

## Product development of sweets chocolate cube using value engineering method

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### Abstract

Cocoa is one of the plantation commodities that has an important role in economic activities as a foreign exchange earner. Indonesia is ranked first in Asia with the highest consumption of chocolate, which is 7.3 kg per capita. Chocolates are seen by consumers as a comfort food or stress relief. For consumers who buy chocolate for their own consumption, consuming chocolate in a small size causes consumers to act more impulsively to consume larger quantities. Consumption of chocolate in small sizes (one bite size) gives the impression that the product has a premium image and higher quality. The purpose of this study was to identify the characteristics of chocolate that influence the decisions of product purchasing and to develop one-bite-sized chocolate cubes using the value engineering method. The study used 433 respondents with the criteria of chocolate consumers aged 15-40 years. Based on the research, chocolate bars and molded chocolate are the types of chocolate most often consumed with a frequency of 2-3 times a month. Consumers have the highest complaints when consuming chocolate, namely melted chocolate which makes hands dirty due to its big size and is too hard to bite. Based on the consumer needs analysis, consumers want the development of milk chocolate cube candy with nuts filling. Four alternative cube milk chocolate concepts with a cocoa mass percentage of 50% were prepared using 2 variations in the number of cocoa beans and cocoa fat (40%:10% and 35%:15%) and 2 variations of nuts (almonds and cashews). Based on the hedonic test results, milk chocolate cubes with a formula of 10% cocoa butter and cashew nut filling had the highest product value of 0.013 compared to other formulas. Chocolate color and ease of eating are the attribute weights with the highest weights. It can be concluded that the milk chocolate cube formula is 40% cocoa beans; 10% cocoa butter, cashew nut filling is the selected formula with a production cost of IDR 985.00/g.

## 1. Introduction

Cocoa is one of the plantation commodities that has an important role in economic activities, one of which is as a foreign exchange earner besides petroleum oil and gas. According to the International Cocoa Organization (ICCO), Indonesia is the seventh-ranked cocoa-producing country in the world after Ivory Coast, Ghana, Ecuador, Cameroon, Nigeria, and Brazil (International Cocoa Organization (ICCO), 2022). Based on Central Bureau of Statistics (2020), Indonesia exported 40,026 tons of cocoa beans and pods, and also imported 44,236 tons of processed cocoa products. Cocoa exported to destination countries will be processed into processed chocolate products, thus indicating the limited processing of cocoa beans into secondary products in

Indonesia (Praseptianga *et al.*, 2018). According to the rate of chocolate consumption, Indonesia will have the sixth-highest rate of chocolate consumption worldwide in 2021. In fact, Indonesia is the first-ranked country in Asia with the highest consumption of chocolate, which is 7.3 kg per capita (Goodstats, 2022). Indonesians' high level of chocolate consumption is influenced by their perceptions, which are that eating chocolate can bring them comfort or reduce stress (Sukma and Baihaqi, 2013). The production of endorphins from chocolate consumption is most likely the attraction's primary mechanism. According to Nehlig (2013), the neurotransmitter systems that control appetite, rewards, and mood may be affected by chocolate. These neurotransmitter systems include dopamine, serotonin,

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and endorphins, which are all found in chocolate and cocoa.

Chocolate products circulating in society also have diverse and attractive shapes, types, flavors, and packaging (Fitriyah *et al.*, 2022). According to Marwati *et al.* (2019), compared to other products, chocolate is one of the most special processed cocoa products. The combination of components in chocolate forms a complex flavor that cannot be replaced by other sources. The chocolate solids play a role in providing flavor and color, while the fat in chocolate plays a role in controlling the texture of the product. The distinctive taste of chocolate is nothing but a balanced combination of the basic tastes of bitter, sour, and sweet which are composed of the components in chocolate. It appears that taste and shape are the most important qualities of chocolate products (Haslindah, *et al.*, 2020). Del Prette and Samoggia (2020), explain that the most important consideration when buying and eating chocolate is taste. Consumers consider taste to be the attribute with the highest consideration in making product purchase decisions (Fortunata *et al.*, 2021). Chocolate with a dominant taste of chocolate with a sweet taste that fits into a measure of good taste in chocolate (Sukma and Baihaqi, 2013). Furthermore, people will be more interested in purchasing the product if the shape is appealing (Setiawan and Japariato, 2012).

