Determination Of Macro Mineral Content In Fresh Noni Fruit (*Morinda Citrifolia* L.) By Atomic Absorption Spectrophotometry

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Abstract.
This study aims to determine the levels of macro minerals such as potassium, calcium, sodium, and magnesium in fresh noni fruit. The sample of noni fruit was destructed, then quantitative analysis of potassium, calcium, sodium, and magnesium were performed using atomic absorption spectrophotometry (AAS) at a wavelength 766.5 nm for potassium; 422.7 nm for calcium; 589.0 nm for sodium; and 285.2 nm for magnesium. The advantages of this method are selective and sensitive. The average % recoveries were obtained in 109.7 % for potassium; 96.4 % for calcium; 99.7 % for sodium; and 92.4 % for magnesium. This method is very suitable for determining mineral content in fruit as shown in the recovery results and in accordance with the validation requirements.

Keywords: *Noni fruit, macro mineral and atomic absorption spectrophotometry*

I. INTRODUCTION

Morinda citrifolia which belongs to the Rubiaceae family, in Indonesia is generally known as noni or pace.[1] Noni grows wild on beaches, forests, fields, or planted in the yard as a vegetable or medicinal plant. In Indonesia, this Polynesian native plant is found from the lowlands to 1500 meters above sea level (m dpl).[2] Noni fruit contains benefits such as antihelminthic, analgesic, antibacterial, antitumor, anti-inflammatory, immunostimulant,[3] as well as antifungal, antioxidant, anticancer, and antiarthritic.[4]Mineral sources can come from plants or animals. Based on previous research, noni contains 31.15 mg/100g calcium, 19.65 mg/100g magnesium, 308.95 mg/100g potassium, and 201.5 mg/100g sodium.[5]Atomic absorption spectrophotometry,[6,7] inductively coupled plasma optical emission spectroscopy (ICP OES)[8,9] and flame atomic spectrometry,[10] were obtained to analyze macro and micro minerals in fruits and vegetables. The most widely used method for mineral analysis is atomic absorption spectrophotometry,[11] because its implementation is relatively simple and has high sensitivity (detection limit is less than 1 ppm).[12]

II. EXPERIMENTAL

Measurements operated by a Shimadzu Atomic Absorption Spectrophotometer complete with potassium, calcium, sodium, magnesium cathode flames. Noni fruit was found in the Medan City area, North Sumatera Indonesia and raw materials of potassium, calcium, sodium, and magnesium were issued by E-merck with pro-analytical quality.Noni fruit samples as much as 25 g was dry destructed at a temperature of 500^{o}C for 24 hours, then dissolved with HNO_3 and filtered by whatman paper. This solution is used for quantitative analysis.Each standard solution of potassium, calcium, sodium and magnesium (concentration 1000 µg/ml), made up to a concentration of 10 µg/ml, then made concentration of 0,2 µg/ml; 0,4 µg/ml; 0,6 µg/ml; 0,8 µg/ml dan 1 µg/ml for potassium and calcium, 0,1 µg/ml; 0,2 µg/ml; 0,3 µg/ml; 0,4 µg/ml dan 0,5 µg/ml for sodium and 0,02 µg/ml; 0,04 µg/ml; 0,06 µg/ml; 0,08 µg/ml dan 0,10 µg/ml for magnesium and absorbance was measured at a wavelength of 766.5 nm for potassium, 422.7 nm for calcium, 589.0 for sodium and 285.2 nm for magnesium with an air-acetylene flame.Then the determination of potassium, calcium, sodium, and magnesium content in the sample were carried out. Method validation was validated based on accuracy, precision, LOD and LOQ.

III. RESULTS AND DISCUSSION

The calibration curves for potassium, calcium, sodium, and magnesium were obtained by measuring the absorbance of standard solutions of potassium, calcium, sodium, and magnesium at their respective

wavelengths. From the measurement of the calibration curve for the four minerals, the regression line equation can be seen in Table 1.

Table 1. The Calibration Curve of Macro Minerals

No.	Macro Mineral	Calibration Curve
1.	Potassium	Y = 0,60215 X + 0,09613
2.	Calcium	Y = 0,07545 X + 0,01815
3.	Sodium	Y = 0,78680 X + 0,12560
4.	Magnesium	Y = 3,82050 X + 0,01291

The calibration curve for standard solutions of potassium, calcium, sodium, and magnesium can be seen in Figure 1.Based on the under curve obtained a linear relationship between concentration and absorbance, with a correlation coefficient (r) potassium of 0.9999; calcium is 0.9996, sodium is 0.9975, and magnesium is 0.9999. The value of r≥0.97 indicates a linear correlation which states that there is a relationship between X (concentration) and Y (absorbance).[13]

