Study on Physical characteristics of Pliek U: comparisons among fermentation stages

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Abstract. Pliek u is most popular food product in Aceh province, made from fermented coconut. There are three derivative products produced from the fermentation process, namely simplah oil, Pliek oil and Pliek U. Prior to be processed, size reduction is performed by means of grating instrument and thus, fermentation is begun. The main purpose of this present work is to systematically study the physical characteristics and compares the effect of fermentation stages to temperature and pH changes. Randomized Complete Design (RAL) with one factor (Length: L) was performed with varied fermentation stages: 4, 7 and 10 days. Least square discriminant test (LSD 5%) showed that the difference in the measurement method in the organoleptic test (colour, smell and taste) of Pliek U, had a significant effect on T and pH, whilst fermentation level stages found to be no significant effect on the organoleptic test of aroma. Based on obtained results, it may conclude that there are differences in the amount of oil and seven day fermentation levels found to be the most acceptable organoleptic test.

1. Introduction

Generally speaking, coconut is one of the most common plants found in coastal area and plays important roles in rural economic life. Coconut (Cocos nucifera. L.), can be utilized as fresh beverages, coconut milk, food additives, and even its waste can be used to meet human needs. One of the most also common practices in utilizing coconut in many rural coastal area is to extract coconut into pure coconut oil. Fresh coconut contains 30-50% of oil, but when dried into copra the fat content reaches 63-65%. Oil content is strongly influenced by the level of fruit maturity. the mature the fruit the higher oil content. Mature coconuts are generally harvested at the age of 11-12 months. Therefore, it is to be believed that optimum harvesting time for coconut is 12 months after flowering and suitable to be extracted onto pure and virgin coconut oil [1].

Coconut oil is one of the most valuable parts in fresh coconut fruit and is widely used as an industrial raw material or as cooking oil. Taking oil from fresh coconut can be performed in several ways. The extraction of oil from the coconut flesh is performed by the fermentation method [2]. Thus, the functionality of coconut oil remains stable and good. The basic principle of this process is to reduce or even avoid the use of heat simultaneously [3].

In Aceh province, coconut is widely used as a material for making special foods, including kuah Pliek u (similar to soup) with the main raw material was coconut. Pliek U is resulted from processed coconut by performing fermentation process. Normally, pure coconut oil is extracted from coconut pulp by a natural fermentation process. After fermentation, the oil is separated from the pulp by pressing.
them. The oil obtained, called Pliek U oil, is used as common cooking oil or ordinary edible oil. On the other hand, coconut pulp is still can be used further as complementary food ingredients or as spices [4].

The processed coconuts produce three derivative products, namely simpah oil, pliek oil and Pliek u. Simpalah oil is a type of oil obtained from the natural fermentation process without being exposed to sunlight and can be used as an antidote for fever and hair oil for children and toddlers. Pliek oil is a type of oil obtained from pressed and fermented coconut pulp which has been dried directly and can be used as cooking oil. Pliek u is a typical foodstuff originating from Aceh Province which has been traditionally used as cooking spices, chili sauce additive and animal feed. Traditionally, pliek u is processed from fermented coconut for maximum 15 to 20 days [5]. Factors influenced fermentation process are temperature, pH and time or level stages [6]. Based from this point of view, we conducted a study to study the physical characteristics and investigate the impact of different fermentation level stages to the quality attributes of Pliek u in term of temperature (T) and pH.

2. Research Methods

2.1. Samples

The main material used as samples in this study is coconut obtained in Montasik, Aceh Besar District. Samples were dried with combination of natural and forced convention by means of self-developed dryers adopted from Hohenheim dryer. Other complementary tools were used are gauges, buckets, digital scales, hydraulic presser, thermometers, Humidity meter, and benchtop pH meter.

2.2. Research procedures and data analysis

This present study was performed and divided onto three stages: preparation, fermentation and drying. The preparatory phase includes determining the amount, stripping, measuring and weighing the coconut from which is used for each sample studied. This research uses factorial completely randomized design (CRD) that includes the fermentation time (L). The fermentation level stages factor (L) consists of three levels: L1 = for 4 days, L2 = for 7 days, and L3 = for 10 days. After fermentation, Plietk U was dried and squeezed using a hydraulics presser. Further, data analysis was conducted to study the changes of Pliek u physical characteristics including yield, water content, T and pH. The data obtained were then analyzed using ANOVA (Analysis of Variance) linear models for each observation are as follows:

\[
Y_{ij} = \mu + N_i + \varepsilon_{ij} \tag{1}
\]

