VOL. 12, NO. 24, DECEMBER 2017 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

TEA LEAVES EXTRACT AS A NATURAL REAGENT FOR QUANTIFICATION OF COPPER USING SEQUENTIAL INJECTION ANALYSIS (SIA)

Armindo Da Costa, Hermin Sulistyarti and Akhmad Sabarudin
Department of Chemistry, Faculty of Mathematic and Natural Science, Brawijaya University, Malang, Indonesia
E-Mail: sabarjpn@ub.ac.id

ABSTRACT

Green chemistry system that utilizing natural extract as natural reagent for determination of metal ions has been investigated. The tea leaf extract has been utilized for copper quantification. The tea leaf extract was prepared in hot water (60 ^{0}C). Optimum condition obtained by 400 µL of tea leaves extract, 18 seconds of reaction time, 65 µL/s of flow rate and 0.078482 ppm of detection limit of Cu(II) ion. The tea leaf extract can be applied as a natural reagent for quantification of Cu(II) ion using Sequential Injection Analysis (SIA).

Keywords: tea leaf extract, natural reagent, Cu (II).

INTRODUCTION

Chemical analysis methods involve a number of operational steps like sampling, reagent preparation, analysis, and waste disposal. Excessive consumption of harmful substances and produced waste causes environmental pollution and gives negative effect on health. Thus, the concept of green chemistry is highly required to minimize or avoid the production of harmful solvent, reagent, and waste [1].

The purpose of green chemistry is to discover alternative reagents or substitutive synthetic methods which can reduce the use of hazardous / poisonous chemicals. One of the approaches to acquire the analysis method which is environmentally friendly is by utilizing natural compounds contained in plants for alternative reagents, and guava leaf extract has been one of the widely-used natural compounds containing chemical substances which function for whitening, anti-pigmentation, anti-bacterial, and diabetes prevention. Besides, guava leaf extract is an alternative natural compound used to identify ferrous metals through flow injection method [3].

Tea leaves can be used as a natural reagent. Tea leaf extract contains polyphenol which has several benefits for health. Main phenolic compounds in tea leaves are in the forms of catechin, *epigallocatechin gallate* (EGCG) and *epicatechin gallate* (ECG). One of polyphenol characteristics is its ability to absorb metal/iron. Polyphenol compounds, especially catechin, can reduce and bond chelate, in which ferrous metal ions formulate complex Fe-polyphenol [1]. With regard to the above principle, tea leaf extract is worth-researching in terms of its use to complexify metal identification, such as Cu (II) through the formulation of complex Cu-polyphenol [2].
Considering the importance of natural reagent as a complexifying mediator to minimize the use of hazardous chemicals and the significance of copper analysis, this research applies some steps, i.e. the production of tea leaf extract as a natural reagent and the quantification of copper by SIA with tea leaf extract as a complexifying agent maximized by the volume optimization of tea leaf extract, the reaction rate (delay time), the product flow rate towards the detector, and the determination of copper content from water samples.

METHOD

The standard solution of 1000 ppm Cu (II) is made by dissolving 0.393 gram of $CuSO_4.5H_2O$ in water.

Tea leaf extract is prepared in 100 ml of hot water and cool water; each contains 5 gram of tea leaves and 100 ml of water. The suspense is refined, and the extract is daily prepared.

Sequential Injection Analysis (see picture-1) with its system consists of syringe pump, holding coil, valve mixing, syringe valve, and detector.

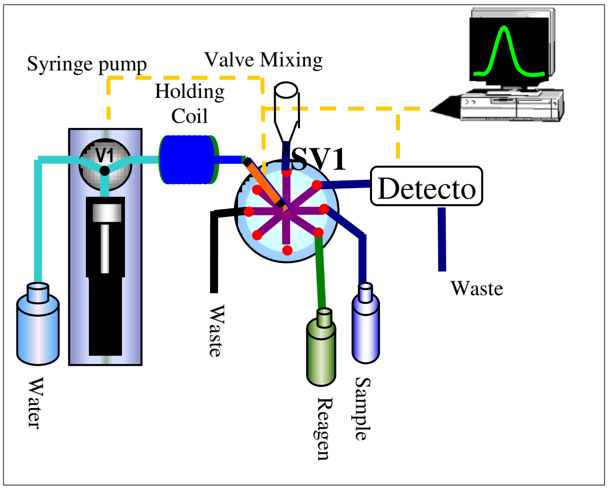

Figure-1. Sequential injection analysis (SIA) system.