Based on a preliminary study, the most widely sold chocolate product in the Indonesian marketplace is Milo cube, which is 1.2 billion per month. Milo cube is the 3rd best chocolate in Malaysia among the five chocolate products circulating in Malaysia in terms of chocolate taste and shape (Milatusadia, *et al.*, 2020). The existence of a different form of Milo cube as compared to the chocolate bar can be used as an opportunity to create new products through product diversification. In addition, according to Del Prette and Samoggia (2020), consuming smaller portions of chocolate rather than one large one offers the impression of being more impulsive, which leads to eating more for individuals who purchase chocolate for their personal consumption. Customers will therefore tend to eat less chocolate if the same amount is provided to them in smaller portions rather than one huge serving. Although smaller snacks are consumed less, the satisfaction obtained will be the same (Kleef, *et al.*, 2013). Chocolate with a small shape is more advisable to create light snacks using persuasive communication strategies (Vermeer *et al.*, 2010). The wide variety of shapes of chocolate affects the perception of chocolate texture and taste when chocolate is put in the mouth. The shape of the chocolate is said to be promising for future product development. The shape of the chocolate piece in order to provide good taste can be

designed by combining two criteria. The criteria of appropriate melting rate and volume of open emptiness induced after the form is introduced in the mouth are considered to provide good taste (Lenfant *et al.*, 2013). Product design and development are needed so that it has higher utility and is needed by consumers (Ushada *et al.*, 2019). Therefore, based on the background that has been described there is an opportunity for the development of chocolate in the shape of a cube by paying attention to the convenience or practicality of the product and the characteristics of chocolate desired by consumers. Product development that has been carried out in previous research uses several methods such as value engineering to be able to produce product concepts that meet consumer desires at minimum cost (Nugroho, *et al.*, 2018; Ulya, *et al.*, 2020). The objective of this research was to identify the chocolate characteristics that affect consumer acceptance and to develop a chocolate cube based on consumer needs using the value engineering method. The development of chocolate cubes needs to be developed to produce chocolate that becomes a new snack product that can provide a more attractive taste and consumption sensation.

## 2. Materials and methods

Value Engineering (VE) method is a systematic method used to increase value and quality by identifying opportunities to reduce costs while maintaining quality, reliability, performance or other important factors so that they remain in line with consumer expectations and even more (Sadikin *et al.*, 2015). The VE method was chosen because it is in accordance with the value engineering function, namely designing new products.

### 2.1 Information stage

At the information stage, the questionnaire was used to gather information regarding chocolate development. The determination of attributes based on the results of a literature study used as research support consists of seven attributes including taste, color, aroma, texture, gloss, ease of melting, and ease of eating which will affect the quality of the product to be developed. In addition, the questionnaire also includes several other information needed, such as consumer demographics, consumer behavior in chocolate consumption, and chocolate consumer behavior towards chocolate cubes consumption. The development of chocolate cubes is adjusted to the characteristics desired by consumers, product characteristics include the type of cube chocolate and the type of chocolate filling. Extracting information related to technical requirements is carried out based on the attribute that has the highest percentage so it requires main attention because it relates to product quality which can affect consumer satisfaction.

## 2.2 Creative stage

The creative stage is carried out by developing as many alternative ideas as possible to fulfill the required function through the information that has been obtained. Determination of alternatives is carried out with several variations of the concept formula that are adapted to the characteristics of the product being designed. The alternative concept designed is a product that hopes to fulfill the desires and needs of consumers. Mapping the functions of product attributes so that their functions remain appropriate can be done using the Function Analysis System Technique (FAST) diagram. FAST diagrams can facilitate researchers in preparing product development ideas. The FAST diagram consists of 4 functions, namely the main function, the derived function, the objective function, and product specifications.

## 2.3 Analysis phase

At the analysis stage, the analysis was carried out based on the results of the hedonic test assessment on each product concept on the prototype chocolate cubes. Hedonic testing is an assessment of the quality attributes of the cube chocolate that has been developed. The hedonic assessment included attributes of chocolate taste, chocolate color, chocolate aroma, chocolate glaze, chocolate texture, meltability in the mouth, ease of eating, filling taste, filling size, and the number of fillings. The results of the hedonic test assessment are used to calculate attribute weights, performance, zero one, cost calculation, and product value analysis for each product concept. The attribute weight calculation is used to find out which attribute has the highest weight value. The attribute with the highest weight is a priority that needs attention in the development of chocolate products. Calculation of performance is the product's ability to meet the needs and desires of consumers. Performance is calculated by multiplying the quality attribute weight by the zero-one percentage for each attribute. The highest performance results are defined as products that have value in terms of quality attribute quality. The higher the performance value, the higher the product attribute quality.

## 2.4 Development and recommendation stage

The development and recommendation stages are stages for analyzing developments that can be carried out based on the results that have been obtained. In this development, the best alternative concept is obtained based on the results of calculating the cost production and value of the product.

