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Sensory Study and Financial Feasibility Analysis of *Alpinia galangal* Fish Shredded Products

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ABSTRACT

Spices have always been a part of Indonesia's culinary culture. One of the spices that has high economic value and efficacy is galangal. Therefore, testing of bioactive compounds and the effect of making shredded spice fish with the addition of various concentrations of galangal needs to be further investigated in terms of sensory quality and financial feasibility. This study aims to determine the bioactive components in galangal spice, determine the best concentration of galangal addition in shredded spiced fish products, and determine the financial feasibility. The research was conducted by making galangal spice and shredded spiced fish at IDAEZ Group MSMEs. Subsequently, the galangal spice was tested for bioactive compound (GC-MS) and then, sensory tests were carried out on shredded fish spices mixed with galangal spices (1%, 2%, 3%). After that, the financial feasibility analysis was calculated. The results obtained showed that there were four main components in galangal spice, such as 5-Eicosenen, (E)-, n-Hexadecanoic acid, oleic acid, and 9-Octadecenoic acid (Z)-, oxiranylmethyl ester. Meanwhile, the best concentration of shredded spice fish was found in treatment P3 (addition of 3% galangal). Lastly, the shredded spice fish was found to be viable with an income of IDR 427,547 per production.

1. INTRODUCTION

Indonesia is a country rich in diversity of spices (Kusuma & Wiraguna, 22018). Spices have always been an inseparable part of Indonesia's culinary culture and are used in various types of traditional cuisines. One of the spices that has high economic value and health benefits is galangal (*Alpinia galangal*) locally called *lengkuas*. Galangal has long been used as a condiment in traditional Indonesia cuisine, such as rendang, curry, and soto, as it imparts a distinctive aroma and delicious flavor to dishes.

Preliminary research has been conducted by (Kusriani &Zahra, 2015) regarding red galangal and white galangal extracts with n-hexane and are known to contain catechin tannins, quinones, steroids/triterpenoids, while ethyl acetate and ethanol extracts of red galangal and white galangal contain flavonoids, tannins, quinones, and triterpenoid steroids. The total phenol levels (mg galic acid/g extract) of n-hexane, ethyl acetate, ethanol extracts from galangal were 2.60, 18.47, 19.61%, respectively. Galangal (*Alpinia galangal*) contains antioxidant compounds that are beneficial to health. Galangal is a plant that is often used as a cooking spice (Khusnul, 2017). Usually, the application of galangal spices is generally carried out by the community by thinly slicing or by browning galangal, then mixing it with other spices and cooking it with the main raw materials. This application is not effective because bioactive components will decrease or even disappear when cooked at high temperatures. That way, to find out the compounds contained in galangal seasoning, testing is carried out using the GC-MS method.

Shredded fish is a delicious and popular food in many countries, especially in Southeast Asia. Shredded fish meat is made from processed fish meat until dry, then crushed into fibrous products. Shredded fish have a distinctive crispy texture and high nutritional content. This snack made from fish has many flavor variants and can be eaten directly or used as an ingredient for other dishes. The addition of galangal seasoning to shredded fish is suspected to have a different effect on the taste and aroma of the product. Galangal, as a typical Indonesian spice, has fresh taste characteristics and a distinctive aroma, which can increase the complexity of the taste of shredded fish and provide the traditional touch desired by consumers (Sartika *et al*., 2023a). In addition, galangal seasoning can also have potential antimicrobial properties. Adding galangal to shredded fish can be an interesting strategy in enriching the added value of the product and increasing competitiveness in the market. Further research related to this needs to be done empirically to confirm the effect of galangal addition on the sensory quality of galangal shreds.

The effect of galangal addition on sensory characteristics in galangal shredded fish is not yet known so it needs to be further researched because the addition of spices can affect the taste of the product. In addition, the calculation of the financial feasibility analysis of galangal shredded fish products with the addition of various galangal concentrations is also unknown. The calculation of this feasibility analysis is quite important for a new business as information on whether a business is feasible or not (Sartika *et al*., 2023b). Therefore, this study aims to determine the bioactive components in galangal powder seasoning, determine the best concentration of galangal addition into shredded fish products through sensory tests, and determine the financial feasibility of shredded fish products with the addition of powdered galangal.

