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SUSTAINABILITY GASTRONOMY IN OPTIMIZING FRAGARIA AS A LOCAL SUPERFOOD USING LOW TEMPERATURE COOKING TECHNOLOGY

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Abstract

Sustainable gastronomy emphasizes culinary practices oriented towards health, environmental sustainability, and local economic empowerment. This study aims to optimize the potential of Fragaria (strawberries) as a local superfood through the application of Low Temperature Cooking (LTC) technology in cake production. The method used is a true experimental design with a Quantitative Descriptive Analysis (QDA) approach, involving a control group and a treatment group using the LTC technique. The products were organoleptically tested by 35 panelists, consisting of expert and non-expert panelists, for four main sensory attributes: taste, aroma, color, and texture. The results showed that the LTC technique was able to maintain the sensory characteristics and nutritional quality of the product better than conventional methods. The best formulation was obtained at a composition of 75% strawberry puree (P2) with an average score of 3.6, indicating a high level of preference for taste, color, and texture attributes. This study confirms that the application of LTC technology to Fragaria-based products not only increases the competitiveness of local gastronomy but also supports the principles of a circular economy and energy efficiency in the sustainable culinary industry. These findings are expected to serve as a reference for developing functional food products based on locally sourced ingredients with high nutritional value and that are environmentally friendly.

Keywords:*sustainable gastronomy, Fragaria, local superfoods, low temperature cooking, culinary innovation.*

INTRODUCTION

Sustainable gastronomy has become an increasingly prominent concept in academic discourse and global culinary practice due to its links to public health, environmental sustainability, and local economic empowerment. This concept emphasizes the importance of culinary practices that are not only oriented towards taste, but also towards a sustainable food supply chain, waste reduction, and the utilization of local ingredients with high nutritional value (Murray et al., 2023). In the Indonesian context, the implementation of sustainable gastronomy aligns with the national food security agenda, which emphasizes food diversification based on local commodities with superfood potential (Richardson, 2024). One such potential local commodity is Fragaria (strawberries), known to be rich in polyphenols, anthocyanins, vitamin C, and other bioactive compounds that play a role in improving the body's antioxidant status, cardiovascular health, and the immune system (Nowicka et al., 2019; Fierascu et al., 2020). Recent research shows that local Fragaria varieties and their processing by-products contain significant bioactive components that can be categorized as superfoods (Mao et al., 2022; Gomes et al., 2021). However, a common challenge is the susceptibility of these functional compounds to degradation due to high temperatures, light, and oxidation during processing and storage (Mao et al., 2022). To address these challenges, low-temperature cooking technology has emerged as an innovative alternative for maintaining food nutritional quality.

Methods such as sous-vide and controlled thermal processing allow cooking at lower temperatures for appropriate durations, thereby reducing the destruction of vitamins, anthocyanins, and polyphenols compared to conventional cooking techniques (Kosewski et al., 2023). Furthermore, the application of these technologies is not only oriented towards consumer health but also supports the principles of energy efficiency and waste reduction, which are key pillars of sustainable gastronomy (Misu et al., 2024). A comprehensive review ofResearch integrating Fragaria's potential as a local superfood with the application of low-temperature cooking technology within a sustainable gastronomy framework is still limited. Therefore, this research is expected to provide a scientific contribution by highlighting the importance of culinary innovation based on high-value local ingredients combined

with nutrition-friendly and sustainability-oriented technology. This study focuses on the processing of Strawberry Cake (Fragaria) with Low Temperature Cooking (LTC) Technique. The important difference in this study is the use of Low Temperature Cooking (LTC) technique along with the oven method. In addition, fresh, pureed strawberries (Fragaria) are used as a wet ingredient in the product, which means that the finished product will differ from cakes made with dry flour in terms of texture and other physical attributes. The Low Temperature Cooking (LTC) method makes the taste and texture will improve while maintaining the nutritional value of the components of the raw materials (Zhou & Hui, 2014). The formulation of the problem in this study is described into two main points, namely: 1) How is the Formula in making Strawberry (Fragaria) products in making cakes? 2) How is the organoleptic test on Strawberries (Fragaria) using the Low Temperature Cooking (LTC) technique in making cakes? 3) How is the consumer acceptance of Strawberry Cake (Fragaria) using the Low Temperature Cooking (LTC) technique in making cakes?