RESULT AND DISCUSSIONS

Volume optimization of tea leaf extract

Picture 2 shows that the increase of tea leaf extract volume leads the absorption better. This optimization result shows that an increase of absorbance

ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

occurs in the tea leaf extract volume of 0.2-0.6 mL, yet it decreases in the volume of 0.8-1 mL. It can be concluded that the higher the volume of tea leaf extract is, the lower the absorption will be. It occurs because the number of reagent used cannot formulate Cu(II) to be used to react with the volume of tea leaf extract. Thus, the optimum volume of tea leaf extract used in this research is 0.6 mL.

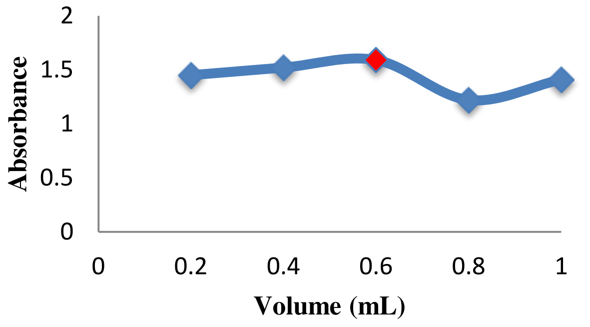

Figure-2. Relation curve between the volume of tea leaf extract and absorbance.

Optimization of delay time

Reaction time (delay time) may influence the absorption result of tea leaf Cu-Extract to be measured by detector. Thus, reaction time needs to be examined. The variation of delay time is made to formulate complex compound of tea leaf Cu-extract in VM. The variation time is 3, 8, 13, 18 and 23 seconds. The result of the research can be seen in picture-3.

Picture-3 shows that the longer the reaction time is, the higher the absorbance will be and it occurs up to certain point. When it reacts too long, the absorbance decreases. The optimum value of the reaction time is 18 seconds.

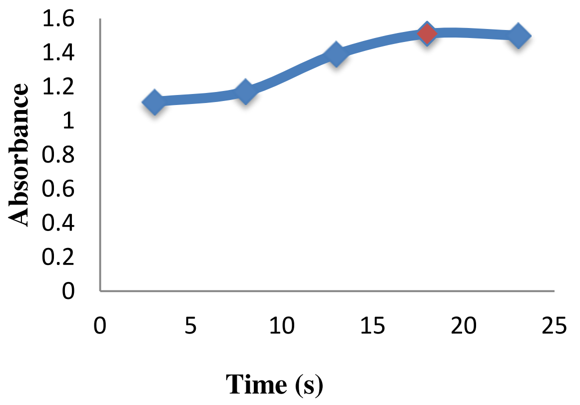

Figure-3. Relation curve between reaction time and absorbance.

Flow rate optimization

Flow rate is highly significant in the process of measuring absorption to find out the capability of detector in detecting the absorption of tea leaf Cu-Extract.

Picture-4 shows that the absorption increases in the flow rate of 50 to 55 µL/s. It concludes that detector is more capable of detecting the absorption of tea leaf Cu-Extract. However, it decreases in the rate of 55 to 70 µL/s, which means some flows (absorption) are not able to be measured by detector and leads into dispersion by carrier when they are heading to detector. From the above data, the absorption is 1.07 in the flow of 55 µL/s.