\(Y_{ij}\) : The results of observations on the treatment of the i-th fermentation and the j-th test
\(\mu\) : Calculated mean (middle value) of the population \(Y_{ij}\)
\(N_i\) : Effect of fermentation time on i-level
\(\varepsilon_{ij}\) : Random treatment of the i-th treatment and j-th test

3. Results and Discussion

3.1 Fermentation temperature of Pliek U

Firstly, temperature measurements were attempted and carried out to determine physical changes in during fermentation processes. Data were collected every 2 hours during the fermentation process and stirred twice a day, the stirring is carried out in the morning at 8:00 a.m. and in the afternoon at 16.00 a.m. The results of temperature measurements and changes is presented in Figure 1.
As inferred on Figure 1, the highest average temperature during the fermentation process is 36.6 °C. Evidence of the occurrence of fermented coconut is due to an increase in temperature during the fermentation process. The increase in temperature until it starts from the second day until the third day then the temperature begins to decline as released of *simplah* oil. Similar findings also occurred in [7]. Fermentation temperature is also influenced by environmental temperature because the higher the ambient temperature, it will be the higher the fermentation one. This is supported by the statement of Khathir, et.al. 2018 which mentions the temperature of fermented coconut is also supported by the ambient temperature, therefore the fermentation process takes place continuously, then the change of day and night also triggers changes in temperature [8].

### 3.2 Pliek U drying

Once fermentation is completed, *Plek U* samples were dried in Hohenheim drying chambers. Data collection during drying includes temperature data in the dryer and ambient temperature, relative humidity (RH) in the drying chamber and environment. Typical changes in temperature during Pliek U drying is shown in Figure 2.
Figure 2 shows the temperature and RH in the drying chamber and the environment. The highest temperature in the drying chamber reaches 46 °C and the lowest temperature is 27 °C. Meanwhile, the highest ambient temperature is 35 °C and the lowest ambient temperature is 28 °C. For RH, on the highest drying rack 90% and lowest RH is 30%, while the highest environmental RH is 88% and lowest RH is 51%. In the dryer room of Pliek u, it is obvious that when the temperature rises, RH decreases. Furthermore, steam pressure depends on the humidity of the air. If the humidity is high, then the difference in water vapor pressure inside and outside the material becomes small so that it inhibits the removal of water vapor from inside samples and causes slight transfer of liquid mass flow [9].

3.3 Physical characteristics of Pliek U
Dried and fermented physical properties of Pliek U, including: yield, moisture content and pH, are presented in Table 1.

| Fermentation stage (days) | yield (%) | moisture content (%) | pH |
|--------------------------|-----------|----------------------|----|
| 4                        | 2.98<sup>b</sup> | 8.3<sup>a</sup>      | 5.8<sup>b</sup> |
| 7                        | 1.11<sup>b</sup> | 8.6<sup>a</sup>      | 5.1<sup>ab</sup> |
| 10                       | 0.6<sup>b</sup>  | 9.4<sup>b</sup>      | 5.0<sup>a</sup>  |

Table 1 shows the results of the calculation of the Pliek u yield. The yield is a comparison of outputs and input of research results, presented in the form of a percentage. The yield of Pliek U is calculated to find out the amount of Pliek u obtained after the coconut is fermented and dried. Statistical test results showed that fermentation time did not significantly affect the yield of Pliek U.

Moisture content also determines the quality of Pliek U samples. Water content is a parameter that affects the level of resistance of Pliek u to damage due to high water content can cause by fungal and mold infections [10]. Final moisture content is calculated after the Pliek u drying process is complete. Statistical test results showed that the final water content in Pliek u on 10-day fermentation was significantly different from 4-day fermentation and 7-day fermentation.
Moreover, pH is the degree of acidity used to express the level of acidity or basicity which is owned by a solution. The pH value is influenced by the growth of lactic acid bacteria in the fermentation process. Based on the table 1, it can be seen that the 7-day fermentation time is not significantly different from the 4-day fermentation time and 10-day fermentation time. Whereas the 4-day fermentation time is significantly different from the 10-day fermentation time. Based on this data shows that the longer the fermentation, the degree of acidity of Pliek u decreases.

4. Conclusions
Based on obtained results, we may conclude that fermentation stage is affect Pliek U quality attributes. Nevertheless, fermentation stage has no significant effect on yield. Further, statistical test results showed that moisture content in Pliek U on 10 days fermentation stage is significantly different from other both 4 and 7 days fermentation stages. Longer fermentation would decreased the pH of Pliek U respectively.

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