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ANALYSIS OF THE QUALITY AND FINANCIAL VIABILITY OF HARD CANDY INNOVATION PRODUCTS WITH THE ADDITION OF GAMBIR CATECHINS (UNCARIA GAMBIR ROXB)

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ABSTRACT

Developing hard candy as a functional food with antioxidants and antibacterial properties derived from natural ingredients will do. By analyzing the formulation of innovations and analysis of the financial viability of hard candy products with the addition of gambir catechins, it is expected to provide information to stakeholders related to the development of hard candy innovation products with the addition of gambir catechins (Uncaria gambir Roxb.). The results of the analysis of organoleptic tests, obtaining formulas 17, 8, 18, 4, 7 hard candies had the rating respondents liked very much (4-5). Then conduct a quality test based on SNI hard candy 3547.1:2008 on products that have the criteria of organoleptic test results. Results from SNI hard candy test 3547.1:2008, the product met the standard requirements of SNI 3547.1:2008 products. When compared to hard candy products on the market with an average selling price of around Rp. 333.33, the hard candy products in this study can compete, especially strawberry variants. On a production scale of at least, 10 kg of hard candy HPP can compete with other products, where the hard candy in this study has a high added value antioxidant and has antibacterial properties useful for the health of consumers.

Keywords: *Hard Candy, Catechins, Organoleptic Test, Financial Viability*

INTRODUCTION

People's awareness of healthy living is increasing during the Covid-19 pandemic, so one of the efforts to maintain a healthy lifestyle through food intake is by eating healthy foods and benefiting the body. This makes consumer demand for food products also change. Food products that have more benefits for the body grow by promising a variety of advantages as shown in labels and advertisements, this product is referred to as functional food (Susanto and Kristiningrum, 2021). Furthermore, food works not only on food that is transferred in the digestive tract but becomes a means or medium to prevent even to treat certain diseases, since with some of its essential ingredients, functional foods can have a positive effect on human health if consumed regularly and vary in the diet every day (Abbas, 2020).

Functional food is one of the fastest-growing and exciting areas of research and innovation (Verma et al., 2018). The development of functional food in the country not only benefits consumers because of the benefits that can be taken, but also opportunities for the food industry, benefiting the government, and building the health of the country. For the food industry, the high demand for functional food means the opportunity to increase profitability by innovating the development of food products and formulations according to market demand.

Confectionery products are the most popular products of people of all ages and social classes, one of which is candy (hard candy). Currently, hard candy products are considered a common food product, despite having negative consumer perceptions because they cause caries/tooth holes. On the other hand, hard candy is the most popular confectionery product of people of all ages and social classes. Its main ingredients are sucrose, glucose syrup, and water (Nurwati, 2011). However, sucrose is a high potential substance that causes caries/tooth holes due to bacteria (Nurramdhan, 2010; Susi and Susari., 2012)

One solution to this problem is to develop hard sweets as a functional food with antioxidant and antibacterial properties derived from natural ingredients. In Annisa, et al (2015) makes hard candy with mulberry leaf extract (Morus sp.), in addition, Pujilestari and Agustin (2017) make hard candy with green tea extract. Based on previous research, there has been no development of hard candy from gambir catechins as a source of antioxidants and antibacterials. The wide use of catechins in the gambir opens up opportunities for this commodity to be used more widely.

Research on the gambir is carried out intensively now because the catechins contained in the gambir are very high between 7-33%. Based on the results of research on the pharmacological activity of gambir, catechins have a function as antioxidants, antimicrobials, antibacterials and so on as the basis for the development of pharmaceutical products and functional food. Catechins are also a potential agent as antioxidants and antibacterials that can boost immunity. Malia (2012) has researched the manufacture of suction tablets (pharmaceutical preparations) of catechin gambir as an immunomodulator. Immunomodulators are substances that play a role in strengthening the body's immune system. His research stated that taking suction tablets for 5 days managed to boost the human immune system. Catechin gambir is a functional compound of the polyphenol group, which is one of the antioxidant compounds that work to protect the body from the onslaught of free radicals.

West Sumatra became the largest gambir production center in the country with supplies reaching 80 percent of the country's capacity. Data from the Indonesian Gambir Commodity Association says that every year gambir farmers in West Sumatra can on average harvest 17,000 tonnes of crops grown widely in Lima Puluh Kota and Pesisir Selatan. For innovation that can be done is to create functional food products that use the local wisdom of gambir catechin in the form of hard candy products.