2. RESEARCH METHODS

2.1. Materials and Tools

The main materials included tilapia purchased from fresh fish sellers in Bangunrejo area, while galangal was obtained from farmers in Gerning Village, Tegineneng District, Pesawaran Regency. The tools used for the analysis of bioactive components of galangal spice with GC-MS were analytical scale, mortar and stamper, measuring cups, beaker glass, hot plate, test tubes, test tube rack, pH meter, spoon, alcohol thermometer, parchment paper, filter paper, aluminum foil, label paper, stirring rod, maceration tools (maceration vessel, bushner funnel, filter paper, waterbath). The tools used in making shredded fish included pan, spatula, gas stove, kitchen knives, meat blender, as well as packaging tools such as jars and plastic bags.

2.2. Research Location

The location of the research was carried out on IDAEZ Group MSME in Sukarame, Bandar Lampung, where galangal shredded fish products were manufactured. Analytical test was carried out at the Agricultural Product Analysis Laboratory of the Department of Agricultural Product Technology, Faculty of Agriculture, University of Lampung.

2.3. Procedure for Making Galangal Shredded Fish

Research on making galangal fish shredded was carried out in two stages. In the first stage, the manufacture of galangal spices began with the sorting process of galangal rhizomes. Next, the galangal was then washed with clean running water. The clean galangal rhizomes were chopped and continued with drying under the sunrise for 3 days. Finally, the dried galangal sample was then ground using a grinder and sieved using a 60 mesh and 80 mesh screens to obtain galangal fine powder and stored in a tightly closed container.

The second stage of galangal fish shredded production was started by preparing tilapia fillet meat that has been cleaned of thorns and innards. Next, the tilapia meat was steamed until cooked and soft. The cooked meat was then shredded and ready to be seasoned with galangal spices. The mixing of galangal spices was done at a concentration of 1%, 2%, and 3% and then cooked under low heat until the shredded fish completely, evenly cooked.

2.4. Test Parameters

The galangal powder was tested for bioactive components using GC-MS. In addition, a sensory test was conducted on shredded galangal fish product with galangal spices concentrations of 1%, 2%, and 3%. Finally, a financial feasibility analysis calculation on the product was performed.

2.4.1. GC-MS Analysis

Identification of chemical compounds in galangal extract was carried out using GC-MS (QP2010S SHIMADZU). Each peak that appears is a type of compound. The sample was injected into the column. Helium was used as a carrier gas with a flow rate of 1 ml/min, the injector was operated at 200°C and the oven column temperature was programmed at 50-250°C with a heating rate of 10°C/min injection mode. The MS conditions used an ionization voltage of 70 Ev, an ion source temperature at 250°C, and a mass range of 50-600 (Hartati *et al*., 2024).

2.4.2. Sensory Test

The sensory test of galangal shredded fish was carried out on several parameters, including aroma, taste, texture, color and overall acceptance. Sensory testing was carried out by 10 trained panelists. Sensory testing used scoring tests on aroma, taste, color and texture parameters, while overall acceptance used hedonic tests. Analysis of variance and homogeneity from Barlett was performed to process sensory and overall acceptance data. Further analysis was conducted with honestly significant difference (HSD) test at a 5% level.

2.4.3. Financial Feasibility Analysis

The initial step in conducting a financial feasibility analysis was to calculate the income analysis. Additionally, a break-even point analysis (BEP) and revenue cost ratio (R/C) analysis were performed to assess the viability of a business. Profit is the difference between revenue and production costs. Profit analysis serve as a useful indicator of the success level of a product and a reference point for future planning. The profit π can be calculated from total revenue *TR* (IDR) and total cost *TC* (IDR) according to the following relation (Bana, 2018):

$$\pi = TR - TC \tag{1}$$

2.4.4. Break-Even Point (BEP)

BEP (break even point) is a way to identify whether an economic activity is experiencing losses or profits (Thoriq *et al*., 2017). The BEP was calculated through the following formula (Asnidar & Asrida, 2017):

$$\text{Production BEP} = \frac{Total\ Cost}{Selling\ Price} \tag{2}$$

$$\text{BEP price} = \frac{Total\ cost}{Total\ production} \tag{3}$$

2.4.5. Revenue Cost Ratio (R/C)

The revenue-cost ratio (R/C) is a form of information from the comparison between revenue and costs. A good enterprise must have a greater revenue than the total cost. The R/C formula was as follows Sidabutar *et al*., (2018).

$$R/C = \frac{TR}{TC} \tag{4}$$

A business is profitable with R/C > 1, means, breaks even at R/C = 1, and loss at R/C < 1.

