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MORALITY BEFORE KNOWLEDGE

Fortification of local fruit *parijoto* on soy yogurt drink and economy analysis

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ABSTRACT

Background: The food and beverage industry is a leading industry that is the government's focus in the Industrial Revolution 4.0. Culinary is the most popular economic sub-sector.. As a food product from biotechnology, yoghurt always manages to occupy a global market share. Yoghurt is proven to maintain the digestive system. Therefore innovation is needed, especially regarding materials, to boost product competitiveness. Animal milk substrate can be substituted with soy milk which is cheap but rich in protein. The addition of natural fortification is projected to improve product quality. Parijoto fruit (*Medinilla speciosa*) typical of the slopes of Mount Muria, Colo Village, Kudus Regency, Indonesia was chosen as a fortificant because it is rich in antioxidants and antibacterial pathogens. At the same time, this adds to the usability and economic value of Parijoto, which is still low so far. **Method:** The research was conducted experimentally, referring to previous research methods. The formulation design was varied regarding adding Parijoto fruit extract to 100 ml of the product. **Findings:** From the results of the organoleptic test, the F1 formula (addition of 5 ml of Parijoto fruit extract) received the best acceptance from the panellists, with a preference level of 4.89. The product characteristics are liquid texture, alcoholic sweet taste, cream colour, and the aroma of Parijoto fruit tends to be faint. **Conclusion:**Parijoto Yogurt has advantages in terms of locality, price and nutrition. However, further research is needed based on more collaboration to increase this product's health and economic impact on local society. **Novelty/Originality of this article:** This study creates new functional food products and opens up opportunities to revitalize local economies and conserve biodiversity.

KEYWORDS: food technology; local fruit; medinilla speciosa; soy yoghurt; yoghurt drink; yoghurt fortificant

1. Introduction

Gastrointestinal disorders are the primary source of the emergence of various diseases; these disorders occur in the abdominal organs. The stomach is a susceptible organ, and it is necessary to regulate an ideal diet to prevent health problems (Salim, 2012). People's unhealthy eating habits cause gastrointestinal disorders. Thus, many cases of health problems originate from the digestive system. For example, the incidence of acute diarrhea in Indonesia is estimated at around 60 million cases yearly (Maryanti et al., 2014). Diarrhoea also accounts for 42% of infant deaths and 25.2% of children aged 1-4 (toddlers) (Yusuf, 2011). From these crucial problems, we need a food supplement that can improve the performance of the digestive system. One of the growing food supplements today is yoghurt. Consuming yoghurt has benefits, including fighting the growth of pathogenic

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bacteria in the digestive tract, protecting the stomach, and reducing the amount of cholesterol in the blood (Ramadhan, 2022).

Yoghurt is milk fermented by probiotic lactic acid bacteria (LAB). According to Shori & Baba (2014), supplementing probiotic bacteria in the daily diet is the best way to balance the beneficial microbial population in the gut and optimize the performance of organs and glands in the digestive system. The recommendation for yoghurt consumption for normal adults is 100 grams/day (109 probiotic cells/day); for pregnant women, 250 ml/day; and for children, 200 ml/day (Santoso, 2016). Unfortunately, the price of yoghurt on the market is quite high for the lower middle class, with a range of IDR 7000.00 - 10000.00 per 200 ml. This causes the majority of people only to consume yoghurt once a week or even not consume it at all. Products circulating in the market do not use local ingredients and often use foreign taglines. There are many potential local natural ingredients, such as yoghurt compositions. The resulting product is projected to be of higher quality and able to reduce selling prices.

In order to achieve these conditions, the government and local communities must strive to develop creative ideas based on local wisdom. The trick is to present new products typical of the region or combine products already on the market by adding local aspects/accents. As a functional food product, yoghurt always responds well in the global market. This is due to the increasing healthy lifestyle of people, especially those living in urban areas. The interest of ordinary people (non-urban) towards yoghurt is also projected to increase.

