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Analysis of Water Content, Free Fattyacids and Gross of Crude Palm Oil (CPO) in PKS PTPN IV Ajamu Labuhan Batu

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ABSTRACT

Crude Palm Oil is the raw oil derived from processed palm oil fruit. The main issue in palm oil mills is the decline in CPO quality due to elevated levels of free fatty acids, water content, and gross content, which are essential factors in PKS. The decline in CPO is being caused by one of the factors, which is the oil storage area, specifically the daily tank. The aim of this research is to assess if the quality of CPO meets the standards set by PKS Ajamu through various parameters, including free fatty acid content, water content, and gross content. Observations must also be conducted to oversee the CPO processing process at the PTPN IV Ajamu Labuhan Batu factory. The titration method was used to analyze free fatty acid levels, while the gravimetric method was employed to measure water content and gross content. The research was conducted over a period of 5 consecutive days, and the obtained data was then averaged for free fatty acids, water content, and gross content.

Keywords: *Crude Palm Oil, Free Fatty Acids, Water Content and Gross Content*

1. INTRODUCTION

Indonesia is recognized as the country with the highest number of oil palm plantations globally (Suandi, 2016). Oil palm, scientifically known as *Elaeis quinensis* Jacq, is a plantation crop that thrives in tropical climates within the Palmae family, originating from West Africa (Soraya, 2013).

Crude palm oil, commonly referred to as CPO, is a derivative obtained from palm oil through various processes including sorting, bunch threshing, fruit cooking, and extraction. CPO stands as the primary processed product derived from palm oil (Harahap et al., 2020). Ajamu is a region that hosts a palm oil factory which consistently supplies CPO. Before marketing, the CPO at PKS Ajamu undergoes thorough analysis to ensure quality, as the longer the CPO is stored, the greater the risk of quality deterioration.

Palm oil seeds contain two main components: free fatty acids and water. Excessive free fatty acids can negatively impact the final production results. An abundance of free fatty acids and water is a primary factor in the low quality of crude palm oil (CPO) produced. The Ajamu plantation has an average free fatty acid content of 5% and a moisture level of 0.25% (Hasibuan, 2018).

Water content refers to the amount of moisture present in a sample. A higher percentage of water content results in a lower quality of Crude Palm Oil (CPO) produced. Excess moisture leads to unpleasant odors in the CPO, accelerates oil spoilage, and hastens decomposition (Juniarto and Isnasia, 2021).

The level of impurities refers to materials that cannot dissolve in oil and can be filtered after the dissolution process using a solvent. The impurity value represents substances that are insoluble in oil and can be separated once the oil is dissolved in a solvent. The level of impurities significantly influences the quality of crude palm oil (CPO). A high level of impurities is often caused by insufficient clarification processes in the wet oil tank. Elevated levels of impurities in oil are affected by foaming at the surface and disturbed flow in the wet oil tank, which hinder complete sedimentation in this area.

In oil palm cultivation, particularly in the fruits produced, oil is extracted from the red-coloured flesh known as mesocarp, which is recognized as crude palm oil. The quality standards for PTPN IV Ajamu can be found in Table 1:

Table 1. PTPN IV Ajamu CPO quality standards

Specification	Palm oil
Free fatty acids	3,50%
Water Content	0,15%
Impurity Level	0,020%

Source: Latest Data on PTPN IV Ajamu CPO Quality Standards 2024.

CPO and KPO processing are products that are processed by refinery and extraction factories and produce vegetable oils such as cooking oil and oil that is further processed. In other products, CPO can be used as raw material for industries such as cosmetics, textile fuel and can also be used as animal feed (Syafrianti, 2021).

From the descriptions above, researchers conducted research aimed at identifying free fatty acid levels, water content and impurities in CPO at the PTPN IV Ajamu Labuhanbatu palm oil mill based on previously existing quality standards. So this research is useful as further information regarding the free fat content, water content and impurities in CPO.

2. MATERIAL AND METHODS

The research was conducted at the PKS PT. Perkebunan Nusantara IV Jamu Laboratory, Labuhan Batu District,

located at 2.452660°N, 100.171941°E, in March 2024.

2.1 Process for Determining Free Fatty Acid Levels

In this research, laboratory equipment used includes a hotplate, analytical balance with four decimal places, a 25 ml burette with a scale of 0.05, a 250 ml Erlenmeyer flask, a 100 ml beaker, a 100 ml dropper bottle, a 1000 ml reagent bottle, a glass funnel, a graduated cylinder, and a stirring rod.

The materials utilized are CPO samples with 96% alcohol, which are then neutralized using a 1% phenolphthalein indicator. The standards used are 0.1 N KOH with 0.1 N oxalic acid and deionized water.

2.2 Gross Content Analysis.

The equipment used is a hot plate, 4 decimal analytical balance, drying oven, evaporating cup, stirring rod, and timer. This research uses the example of CPO.