## 3. Results and discussion

Value engineering has several stages in the product development process including the information stage, the creative stage, the analysis stage, the development stage, and the recommendation stage (Ulya *et al.*, 2020). The information stage in this research is analyzing consumer demographics, consumer behavior, and consumer needs and desires for product development. A total of 433 respondents filled out a questionnaire with several different demographics. The majority of respondents are women aged 21-25 years as students with undergraduate/graduate education with a monthly allowance of IDR 1,000,001 - 3,000,000. The results of the study are in line with Sabarisman and Purwaditya (2019) that stated ages 16-25 years are the highest in consuming chocolate. The status of students/students is in line with the majority of ages obtained, which in this range are students who are currently studying. Income data can be used to determine the price of a product, with data on average consumer income, product results can be adjusted to the target market. Product pricing can be done by using ingredients in the product so that product production costs can be controlled. The respondent's identity profile is presented in Table 1.

Table 1. Respondent identity profile of chocolate cube development.

	Categories	Quantity	Percentage (%)
Gender	Male	150	34.64
	Female	283	65.36
Age (years old)	15-20	98	22.63
	21-25	151	34.87
	26-30	91	21.02
	31-35	41	9.47
	36-40	52	12.01
Profession	Student/undergraduate	266	61.43
	Private Employed	87	20.09
	Government Employees	70	16.17
	Businessman	2	0.46
	Housewife	1	0.23
	Other	7	1.62
Income (IDR)	< 1,000,000	111	25.64
	1,000,001-3,000,000	179	41.34
	3,000,001-5,000,000	86	19.86
	5,000,001-7,000,000	27	6.24
	> 7,000,000	30	6.93

Chocolate consumer behavior is an action taken by consumers related to chocolate consumption. The majority of consumers consume chocolate bars with the highest consumption brands being Silverqueen and Cadbury Dairy Milk. According to Sukma and Baihaqi (2013), the choice of chocolate is also influenced by the

social class that consumers have. Consumers who are in a higher social class tend to buy famous brands of chocolate with a special place and price that can be said to be quite expensive. Based on the data obtained, it turns out that consumers have their perceptions of consuming chocolate, consumers assume that consuming chocolate will improve their mood for the better. Emotional comfort and chocolate are frequently linked. This effect appears to be related to the ability of carbohydrates, particularly chocolate, to foster these kinds of joyful emotions by releasing several peptides in the gut and brain. Chocolate may affect certain neurotransmitter systems, including those that control appetite, reward, and mood, such as serotonin, endorphins, and dopamine (chocolate includes the dopamine precursor tyrosine) (Nehlig, 2013).

Most consumers have complaints when consuming chocolate products that melted chocolate makes their hands dirty. The complaints experienced support the development because developing a bite chocolate cube shape is expected to overcome existing complaints. Subsequently, consumer behavior towards chocolate cubes is obtained to determine the attractiveness of consumers in consuming cube products. As many as 76.44% of respondents stated that they had consumed cube products, meaning that cube products were familiar to most consumers. Several brands have been consumed by respondents, namely, 84.59% of respondents have consumed Milo cube, followed by Chocomalt cube products, and Choco truffle-logy. Milo cube in Malaysia is positioned as the 3rd best chocolate in Malaysia compared to other chocolates in terms of shape and taste (Milatusadia, *et al.*, 2020).

Apart from Malaysia, it turns out that Indonesian consumers also consume a lot of Milo cubes. This is interesting enough to be taken into consideration in the development of the chocolate cubes because of its shape. The statement that Milo cube is the best in terms of taste and shape is in line with the results obtained in the study. The majority of respondents consumed cube chocolate for reasons of taste and shape. In addition, in the open statement provided, several respondents answered that "curiosity, size, and uniqueness of the product" were the reasons for buying a cube product. This result in accordance with Del Prete and Samoggia (2020) that stated consuming less chocolate than the same amount in one piece makes the customer believe there is less product available. Smaller pieces of chocolate are linked to a more "premium image and higher quality," in addition to being eaten more carefully. Information regarding the consumption of chocolate cubes is presented in Table 2.

The existence of a preliminary survey in

Table 2. Information regarding the consumption of chocolate cube.

Item	Categories	Quantity	Percentage (%)
Consumption of chocolate cubes	Yes	331	76.44
	No	102	23.56
Product type of chocolate cube	Milo Cube	280	84.59
	Chocomalt Cube	44	13.29
	Choco Trufflelogy	2	0.60
	Unbranded	1	0.30
	Other	4	1.20
Reasons	Taste	238	37.18
	Texture	136	21.25
	Design	189	29.53
	Price	77	12.03

development is useful to gather as much information as possible. The information obtained is useful so that developers can create a product according to the wishes of consumers. The choice of the type of chocolate that will be developed in this study is milk chocolate with a higher number of answers. Therefore, previously asked questions related to the desire for filling in chocolate. As a result, 75.75% of respondents prefer chocolate fillings with a variety of fillings available. As many as 75% of respondents selected chocolate with nuts inside. The characteristics of chocolate that consumers desire is presented in Table 3.