Yoghurt production with different substrates fortified with local natural ingredients will provide superior yoghurt in the national market. The government no longer needs to import yoghurt, and the regional economy is increasingly stimulated. Marketed yoghurt can also have a lower selling price despite better quality. Currently, the majority of yoghurt is made from animal milk. The transfer of these essential materials (substrates) may be exciting, especially if substitutes are abundant in the regions. Soy milk, which results from processed local soybean crops, can be used. Soy milk is potentially a yoghurt substrate because its carbohydrate content is 16% higher than cow's milk. The resulting product is called Soy yoghurt. This is supported by soybean production in Indonesia, which has increased yearly. According to the Central Statistics Agency for 2018, Central Java province experienced an increase in 2017-2018 by 23.66%, while soybean production in Indonesia increased in 2017-2018 by 82.39% (Ministry of Agriculture Indonesia, 2018). So that changing the yoghurt substrate from cow's milk to soy milk is a promising breakthrough; apart from being a variant of processed biotechnology products, it can also help soybean farmers in the future. Soy milk is also superior in protein, with levels 1.5 times higher than cow's milk (Nirmagustina & Wirawati, 2014). The fat content is influenced by the condition of the initial fat content of the milk before fermentation. Sunarlim & Setiyanto (2001) stated that cow's milk has a denser fat content. According to Purwantiningsih et al. (2022), high fat content in yoghurt will affect the total solids which makes the yoghurt thicker.Based on the research results of Kilara & Chandan (2013), the protein content contained in Greek yoghurt is 8.69%, while in the research of Costa et al. (2019) the protein percentage in Greek yoghurt ranges from 6.4-6.8%. Soy milk on the market is also cheaper when compared to cow's milk. Therefore, the innovation of processed yoghurt from soy milk will have a much more significant economic impact when compared to cow's milk. Soy yoghurt have been researched used soy yoghurt (100%) (Mehaya et al., 2023; Almghawesh et al., 2022; Kong et al., 2022).

In order to increase the added value, it is necessary to fortify it with other natural materials. Parijoto, a typical plant on the slopes of Mount Muria in Colo Village, Dawe, Kudus Regency, Indonesia can be a choice of fortification. The plant, which has the Latin name *Medinilla speciosa*, blume fruit, is often used for its fruit. Parijoto's current economic value is derived from its popularity in supporting female fertility or pregnancy. As for several other local community groups, they usually consume Parijoto fruit as a medicine for diarrhoea and canker sores. The majority use of Parijoto fruit is by consuming it orally, even though it tastes sour-astringent (Wibowo et al., 2012). Based on the background that has

been described, the following research problems arise: 1. What is the effect of the formulation of adding parijoto fruit extract as a food additive to soy yogurt? 2. Is this innovation economically feasible?

Therefore the selling price of this fruit is still relatively low. Recent research states that the sour-acidic taste comes from the high levels of beneficial secondary metabolites with pathogenic antibacterial activity (Niswah, 2014). The greater the total lactic acid, the lower the pH value in yoghurt (Savitry et al., 2017). Therefore, Parijoto fruit is considered relevant as a yoghurt fortifier that supports the anti-pathogenic bacteria resistance function in the digestive tract. Making yoghurt by replacing the soy milk substrate and fortifying Parijoto fruit is an effort to support the 12th SDGS program, namely sustainable consumption and production patterns. This is because the substrate and fortification come from nature, which has abundant sources in Indonesia, so people can produce and consume it continuously. Making Soy yoghurt also doesn't damage the surrounding environment because soybeans and Parijoto are easy to cultivate, and of course, everyone can cultivate them without requiring large areas of land.

The development of soy yogurt fortified with parijoto fruit not only holds great potential in terms of health and economic benefits but also contributes to environmental sustainability. Soybeans, as the main ingredient, are relatively easy to cultivate and demonstrate higher land-use efficiency compared to dairy production. This aligns with global efforts to reduce the carbon footprint within the food industry. On the other hand, the utilization of parijoto fruit as a fortification ingredient not only enhances the nutritional value of the product but also promotes the conservation of Indonesia’s endemic plants. Thus, this innovation serves as an example of how functional food products can be developed while considering local and ecological sustainability aspects.

Furthermore, the development of soy yogurt fortified with parijoto fruit also creates opportunities for local economic empowerment, particularly for soybean farmers and parijoto fruit gatherers. Through partnerships between yogurt producers and local farmers or gatherers, a more equitable and sustainable value chain can be established. This will not only increase rural community income but also encourage economic diversification in areas that may have been overly dependent on traditional agricultural sectors. Additionally, this product innovation has the potential to serve as a catalyst for the development of ecotourism in the region where the parijoto fruit originates, namely Mount Muria, which in turn can enhance the well-being of the local community through sustainable tourism.

The research aims to obtain a yoghurt formulation with the addition of parijoto fruit extract and economic business possibilities. The purpose of this research is to provide information on the potential of local wisdom of parijoto fruit which contains antioxidant activity, and innovation of Soy yoghurt with the addition of parijoto fruit fortification. The addition of parijoto fruit extract to yoghurt, apart from functioning as a natural antioxidant, is also an effort to increase the selling value of parijoto fruit. It is hoped that this research can contribute to the development of yoghurt products, especially as functional food innovation products and yoghurt diversification.