The basis for developing hard candy products as functional food products is innovative product analysis data that includes organoleptic testing and SNI testing, as well as financial feasibility analysis data. In the early stages of the study, an analysis of organoleptic tests was carried out to determine the level of acceptance of the product to color, aroma, taste, and overall evaluation. From the results of organoleptic tests, it is obtained product innovation that consumers are interested in. Organoleptic tests directly related to the consumer's taste for the product to be consumed must be coordinated with the target consumer so that

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organoleptic evaluation can be used to evaluate quality in the food industry and other agricultural product industries (Khalisa et al., 2021). Then the analysis of financial feasibility is focused on looking at the cost of production of the innovation product. The determination of the formulation becomes very important so that it can produce food products that are acceptable to the community. Determination of formulations can be done with various methods including simplex method with linear programming, Lindo software, solver facilities in Microsoft Excel, and Design Specialist.

Formulations assisted using Design-Expert are more profitable because in the stages in it there are guidelines that provide direction and can be selected according to the purpose of Design Of Experiments (DOE) or experimental designs to be carried out (Hidayat et al., 2021). Design-Expert provides a solution feature, where this feature aims to provide information about the selected formulation according to the program that has been summarized based on the conclusion of the entire response. Several previous study (Taufik and Widiantara, 2018) made food products that use design experts in determining formulation optimization. By using the Design Expert program, it is expected to get a hard candy formula that can be accepted by the community. Therefore, this study will raise the topic of functional food by finding solutions regarding the analysis of innovation formulations and financial feasibility analysis of hard candy products with the addition of gambir catechins. The results of this study are expected to provide information to stakeholders on the development of hard candy innovation products with the addition of gambir catechins (Uncaria gambir Roxb.).

EXPERIMENTAL SECTION

Materials

The ingredients used in this study were sucrose, glucose syrup, aquades, mint flavor, strawberry flavor, citric acid, gambir catechins, and plastic candy packaging.

Instrumentation

The equipment used is a hard candy reactor, printers, hard candy wrappers, thermometer, measuring glass and digital scale.

Procedure

The research will be conducted in 7 stages, with each stage being as follows:

1. Prepare raw materials by collecting the necessary raw materials and equipment.
2. Determine the laboratory scale formulation using Design Expert 12.0 software with d-optimal mixture. The experimental design of the formulation can be seen in Table 1.

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Table 1. Hard Candy Formulation with The Addition of Catechins from Gambir (%)

Run	Catechins (X_1)	Sucrose (X_2)	Glucose (X_3)	Water (X_4)
1	0.75	45.00	14.75	35.50
2	0.74	45.76	14.74	34.76
3	0.50	45.85	15.21	34.44
4	0.74	45.76	14.74	34.76
5	0.72	46.50	14.00	34.78
6	0.50	45.84	14.23	35.44
7	0.74	45.76	14.74	34.76
8	0.75	45.00	14.75	35.50
9	1.00	45.68	14.00	35.32
10	0.50	45.15	15.50	34.85
11	1.00	45.94	15.00	34.06
12	1.00	46.09	14.31	34.61
13	0.50	46.38	15.00	34.13
14	0.50	46.39	14.53	34.58
15	0.74	45.76	14.74	34.76
16	1.00	45.33	14.62	35.06
17	0.82	45.68	15.50	34.00
18	0.50	45.84	14.23	35.44
19	1.00	46.34	14.53	34.13
20	1.00	45.06	15.24	34.70

3. This stage is to make hard candy according to the experimental design that has been set on a laboratory scale. The ingredients are cooked at high temperatures (140-150 °C) until the product is obtained hard, shiny, and clear texture.
4. The organoleptic test of the product includes: attributes of color quality, gloss, taste, and texture (mouth). Organoleptic tests were used with a scoring method to 15 respondents. The hedonic rating score used ranges from 1-5 with the following criteria:

Very Dislike	1
Dislike	2
Enough	3
Likes	4
Very Like	5

Organoleptic assessments of hard-sugar products using hedonic tests are conducted subjectively based on observations in five senses. Parameters that are considered include color, gloss, taste, and texture. To find

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out the level of acceptance of users of this product, it was tested by 15 respondents. Technically, respondents assess by filling out organoleptic test forms provided with their respective preferred levels.

5. Test by Hard Candy SNI 3547.1:2008
6. Conduct scale production experiments. This stage will be tried on a scale of 10 kg of material.
7. Analysis of the financial viability of the product, i.e. determination of production cost.