LITERATURE REVIEW

1. Gastronomy Sustainability Concept

Gastronomy is no longer understood simply as the art of cooking and serving food, but has evolved into a system that reflects the relationship between humans, culture, and the environment. In the modern context, the term sustainability gastronomy has emerged, emphasizing the relationship between taste, sustainability, and social responsibility in every process of food production and consumption (Östergren, 2023). According to Östergren (2023), sustainable gastronomy is a multidimensional approach that integrates local values, a green economy, and environmental preservation through culinary practices. This includes the use of local food ingredients, efficient supply chain management, and the reduction of food waste. Furthermore, this approach encourages culinary practitioners to consider the welfare of local farmers and social sustainability in their business practices (Richardson, 2024). From a sustainability perspective, restaurants and the culinary industry are expected to play an active role in implementing responsible production and consumption practices, from raw material selection to serving food to consumers (Vermeir et al., 2020). The application of sustainable gastronomy not only adds value to culinary products but also serves as an educational tool that raises public awareness of the importance of consuming environmentally friendly and healthy food (Vermeir et al., 2020; Östergren, 2023). In the Indonesian context, sustainable gastronomy is highly relevant to the richness of local biodiversity, including the potential for developing food ingredients such as Fragaria (strawberries). The use of local ingredients supports the concept of a circular economy, shortens supply chains, and strengthens the competitiveness of local gastronomic products in the global market (Richardson, 2024).

2. Fragaria as a Local Superfood

Strawberries (Fragaria × ananassa and other species of the genus Fragaria) are known as a fruit rich in nutrients and bioactive compounds that provide health benefits. According to Fierascu et al. (2020), strawberries have a high polyphenol content, especially anthocyanins, flavonoids, and phenolic acids, which contribute to antioxidant and anti-inflammatory activities, as well as potential prevention of degenerative diseases. Atazhanova (2025) added that each strawberry cultivar varies in chemical composition and nutritional value, depending on genetic factors, environmental conditions, and post-harvest techniques. The high vitamin C content in strawberries is also an important indicator in supporting the immune system and slowing oxidative processes in the body. A study conducted by Charoenwoodhipong et al. (2024) showed that regular strawberry consumption can improve plasma antioxidant status and reduce inflammatory biomarkers in humans. Furthermore, the content of dietary fiber, pectin, and other bioactive compounds makes strawberries a superfood with significant health value. In the local context of Indonesia, strawberry cultivation is often found in highland areas such as Lembang, Malang, and Brastagi. With high production potential and the availability of local raw materials, strawberries can be optimized as a basic ingredient in the development of functional gastronomic products based on sustainability (Fierascu et al., 2020; Atazhanova, 2025). Utilizing local strawberries not only reduces dependence on food imports but also strengthens the competitiveness of local products in the culinary tourism sector.

3. Low Temperature Cooking (LTC) Technology

Low Temperature Cooking (LTC) technology, including sous-vide, is a cooking method that uses relatively low temperatures (typically 50–85°C) for extended periods with precise temperature control (Misu et al., 2024). Food is typically vacuum-packed to prevent oxidation and nutrient loss during the cooking process.

According to Zavadlav et al. (2020), the LTC technique has several key advantages over conventional cooking methods, including maintaining a soft texture, preserving the natural color of the ingredients, and minimizing the loss of vitamins and minerals due to exposure to high temperatures. Furthermore, this technique also maintains the natural volatile aromas of foodstuffs because there is no direct contact with water or air (Zavadlav et al., 2020). Misu et al. (2024) emphasize that LTC can improve the microbiological safety of foodstuffs if the time and temperature parameters are precisely controlled. In a study of animal and plant products, it was found that the sous-vide technique can preserve vitamin C up to 80% better than traditional boiling, and retain more than 90% of the anthocyanins in pigmented ingredients such as strawberries and blueberries. Furthermore, the use of LTC in the context of sustainable gastronomy is also considered more energy efficient than frying or baking methods, due to the use of lower temperatures and controlled time (Misu et al., 2024). Thus, this technology has the potential to support the principles of sustainable gastronomy through energy-efficient processing, minimal waste, and maintaining nutritional quality.

