

Sensory Analysis of Pliek U Using the Analytical Hierarchy Process (AHP) Method

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ABSTRACT

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The people of Aceh usually use coconut flesh to produce three derivative products, namely Pliek u oil, Simplah oil, and Pliek u oil. Pliek u is made from coconut flesh (*Cocos nucifera* L.) that has been fermented, dried, and oil-extracted without the addition of microbes. It has developed into a traditional recipe for cooking spices, chili sauce, and salad. Therefore, this study aims to perform sensory analysis on various forms of Pliek u based on its thickness and fermentation time using the Analytical Hierarchy Process (AHP). The product was assessed for certain sensory parameters, such as color, aroma, and taste. According to the preference of the panelists for product acceptance, the sensory criteria with the highest priority weight were taste, aroma, and color at 0.550, 0.230, and 0.219, respectively. The result showed that the highest alternative weight was observed in the Pliek u with a thickness of 30 cm and a fermentation time of 7 days (K3F2) at 0.212, while a thickness of 10 cm and a fermentation time of 3 days (K1F1) were obtained the lowest alternative weight of 0.042. Also, the overall consistency value of Pliek u sensory taste was 0.02, which was acceptable since it was less than the pairwise consistency level of 0.1. According to the descriptive test, the best result was obtained by processing Pliek u at a thickness of 30 cm and a fermentation time of 7 days (K3F2), with a light brown color, no rancid odor, and a slightly sour taste.

1. INTRODUCTION

Pliek u is a traditional Acehnese food made from the fermentation of coconut flesh (*Cocos nucifera* L.). It is prepared by fermenting, incubating, drying, and separating the coconut flesh from its oil [1, 2]. It can be used as a cooking spice through a process that could take about one to two weeks. Most people prefer to store Pliek u for up to one and a half years before consumption [3]. Subsequently, this traditional way of processing coconut is very unique with 100% efficiency since it does not produce useless parts [4]. The importance of Pliek u should be promoted and preserved due to its distinct flavor and its relatively high nutritional value [5], enabling its suitability as a popular traditional food. Taste is a product characteristic that includes appearance, flavor, aroma, and texture. Sensory testing is a method of measuring product acceptance that relies on the human senses (olfaction, taste, touch, hearing, and sight) [6].

Sensory testing is an assessment procedure required to evaluate the taste of Pliek u. It is a collection of sensations in food consisting of sweet, bitter, sour, and salty tastes, which are the tongue's four types of impulses. However, the aroma in a food product can evoke other sensations different from the bitter, sour, sweet, and salty tastes. The process of adding aroma to a food product allows the tongue to taste other flavors depending on the aroma [7].

So far, Pliek u fermentation is still applying the traditional method, and there has been no research that combines variations in thickness and fermentation time. This is important to do because fermentation can affect the taste of

Pliek u. Sensory testing is very important in determining consumer acceptance of a product [8]. It requires an appropriate decision support system, which makes it a subjective process. Analytical Hierarchy Process (AHP) is an example of the decision support system, which is widely used in various decision analyses, such as the selection and packaging of raw materials in the food industry [9], food safety supervision [10], food quality management [11], halal culinary tracking applications [12], selection of raw material suppliers using analytical hierarchy process in food and beverage company [13], decision support systems in the promotion [14]. Other areas include decision support in the field of contractor selection [15], evaluation of sewage treatment plants [16], assessment of product competition [17], selection of Calista product suppliers [18], and many other areas.

1.1 Analytical Hierarchy Process (AHP)

A decision support system was used in order to obtain precise and targeted decisions [19]. AHP is one of the decision support systems used to develop a priority list from a set of options based on multi-criteria, specifically while dealing with complex problems [20]. It is a program that converts qualitative, subjective values into quantitative data (weights) [21].

These support systems are designed to provide information, guide, predict, and direct users to make better decisions [22, 23]. AHP decision model is described as a hierarchy with several levels determined by various factors or criteria. A hierarchy is a multi-level structure that represents a complex

problem. The first level is the goal, which is followed by the levels of factors, criteria, sub-criteria, and others to the final level consisting of alternatives. A complex problem can be broken down into groups and then arranged in such a way that the problem appears more structured and systematic using a hierarchy [24].

Therefore, this study aims to utilize the AHP method to analyze the sensory Pliek u based on variations in thickness and duration of fermentation. AHP method is thought to be very useful in accelerating the decision-making system through pairwise comparisons of available criteria and alternatives. Sensory variables include color, aroma, and taste as criteria considered in pairwise comparisons with alternative products based on variations in thickness and duration of fermentation. Through sensory analysis, the study results are expected to be one of the problem-solving models in product acceptance decisions (Pliek u as traditional food). The decision-making system approach with the AHP method is one method that can continue to be developed in applying sensory assessment of food products.