2. Methods

The research consisted of several stages of writing to gather information and data regarding the potential of Soy yoghurt as an innovation for Parijoto fortified yoghurt through the penta helix strategy. These stages modified with previous research concepts (Afonso et al., 2012) include: a. Observing the problem is necessary for overcoming gastrointestinal disorders by making innovative yoghurt b. There is local potential, namely soybeans and parijoto (*Medinilla speciosa*), which have yet to be utilized optimally. c. Determine the library collection technique to be used. d. Conduct literature analysis. e. Making suggestions or recommendations. The author uses a data source in the form of literature in electronic form, which is related to the purpose and object of writing. Electronic literature in the form of credible journals, proceedings and books.

The data collection technique in writing this research is a document analysis technique and mini design for experimenting. The author collects data from various sources, both journals and electronic literature, supporting this research's purpose. Analysis of documents and data from the relevant sources was carried out to conclude results and provide suggestions. Data analysis was carried out, among other things, in a descriptive-qualitative way, which was carried out on data within a certain period, namely when data collection took place and after collection.

In this research, selecting, processing and focusing on the discussion of the data supports the framework of thinking about the biotechnology potential of Parijoto fortified soy yoghurt. Referring to the research of Kartikasari & Nisa (2014), the average organoleptic test result data was taken for each assessment factor and then presented in graphical form. From the graph, it can be determined whether the effect of differences in the concentration of parijoto fruit extract in the composition of soygurt is significant. It is hoped that there will be 1 formula that has the best level of acceptance by the majority of panelists.

The tools used in this research include: blender, dropper pipette, plastic measuring cup, analytical balance, spoon, pan, electric stove, filter, bottle (yoghurt container), plastic container (basin), thermometer, refrigerator, and Closed food cupboard/shelf. The ingredients used in the composition of *Medinilla speciosa* Soygurt are: fresh soy milk, ripe parijoto fruit (taken from Colo village, Kudus Regency), natural honey, Heavenly Blush brand plain yoghurt, and mineral water.

3. Results and Discussion

3.1 Fortified soy yogurt concept

Yoghurt is a biotechnology product made from milk through a fermentation process by lactic acid bacteria. Lactic acid bacteria used in yoghurt products are *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. The distinctive aroma of yoghurt is caused by the presence of lactic acid, acetaldehyde and other volatile compounds produced by the starter culture as a result of fermentation (Arifin et al., 2020). Yoghurt is very good for health, especially for maintaining stomach acidity and suppressing the growth of pathogenic bacteria in the intestine. The basis for making yoghurt, in general, is to use milk-based ingredients, which are added with food flavourings to make the taste of the yoghurt produced more delicious (Bankole et al., 2023). Prebiotics are food components that cannot be digested by the human digestive tract enzymatically so they will be fermented by the microflora in the large intestine (Cahyaningtyas & Wikandari, 2022).

The growth of the dairy market is in line with the demands and needs of urban communities in Indonesia. Even a healthy lifestyle has now become a lifestyle. According to data from Fonterra Brands Indonesia, 97.8% of urban families stated that they buy milk and its derivatives in their daily shopping within a year. This indicates that Indonesia is a prospective market for marketing milk and its processed products as healthful products (Bisnis UKM, 2016). On the other hand, the Central Agency of Statistics states that Indonesia's dependence on imported milk and its derivatives is still very high. One of the causes of this is the increasing consumption of yoghurt products since 2004. The Ministry of Industry 2009 confirmed that the great interest of the Indonesian people in yoghurt can be seen through national yoghurt import data of 734,985 kg (Indonesiana, 2017).

BPOM Indonesia then intervened in 2017 by launching the Food Safety Movement. This program supports SMEs and local industries to innovate in presenting healthy food products, including yoghurt (Indonesiana, 2017). The positive effect of yoghurt import figures can be suppressed. That is why the domestic yoghurt industry has to look for alternative yoghurt variants that are more nutritious and have a unique taste. According to Tamime & Robinson (2007), there are two types of yogurt in terms of preparation, namely yogurt drink and yogurt stir. Meanwhile, in terms of taste, it is categorized into three, namely plain yogurt, yogurt with added fruit, and yogurt with added flavors. One extract

that can be added is red fruit extract. This innovation will be realized by utilizing local materials as substrates and fortifications.

Soy yogurt is a fermented soy milk food product. In general, yoghurt is produced from cow's milk, but the fact is that soy milk contains 16% carbohydrates, so it can be an alternative to making yoghurt (Nirmagustina & Wirawati, 2014). Soy milk is also superior in protein content because it is 1.5 times higher. However, soy milk contains off flavour, in the form of beany flavour, which is less desirable. Fermentation of soy milk into Soy yoghurt is an effort that has been proven to increase the nutritional value and improve the acceptability of soy milk (Chumchuere & Robinson, 1999). Lactic acid bacteria (LAB) fermentation activity on legume milk substrates which could increase lactic acid levels and dissolved protein levels in the substrate. The lactic acid in the substrate will give flavour to the nut milk, while the dissolved protein content can increase the nutritional value of the nut milk. Both yoghurt and soy yoghurt can maintain the digestive system with a similar mechanism. LAB from the genus *Bifidobacterium, Lactobacillus,* and several *Streptococcus* strains can reduce the accumulation of pathogenic bacteria in the intestine by suppressing their metabolic activity (Caleja et al., 2015). This indicates that Soy yoghurt is also helpful in overcoming the problem of diarrhoea, lactose intolerance, cancer and inflammation of the intestine, as well as a decrease in the immune system due to gastrointestinal disorders.