2.3 Impurity Percentage Analysis

This research utilized tools such as a hotplate, 4-digit analytical scale, 100ml beaker, propylene detergent, 500ml filtering flask, Whatman filter paper, 500ml washing bottle, oven, crucible barrel, cooler or desiccator, and stopwatch. When determining impurity levels in CPO samples containing N-hexane.

2.4 Research Procedure

2.4.1 Titration Method for Determining Free Fatty Acids

The CPO sample was heated to 50 degrees Celsius using a hotplate until the oil layer melted, and was then homogenized with a stirring rod. 5 grams of the sample were weighed into a calibrated Erlenmeyer flask, and then 50 ml of 96% alcohol was added to the CPO sample. The mixture was heated on a hot plate at 50 degrees Celsius until it was completely dissolved. Samples that have been heated and titrated with 0.1 N KOH using a burette range in color from yellow to reddish yellow, indicating greater stability. Next, measure the amount of KOH used and record it. The same procedure is followed for the blank or control treatment.

Formula :

$$\%\boldsymbol{ALB} = \frac{(\boldsymbol{mL} \times \boldsymbol{N})\boldsymbol{KOH} \times \mathbf{256} \times \mathbf{100}\%}{\boldsymbol{Sample\ Weight} \times \mathbf{1000}}$$

Notes :
N = Normality of NaKOH after standardization
256 = BM Palmitic Acid(equivalent weight)

2.4.2 Oven Method for Determination of Moisture Content

The CPO samples were heated on a hotplate at 50 degrees Celsius until the oil layer melted, and then stirred with a stirring rod until it became homogeneous. Following that, 10 grams of the sample are measured into a calibrated cup, and then it is heated at a temperature of 105 degrees Celsius for 3 hours. After a duration of 3 hours, the cup was taken out, and the consistent weight was computed. The blank or control treatment is treated in the same way.

Formula:

$$\boldsymbol{Water\ content}\% = \frac{\boldsymbol{W1} - \boldsymbol{W2} \times \mathbf{100}\%}{\boldsymbol{Sample\ gram}}$$

Notes :
W1 : mass of sample porcelain cup before the oven
W2 : mass of porcelain cup + sample after oven process

2.4.3 Gross Concentration Analysis (Gravimetric Method)

The sample of CPO was thinned out by mixing in 50 ml of n-hexane and then heating it on a hot plate until it was fully dissolved. Gently open the tap and slowly pour the oil sample into the filter valve. The beaker was rinsed with an n-hexane solution and then poured into the gooch filter. The process is repeated until

the goch filter glass is free from oil and solvent solution. Then, the filter is taken out of the filtering flask and placed in an oven at 103℃ for 30 minutes. Afterward, the filter is taken out of the oven with crucible tongs and left to cool in a desiccator for 15 minutes. Following that, the goch filter was weighed with the use of an analytical balance. The same procedure is carried out for control or blank treatments, or when samples are not utilized.

Formula :

$$\%\boldsymbol{Dirt} = \frac{\boldsymbol{A - B \times 100\%}}{\boldsymbol{Sample\ Gram}}$$

Notes:
A : initial mass of filter paper before the sample is filtered
B : final mass of filter paper after the sample is filtered

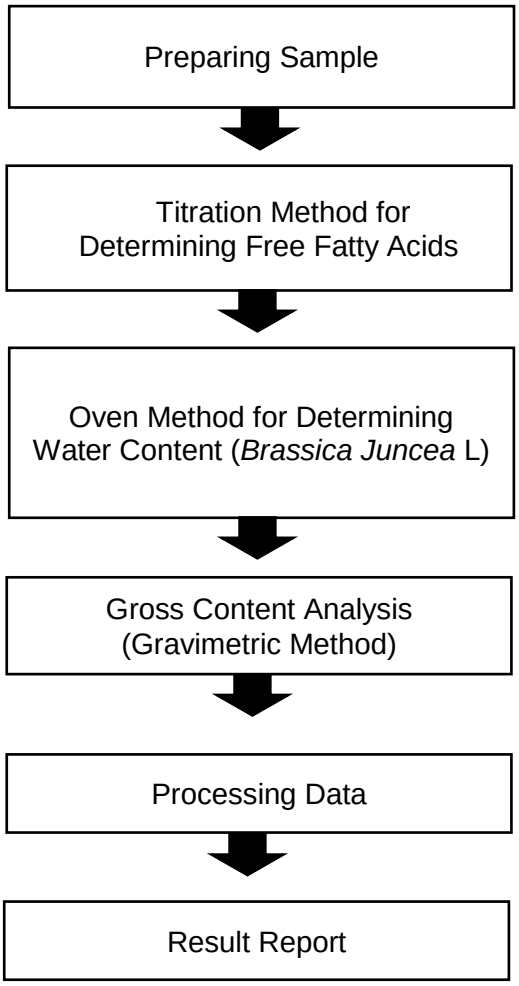

Figure 1. Research Flow Diagram

3. RESULT AND DISCUSSION

3.1 Free Fatty Acids.

Free fatty acids are fatty acids that are not bound as triglycerides (Irmawati, 2013). These free fatty acids are generated through the process of hydrolysis or decomposition and oxidation, which then combine with neutral fats.

