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Determination of Potassium in Empty Bunches Palm Oil (*Elaeis guineensis Jacq.*) Using Flame Photometry Method

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Abstract. Research on the determination of potassium in empty bunches palm oil have been done with the flame photometry method. The samples were taken randomly from five areas in Northen Sumatera with various heights in the range of < 25- 400 m above sea level. The first sampling was of Datuk Bandar district at Tanjung Balai < 25 m, Meranti district at Kisaran 50 to 100 m, Bosar Maligas district at Simalungun 150-200 m, Simarimbun district at Pematang Siantar 250 to 300 m, and the last Sari Matondang district at Sidamanik 350-400 m. The sample was digested using concentrated nitric aid and 30% hydrogen peroxide then heated with the addition of nitric acid concentrated. Potassium content was measured with a flame photometer at $\lambda_{specific}$ 767.5 nm by using calibration methods. The result obtained that potassium contents in the samples were 11.83%; 17.56%; 21.89%; 24.68%, and 25.14% for Tanjung Balai, Kisaran, Simalungun, Pematang Siantar, and Sidamanik respectively. The data obtained showed the higher area of the sea, the lower the temperature so the content of potassium increased in the palm oil empty bunches.

Keywords: Oil Palm Empty Fruit Bunches, Palm, Potassium, Flame photometry

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1 Introduction

Palm oil (*Elaeis guineensis Jacq.*) is a tropical plant that produces vegetable oil which is recognized as the most productive and economical compared to other vegetable oil-producing plants, such as soybean, peanut, coconut, sunflower, and others. (Hadi, 2004).

Based on data from the Directorate General of Plantation, 2012 the area of oil palm plantations in 2011 reached 8,992,824 ha with the largest oil palm land in Riau Province reaching 2,103,175 ha and production of fresh fruit bunches of 36,809,252 tons per year.

The distribution of oil palm plantations in Indonesia covers 19 provinces, including North Sumatra. North Sumatra is a province that has the second largest oil palm area after Riau, which is about 17.53% of the total national oil palm area (Pahan, 2008).

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Oil palm plantations scattered in North Sumatra from the coast to the highlands have different soil fertility. This causes the potassium content in oil palm to be also different (Gerritsma, 1988). The development of oil palm plantations in North Sumatra was followed by the establishment of various palm oil processing industries.

The processing of palm oil from fresh fruit to palm oil produces solid waste in the form of empty palm oil bunches. Oil palm empty fruit bunches (TKKS) are the main waste of around 23% of the palm oil processing. Each processing of 1 ton of fresh fruit bunches will produce about 230 kg of empty oil palm fruit bunches. (Fauzi, 2012).

The main chemical compositions contained in oil palm empty fruit bunches are lignin 22.60%, pentosan 25.90%, cellulose 45.80%, holocellulose 71.80%, and pectin 12.85% (Nuryanto, 2000). Generally, the nutrients contained in the empty fruit bunches of oil palm K_2O are 30%. Potassium in empty oil palm fruit bunches can substitute for potassium fertilizer costs. Potassium fertilizer is a fertilizer that is widely traded and is used as a source of potassium dioxide, which is known as a source of potassium (Pahan, 2008).

Flame photometers are good for metal determination, especially in liquid samples, and provide an easy way of working for the determination of alkali and alkaline earth metals.

Based on the description above, the authors are interested in examining potassium levels in empty fruit bunches of oil palm growing on the mainland of North Sumatra with altitude differences from < 25-400 m above sea level. Oil palm empty fruit bunches were subjected to wet destruction and analyzed by the flame photometry method (Satiadarma, 2004).

2 Materials and Methods

2.1 Equipments

The equipment used in this study includes: Erlenmeyer glass, beaker glass, volume pipette, measuring flask, porcelain cup, funnel, dropper, Whatman No. 42 filter paper, flame photometer (XP 2011), oven, pH meter, analytical balance, and hot plate.

2.2 Materials

The materials used were 1000 ppm potassium mother liquor, concentrated HNO_3, H_2O_2 30%, distilled water, and empty fruit bunches from 5 regions, namely Tanjung Balai, Kisaran, Simalungun, Pematang Siantar, and Sidamanik.

2.3 Preparation of Standard Solution

2.3.1 Preparation of 100 ppm potassium standard solution

A total of 10 mL of 1000 ppm potassium mother liquor was pipetted, put into a 100 mL volumetric flask then diluted with distilled water to the mark and homogenized.

2.3.2 Preparation of potassium standard series solution 1.0; 2.0; 3.0; and 4.0 ppm

From the standard solution of potassium 100 ppm pipette 1, 2, 3, and 4 mL and put into a 100 mL volumetric flask then diluted with distilled water to the marked line and homogenized.

2.3.3 Preparation of potassium standard solution curve

Emissions of 0 ppm potassium standard series solution were measured using a flame photometer at a specific 767.5 nm. The treatment is done 3 times. Do the same for the standard series solution Potassium 1.0; 2.0; 3.0; and 4.0 ppm.

2.4 Preparation of Empty Bunches Palm Oil

Empty bunches palm oil were cut into pieces, washed, and dried in an oven at 105 ºC for 5 hours to remove the moisture content. Then grind it to a homogeneous powder.