3. RESULTS AND DISCUSSION

3.1. GC-MS Reading Results of Refined Galangal Spice

Through extraction and analysis methods using chromatography or spectroscopic techniques, various bioactive components in galangal spice have been identified, including alkaloids, flavonoids, phenolic compounds, and others. The chromatogram of fine galangal spice is presented in Figure 1. The chemical compounds identified or obtained are presented in Figure 2. In the results of the TIC report (Figure 2) with an area of 1.35% and a weight of 3.39%, it is 5-. Eicoseene, (E)- 5-Eicoseene, (E)- is an organic compound belonging to the class of alkene compounds. 5-Eicosenen, (E)-, has certain biological activities, such as antioxidant or anti-inflammatory potential (Sartika *et al*., 2019). Furthermore, n-Hexadecanoic acid is a saturated fatty acid with the molecular formula $C_{16}H_{32}O_2$. N-hexadecanoic acid is also known as palmitic acid. Palmitic acid plays an important role in lipid metabolism and is one of the main

constituents of cell membranes. Palmitic acid has been commonly used in various industries, including the food and cosmetic industries as a raw material for the manufacture of soaps, creams, lotions, and other skincare products (Sartika *et al*., 2020a).

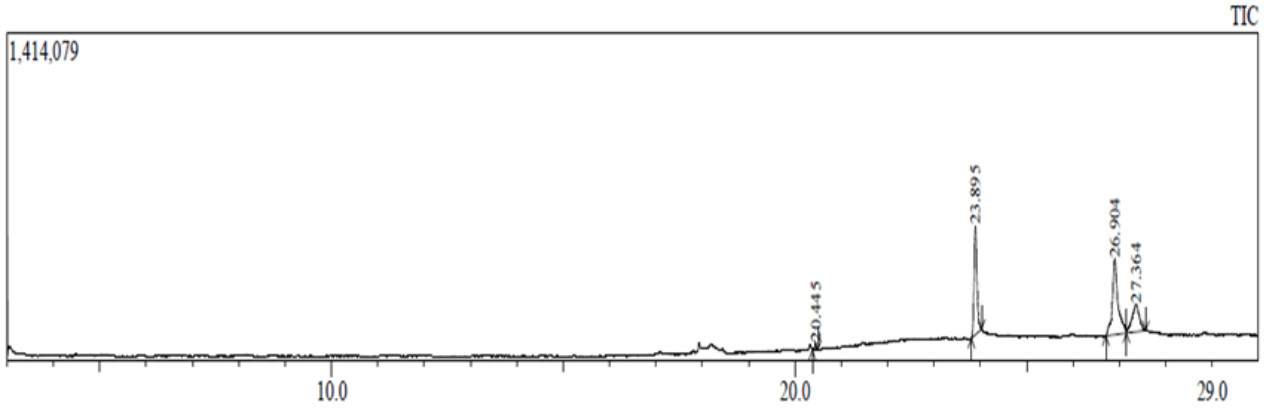

Figure 1. GC-MS Reading Results.

Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height	Height%	Name
1	20.445	20.375	20.490	83123	1.35	32206	3.39	5-Eicosene, (E)-
2	23.895	23.805	24.030	2033795	32.94	468481	49.35	n-Hexadecanoic acid
3	26.904	26.710	27.155	2754290	44.62	326696	34.42	Oleic Acid
4	27.364	27.155	27.570	1302199	21.09	121842	12.84	9-Octadecenoic acid (Z)-, oxiranylmethyl ester
				6173407	100.00	949225	100.00	

Figure 2. Dominant structure in galangal spice

Also, oleic acid as a type of monounsaturated fatty acid known as the molecular formula $C_{18}H_{34}O_2$. Oleic acid provides a distinctive aroma and taste to a variety of foods and beverages. Oleic acid is used in a variety of industries, including the food, cosmetics, and pharmaceutical industries. It is used as a raw material for the manufacture of soaps, creams, lotions, dietary supplements, and other beauty products. Finally, 9-Octadecenoic acid (Z)-, an oxiranylmethyl ester, is also known as epoxy oleate or oleyl epoxy ester. Although information on its potential biological activity is limited, it may have potential in a variety of biological and pharmaceutical applications by taking advantage of its properties. These compounds can be used in various industries, including the chemical, pharmaceutical, and cosmetic industries, as raw materials or additives in various products (Sartika *et al*., 2019).

3.2. Sensory Test

Sensory assessments provide an overview of consumer acceptance of the product. The data obtained from this assessment was analyzed using the statistical method of variety analysis and further test of HSD. Data processing was carried out to determine whether the addition of galangal spices provided a significant difference in the sensory attributes of shredded fish (Utami *et al*., 2023).