METHOD

True experimental design with QDA (Quantitative Descriptive Analysis) test experiment using reference product as control in making strawberry cake product (Fragaria) that is with regular baking technique, then compared with cake processed with Low Temperature Cooking (LTC). Sugiono (2013) provides an understanding that experimental research is 3 research methods used to find the effect of certain treatments on others under controlled conditions. The main characteristic of True Experimental is that, the samples used for experiments and as control groups are taken randomly from a certain population. The reference product in this study is a strawberry-based cake product (Fragaria) using regular baking technique, will be compared with the independent variable in this study, namely the cake product that will be tested using Low Temperature Cooking (LTC). To get the starting recipe, researchers analyzed 3 cake recipes made from strawberries (Fragaria), and conducted experiments and tested them on expert panelists. The product manufacturing trial was conducted in the Kitchen Laboratory of the Bogor Unity Institute of Business and Informatics, while the QDA test and acceptance test were conducted in the Bogor Unity Institute of Business and Informatics environment by distributing questionnaires to 30 consumer panelists involving educators, lecturers, students and the community around the campus and 5 expert panelists who are culinary practitioners. The data collection method was carried out using literature studies to find the desired recipe, interview techniques to collect qualitative data on the product being tested, and a questionnaire as a hedonic test instrument. The questionnaire instrument presented a 4-point attitude scale.The levels range from very dislike, dislike, like, and very like. Meanwhile, to assess product quality, a hedonic quality test is conducted, analyzing four aspects: taste, aroma, texture, and color (Lamusu, 2018). In this study, the author used an experimental research data analysis method. Furthermore, by using observation in the form of a questionnaire, the author used descriptive statistics for data processing, namely calculating the mean, median, mode, and standard deviation.

RESULTS AND DISCUSSION

The following are the results of the calculation of the product "Strawberry Cake (Fragaria) with Low Temperature Cooking (LTC) Technique"

Table 4.35 Conclusion of the Results of the Strawberry Cake Product (Fragaria) Kulesilonler Using the Low Temperature Cooking (LTC) Technique in Making Cakes

	Dimensi	**Ttotal Skor**	***Mean***	***MEdian***	***Modus***	***Standard Ddeviation***
P1	Flavor	2.6	2.6	3	3	0.55
	Color	3.2	3.2	3	3	0.55
	Ttexture	2.4	2.4	2	2	0.55
	Argrandma	3.8	3.8	3	3	0.84
P2	Flavor	3.8	3.8	4	4	0.45
	Color	3.6	3.6	4	4	0.55
	Ttexture	2.6	2.8	4	4	0.55
	Argrandma	2.8	2.8	4	4	0.45
P3	Flavor	2.4	2.4	2	2	0.89
	Color	3.2	3.2	4	4	1.1
	Ttexture	2.6	2.6	3	2	0.89
	Argrandma	2.4	2.4	3	3	0.71
Ttotal			**36.6**	**39**	**38**	**8.37**
Average		**3.1**	**3.1**	**3.3**	**3.2**	**0.70**

Source: Original Culinary, 2025

In the production of strawberry cake (Fragaria) using the Low Temperature Cooking (LTC) technique and the conventional cooking technique, conclusions were drawn from questionnaire data from five expert panelists, using three aspects: Taste, Color, Texture, and Aroma in three experimental formulations. The total score for the Taste aspect in the three experimental formulations was 3.1, indicating a "Like" conclusion; the total score for the Color aspect in the three experimental formulations was 3.1, indicating a "Like" conclusion; the total score for the Texture aspect in the three experimental formulations was 3.3, indicating a "Like" conclusion; and the total score for the Aroma aspect in the three experimental formulations was 3.2, indicating a "Like" conclusion.

The results of the strawberry cake (Fragaria) research using the Low Temperature Cooking (LTC) technique yielded a total score of 36.6, falling in the "Very Like" category. The lowest score for the questionnaire was for the Taste aspect (P3), with a score of 2.4. Meanwhile, the highest scores were for the Taste, Color, and Aroma (P2), Color and Texture (P2), and (P2) aspects, with a score of 3.8. The research results indicated that the panelists were interested in the experimental formulation of strawberry cake (Fragaria) using the Low Temperature Cooking (LTC) technique. Of the three experimental formulations, based on panelist data collected, the panelists preferred the P2 formulation. This is evident from the three aspects of P1, P2, and P3, as shown in the table above.