Parijoto (*Medinilla speciosa*) is a medicinal plant as a shrub that grows wild on mountain slopes or in forests (Figure 1). This typical plant of Colo village, Dawe District, Kudus Regency (slope of Mount Muria) can grow on high humus and moist soil at an altitude of 800-2,300m above sea level. This plant bears fruit in March-May. The part that is used as medicine is the fruit. The morphology of the Parijoto fruit is a round bun with a diameter of 5-8 mm, protruding ends, purplish-red colour with a slightly astringent sour taste (Wachidah, 2013).

Fig. 1. *Medinilla speciosa*

According to Wachidah (2013) in Table 1, parijoto extract is active as an antioxidant with IC50 in the ethyl acetate fraction of 20.34 µg/mL, the methanol fraction is 46.65 µg/mL, and the crude extract is 48.24 µg/mL. Syairna et al., (2015) stated that 5% parijoto fruit extract proved to have bacteriostatic abilities with an inhibition zone diameter of 14.7mm in *E. coli* and 18.5mm in *S. aureus*. The diameter of the inhibition zone is relatively high. Meanwhile, research by Laraswati & Sugiarti (2017) showed that hand sanitizer gel preparations enriched with 5% Parijoto extract effectively reduced bacterial colonies by up to 53%.

In addition, the bioactive compounds contained in the parijoto fruit, such as flavonoids and tannins, exhibit significant potential for pharmaceutical and cosmetic applications. According to Wachidah (2013), flavonoids possess strong antioxidant capacity, functioning to neutralize free radicals and protect cells from oxidative damage, which is one of the leading causes of degenerative diseases such as cancer and cardiovascular diseases. Tannins, found in high concentrations in parijoto extracts, also have anti-inflammatory and

astringent properties, making them suitable for application in skincare products to reduce irritation and inflammation. This presents substantial opportunities for the pharmaceutical and cosmetic industries to develop products that combine health and beauty benefits based on natural parijoto ingredients.

Beyond pharmaceutical and cosmetic applications, the potential of parijoto can also be further explored within the functional food industry. Its high antioxidant content makes this fruit highly suitable for use in food and beverage products that promote health. For instance, the development of probiotic beverages based on soy yogurt fortified with parijoto could offer dual benefits: improving digestive health while providing antioxidant protection to consumers. With the growing global awareness of the importance of consuming natural and healthy products, parijoto holds promising prospects as a key ingredient in innovative and high-value functional food products.

Table 1. Results of phytochemical screening of parijoto fruit

No	Secondary Metabolite	Extract	Faction		
			n-heksana	Etil-asetat	Methanol
1	Saponin	++	-	+	+
2	Glikosida	+	-	+	++
3	Flavonoid	++	-	++	++
4	Tanin	+++	-	+++	+++

(Wachidah, 2013)

3.2 Excellence of soy milk and parijoto fruit as a yogurt composition

Based on Table 2. Soy milk is rich in protein content with higher levels than cow's milk, but fat content is higher in cow's milk. According to Iyyah et al. (2019) the protein content in yoghurt is influenced by the protein content in the raw material, the higher the protein content in the raw material, the greater the protein content in the yoghurt produced. When fermented by lactic acid bacteria, protein in soy milk will form peptide bioactive compounds. These compounds have low molecular weight, either in the form of proteins or short peptides that have an activity to inhibit or kill microbes (antimicrobial). Because of its antimicrobial content, this peptide bioactive compound is often called Antimicrobial Peptide (AMP). AMP is a cofactor molecule in the body's defence and immune systems against infection. On the other hand, Parijoto fruit contains phenolic bioactive components in the form of saponins, tannins, flavonoids, and glycosides which have antioxidant & antimicrobial activity (Wachidah, 2013; Syairna et al., 2015; Laraswati & Sugiarti, 2017). Antioxidant and antimicrobial substances are, in fact, widely needed by the yoghurt industry today as preservative fortification as well as double resistance against intestinal pathogenic microbes (Caleja et al., 2015).