3.2.1. Aroma

The results of the HSD test (Table 1) show that the concentration of adding galangal spices has a real effect on the aroma of shredded fish. The concentration of galangal spice in fish shredded treatment P1 (galangal spice concentration 1%) was not significantly different from P2 (galangal spice concentration 2%), but was significantly different from other treatments, namely P3 (galangal spice concentration 3%). So then the treatment of P1 (1% concentration of galangal

spice) to P3 (3% concentration of galangal spice) showed a very different difference with a difference of 1.1 with $HSD_{0.05}$ = 0.85. the aroma of spice fish that showed a very desirable result was in the P3 treatment (3% concentration of galangal spice) with a value of 3.86±1.1 (typical of galangal). The results of this observation are based on information from Sartika *et al*. (2024), that the more spices are added, the stronger the aroma that appears on the product. The appearance of this aroma is also due to the softening of the spices during the cooking process so that the essential oils (volatile compounds) present in the spices come out and react with the product. In fine galangal seasoning, based on GCMS analysis, it is known to contain around oleic acid (44.62%), where oleic acid gives a distinctive aroma and taste to various foods and beverages (Sartika *et al*., 2020b).

Table 1. Effect of different galangal concentrations on the aroma of galangal shredded based on HSD test results.

Galangal Seasoning Concentration	Average
P3 (3%)	$3.86±1.1^{A}$
P2 (2%)	$3.06±0.8^{A}$
P1 (1%)	$2.76±0.3^{ab}$

Remarks: Values followed by the same letter have no real meaning. The score was (1) very unusual galangal, (2) not typical galangal, (3) somewhat typical galangal, (4) typical galangal, (5) very typical galangal. $HSD_{0.05}$= 0.85

3.2.2. Taste

The results of the HSD test of the taste of galangal fish shredded in (Table 2) the concentration of galangal spices given to fish shredded has a real effect on the taste of fish shreds. The concentration of adding galangal spice to shredded fish treated P2 (galangal spice concentration 2%) was not significantly different from P1 (galangal spice concentration 1%) and there was a significant difference between P2 (galangal spice concentration 2%) and P3 (galangal spice concentration 3%). The panelists assessed that the most preferred reception in taste points was at the concentration of P3 (3% galangal spice concentration) with a value of 4.92±1.5 (typical galangal / very typical galangal). The results of these observations are in accordancewith information from Sartika *et al*. (2024), that the addition of spices is able to provide a distinctive taste so as to add to the deliciousness of galangal shredded fish products.

Table 2. The Effect of Different Galangal Concentrations on the Taste of Galangal Shredded Fish Based on HSD Test Results.

Galangal Seasoning Concentration	Average
P3 (3%	$4.92±1.5^{A}$
P1 (1%)	$3.82±1.1^{b}$
P2 (2%)	$3.42±0.4^{b}$

Remarks: Values followed by the same letter have no real meaning. The score was (1) very unusual galangal, (2) not typical galangal, (3) somewhat typical galangal, (4) typical galangal, (5) very typical galangal. $HSD_{0.05}$= 0.72

Table 3. Effect of different galangal concentrations on the color of galangal shredded fish based on HSD test results.

Galangal Seasoning Concentration	Average
P1 (1%)	$4.57±0^{A}$
P2 (2%)	$4.57±0.1^{A}$
P3 (3%)	$4.47±0.1^{A}$

Remarks: Values followed by the same letter have no real meaning. The score is (1) white, (2) yellowish white, (3) yellow, (4) golden yellow, (5) golden. $HSD_{0.05}$= 0.87

3.2.3. Color

The results of the HSD test of the color of galangal fish shredded fish in (Table 3) the concentration of galangal spices given to fish shredded had no real effect on the color of the fish shredded. The concentration of adding galangal spice to shredded fish treatment P1 (galangal spice concentration 1%) was not significantly different from P2 (galangal spice concentration 2%) and the comparison was also not much different between P1 (galangal spice concentration 1%) and

P3 (galangal spice concentration 3%). But in essence, between P1, P2, and P3 show the same results, namely no real difference. The panelists assessed that the most preferred reception in color points was at the concentration of P1 (1% concentration of galangal spice) with a value of 4.57±0 (golden yellow). The absence of the effect of adding galangal on the color of galangal fish shredded products is caused by a change in color, not by galangal spices. Based on information from Sartika *et al*. (2024), the golden yellow color in Shredded galangal fish is caused by the addition of turmeric spices and the roasting process in the fish meat will trigger a Maillard reaction. Roasting will produce a golden brown color due to the reaction between fish protein and reduced sugar from the sugar hydroxyl group (Yuliani *et al*., 2021).