RESULTS AND DISCUSSION

Organoleptic testing

Organoleptic testing is one of the important parameters in food products. Organoleptic exam decisions will show acceptance of hard candy products by the user. Recapitulation of organoleptic test results on hard-sugar products can be seen in Table 2.

Table 2. Recapitulation of organoleptic test results

Sample Code	Quality Parameters				Average
	Color	**Glossy**	**Rasa**	**Color**	**Glossy**
1	3.20	3.33	3.33	3.60	3.37
2	4.00	3.73	2.73	3.87	3.58
3	3.53	3.67	3.73	3.53	3.62
4	4.27	4.13	4.00	3.87	**4.07**
5	3.80	3.93	3.67	3.80	3.80
6	3.47	3.20	3.00	3.73	3.35
7	4.27	3.87	3.87	4.12	**4.03**
8	4.60	4.20	4.07	4.27	**4.28**
9	3.93	3.73	2.93	3.80	3.60
10	4.13	4.00	3.27	4.20	3.90
11	3.93	4.07	2.93	3.73	3.67
12	4.00	3.93	3.00	3.67	3.65
13	3.13	3.00	2.80	3.47	3.10
14	3.60	3.87	3.07	4.00	3.63
15	3.40	3.67	2.73	3.40	3.30
16	4.07	3.73	3.07	3.53	3.60
17	**4.47**	**4.27**	**4.27**	**4.40**	**4.35**
18	4.20	4.27	4.27	4.27	**4.25**
19	3.73	3.33	3.87	3.73	3.67
20	3.47	3.53	3.53	4.07	3.65

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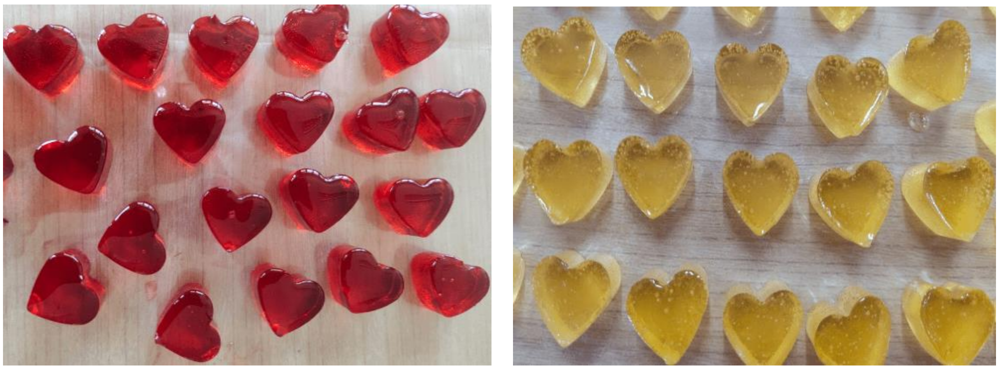
Based on Table 2 on the formulas 17, 8, 18, 4, 7 hard candy has the respondents a like - very like rating (4-5). Hard candy products are made to have 2 variants of flavors, namely strawberries and mint as shown in Figure 1. The harsh candy most accepted by the user because it has the highest average rating on each parameter of the quality of organoleptic testing is the 17 formula with the strawberry variant.

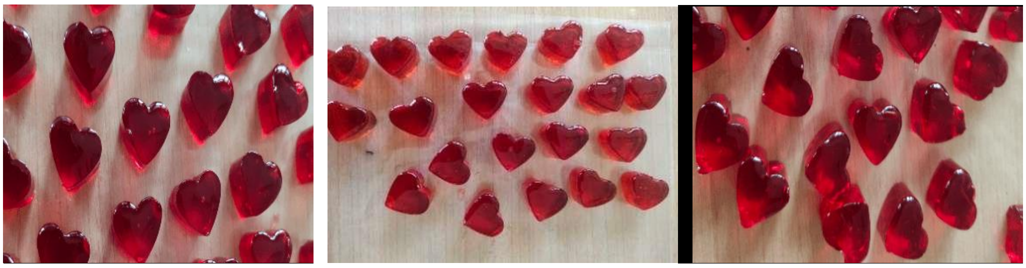


(a) (b)

Fig 1. Strawberry Variant Hard Candy Products (a); Mint Variant (b)

Color is a visual aspect that has an important role because it can be one of the attractions of the product, not least the food product. As one of the parameters that can affect the level of desire, an objective measurement of color is required. The respondent's preferred color was formula 17 with strawberry variants. Photos of some hard candy colors can be seen in figure 2.

