Sensory Quality of Sate Rembiga in A Retort Pouch Packaging with Different Sterilization Time

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Abstract. Rembiga satay is a local culinary product of Lombok Island which is in high demand by tourists. The development of sate rembiga into a product with high shelf life that is practical and efficient to carry has the potential to increase the market reach. To achieve this goal, the development of rembiga satay can be directed at the canning process using retort pouch. The application of commercial sterilization in the canning process is not only aimed at killing microorganisms, but must be able to maintain the quality of the final product by minimizing quality damage, especially sensory quality. The purpose of this study was to determine the effect of sterilization time at 121ºC on the organoleptic quality of rembiga satay in a retort pouch. The design used in this study was a Randomized Block Design (RBD) with a single factor experiment, namely the 3, 6, 9, 12, 15 and 18 minutes sterilization time at 121ºC. Observational data were analyzed using Analysis of Variance with a significance level of 5% and further tested with the Honest Significant Difference (HSD). The result showed that the sterilization time at 121ºC significantly affected the texture, color and appearance, but did not affect taste and aroma. The increase in sterilization time decreased the panelist's level of preference for the texture, color and appearance of rembiga satay in retort pouch. Sterilization for 9 minutes is the maximum sterilization time to produce rembiga satay in retort pouch which is preferred by panelists because it has a soft texture, slightly red-brown color and intact appearance.

Keywords: canning, rembiga satay, retort pouch, sterilization time

1 Introduction

Rembiga Satay (in Indonesia called Sate Rembiga) is one of the traditional culinary of Lombok Island. This sweet and spicy meat dish with a typical spice is preferred by tourists both to be consumed in person or as a souvenir. However, this product is only packaged with bananas leave or plastic packaging, which results in a low storage time and becomes a limitation in the marketing of this product. Effective packaging in the market should consider and demonstrate several key factors [1]. These factors encompass the safety aspect, which emphasizes the packaging's ability to safeguard the

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product against potential damages caused by various factors. Additionally, the distribution factor highlights the packaging's capacity to facilitate smooth transportation from the production site to the distributor and ultimately to the end consumer. The potential market penetration of this product might be enhanced by the implementation of packaging that possesses a combination of superior durability and convenient portability while ensuring the security of the product during transportation.

In order to ensure shelf-stable food quality, the chosen packaging solutions play an important role [2]. The utilization of the canning process as an alternative to conventional packaging methods enables the production of a product that aligns with the specifications expected. Rembiga satay is not packaged within a can but rather within a flexible retort pouch. The retort pouches consist of a combination of laminated aluminum foil and a polymer material that is resistant to the sterilizing process [3]. This packaging is capable of maintaining the quality and safety of the product for an extended period of time while it is maintained at room temperature. The utilization of retort pouch packaging is compatible with rembiga satay, which lacks liquid components. So, it may be effectively integrated with vacuum packaging, extending the product's shelf life. Furthermore, the utilization of retort pouch packaging offers several advantages, including enhanced visual appeal, cost-effectiveness, reduced sterilization duration, decreased weight, and convenient portability [4]. Consequently, it is seen as highly ideal for implementation within small and medium-sized enterprises, as in the case of rembiga satay. The application of this method to packaging has been applied to some local culinary products and has been shown to extend the shelf life of these products. The chicken satay packaged in retort pouches can be considered suitable for consumption for a duration of up to 8 weeks [5]. Another research found that paper chicken packaged in retort pouches can be safely stored for a period of 90 days [6]. Additionally, fried rice packaging retort pouches have a shelf life of 8 months [3].