On the other hand, a sensory evaluation of the quality of Pliek u using the best fermentation time of 10 days [4]. Still, this research did not consider the thickness of the Pliek u collision during the fermentation. For this reason, this research focuses on the study of variations in the thickness of the collision material and the duration of fermentation. Pliek u fermentation for 7 days was the highest time for product acceptance by panelists, but this study focused on the method of measuring time in the Pliek u manufacturing process, namely mechanical and manual measurements [1], fermentation for 7 days with one impact thickness of 30 cm showed the best results [25].

2. MATERIALS AND METHODS

The materials used in this study were digital scales, small transparent plastic containers, jars, and the coconut, which was processed into Pliek u. The first stage involved preparing and weighing the coconuts and grater coconuts. Subsequently, the grater coconut was placed in a plastic container with a 10 cm, 20 cm, and 30 cm pile thickness and fermented for 3, 7, and 10 days, respectively. The ingredients were stirred twice daily during the fermentation process, in the morning and evening. The fermented coconut was dried in a rack-type dryer to about half its original size and squeezed using a hydraulic press.

Therefore, the authorities can make the action faster in order to prevent more danger to road users.

Additionally, this step was conducted to extract the oil from the coconut and hasten the drying process without the release of any additional oil. The preparation of Pliek u is complete when the coconut is completely dried and emits no more oil. AHP method was used to conduct the sensory analysis of color, aroma, and taste. The thickness of the material used in the coconut fermentation process was determined to be 10 cm (K1), 20 cm (K2), and 30 cm (K3), while the fermentation time was determined to be 3 days (F1), 7 days (F2), and 10 days (F3). Lastly, the data was processed using expert-choice software version 11.

2.1 Sensory analysis

Sensory analysis is a test that is based on the process of sensing [26]. Therefore, Pliek u sensory analysis requires

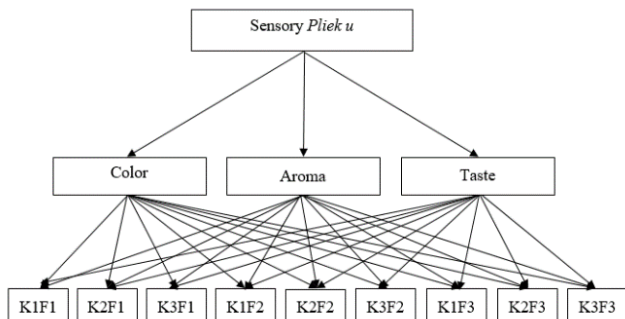
respondents who are familiar with the analyzed product. The respondents were selected from a pool of individuals and tasked with assessing the quality and nature of the product based on subjective impressions. Furthermore, they serve as measuring or assessment instruments while evaluating the sensory properties of food products. Sensory analysis of Pliek u was conducted by 10 randomly selected panelists who determined the acceptance of the product. The panelists were selected based on their previous familiarity with sensory cooking spices, particularly Pliek u. The panelists were selected based on their experience with the processing and production of Pliek u, their familiarity with and fondness for consuming Pliek u both raw and in mixed products, their ability to identify the taste of the product, their willingness to serve as a panelist and understand the assessment procedure used in this study, and the absence of pain that would interfere with or affect the taste-testing process.

The hierarchical structure consisted of three levels. The first level was the sensory Pliek u, which was the main focus of this study. The second level included certain criteria, such as color, aroma, and taste, for ascertaining the sensory Pliek u. Also, the third level was an alternative to sensory Pliek u, which consisted of various thicknesses and duration of Pliek u fermentation, specifically a thickness of 10 cm, 20 cm, and 30 cm at a fermentation time of 3 days for K1F1, K2F1, and K3F1, 7 days for K2F1, K2F2, and K2F3, and 10 days for K3F1, K3F2, respectively. Figure 1 illustrates the hierarchical structure of the sensory assessment.