Table 4.36 Conclusion of the Results of the Strawberry Cake (Fragaria) Product Cooking Using the Low Temperature Cooking (LTC) Technique in Making Cakes

Percmedicine	Dimensi	Ttotal Skor	*Mean*	*MEdian*	*Modus*	*Standard Ddeviation*
P1	Flavor	3.6	3.6	4	4	0.62
	Color	3.0	3.0	4	4	0.51
	Ttexture	4	4	4	4	0.61
	Argrandma	2.9	2.9	4	4	0.50
P2	Flavor	3.0	3.0	3	4	0.67
	Color	3.1	3.1	3	4	0.52
	Ttexture	3	3	4	3	0.59
	Argrandma	2.9	2.9	3	3	0.66
P3	Flavor	2.8	2.8	3	4	0.75
	Color	2.6	2.6	3	3	0.72
	Ttexture	3	3	4	3	0.76
	Argrandma	2.6	2.6	3	4	0.72
Ttotal		**37.6**	**37.6**	**40**	**38**	**7.64**
Average		**3.1**	**3.1**	**3.3**	**3.2**	**0.64**

Source: Original Culinary, 2025

In the making of strawberry cake products (Fragaria) with the Low Temperature Cooking (LTC) technique in making cakes, conclusions were obtained in the form of data from the panelists, which amounted to 30 panelists in the non-expert category, using 3 aspects, including: Taste, Color, Texture and Aroma in 3 formulations of the trial. Total for asplek Rasa in 3 flormulasi plerclobaan mlendapatkan sklor 3.1 dlengan klesimpulan clendlerung Suka, total for asplek Warna in 3 flormulasi plerclobaan mlendapatkan sklor 3.1 dlengan klesimpulan clendlerung Suka, total asplek Ttekstur in 3 flormulasi plerclobaan mlendapatkan sklor 3.3 dlengan klesimpulan clendlerung Suka, total asplek Arloma in 3 flormulasi plerclobaan mlendapatkan sklor 3.2 dlengan klesimpulan clendlerung Suka. Based on the results of a study of strawberry cake (Fragaria) products using the Low Temperature Cooking (LTC) technique, a total of 37.6 people were in the "Very Like" category. The lowest score for the cake was in the Flavor (P3) aspect with a score of 2.4. Meanwhile, the highest scores were in the Flavor, Color, and Texture (P2) aspects, and Color and Texture (P2) with a score of 3.8. The results of the study showed that the panelists were interested in the experimental formulation of strawberry cake (Fragaria) products using the Low Temperature Cooking (LTC) technique in cake making. Of the 3 experimental formulations of strawberry cake products (Fragaria) with the Low Temperature Cooking (LTC) technique in making cakes from the panellist data that has been taken, the panellists like the P2 formulation product. Seen from the 3 aspects between P1, P2 and P3 which are tested in the table data above.

CLOSING

Based on the results of research conducted by the author withThe title "Sustainability Gastronomy in Optimizing Fragaria as a Local Superfood with Low Temperature Cooking Technology" resulted in the following results:

1. Results of the trial usecake productsstrawberries (Fragaria) with Low Temperature Cooking (LTC) techniquein pcake makingcan be used as an innovation in making cakes.
2. Trial test of 3 formulascake productsstrawberries (Fragaria) with Low Temperature Cooking (LTC) techniquein pcake makingwith different formulas, namely (50%, 75% and 100% strawberries (Fragaria), it was concluded that the formulation used by the author in using strawberries (Fragaria), in making cakes got good results and for the basic ingredients 100% strawberries (Fragaria).
3. Judging from the mean, median, mode and standard deviation values that have been obtained from the calculation and distribution of questionnaires to expert and non-expert panelists. For expert panelists it can be concluded that the overall product total value is 44.2 with an average value of 3.7 and for the most preferred is P1 (50%) with a total value of 15 with an average value of 3.75. For non-expert panelists it can be concluded that the overall product total value is 42.6 with an average value of 3.6 and for the most

preferred is P1 with a total value of 14.7 with an average value of 3.67. That the product of using strawberries (Fragaria), in making cakes can be accepted with values dominated by the Very Like category from the aspects of Taste, Color and Texture. However, there is still a value of dislike for the Aroma of strawberries (Fragaria) in making cakes.

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