The application of commercial sterilization in the canning process to preserve food is not only aimed at killing microorganisms but must also be able to maintain the quality of the final product by minimizing quality damage, especially sensory quality. Sensory quality is an important aspect of consumer judgement of a food product. However, prolonged heating with the application of commercial sterilization can have a detrimental effect on food sensory quality, including off flavors, bitter and rancid taste, unpleasant color and texture [7]. Commercial sterilization of chicken curry mousse fortified with branched-chain amino acids resulted in the mousse becoming darker, and the unique bitter taste showed a slight increase after the treatment compared to the control [8]. The sensory changes in the quality of two types of soups on sterilization above 116ºC, namely borsch samples that show unsatisfactory quality after treatment, including non-appetizing broth color, bitter taste, and aftertaste, and overcooked vegetable pieces, while on pee soup, the products become overcooked, especially pea and potato components, and the broth is very thick with an inadequate aroma and unpleasant taste [2]. Therefore, research is needed to look at the long-term influence of sterilization at a commercial sterilization temperature of 121ºC on the sensory quality of sate rembiga in the retort pouch packaging.

2 Materials and methods

2.1 Methodology

The research employed an experimental method conducted in a laboratory. Randomized Block Design (RBD) was utilized with six sterilization time, including 3, 6, 9, 12, 15, and 18 minutes. The experiment was replicate three times for each treatment. The data collected from the observation were subjected to analysis of variance (ANOVA) at a significance level of 5% using the Costat software. When there was a significant difference, a subsequent examination was conducted with the Honest Real Difference Test (HSD) at the same level of significance.

2.2 The Manufacture of Rembiga Satay

The primary ingredient in rembiga satay is sirloin beef. The beef utilized contains no fat or connective tissue**.** The beef undergoes a process of rinsing with a continuous flow of water. The meat that has been cleaned is subsequently diced into cubes measuring approximately 2 cm in length, 0.5 cm in width, and 1 cm in thickness. The ingredients utilized in the preparation of rembiga satay consist of cayenne pepper (6.11%), huge chili (4.07%), dried chili (17.18%), garlic (4.07%), granulated sugar (30.54%), salt (2.04%), flavoring (1.18%), candlenut (2.04%), cooking oil (10.18%), brown sugar (20.34%), and lime (2.23%). The grinding procedure is conducted on cayenne pepper, huge chili, dried chili, garlic, and candlenut. Once the spices have been thoroughly blended, supplementary components including granulated sugar, brown sugar, salt, flavoring, and lime are incorporated.

Subsequently, the meat is combined with a seasoning. The meat portions that have been combined with the seasonings are threaded onto bamboo skewers. Following the process of skewering, the marination stage involves allowing the food to rest at room temperature for a duration of 30 minutes. After marination process, the satay is manually grilled using charcoal fuel derived from coconut shells for a duration of 2-3 minutes until it reaches a cooked state, indicated by the characteristic red-brown coloration of the satay. The rembiga satay, which has undergone the cooling process, is afterwards packaged in a retort bag of 16 cm x 22.5 cm. Each package has 10 skewers, with a weight of 100 g per package. The rembiga satay, which has been placed within the packaging, is afterwards subjected to vacuum sealing using a vacuum sealer.

2.3 Sterilization

The sterilization procedure is conducted immediately following the closure of the retort bag. The sterilization process involves subjecting the materials to a temperature of 121°C for varying durations, including 3 minutes, 6 minutes, 9 minutes, 12 minutes, 15 minutes, and 18 minutes. Following the sterilization procedure, the retort pouch was next subjected to a cooling process at -4°C in a cool box for 15 minutes. This cooling step aims to prevent the regrowth of thermophilic bacteria and prevent overcooking.

2.4 Determination of the sensory quality parameters of retort pouch-packaged products

The sensory quality of the Rembiga satay packed in retort pouches were assessed following a 14-day incubation period at room temperature. The parameter observed in

this research including the scoring and hedonic test. The rembiga satay was evaluated by 25 panelists. The sample was coded and given to each panelist in a random order. The panelists were asked to evaluate the aroma, taste, color, texture and appearance of the samples using a 5-point hedonic scale. The scale points for hedonic test were: 1; dislike extremely, 2; dislike moderately, 3; like slightly, 4; like moderately, and 5; like extremely. Drinking water was provided for cleaning the palate after testing each sample.