Table 2. Comparison of soy milk content - cow's milk (100 g)

Content	Soy milk	Cow's milk
Energy (kcal)	41	61
Protein (g)	3.5	3.2
Fat (g)	2.5	3.5
Carbohydrates (g)	5	4.3
Calcium (mg)	50	143
Phosphorus (mg)	45	60
Iron (mg)	1	2
Vitamin A (IU)	200	130
Vitamin B (mg)	0.08	0.03
Vitamin C (mg)	2	1

(Aman & Hardjo, 1973)

Various kinds of literature show that most yoghurt products on the market contain limited bioactive components, so the nutritional value of yoghurt rapidly decreases with the

length of storage time (Bertolino et al., 2015). Some researchers suggest the existence of fortification in yoghurt in the form of plants, especially fruits rich in phenolic components. Previous research stated that the antioxidant activity of yoghurt increased with the addition of natural fortifications, such as dragon fruit, grape seeds (Chouchouli et al., 2013), blackberries (Martins et al., 2014), and chamomile (Caleja et al., 2015). Natural fortification makes yoghurt that has a much better reducing ability at a more affordable price than chemically fortified yoghurt. The yoghurt storage period also becomes longer. By adding Parijoto fruit extract, it is projected that the yoghurt formed will have the same advantages as the research results above. Regarding antimicrobial activity, the mechanism of action of the bioactive components in Parijoto fruit extract is as follows. Phenolic compounds denature proteins through adsorption involving hydrogen bonds. The higher the oxidized phenol, the stronger the inhibition of organism growth. Tannins inhibit the enzymes reverse transcriptase and DNA topoisomerase so bacterial cells cannot form. Flavonoids inhibit nucleic acid synthesis, cell membrane function and energy metabolism. Saponins lower surface tension, releasing intracellular compounds due to cell leakage (Ngajow et al., 2013).

3.3 Soy yogurt formulation (soy yoghurt)

Before making soy yoghurt, it is necessary to determine the exact formulation of the composition (Table 1). Based on previous research by Kartikasari & Nisa (2014) and Nguyen & Hwang (2016), the soy yoghurt formulation is obtained as follows (Table 3). In the formulation of soy yogurt, each ingredient plays a specific role crucial to the final product's quality. Parijoto Fortifikan Extract serves as a source of antioxidants and antimicrobials, enhancing the nutritional value and extending the shelf life of the yogurt. Soy milk acts as the primary substrate, providing the essential base for yogurt production. Natural honey functions both as a sweetener and a cryoprotectant agent, contributing to the product's flavor and stability during freezing. Plain yogurt is utilized as the fermentation agent, supplying the necessary lactic acid bacteria culture required for the fermentation process. Together, these ingredients are strategically combined to produce a soy yogurt that is both flavorful and nutritious.

Table 3. Yogurt formulation design

Composition (ml)	Control	F1	F2	F3
Parijoto fruit extract 10%	0	5	10	15
Soy milk	92.5	87.5	82.5	77.5
Natural honey	2.5	2.5	2.5	2.5
Plain yogurt	5	5	5	5
Total Amount (ml)	100	100	100	100

(Kartikasari & Nisa, 2014; Nguyen & Hwang, 2016)

Parijoto fruit is washed clean, sorted wet, and air-dried. The fruit weighed 20 grams, followed by grinding using a blender with 180 ml of mineral water. The mixture is then filtered to be separated from the dregs. The result of this process is 10% Parijoto fruit extract. Soy milk is pasteurized at 75^{o}C for 10 minutes. The milk is then cooled down to 37°C. Other ingredients, such as 10% Parijoto fruit extract, liquid honey, and plain yoghurt, are added according to the formulation that has been designed. The yoghurt mixture was incubated at 32^{o}C for 8 hours. After incubation, the temperature was lowered to 25^{o}C, then stored in a refrigerator at 4^{o}C for 12 hours, and was ready to be packaged. The process of incubating milk in yoghurt sets is carried out in a small container to maintain the gelation structure of the yoghurt so that it remains intact and does not change when cooled until it is ready to be consumed (Tanaya et al., 2014). Stirred yoghurt fermentation is incubated in a large fermentation vessel accompanied by a stirring process to produce a soft and thick product before packaging (Li et al., 2021).

3.4 Organoleptic test results

Adding natural fortification can maintain the nutritional value of yoghurt but significantly affect its sensory quality (Caleja et al., 2015). The organoleptic test was based on the hedonic test on ten untrained panellists. Panellists were taken randomly from students aged 18-25 years at Sebelas Maret University, Surakarta. The hedonic scale is made up of five rating levels, starting from 5 (very like), 4 (like), 3 (standard), 2 (dislike), and 1 (dislike very much) (Figure 2). An organoleptic assessment was conducted on soy yoghurt's colour, taste, aroma, and overall acceptance. Based on the panellists' answers, the graph of the test results is as follows