2.5 Determination of Potassium

A total of 3 grams of fine dry sample was put into a porcelain cup, added 10 mL of concentrated HNO_3, and heated for 30 minutes at a temperature of 120 ºC until almost dry. After cooling, 3 mL of H_2O_2 30% was added and then 5 mL of concentrated HNO_3 was added until white smoke appeared. Heating was continued for 30 minutes and cooled. After cooling, it was filtered with Whatman filter paper no. 42 and the filtrate were collected in a 50 mL volumetric flask and adjusted to pH 2-4. The emission of the sample was then measured using a flame photometer.

3 RESULT AND DISCUSSION

Table 1. Emission measurement results of K^+ standard solution

Level (ppm)	Emissions
0	0.0000
1	4.6000
2	10.6600
3	15.7667
4	19.6467

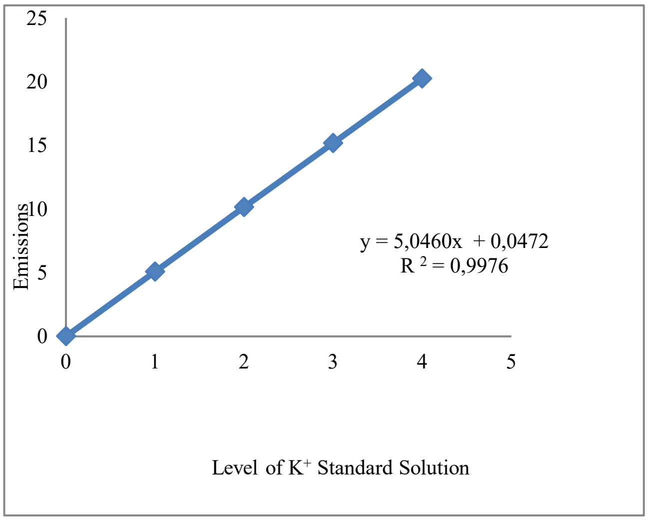

Figure 1. Potassium standard solution calibration curve.

The calibration curve of the potassium standard solution (figure 1) was created by varying the concentration of the K^+ standard solution (Table 1) using the least square equation to obtain a linear line $y = 5{,}0460x + 0{,}0472$. This indicates a positive correlation between concentration and emission (Miller, J.C. 2010).

Table 2. Results of sample emissions measurement

No.	Sample		Emissions
	Region	Height (asl)	
1.	Tanjung Balai	< 25 m	7.1033
2.	Kisaran	50-100 m	10.5667
3.	Simalungun	150-200 m	13.2167
4.	Pematang Siantar	250-300 m	14.8733
5.	Sidamanik	350-400 m	15.1433

The analyte content can be determined using the calibration curve method by substituting the *y* value (emission) obtained from the measurement data against the regression line and calibration curve using the sample emission in Table 2.

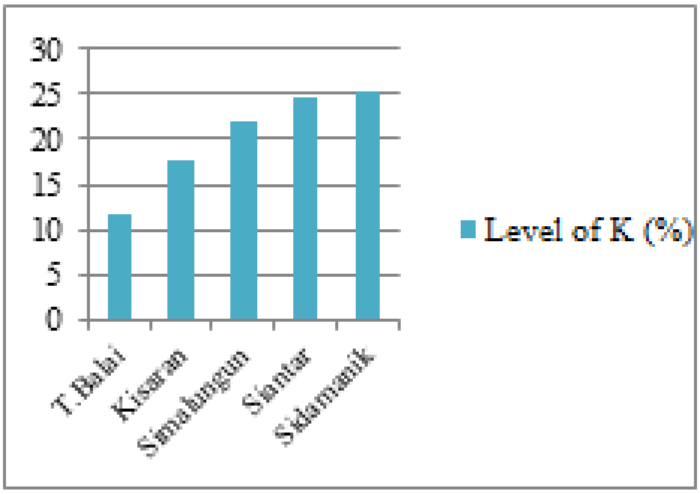

Figure 2. Graph of analysis of potassium level in empty bunches palm oil.

The graph analysis provides information that the empty bunches palm oil from Sari Matondang District, Sidamanik; Simarimbun District, Siantar; Bosar Maligas District, Simalungun; Meranti, Kisaran, and Datuk Bandar sub-districts, Tanjung Balai with altitude differences < 25-400 m above the sea level have different potassium content.

The results obtained indicate that the potassium content in empty oil palm fruit bunches from Sidamanik with an altitude of 350-400 m asl is much greater than Tanjung Balai with an altitude of < 25 m asl. The higher an area above sea level, the lower the temperature which affects the increase in potassium levels in empty bunches. Coastal soil is very easy to cultivate, has the availability of air voids, and has good drainage. However, water absorption, nutrient absorption, and oil palm water potential are less good than in the highlands which causes the potassium content to increase. (Squire, 1990).

4 Conclusion

From the data obtained in this study, it can be concluded that the potassium content of empty bunches palm oil growing in the Sidamanik highlands area is 25.14% higher than the Tanjung Balai coastal area of 11.83%.

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