3 Results and discussion

3.1 Aroma

The effect of sterilization time on the aroma of rembiga satay in retort pouch packaging can be seen in Table 1 for scoring test and Table 2 for hedonic test.

Table 1. Aroma, Taste, Color, Texture and Appearance of Rembiga Satay in Retort Pouch Packaging Based on Scoring Test

Sterilization duration (minutes)	Aroma	Taste	Color	Texture	Appearance
3	3,55	3,50	2,80^{b}	3,00^{ab}	2,05
6	3,50	3,40	3,35^{ab}	3,10^{a}	2,20
9	3,45	3,55	3,35^{ab}	3,40^{a}	2,15
12	3,40	3,35	3,20^{ab}	2,65^{ab}	2,05
15	3,25	3,50	3,70^{a}	2,45^{bc}	2,00
18	3,10	3,30	3,75^{a}	2,05^{c}	2,15
HSD	-	-	0,615	0,591	-

Different letters in the same column indicate data is significantly different at 5% alpha.

Table 2. Aroma, Taste, Color, Texture and Appearance of Rembiga Satay in Retort Pouch Packaging Based on Hedonic Test

Sterilization duration (minutes)	Aroma	Taste	Color	Texture	Appearance
3	3,00	3,35	3,75^{a}	3,85^{a}	3,95^{a}
6	3,05	3,40	3,55^{ab}	3,70^{a}	3,95^{a}
9	3,25	3,60	3,35^{ab}	3,65^{a}	3,60^{ab}
12	3,20	3,30	3,30^{ab}	3,55^{ab}	3,55^{ab}
15	3,15	3,40	2,95^{b}	3,05^{bc}	3,55^{ab}
18	3,20	3,30	2,90^{b}	2,90^{c}	3,20^{b}
HSD	-	-	0,698	0,549	0,70

Different letters in the same column indicate data is significantly different at 5% alpha.

The effects of sterilization time are not significantly different from the hedonic test or the scoring test of the aroma of rembiga satay packaged in a retort pouch (Table 1 and 2). Based on the hedonic test rate with an average aroma value of around 3 to 3.25 and the criterion is "like slightly". Result from this research is align with another research from Majumdar et al (2015) which shows that flavor of fish in curry medium after processed for 7, 8, and 9 minutes still accepted by panelists with hedonic criterion is "like very much" [9]. Cayanne pepper are used to create the dominant aroma of rembiga satay. The aroma of peppers dominates the rembiga satay's typical aroma. Capsaicin is a terpenoid compound that functions as an aromatic source and it was revealed that volatile compounds are an essential factor in giving food its characteristic aroma [10][11]. The change in aroma of a material can be caused by the decomposition of volatile compounds from the degradation of the components of the compound that will generate a particular characteristic aroma in the food product [12].

3.2 Taste

The perception of taste holds significant importance as it plays a crucial role in influencing the degree of consumer acceptability towards a certain product. According to the findings presented in Tables 1 and 2, it can be concluded that the sterilization time does not yield any noticeable variation in the taste of the rembiga satay packaged in a retort pouch, as determined by hedonic and scoring tests. The hedonic test results for rembiga satay packaged in a retort pouch ranged between 3.3 and 3.6 on a scale from "like slightly" to "like moderately". A research form Majumdar et al (2015) shown that taste hedonic score of curry fish after 7, 8, and 9 processing time is categorized "like very much" [9]. The distinct sweetness of the rembiga satay can be attributed to the incorporation of sugar and palm sugar, which collectively constitute up to 50% of the spice composition. Additionally, the spicy sensation is derived from the presence of capsaicin in the chili and cayenne pepper, which are added in quantities of up to 27% of the rembiga satay seasoning.