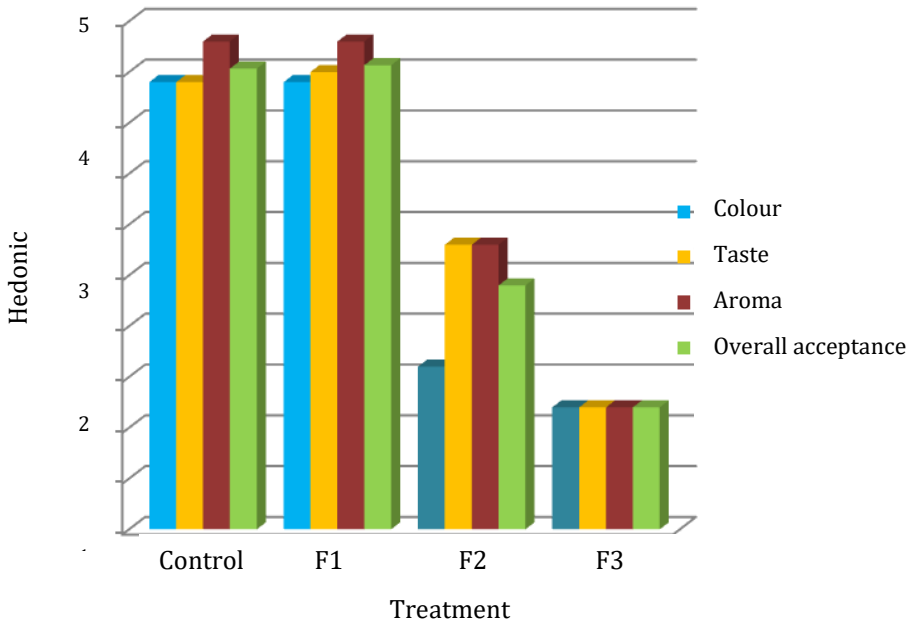

Fig. 2. Organoleptic test results

According to the color of a food, it can influence consumer tastes and arouse food appetite. Aroma assessment is carried out using the sense of smell by capturing volatile compounds in the product being assessed. Rahmawati & Kusnadi (2017) explained that the formation of lactic acid during the fermentation process causes the release of H^+ ions, resulting in a decrease in pH. states that lactic acid bacteria (LAB) such as S. thermophilus and L. bulgaricus cause the formation of lactic acid due to the breakdown of lactose which causes a decrease in pH. Based on Figure 2, it can be ascertained that the F1 formula (5 ml of Parijoto fruit extract in 100 ml of product) is the best Soy yoghurt formula that many panellists like. The panellist's preference level for the F1 treatment was 4.89. The F1 formula gives a product with a sweet, slightly sour taste (alcoholic) and yellow (beige) colour and tends to have a faint Parijoto fruit aroma. Meanwhile, the characteristics of Soy yoghurt from the F2 and F3 treatments were brownish yellow to milk chocolate, sweet to sour (alcoholic) taste, and the distinctive aroma of Parijoto fruit. The soy yoghurt products from the three treatments are classified as liquid yoghurt, so there is no coagulated mass of the substrate. The more the addition of Parijoto fruit extract, the panellist's level of preference for the product decreases. This is because the Parijoto extract contains phenolic compounds, which tend to be astringent/alcoholic, giving a slightly cloudy (brown) colour and a strong aroma. This change in sensory factors is a marker for bioactive components in Soy yoghurt. In general, the panellists responded positively to the Soy yoghurt product because it converted the parijoto fruit's acid-phosphoric acid into a beneficial probiotic drink.

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3.5 Economic analysis

The market segmentation for soy-based and Parijoto yoghurt products encompasses all societal layers that recognize the importance of nutrition and health, regardless of economic status. This is made possible because the product is offered at a relatively affordable price, making it accessible to a wide range of consumers. The target market for this product is extensive, covering consumers from various age groups, ranging from children to adults, across all regions of Indonesia. The uniqueness of this product lies in the use of local raw materials, namely Parijoto, which adds value and serves as a distinctive selling point.

More specifically, the potential market segments include tourists visiting Kudus, students pursuing their education in the city, and workers from outside the region temporarily residing in Kudus Regency. The product is positioned as a ready-to-consume fermented beverage with the characteristic aroma of Parijoto, which holds a unique appeal for consumers. This distinctive aroma serves as one of the strong differentiating factors in the fermented beverage market.