3.2.4. Texture

The results of the HSD test of the texture of galangal fish shredded fish in (Table 4) The concentration of galangal spices given to fish shredded fish had no real effect on the texture of the fish shredded. The concentration of adding galangal spice to fish shredded treatment P2 (galangal spice concentration 2%) was not significantly different from P1 (galangal spice concentration 1%) and the comparison was also not much different between P1 (galangal spice concentration 1%) and P3 (galangal spice concentration 3%). But in essence, between P1, P2 and P3 show the same results, namely no real difference. The panelists assessed that the most preferred acceptance in texture points was at P3 (3% galangal spice concentration) with a value of 3.68±0.5 (fibrous). The addition of galangal spices actually has no effect on the texture of galangal shredded fish. This is because the texture formed in shredded fish is influenced by the roasting process carried out and the nutritional content of the raw materials (protein, fat, carbohydrates) so that the addition of spices will not affect the texture of the product (Sartika *et al*., 2024). Generally, the texture of shredded meat will be shaped like fine fibers because during the roasting process, the water content in the meat will come out and cause the texture of the meat to wrinkle and then dry out (Sinambela *et al*., 2020).

Table 4. Effect of Different Galangal Concentrations on the Texture of Galangal Shredded Fish Based on HSD Test Results.

Galangal Seasoning Concentration	Average
P3 (3%)	3.68 ± 0.5^{A}
P1 (1%)	3.58 ± 0.1^{A}
P2 (2%)	3.18 ± 0.4^{A}

Remarks: Values followed by the same letter have no real meaning. The scores are (1) very fibrous, (2) non-fibrous, (3) somewhat fibrous, (4) fibrous, (5) very fibrous. $HSD_{0.05}$= 1.18

Table 5. Overall acceptance of galangal shredded fish based on the results of the HSD test.

Galangal Seasoning Concentration	Average
P3 (3%)	4.93 ± 1.9^{A}
P2 (2%)	3.23 ± 1.7^{b}
P1 (1%)	3.03 ± 0.2^{b}

Remarks: Values followed by the same letter have no real meaning. The score is (1) very disliked, (2) disliked, (3) slightly liked, (4) liked, (5) strongly liked. $HSD_{0.05}$= 0.63

3.2.5. Overall Acceptance

Overall acceptance shows consumer assessment of product acceptance (Chori *et al*., 2023). HSD Test Results from overall receipts Kalal shredded fish in (Table 5) The concentration of galangal spices applied to shredded fish has a real effect on the overall acceptance of shredded fish. The concentration of adding galangal spice to shredded fish treated P1 (galangal spice concentration 1%) was not significantly different from P2 (galangal spice concentration 2%) and there was a significant difference between P1 (galangal spice concentration 1%) and P3 (galangal spice concentration 3%). However, in essence, P1 and P2 show the same results, namely no real difference, while between P1 and P3 there is a real difference. Likewise, between P2 and P3 showed real different results. The panelists assessed that the most preferred reception in overall acceptance was in the P3 concentration (3% galangal spice concentration) with a score of 4.93±1.9

(like). The best overall acceptance in treatment 3 was with a concentration of 3% or more than the others, this also supported the previous results of aroma and taste because taste and aroma got the best results in treatment 3 as well which was 3%.

3.3. Financial Feasibility Analysis

3.3.1. Fixed Fees

The cost will definitely remain large and small even if the capacity during production changes. Fixed costs are affected by depreciation charged to asset costs (Septiawan *et al*., 2017). The amount of depreciation costs of the tool is obtained from the calculation results. The results of the calculation of the depreciation cost of the tool in processing galangal shredded fish were found to be IDR 80,032. A breakdown of fixed costs can be seen in Table 6.

Table 6. Data on the fixed cost of processing galangal shredded fish.