(a)



(b)

Fig 2. Product Color Mint Variant (a), Strawberry Variant (b)

Based on Figure 2 the color of the product in one variant is different. This is due to the heating temperature during an unequal (unstable) cooking process in each treatment because the process is carried out in a simple reactor. In the process of making hard sugars, sugars heat up for a long time. This will cause

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the sugar level as sucrose to decrease, causing a non-enzyme war, namely, caramelization, which will lead to the brown color in food products (Miranti, 2020).

Based on Figure 2, hard candy products produced have shiny effects such as glass, smooth, clear, and not cloudy or boring. Based on organoleptic tests on gloss parameters, the most preferred consumer product is the 17 formulas with a strawberry variant. The increased sucrose levels would increase its viscosity, to produce sweets with good clarity or the appearance of the water required sugar with high purity and low ash content. Sweets that use pure sucrose are easily crystallized, therefore it is necessary to use other substances to prevent crystallization for example glucose syrup that will maintain high viscosity. In addition, good glucose consumption will make the candy without crystallization causes the candy to blur or blurry appearance (Mandei and Nuryadi,2019).

Based on the test of organoleptic taste parameters, the most preferred hard candy is the formula of 17 strawberry variants. Hard candy with a concentration of 1% catechins tend to be less preferred in terms of taste because there is a slightly bitter taste. The sweet taste is derived from the sugar used. Sugar has different characteristics and levels of sweetness (Wijanarti et al., 2020). Increased sweetness is due to higher concentrations of sucrose, so glucose and fructose produced from sucrose inversion will also increase. The sweet taste of sucrose is pure because it does not leave after taste (the second taste that appears after the first taste).

Texture has an important influence on the product for example from the level of hardness or type of surface. The texture is a stress sensation that can be observed with the mouth (when bitten, chewed, lubricated, and swallowed) or in contact with the finger. The organoleptic parameters of the texture include an assessment of hardness, the effect of sharp texture on the resulting hard candy products, and the assessment of the level of preference for the overall texture. In more detail, hard candy is declared non-sticky if the product has a smooth and non-sticky surface texture when taken in a container, or is not sticky on the roof when eaten.

Based on the parameters of the texture of organoleptic tests, the most preferred hard candy is the formula of 17 strawberry variants. These unstickiness hard candy prove that the composition of glucose syrup in this study is appropriate. Some samples of hard candy have a sticky texture, especially at a high glucose composition. Another factor is that hard candy is not properly packaged, so hygroscopic sweets are getting sticky and moist. The much reverse sugar can cause additional heating so that it can make the product soften or even the product cannot harden, so the addition of reverse sugar in the manufacture of hard sugars during cooking requires control and acid-raising to adjust the pH and speed of the meet. Sucrose and glucose will absorb moisture and air, thus adding stickiness.

Hard texture indicates that all hard candy products produced from the entire composition have a hardness, with non-soft properties, unlike sugar, not bending when in the mouth, and hard candy products can only break if bitten. According to Prayogi (2016), The increase in the amount of sucrose content will increase the consistency of hard candy so that it will form a hardness and dense texture. The largest concentration in sucrose can become soluble with an increase in temperature in the water. The higher the

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sucrose higher the boiling point of the solution. It can be used to control the level or level of water in sugar production at boiling point and sucrose concentration. Excessive glucose consumption causes sweets to harden so that the sweets are easily melted and when consumed will stick between the teeth or oral cavity.

SNI Hard Candy 3547.1:2008 Testing

Product testing based on SNI hard candy 3547.1:2008 on this study was done on products that had the criteria for organoleptic testing results like to be like-very like by consumers (values 4-5). Based on the results of the organoleptic test in Table 2, the product that had a 4-5 rating is the product on the formulas 17, 8, 18, 4, 7. The results of the test can saw in Table 3.

Table 3. Hard Candy Quality Test Results in accordance with SNI (3547.1:2008)

No	Criteria	Unit	Standard	Result				
				17	8	18	4	7
1	Shape, Taste, Smell		Normal	Normal	Normal	Normal	Normal	Normal
2	Water	% (b/b)	Max. 3,5	0.73	0.80	0.47	0.42	2.78
3	Ash	% (b/b)	Max. 2,0	0.39	0.37	0.39	0.42	0.47
4	Reducing Sugar	% (b/b)	Max. 24	9.91	7.11	13.7	14.2	14.3
5	Sucrose	% (b/b)	Min. 35	61.2	68.4	61.2	58.2	56.4
6	Additives							
	Artificial sweeteners		Negatif	Negatif	Negatif	Negatif	Negatif	Negatif
	Artificial color		Negatif	Negatif	Negatif	Negatif	Negatif	Negatif