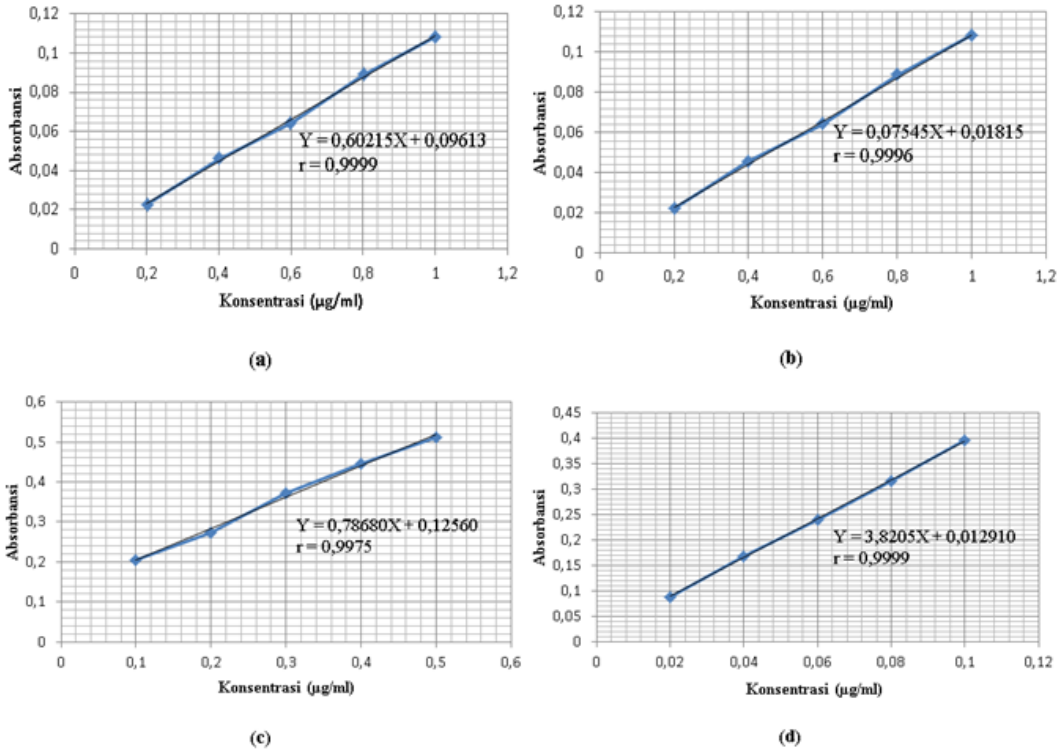

Fig 1. Calibration Curve of (a) Potassium, (b) Calcium, (c) Sodium, and (d) Magnesium

Determination of potassium, calcium, sodium, and magnesium levels was carried out by atomic absorption spectrophotometry. The concentration of potassium, calcium, sodium, and magnesium minerals in the sample was determined based on the regression line equation of the calibration curve of each mineral's standard solution.For the atomization of these metals, a fuel and an oxidizing agent, namely air-acetylene, are used. The temperature of this fuel mixture is about 2300^{o}C. This temperature cannot make calcium compounds into neutral atoms, because calcium atoms are refractory or difficult to decompose.[14] To overcome this, in the process it is necessary to add a compound, namely lanthanum oxide (La_2O_3), so that refractory calcium compounds are easily separated from their compounds and become neutral atoms.The results of the quantitative analysis of potassium, calcium, sodium, and magnesium minerals in the sample can be seen in Table 2.

Table 2. Results of Quantitative Analysis of Macro Minerals in the Sample

Sample	Potassium (mg/100g)	Calcium (mg/100g)	Sodium (mg/100g)	Magnesium (mg/100g)
Noni	227,0243 ± 3,3339	223,2223 ± 4,5232	163,7351 ± 4,1028	7,1779 ± 0,1392

The percentage recovery of potassium, calcium, sodium, and magnesium in the sample can be seen in Table 3.

Table 3. Percent Recovery Test of Macro Mineral Levels in Fresh Noni Fruit

No.	Macro Minerals	Recovery (%)	Requirements Recovery Range (%)
1.	Potassium (K)	109,7	80 – 120
2.	Calcium (Ca)	96,4	
3.	Sodium (Na)	99,7	
4.	Magnesium (Mg)	92,4	

Based on the table above, it can be seen that the average recovery test results for the potassium content of noni is 109.7%; for noni calcium content is 96.4%; for noni sodium content is 99.7%; and for noni magnesium content is 92.4%.The percent recovery shows satisfactory accuracy of work when examining the levels of potassium, calcium, sodium, magnesium, and iron in the sample. The results of this recovery test meet the specified accuracy requirements, if the average recovery results are in the range of 80% – 120%.[13]From the calculations that carried out on the measurement data for the mineral levels of potassium, calcium, sodium, and magnesium in noni, the standard deviation values (SD) and the relative standard deviation values (RSD) were obtained.

Table 4. The Value of SD and RSD

Minerals	SD (%)	RSD (%)
Potassium	1,69	1,55
Calcium	2,55	2,65
Sodium	0,97	0,97
Magnesium	0,19	0,20

The value of the relative standard deviation (RSD) for analytes with a part per million (ppm) content is not more than 16% and for an analyte with a part per billion (ppb) RSD content is not more than 32%.[15] From the results obtained indicate that the method used has good precision.From the calculation results obtained for the measurement LOD and LOQ of potassium, calcium, sodium and magnesium as follows

Table 5. The Value of LOD and LOQ

Minerals	LOD (µg/ml)	LOQ (µg/ml)
Potassium	0,0116	0,0387
Calcium	0,0298	0,0994
Sodium	0,0391	0,1302
Magnesium	0,0017	0,0055

From the calculation results above, it can be seen that all the results obtained in the sample measurement are above the limit of detection (LOD) and the limit of quantitation (LOQ).

IV. CONCLUSION

The results of this study indicate that the atomic absorption spectrophotometry method can be used to analyze the mineral content in the noni fruit (*Morinda citrifolia* L.), where the results are in accordance with the requirements of the validation method, namely accuracy, precision, LOD and LOQ.

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