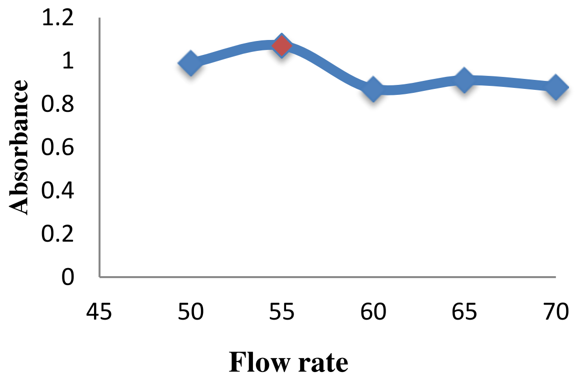

Figure-4. Flow rate formation curve.

Standard curve formation

The research results in the picture 5. shows that the bottom curve is linear enough by seeing its linear price (R) as much as $R^2 = 0{,}9955$. When R is heading to 1, the curve line is more linear. Linear line is found from the data.

The data in picture 5 illustrate that the equation of linear regression in y = ax+b is y = 0,1387x + 0,1033 where a (slope) = 0,1387 and b (intercept) = 0,1033.

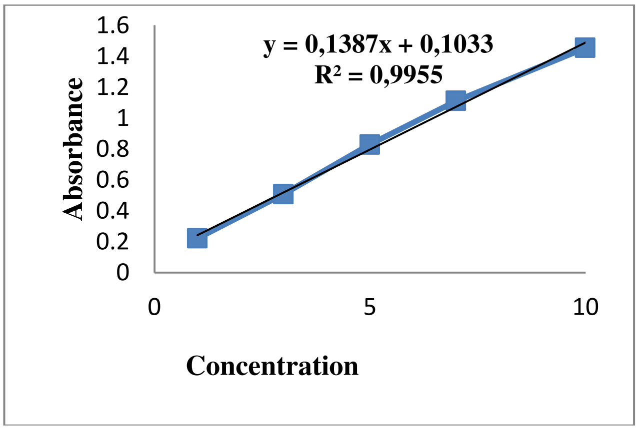

Figure-5. Standard curve formation of Cu(II).

Measurement of Cu (II) in tap water

The copper measurement based on SI-VM is applied into a sample of tap water around the University of

Brawijaya, Malang. Table-1 shows the measurement result of the tap water sample.

Table-1. The result of cooper measurement on tap water.

Tap water sample	**Concentration** (ppm)
Sample A	8.844
Sample B	7.955
Sample C	9.469

The absorbance results are measured using RGB colorimetric detectors. The result obtained is plotted into the equation of calibration curve y = 0.1387x + 0.1033 with R^2 = 0.9955.

CONCLUSIONS

Based on the results of this study the following conditions are drawn:

- The process of determining Cu(II) based on SIA can be administered by examining the optimum condition of complex compound formation of tea leaf Cu-extract and the limit of detection (LOD). The optimization result is reached, tea leaf extract volume 400 µL, reaction time 18 seconds, flow rate 65 µL/s and LOD which was 0.078482 ppm.
- Cu(II) content in tap water with different location distance of the sampling point A, B, and C is tap water sample of point A 8.844 ppm, tap water sample point B 7.955 ppm, and tap water sample point C 9.469 ppm.

REFERENCES

[1] Piyanut Pinyou, Supaporn Kradtap Hartwell, Jaroon Jakmunee, Somchai Lapanantnoppakhun, and Kate Grudpan. 2010. Flow Injection Determination of Iron Ions with Green Tea Extracts as a Natural Chromogenic Reagent. Analytical Science. 26: 619-623.

[2] Ṙužička J. & Hansen E. H. 1975. Flow injection analyses: Part I. A new concept of fast continuous flow analysis. Analytica Chimica Acta. 78(1): 145-157.

[3] Settheeworrarit T., Hartwell S. K., Lapanatnoppakhun S., Jakmunee J., Christian G. D. & Grudpan K. 2005. Exploiting guava leaf extract as an alternative natural reagent for flow injection determination of iron. Talanta. 68(2): 262-267.