The Break-Even Point (BEP) analysis is a crucial element in the business planning of this soy yoghurt product. The total BEP illustrates the number of product units that must be sold to reach the break-even point, where total revenue equals total costs. Meanwhile, the BEP in monetary terms indicates the amount of revenue needed to cover all operational costs. The time required to reach the break-even point, based on the BEP calculation, is an important indicator of the sustainability of this business, providing insight into how quickly the initial investment can be recovered and the business can start generating profit.

$$\text{BEP total products} = \frac{5{,}890{,}000}{(6000-4440)} = 3775 \text{ bottles}$$

$$\text{BEP break even (IDR)} = \frac{5{,}890{,}000}{(1-(4440/6000)} = 22{,}653{,}846$$

The time required to reach the breakeven point is based on the value of the BEP results:

$$\text{BEP results} = \frac{22{,}653{,}846}{(6000x50)} = 75.5 \text{ days rounded up to 76 days}$$

Here's the analysis Total cost:

Total cost = Fix Cost + Variable Cost
= IDR 5,890,000 + IDR 222,000 = IDR 6,112,000

Where the fixed cost is the initial capital for buying equipment + Overhead Cost for 1 month first. Meanwhile, the variable cost is material capital per 50 bottles of soy yoghurt.

Selling price of soy yoghurt per 200ml bottle = IDR 6,000.00
Equipment technical age : 5 years
The final value after the economic life of the tool : 10% / year

$$\text{Depreciation expense per year} = \frac{\text{(Initial price – final price)}}{\text{tool economic life}}$$

$$= \frac{\text{IDR 4,340,000– IDR 434,000}}{5}$$

= IDR 781,200/year

$$\text{Break even point} = \frac{\text{Investment Value x Production Period}}{\text{One Month Profit}}$$

$$= \frac{\text{IDR 5,890,000 x 1 month}}{\text{1560 x 30 days x @50 bottles}}$$

$$= \frac{\text{IDR 5,890,000 x 1 month}}{\text{IDR 2,340,000}}$$

= 2.52 months = 2 months 16 days

The fixed costs in this analysis include the initial investment for purchasing equipment, as well as overhead expenses for the first month of operations. On the other hand, variable costs represent the capital required for raw materials to produce 50 bottles of soy-based yoghurt. The selling price of IDR 6,000 per 200ml bottle is part of a pricing strategy based on production cost calculations and consumer purchasing power in the market.

Another important aspect of this financial analysis is the calculation of equipment depreciation. With an estimated economic lifespan of five years and a residual value of 10% per year, depreciation is incorporated into the long-term cost projections. The relatively short Break-Even Point (BEP) period of 2 months and 16 days indicates that the production of soy-based yoghurt offers promising opportunities for empowering the local economy. The daily production target of 50 bottles (200ml), assuming 100% sales, reflects significant market potential. The break-even point is reached when cumulative sales total 3,775 bottles.

The advantages of this soy-based yoghurt, infused with Parijoto, lie not only in its economic aspects but also in its contribution to local economic empowerment. The use of Parijoto, a distinctive raw material from the Kudus region, imparts a unique flavor to the product while supporting local farmers and introducing regional wisdom to the national market. Moreover, the potential for market expansion is highly promising. With the increasing awareness of the importance of consuming healthy foods and beverages, Parijoto soy yoghurt has the opportunity to position itself as a healthy, delicious, and culturally rich choice. Effective marketing strategies, such as leveraging social media and collaborating with local influencers, could accelerate market penetration and enhance brand awareness. In the long term, product innovation—such as developing new flavor variants or utilizing more environmentally friendly packaging—can serve as a strategy to maintain competitiveness and expand market share. Thus, the production of Parijoto soy yoghurt has the potential not only to be a short-term economic solution but also to grow into a sustainable industry, delivering broader positive impacts on the local community.

3.5 Potential, challenges, and development prospects of Parijoto

Medinilla speciosa, locally known as parijoto, is an endemic plant species that thrives in the Muria Mountain Range, particularly in the Dawe region of Kudus Regency, Central Java. Parijoto plays a significant role in local traditions, not only as a consumable fruit but also as an integral part of the community's beliefs. The fruit is often used in traditional ceremonies, especially for pregnant women, as it is believed to benefit both maternal and fetal health. Parijoto fruit contains a variety of bioactive compounds, including flavonoids, polyphenols, and anthocyanins. Its high phenolic and flavonoid content serves as potent antioxidants, protecting cells from oxidative damage (Wachidah, 2013; Syairna et al., 2015; Laraswati & Sugiarti, 2017). Additionally, parijoto fruit extract exhibits anti-inflammatory and antimicrobial activities. A study by Syairna et al. (2015) found that the ethanolic extract of parijoto fruit demonstrated antimicrobial activity against pathogenic bacteria such as *Escherichia coli* and *Staphylococcus aureus*. This antimicrobial activity is thought to be due to the presence of flavonoids and tannins. Furthermore, it revealed the antiproliferative potential of parijoto extract against cancer cells, making it a promising candidate for the development of natural chemopreventive agents.