Based on Table 3, the hard candy water content test results between 0.42 – 2.78 % have met the standard requirements of SNI 3547.1:2008 products which require a maximum water content of 3.5%. In addition, the hard candy ash test results between 0.37 - 0.47% have met the standard requirements of SNI 3547.1:2008 products where the maximum level is 2.0%. The hard candy test results ranged from 7.11 – 14.3% to meet the standard requirement of SNI 3547.1:2008 products which required a maximum sugar reduction of 24%. Formula 7 produces products with the highest reduced sugar content with a value of 14.3%. This suggests that the hard candy produced from this composition is more susceptible to sticking compared to other compositions, due to its hygroscopic properties so that it is more able to absorb water or air from the outside. Formula 8 produces hard candy with the lowest reduced sugar content, with a 7.11 % percentage. The overall composition produces hard candy products with a sucrose level of between 58.2 - 68.4% according to SNI 3547.1:2008, which is at least 35%. As for the test criteria of cyclamate, it is found that each product formula does not contain artificial sweeteners (cyclamate). This is in accordance with SNI 3547.1:2008.

Production Cost

Assumptions:

Yield of production	: 50%
1 time of production	: 2 hours
Direct labor wage per person	: Rp 2,000,000/mo
1 working month	: 20 working days for 8 hours worked/ day
Electricity bill	: Rp 200,000/mo
Commercial hard candy size	: 4 grams/pcs
The cost of production	: Production costs + (Direct labor costs + electricity costs) + Overhead Costs (if any)

Prices of production raw materials can be seen in Table 4.

Table 4. Price of Raw Materials Production

No	Raw Material	Total	Unit	Volume	Price (Rp)	Price (Rp/unit gr/ml/pcs)
1	Sucrose	1	kg		13,000	13.00
2	Aquadest	1	liter		3,500	3.50
3	Glucose Syrup	1	kg		25,000	25.00
4	Mint Flavor	1	btl	25 ml	25,000	1,000.00
5	Strawberry Flavor	1	btl	30 ml	10,000	333.33
6	Catechin Gambir	1	kg		2,000,000	2,000.00
7	Candy Packaging	1	pack	200 pcs	30,000	150.00

The cost of production is a method of full costing determining the cost of a product by taking into account all production costs, such as direct raw material costs, direct labor, factory overhead costs. The price of hard candy mint variant is higher when compared to the strawberry variant because the price of mint flavors is higher than the strawberry flavor. When compared to hard candy products on the market with an average selling price of Rp. 350, the hard candy products in this study can compete, especially strawberry variants. The cost production of mint variation can be lowered by finding alternative mint flavors that are lower in price. The production cost of hard candy with a production scale of 10 kg can compete with other products, where the hard candy in this study has a high added value of antioxidants and has antibacterial properties that are beneficial to consumer. Cost of hard candy production can be lowered by finding lower raw material prices, for example, by comparing various suppliers of raw materials or making large-scale purchases. The results of the calculation of the cost of production of hard candy with various production scales can be seen in Table 5.

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Table 5. Cost of Hard Candy Production

Variant	Cost of Production (Rp) on The Scale of Production			
	100 gr	10 kg	15 kg	20 kg
Mint Flavor	1304.63	469.82	466.04	464.15
Strawberry Flavor	1213.86	379.05	375.27	373.38

Production costs are all costs incurred by the company in making a particular product. Industry / MSME is very important to determine the cost of production to create the right selling price and generate maximum profit. Production costs determine the company's profits and losses. The error of determining profits and losses is usually due to companies lacking in determining production costs, especially the current industry competition is very sharp and encourages to compete with each other in producing the same replacement products and products.

Production cost information is indispensable for various management decisions to determine the sale price of products, monitor the realization of production costs, calculate periodic profits or losses and determine the cost of goods and products in the process presented on the balance sheet The calculation of production costs has a major influence on the continuity of the company's business. Production costs can cause the determination of the sale price to be too high or low and will affect the profit to be earned by the company.

CONCLUSION

The results of organoleptic test analysis, obtaining formulas 17, 8, 18, 4, 7 hard sugars had the assessment respondents liked very much (4-5). The product has met the requirements of product standard SNI 3547.1:2008. Production cost of hard candy is Rp. 469.82 for the mint variant and Rp. 379.05 for the strawberry variant on a 10 kg production scale.

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