The panelists could assess the level of importance using a paired comparison scale with a value range of 1-9 based on the hierarchical structure, as seen in Table 1 and Figure 1. Pairwise comparison is any process of comparing paired entities to assess which entity is preferred or has more quantitative properties or whether the two entities are identical or ordinary. Pairwise comparison methods are used in scientific studies related to preferences, attitudes, voting systems, social choices, public choices, requirements engineering, and artificial intelligence (AI) multi-agent systems [27]. The pairwise comparison matrix generates relative weights between criteria and alternatives. A criterion will be compared with other criteria regarding how important it is to the selected choice. For example, the aroma and taste criteria will be compared to how important they are in selecting the acceptance of the product being assessed. Likewise, for alternatives, products A, B, and C will be compared in pairs (and a matrix will be formed) in terms of sub-criteria for the product with the highest level of acceptance.

Table 1. Pairwise comparison scale [28]

Intensity of interest	Definition
1	The two elements are equally important
3	One element is slightly more important than the other element
5	One element is more important than the other
7	One element is clearly more absolutely important than the other elements
9	One element is absolutely important than the other elements
2, 4, 6, 8	Intermediate values
Opposite	If for activity <i>i</i> is get one number proportional to activity <i>j</i> , then <i>j</i> has the opposite value compared to <i>i</i>



- K1F1: Thickness 10 cm, fermentation time 3 days
- K2F1: Thickness 20 cm, fermentation time 3 days
- K3F1: Thickness 30 cm, fermentation time 3 days
- K1F2: Thickness 10 cm, fermentation time 7 days
- K2F2: Thickness 20 cm, fermentation time 7 days
- K3F2: Thickness 30 cm, fermentation time 7 days
- K1F3: Thickness 10 cm, fermentation time 10 days
- K2F3: Thickness 20 cm, fermentation time 10 days
- K3F3: Thickness 30 cm, fermentation time 10 days

Figure 1. Pliek u sensory hierarchical structure

2.2 Expert choice software

The collected data were processed by data analysis using Expert-choice software version 11. Expert-choice is a Decision Support System (DSS) application that enables the selection of a decision based on the Analytical Hierarchy Process (AHP). Additionally, it was selected because it is a relatively simple application that can be used freely for a number of predetermined criteria [29, 30].

Input criteria data for expert choice (color, aroma, and taste) and alternatives (varying thickness of 10 cm, 20 cm, and 30 cm at fermentation times of 3 days, 7 days, and 10 days) were used to analyze the sensory Pliek u. The inclusion of experts was significantly important in analyzing AHP weighting results and determining the acceptability of Pliek u products.

3. RESULTS AND DISCUSSIONS

Sensory analysis is very important in determining the quality of a product, particularly food products. The three general criteria used include color, aroma, and taste, which are thought to be extremely important in determining sensory Pliek u.

The results of Pliek u sensory criteria calculation showed that the selected taste had the highest priority, with a weight of 0.550 and the aroma and color with a weight of 0.230 and 0.219, respectively, as seen in Figure 2. Additionally, Figure 2 explains that the inconsistency ratio for sensory pain was 0.02, indicating that the calculated data was consistent and acceptable because of the Consistency Ratio (CR) < 0.1. The CR is calculated by comparing the Consistency Index (CI) to the Random Index (RI). Panelist acceptance is a preference level for a product. The term "panelist acceptability" refers to the attitude of panelists towards the taste, aroma, and color of the product [31].

Taste is the most important factor compared to aroma and color in determining sensory Pliek u. The taste assessment of Pliek u is determined by the panelists' preference toward the product's taste. Furthermore, this is because taste is the primary factor determining whether a consumer will accept or reject food [32]. Each product has a distinct taste that varies depending on the ingredients and processing method used. The

taste of food is composed of three components, which include smell, taste, and oral stimulation. The overall taste of the food being assessed serves as the interaction unit between these properties. Therefore, consumers will reject food with poor taste, even if its color and aroma are acceptable in the good category [33, 34].



Figure 2. The results of the calculation of the sensory criteria for the taste of Pliek u

Aroma refers to the smell of a food product and a response to the volatile compounds from food, which enter the nasal cavity and are detected by the olfactory system. Additionally, it plays a significant role and can influence the delicacy of a food product, particularly when it comes to food ingredients [35]. Food aromas have a strong attraction and ability to stimulate the sense of smell and appetite [36]. The aroma of food is produced due to the formation of volatile compounds. The fermentation and drying processes have an effect on the aroma produced in Pliek u.

Color is a physical property of a product that can be viewed as both objective and subjective. Also, it is important in food commodities since it contributes to their attractiveness, identification, and quality attributes. Color is the most noticeable among the other properties of food products and gives the most immediate impression of being liked or disliked. This is based on the initial steps taken by an individual while selecting food, such as observing the appearance of the food based on its color [37].