In traditional health practices, parijoto has long been used by the people of the Muria Mountains, particularly as a supplement for pregnant women. The consumption of parijoto during pregnancy is believed to support fetal health, strengthen the mother's body, and facilitate childbirth. This belief is also supported by a spiritual conviction that the fruit can bestow blessings of health and safety for the unborn baby. Additionally, parijoto is consumed to boost general immunity. The local community utilizes the fruit either fresh or in the form of candied products to enhance energy and combat illness. The high natural antioxidant content is one reason why people believe that parijoto can protect against diseases associated with aging and a weakened immune system.

Although parijoto has been widely used in traditional medicine, its scientific potential in modern medicine is only beginning to be explored. Recent studies have shown that parijoto is rich in flavonoids, polyphenols, and anthocyanins, all of which possess significant antioxidant activity. The bioactive compounds in the aqueous and ethanolic extracts of Medinilla speciosa, including flavonoids (fisetin, robinetin, luteolin, kaempferol) and polyphenols (ellagic acid), offer various pharmacological benefits such as antioxidant, anti-inflammatory, anticancer, antimicrobial, antidiabetic, and organ-protective properties (Purba et al., 2023). The anti-inflammatory effects of flavonoid and phenolic compounds in parijoto also hold potential for reducing chronic inflammation often associated with degenerative diseases.

Further research by Purba et al. (2023) has demonstrated that the ethanolic extract of parijoto possesses strong antimicrobial effects. This antimicrobial activity opens up possibilities for parijoto as a candidate for the development of herbal antimicrobial drugs that could be used to treat bacterial infections resistant to conventional antibiotics. Moreover, Anthocyanins, the main compounds found in parijoto fruit, have shown effectiveness in lowering the risk of cardiovascular disease and diabetes by exhibiting anti-inflammatory and antioxidant properties (Ananingsih et al., 2024). This activity may be due to parijoto's antioxidant ability to prevent DNA damage, which often triggers cancer cell growth. These findings provide promising opportunities for developing parijoto as a chemopreventive agent or as an adjuvant therapy in cancer treatment.

In the realm of modern medicine, parijoto is also being considered for the development of health supplements. Its high antioxidant content and other bioactive compounds make parijoto an attractive ingredient for health supplements and cosmetics, particularly those focused on anti-aging or protection against oxidative stress. Ananingsih et al. (2024) suggested that formulation of nanoemulsion using parijoto fruit extract (*Medinilla speciosa*).

Despite parijoto's significant potential, challenges remain in its commercial development for modern medicine. One such challenge is the lack of in-depth research on the mechanisms of action of its bioactive compounds, appropriate dosages, and the safety of long-term use. Additionally, the development of processing technologies that ensure the stability and effectiveness of products is necessary. Clinical development of parijoto requires more comprehensive trials to understand its toxicity, interactions with other drugs, and therapeutic efficacy in humans. With further research, parijoto has promising prospects for becoming a plant-based therapeutic agent originating from Indonesia.

4. Conclusions

Parijoto fortified soy yoghurt is an innovative vegetable yoghurt made from soy milk and parijoto fruit typical of Colo Village, Kudus Regency, Indonesia. Soy milk is superior as the main substrate for yoghurt because it is high in protein. Parijoto fruit extract as a fortifier is rich in phenolic components which have antioxidant and antimicrobial effects on pathogens. This makes soy yoghurt a superior yoghurt product. The product characteristics are liquid texture, alcoholic sweet taste, cream colour, and the aroma of Parijoto fruit tends to be faint. The production of soy yoghurt is similar to other yoghurts, namely using the principle of pasteurization of the substrate and fermentation. Production time per batch is around 14 hours. Based on the economic analysis and BEP estimates, Soy yoghurt has price,

nutrition and locality advantages. Soy yogurt product also meets the eligibility for industrialization because, with a production capacity of 50 bottles/day, the payback period is only two months and 16 days.

Based on the analysis of the potential and challenges, the development of soy-based yogurt fortified with parijoto fruit shows highly promising prospects, both from economic and health perspectives. This product offers significant health benefits due to the antioxidant and antimicrobial properties of parijoto, as well as the high protein content of soy milk. Furthermore, the use of local ingredients, such as soybeans and parijoto, supports local economic empowerment and contributes to environmental sustainability efforts. With the right marketing strategy and continuous technological development, parijoto soy yogurt has the potential to become a leading functional food product, both in domestic and international markets. However, this study is limited by the small sample size and the relatively short observation period. Product durability testing and long-term studies on the effectiveness of the bioactive compounds in parijoto within the yogurt have not yet been thoroughly investigated. For future research, it is recommended to conduct larger-scale trials, involving panelists from various age groups and demographic backgrounds to obtain more representative results. Further research is also needed to explore the stability of parijoto's bioactive compounds during storage and their long-term effects on consumer health. In addition, clinical trials on the health benefits of parijoto soy yogurt are crucial to validate its therapeutic potential. The development of new flavor variants and more environmentally friendly packaging is also expected to increase the product's appeal in broader markets.

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