3.3 Color

According to Tables 1 and 2, sterilization time has a significantly effect on the color of rembiga satay packaged in retort pouch. Hedonic testing showed that products with a sterilizing period of 3 minutes were preferred more than those with 15 and 18 minutes. Food products in pouch packaging that are processed at high temperatures will produce products whose color quality parameters are still accepted by consumers. For example, food products, made from processed shrimp mixed with spices which is a typical Indian food, the criteria for color parameters based on the hedonic test is liked extremely [13][14]. Nevertheless, increasing the sterilization processing time at high temperatures will have an impact on reducing panelists' preferences for product color [13]. Scoring experiments showed that a 3 to 12 minutes sterilizing treatment created a brownish-red color, whereas a 15 to 18 minutes treatment produced brown. The longer sterilization at high temperatures, the greater the possibility of color changes to darker. Variation in color resulting from variations in sterilization time can be attributed to alterations in the pigment's coloration on the material during the sterilizing process. Pigments degradation oc-curs as a result of the thermal treatment involved in the sterilization procedure. The alteration in color from red to dark brown is attributed to the oxidation of a fraction

of the carotenoid pigment catalyzed by the phenolase enzyme [15]. Furthermore, it has been observed that an increase in sterilization time at elevated temperatures leads to a corresponding intensification of the Maillard reaction, resulting in a darker appearance [16].

3.4 Texture

According to the results of the observations in Tables 1 and 2, the duration of sterilization has a significantly different effect on the texture of the retort pouch packaging in both hedonic and scoring tests. The texture value of rembiga satay decreases as the duration of sterilization increases. A decrease in hardness caused by a prolonged heating procedure would break the protein bonds in the connective tissue, thereby softening the flesh muscles [17]. The hedonic test results of rembiga satay in retort pouch packaging yielded a range of values between 2.9 and 3.75 with the criteria "like slightly" and "like moderately", with the maximum score found in a 3-minute sterilization treatment (3.75), and the lowest score found in an 18-minute treatment (2.9). In contrast, the range of texture scores for Rembiga Pouch is approximately 2.8–3.75 for the criteria "tender" and "too tender," with the maximum score of 3.75 found in the 18-minute process and the lowest score of 2.8 in the 3-minute process. The preference value of the panels on the rembiga satay in retort pouch packaging decreases as the duration of sterilization causes the texture of the sate rembiga to become excessively tender. The panel expresses a preference for a texture parameter with a sterilizing value of 18 minutes. It is noted that a texture that is excessively tender may result in the rembiga satay in retort pouch packaging being easily eaten, which is considered atypical for this particular dish. This finding aligns with the research conducted by Maherawati (2022) which indicates that an increase in sterilization duration is associated with a decrease in product hardness [18]. On the other hand, the result of this research was different from several similar researches which stated that hardness of the product is higher after a longer processing time [13][14][19].

3.5 Appearence

The findings from Tables 1 and 2 indicate that the sterilization time has a statistically significant impact on the sensory evaluation of rembiga satay in retort pouch packaging, as determined by hedonic tests. However, there is no significant influence observed when scoring tests are employed. Significant differences treatment occurred mainly in the short sterilization time of 3 and 6 minutes with the highest sterilization treatment length of 18 minutes. In the hedonic test, a significant difference was obtained with a range of values of 3.2–3.95, with the same preference value of "like extremely" for the treatment of 3 to 15 minutes and a decrease to "like moderately" in the 18-minute treatment. Food packaged in retort pouch that undergo heat processing still accepted by panelists, as shown by Azhari et al. (2023) [20]. However, based on the scoring test, the appearance of the retort pouch packaging is not significantly different and is entirely on the “intact” criterion. This condition happened due to the oxygen and water extraction carried out in the vacuum process can suppress the product that is in the packaging, so that the appearance of this pouch looks like clamping and integrity [21].

4 Conclusions

The sterilization time at 121ºC significantly affected the texture, color and appearance, but did not affect taste and aroma. The increase in sterilization time decreased the panelist's level of preference for the texture, color and appearance of “rembiga” satay in retort pouch. Sterilization for 9 minutes is the maximum sterilization time to produce “rembiga” satay in retort pouch which is preferred by panelists because it has a soft texture, slightly red-brown color and intact appearance.

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