The highest priority sensory alternative for product acceptance was Pliek u, with a thickness of 30 cm and a fermentation time of 7 days (K3F2) of 0.212 (Figure 3). Therefore, it was inferred that the sensory analysis inferred that Pliek u K3F2 had the highest level of acceptance for color, aroma, and taste. Pliek u is at its best when it is light brown in color, smells fresh, and has an appropriate sour flavor. This was supported by [38], indicating that Pliek u is typically brownish in color, rather than black and has a sour taste. The most desired Pliek u by panelists was Pliek u with 7 fermentation times [39]. The longer the process of Pliek u fermentation, the higher the acidity level, which is indicated by a decrease in the pH value [40]. The duration of the fermentation process has an effect on the quality of the product [41].

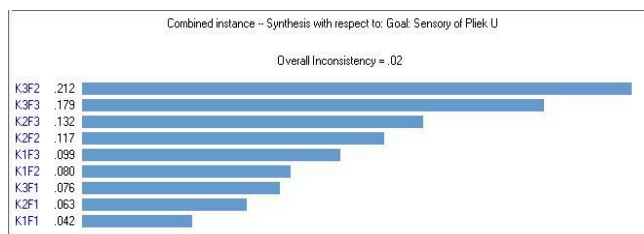


Figure 3. The results of the selection of sensory and taste alternatives for the Pliek u quality

There was no significant difference between the performance sensitivity graph calculation results and the sensory Pliek u selection for criteria and alternatives, as seen in Figure 4. The alternative weights were represented visually using line charts, while the criteria weights were represented visually using vertical bar charts. The overall consistency ratio value for sensory Pliek u using expert choice software version 11 was 0.02. Furthermore, this indicates that the data calculation was consistent since CR is equal to 0.1 and can be used to determine the sensory analysis of Pliek u. The comparison matrix is consistent when the CR value is 0.1. However, the data generated must be reviewed and corrected again when the CR value > 0.1 [42].

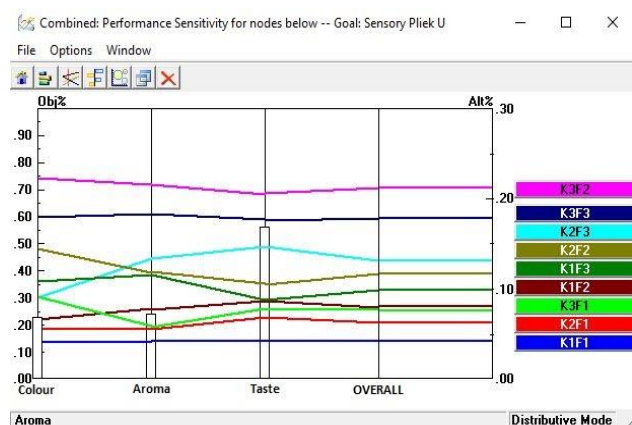


Figure 4. Performance sensitivity graph

Pliek u with a thickness of 30 cm and 7 days fermentation time (K3F2) was more desirable due to the more complex sensory Pliek u produced by this product. The final taste was more delectable, the aroma was less rancid, and the color was more appealing than the other products. The Pliek u with a thickness of 30 cm and 10 days fermentation time (K3F3) produced acceptable sensory results, but the prolonged fermentation process increased the sour taste in this product, which led to an overly sour taste. However, this product had a delectable aroma and an equally attractive color even though it was overly sour. The durability of Pliek u was based on the thickness of the pile, the length of the fermentation, as well as the drying process.

4. CONCLUSIONS

According to the final results of the sensory assessment, the following conclusions can be drawn, The most important criterion to consider while establishing the sensory priority weight Pliek u and ensuring that it is acceptable to panelists is the taste criterion (0.550), followed by aroma (0.230) and color (0.219), Pliek u with a thickness of 30cm and a fermentation time of 7 days was preferred over other products, inferring that its acceptance is affected by its thickness and fermentation time. The appropriate fermentation time will produce a more delectable Pliek u. Meanwhile, it may have an extremely sour taste or no taste at all when the fermentation process is too long or too short. AHP is extremely beneficial for sensory decision-making because it can select the best product. The best sensory Pliek u was selected based on panelists' acceptance of consistent data, which was 0.02. This research is still limited to variations in the thickness of the Pliek u pile treatment and the length of fermentation time.

There are still opportunities for further research related to the shelf life of Pliek u, chemical quality, and post-production handling. The managerial implications of using a decision-making system with the AHP method are an alternative for sensory assessment of food products. Of course, the development through various sensory assessment cases can be considered to facilitate a product acceptance decision.

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