After undergoing hydrolysis, palm oil will generate glycerol and free fatty acids. If the reaction lasts longer, a greater amount of fatty acids will be produced. (Marliana & Imam, 2017). The findings from the analysis of free fatty acid levels (ALB) can be found in Table 2.

The processing results in above Table 2 show that the average value of the free fatty acid analysis data obtained is 3.36%. This shows that the free fatty acids in PKS Kebun Ajamu have met the standard set by the company, which is

3.50%. The lowest value occurred on March 1, 2024, and the highest value occurred on March 4, 2024. The fluctuation of free fatty acids throughout the study was attributed to the inclusion of new and restan fruits that were processed during the study.

Table 2. Results of Fatty Acid Levels in CPO Samples

No	Date	Result
1	1 March 2024	2.97%
2	2 March 2024	3.46%
3	3 March 2024	3.34%
4	4 March 2024	3.62%
5	5 March 2024	3.43%
	Average	3.36%

Source: Free Fatty Acid Research Data in the laboratory March, 2024.

The processing results in above Table 2 show that the average value of the free fatty acid analysis data obtained is 3.36%. This shows that the free fatty acids in PKS Kebun Ajamu have met the standard set by the company, which is 3.50%. The lowest value occurred on March 1, 2024, and the highest value occurred on March 4, 2024. The fluctuation of free fatty acids throughout the study was attributed to the inclusion of new and restan fruits that were processed during the study.

3.2 Water Content.

The moisture in CPO is a factor that can lead to biochemical reactions, resulting in the production of free fatty acids from the raw CPO oil. (Silitonga, 2019).

The water content value has an influence on both the quality of the oil and the quality of the oil products produced. According to Yuniva (2010), it is necessary to process the materials intensively as presented in Table 3 in order to achieve the desired oil results.

Table 3. Water content value in the CPO samples used

No	Date	Result
1	1 March 2024	0.11%
2	2 March 2024	0.14%
3	3 March 2024	0.12%
4	4 March 2024	0.16%
5	5 March 2024	0.15%
	Average	0.14%

Source: Water Content Research Data in the Laboratory March 2024.

The data processing results for water content analysis are displayed in Table 3. The obtained data shows that the average water content is 0.14%. The above data indicates that the water content in the Ajamu Plantation PKS meets the standards set by the Ajamu Plantation PKS at 0.15%. The research results are closely aligned with the standards established by PKS. The lowest value occurs on March 1, 2024, and the highest value occurs on March 4, 2024. A problem with the vacuum dryer, which is supposed to reduce the water content in CPO by lowering the temperature and pressure, is causing the high water content.

3.3 Impurity Level.

Impurities are small particles that are unable to dissolve in the CPO processing process using gravimetrics that have been carried out. The screening process of the CPO sample is purified using centrifugation. (Marunduri, 2009). Observation data on impurity levels in CPO is presented in Table 4.

The data processing results for the dirt content in Table 4 show that the

average amount is 0.016%. This value confirms that the dirt content in the Ajamu Plantation PKS meets the standards determined by the PKS, which is a maximum of 0.020%. The lowest value observed in the analysis occurred on day 3, March 3, 2024, at 0.013%, while the highest value was recorded on day 4, March 4, 2024, at 0.019%. The oil refining process is not given maximum attention, leading to high levels of impurities. During the oil refining process, an oil purification tool, also known as an oil purifier, is utilized (Hudori, 2011). Insufficient tool maintenance will lead to a higher level of impurities in the produced CPO. Hence, the retention time method can help decrease the amount of dirt present (Rahayu, 2011).

Table 4. Value of Impurity Content in CPO Samples

No	Date	Result
1	1 March 2024	0.016%
2	2 March 2024	0.014%
3	3 March 2024	0.013%
4	4 March 2024	0.019%
5	5 March 2024	0.018%
	Average	0.016%

Source: Research data on gross levels in laboratories March 2024.

4. CONCLUSION

The table data shows that we can conduct a descriptive analysis of the research results on CPO analysis. This includes various quality parameters such as free fatty acids, dirty substances, and water content in PTPN IV Ajamu PKS. The CPO has the highest fatty acid content of 3.62%, with an average of 3.36%. Additionally, the highest water content percentage is 0.16%, with an average of 0.14%, while the highest impurity percentage in CPO is 0.019%, with an average of 0.016%. Based on the research findings, it can be concluded that the observations in sample 4 on March 4th show that the three parameters have the highest levels, therefore not meeting the CPO quality standards set by PKS PTPN IV Ajamu. However, based on the average value, they still meet the quality standards, which is below the norm. Numerous factors contributed to the high level in the 4th sample, including the restan fruit processing, a faulty vacuum dryer, inattentiveness during processing, and inadequate maintenance, leading to a hydrolysis process during storage.

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