Table 3. Characteristics of chocolate that consumer wants.

Item	Categories	Quantity	Percentage (%)
Type of Chocolate	Dark Chocolate	214	49.42
	Milk Chocolate	219	50.58
Chocolate Filling	Yes	328	75.75
	No	105	24.24
Filling Types	Nuts	247	75.00
	Dried Local Fruits	81	25.00

Attribute weight is an analysis to find out what important attributes are considered by consumers in receiving chocolate products. Assessment can be weighted to find out the priority attributes that need more attention in development. Assessment of chocolate that is already on the market has a value that still does not meet consumer expectations. The result shows that the 3 priority attributes with the highest weight were chocolate taste, ease of eating, and chocolate texture. Therefore, these 3 attributes are of greater concern in the development of cube-shaped chocolate. The calculation of the quality attribute weights is presented in Table 4.

The creative stage is the stage used to develop ideas by paying attention to several important product attributes at the information stage. Furthermore, the

Table 4. Calculation of the quality attribute.

Milk Chocolate	Performance	Consumer needs	Quantity Consumers need	Quality (%)	Priority
Taste	3.64	3.83	838	13.3	1
Ease of eating	3.49	3.78	827	13.12	2
Texture	3.38	3.7	810	12.85	3
Ease of melting in the mouth	3.45	3.65	800	12.69	4
Flavor	3.43	3.63	795	12.61	5
Color	3.35	3.53	774	12.28	6
Chocolate filling	3.12	3.43	752	11.93	7
Glossiness	3.05	3.23	707	11.22	8
Total			28.78	100	

determination of alternatives is made into 4 alternative product concepts that are differentiated in the composition of cocoa beans (35% and 40%) and the composition of cocoa butter (10% and 15%). Variations of the nut type (almond and cashew) are also used for the alternative concepts. The analysis phase was carried out based on the results of the hedonic test assessment on each product concept of the chocolate cube prototype. Hedonic testing was carried out by panelists who had previously been research respondents. That, as a manifestation of the characteristics of chocolate that consumers want. Details of product value calculations are presented in Table 5.

Based on the performance calculation results, it was found that the formula of 35% cocoa beans, 15% cocoa butter, and 0.5 g cashew had the highest performance value of 3,653. The development and recommendation stage is a stage of cost analysis and product value determination for each development alternative. After that, the alternative with the best results will be a recommendation for determining product development. The formulation of the concept that has the highest product value is found on cube chocolate with the formula of 40% cocoa beans, 10% cocoa butter, and 0.5 g cashew nuts of 0.01 with a production cost of IDR 985.00/g. Thus, based on the development of chocolate cubes which was carried out using the value engineering method, the formula concept is chosen because it has the highest value among the others.

#### 4. Conclusion

Chocolate bars and molded chocolate were the most frequently consumed types of chocolate with a frequency of 2-3 times a month. The 3 highest attributes are

prioritized for the chocolate cube's development, namely chocolate taste, ease of eating, and chocolate texture. Consumers have the highest complaints when consuming chocolate, namely inconvenient melted chocolate that causes dirty hands and a texture that is too hard to bite. Based on the consumer needs analysis, consumers want milk chocolate cubes with nuts filling. The priority attributes that have the highest weight, namely taste, ease of eating, and chocolate texture. The four alternative designs of chocolate cube concepts were developed in accordance with consumer needs. The best formula is determined by calculating the product value. The highest value of 0.0143 is in cube chocolate with the formula of 40% cocoa beans; 10% fat; 24% sugar; 24.4% milk; 0.5% lecithin; 0.1% vanilla, and 0.5 g of cashew nuts with a performance value of 3,346 and the production cost is Rp 985.00/g. This formula is chosen as the best formula in the development of filled chocolate cubes.

#### Conflict of interest

The authors declare no conflict of interest.

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Table 5. Product value calculations.

Formula (cocoa beans:cocoa butter)	Performance	Production Cost/g (IDR)	Value
40%:10% (Almond)	1,330	976	0.005
40%:10% (Cashew)	3,346	985	0.013
35%:15% (Almond)	1,839	1,061.00	0.006
35%:15% (Cashew)	3,653	1,392.00	0.012

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