Equipment	Quantity (units)	Initial Value (IDR)	Final Value (IDR)	Economic Life (years)	Depreciation (IDR/year)
Digital scales	1	24,000	2,400	5	4,320
Washbasin	2	24,000	2,400	5	4,320
Wok	2	100,000	10,000	5	18,000
Knife	2	20,000	2,000	5	3,600
Stove	1	300,000	30,000	10	27,000
Plate	5	20,000	2,000	5	3,600
Chopper	1	53,000	5,300	8	5,962
Spatula	2	24,000	2,400	5	4,320
Measuring cup 500 ml	1	5,000	500	5	1,080
Pot	1	60,000	6,000	8	6,750
Spoon	3	6,000	600	5	1,080
Total Investment		**636,000**	**63,600**		**80,032**

3.3.2. Variable Costs

Costs will change when there is a change in capacity during the production process (Septiawan *et al*., 2017). Variable costs consist of the cost of main raw materials including the cost of purchasing tilapia fish of IDR 50,000 per production, various spices of IDR 2,000 per production, galangal of IDR 15, coconut milk of IDR 6,500 per production. The description of the variable costs used in making galangal shredded fish is seen in Table 7.

Table 7. Data on variable costs of processing galangal shredded fish.

Description	Quantity/production	Price (IDR)
Variable Cost:		
- Tilapia	2 kg	50,000
- Spices		2,000
- Galangal	2 g	15
- Coconut milk	130 ml	6,500
- Packaging and Labels	1 pack	21,000
- Gas	1 tube	18,000
Total Variable Costs		**97,515**

3.3.3. Total Production Costs

The total production cost of a business consists of fixed and variable costs. Every business must have its own total cost, and the size of the total cost is based on the amount of fixed costs and variable costs. In making galangal shreds, the fixed cost obtained is IDR 80,032 and variable costs are IDR 97,515. The total cost is obtained simply by adding fixed cost and variable cost, which will be IDR 177,547.

3.3.4. Revenue Analysis

In the manufacture of galangal shredded fish using tilapia, 2 kg of tilapia produces 10 pieces of galangal shredded fish, each weighing 150 grams. The per-production income, which is the difference between the revenue and the total cost of producing galangal shredded fish, can be observed in Table 8. The income or profit obtained in the production of galangal shredded fish is IDR 427,547 per batch production.

Table 8. Data on Galangal Shredded Fish Processing Revenue.

Description	Quantity	Unit Price (IDR)	Price (IDR)
Production	10 (150 g)	25,000	250,000
Total Cost			177,547
Income			**427,547**

3.3.5. Break Even Point (BEP)

The BEP is the point at which a company neither makes a profit nor incurs a loss. The calculation of the break-even point for galangal shredded fish production follows formula (2). The results show that the break-even point occurs when 7 pieces of galangal shredded fish are produced. Additionally, the calculation of the price BEP for galangal shredded fish products follows formula (3). According to the calculation results, the galangal shredded fish business must sell 7 pieces at a price of IDR 17,000 to break even. The production BEP value indicates the minimum production level required to avoid losses, while the price BEP value indicates the minimum selling price that must be achieved (Darmilayanti *et al*., 2020). This business can be considered profitable if the production BEP and price BEP are lower than the actual production amount and selling price of the product.

3.3.6. R/C Ratio Analysis

The Revenue Cost Ratio (R/C) is a feasibility analysis that compares total revenue with total expenses. The calculation of the R/C for galangal shredded fish production follows formula (4). The resulting value was 1.40. When the R/C ratio is greater than 1, the business is considered profitable or feasible. With an R/C ratio of 1.40, the galangal shredded fish business is profitable, indicating that for every IDR 100 spent, the business generates IDR 140 in revenue. Compared to the feasibility analysis of catfish shredded products—a freshwater fish priced similarly to tilapia but cheaper—the R/C ratio for galangal shredded fish remains competitive. According to Riani (2023), the R/C ratio for catfish shredded products is 1.46.

4. CONCLUSION

Conclusion of this study

1. Based on the results of the GC-MS test, the dominant bioactive compounds in galangal fine spices are 5-Eicosenen, (E)-, n-Hexadecanoic acid, oleic acid, and 9-Octadecenoic acid (Z)-, oxiranylmethyl ester.
2. The results of sensory testing showed that panelists preferred shredded fish with the addition of finely seasoned galangal at a concentration of 3%. The resulting galangal shredded fish has a distinctive galangal aroma, a very distinctive galangal taste, a golden yellow color, and a slightly fibrous texture.
3. The financial feasibility analysis indicates that the galangal shredded fish business is feasible and profitable. Revenue analysis showed a profit of IDR 427,547. The Break Even Point (BEP) test revealed that the business must sell 7 pieces of the product at a price of IDR 17,000 to break even. Additionally, the Revenue Cost Ratio (R/C) analysis resulted in a value of 1.40, which is greater than 1, indicating that the business is profitable.

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