
	P_3	0.143	0.028	$P_3 = 0.189$
C_2 (0.193)				
	P_1	0.571	0.110	
	P_2	0.286	0.055	
	P_3	0.143	0.028	
C_3 (0.105)				
	P_1	0.400	0.042	
	P_2	0.400	0.042	
	P_3	0.200	0.021	
C_4 (0.193)				
	P_1	0.429	0.083	
	P_2	0.429	0.083	
	P_3	0.143	0.028	
C_5 (0.193)				
	P_1	0.333	0.064	
	P_2	0.333	0.064	
	P_3	0.333	0.064	
C_6 (0.062)				
	P_1	0.400	0.025	
	P_2	0.400	0.025	
	P_3	0.200	0.012	
C_7 (0.062)				
	P_1	0.571	0.035	
	P_2	0.286	0.018	
	P_3	0.143	0.009	

CONCLUSION

The criteria that become the main priority in choosing the superior products in the OVOP Cacao-based processing industry of SME scale include the criteria of added value, market opportunity, availability of process technology, availability and feasibility of raw materials with the priority weight value of 0.193. The second priority criterion concerns the availability of human resources with a weight of 0.105 and the third priority criterion is the ease of use of technology and taste that is typical of processed cocoa products with a weight each of 0.069. Based on the utilization of established criteria, the increase value-added factor of cocoa processing products should be supported by product innovation and process technology to enhance competitiveness and market opportunities. By analyzing the assessment based on the priority product of criteria that has been determined, the superior product ideally produced by the small-scale industry of OVOP cocoa processing is the cocoa powder because it has the biggest weight value of 0.411.

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