

# Analysis of Cadmium Metal in Facial Moisturizing Cream with Atomic Absorbtion Spectrophotometry Method

Hilda Ardhya GAP\*, Annisa Chiyarotul Wardah\*, Pipit Rachmawati\*

\*Department of Chemistry Education, Universitas Negeri Yogyakarta

## Article Info

### Article history:

Received Oct 5<sup>th</sup>, 2017

Revised Oct 30<sup>th</sup>, 2017

Accepted Nov 17<sup>th</sup>, 2017

### Corresponding Author:

Hilda Ardya GAP

Dep. of Chemistry Education

Universitas Negeri Yogyakarta

Email:

hildardhyagap@gmail.com

## ABSTRACT

This study aims to determine the concentration of cadmium (Cd) metal content in various facial moisturizing creams with atomic absorbtion spectrophotometry (AAS). Samples were analyzed in the form of 6 brands of facial moisturizer cream that sold in market and selected randomly. The cream samples were destructed by wet destruction method. Next, the samples of destruction result were analyzed by atomic absorbtion spectrophotometry method with wavelength about 228.8 nm to determine the concentration of cadmium. The results of this research showed that there was cadmium (Cd) metal content in the 2 samples of facial moisturizing cream that analyzed. Cadmium metal concentration on brand A is  $0.1389 \pm 2.7817 \times 10^{-3}$  ppm and and brand B is  $0.1321 \pm 2.6468 \times 10^{-3}$  ppm. Based on this result, the moustirizing creams are safe to use due to the BPOM regulation

**Keyword:** facial moisturizing cream, cadmium, atomic absorbtion spectrophotometry

## 1. INTRODUCTION

Cosmetics derived from the Greek, which is from *kosmein* word which means ornate, is the material used in effort to beautify themselves. Although not a primary requirement, cosmetic is one product that is used regularly and continuously, especially by women. One of the most frequently used cosmetics is moisturizer. As a part of cosmetics, there are many active ingredients deriving from fish, meat and dairy products (Barbulova, Colucci, & Apone, 2015). Facial moisturizer is used by applying it evenly to face and neck. Facial moisturizer is very beneficial for the skin because it can moisturize the skin, prevent dry skin, tighten the skin, restore the brightness of the skin, and can remove the marks of black spots in a short time.

Currently some cosmetics especially facial moisturizers are found to contain heavy metals (Okereke, Udebuani, Ezeji, Obasi, & Nnoli, 2015). Heavy metals contained in cosmetics are generally impurities (impurities) on the basic ingredients of cosmetics. The excessive content of heavy metals in cosmetics whether added intentionally or unintentionally is not justified because the heavy metals will be in direct contact with the skin. When absorbed, heavy metals will enter the blood and attack the organs of the body resulting in various diseases. Heavy metals often found in cosmetics are lead, cadmium, mercury and arsenic (Sahu, Saxena, & Johmson, 2014). Research has proven that heavy metals contained in cosmetics when used continuously can cause some disruption to the body so that in some countries heavy metal use has been banned.

Heavy metals can have disruptive effects on human health, depending on which part of the heavy metal is bound in the body and the amount of exposure dose. Toxic effects of heavy metals

are able to block the action of enzymes that interfere with the body's metabolism, causing allergies, mutagenic, teratogenic, or carcinogens for humans and animals. Toxicity levels of heavy metals to humans from the most toxic are Hg, Cd, Ag, Ni, Pb, As, Cr, Sn, Zn (Jaishankar, Tseten, Anbalagan, Mathiew, & Beerogowda, 2014). Heavy metal cadmium (Cd) is one of the common contaminants found in various cosmetic products, one of which is a facial moisturizer. The concentration of cadmium in cosmetic sample based on BPOM stipulation Number HK.03.1.23.08.11.07331 Year 2011 is 1 ppm.

The presence of heavy metals Cd in cosmetics can cause serious problems to consumers such as causing skin problems, skin allergies, and skin cancer (Sukendar, Jaspreet, Sneha, & Munish, 2012). Further, it pushes towards inflammation within the veins or tissues, resulting in osteoporosis (Farr, 2009). Based on the above description, it is necessary to identify and determine the content of cadmium metal (Cd) on facial moisturizer with Atomic Absorption Spectrophotometric (SSA) method. This study aims to identify and determine the content of Cd content in facial moisturizers with atomic absorption spectrophotometry.

## 2. RESEARCH METHOD

### Tools and Materials

The tools used in this research were AAS, glassware, hot plate, whatman Paper No. 41, analytical balance, spatula and flakon bottles. Materials used are facial moisturizer cream, concentrated HCl, concentrated HNO<sub>3</sub>, H<sub>2</sub>O<sub>2</sub>. Samples of facial moisturizer products were taken by random on the market which were A, B, C, D, E and F.

### Destruction of sample

Samples weighed as much as 1 gram, incorporated into erlenmeyer added 11.25 mL concentrated HCl and 3.75 mL concentrated HNO<sub>3</sub>, heated on a hot plate and covered with a watch glass. The solution was heated to boiling for ± 10 minutes above the hot plate, then the opened glass glaze was added drop by drop 2 mL of H<sub>2</sub>O<sub>2</sub> and heated until the color changed to clearer than the original solution. Erlenmeyer is lowered from the top of the hot plate and cooled, then the solution is filtered by Whatman no. 41. The resulting solution of the obtained destruction is then fed into the flakon bottle.

### Measurement of Cd concentration

The AAS equipment is prepared and optimized in accordance with the instructions for its use. Standard solutions and samples were measured in absorbance by means of AAS. The calibration curve was made by plotting between standard concentrations with absorbance measured by AAS tools. After that the linear regression line equation is determined by using standard calibration curve. To calculate the metal content of Cd can be determined by using the formula:

$$X = \frac{Y - b}{a}$$

Where as:

X = metal concentration in sample solution

Y = atomic absorption value

b = tangent point of the curve line on the Y axis

a = slope (trend) curve line

### Preparation of Standard Solutions

Standard solutions were prepared by taking 5 ml of a standard solution concentrating Cd 1000 mg/L. Put into a 50 ml measuring flask. This concentration is then re-diluted to a concentration of 0.1 mg/L; 0.2 mg/L; 0.3 mg/L; 0.4 mg/L, and 0.5 mg/L.

### Data analysis

Data analysis was done descriptively through measurement data using SSA. The data are presented in tables and graphs, then compared with the Regulation of the Head of BPOM Indonesia on Cosmetic Analysis Method of 2011.

### 3. RESULTS AND ANALYSIS

The aim of this research were to know the presence of cadmium metal and to know how much the content of cadmium metal in facial moisturizing cream samples on several brands circulating in the market, namely A and B brands, using Atomic Absorption Spektofotometry (AAS) method. This method was chosen because it is appropriate for determining small amounts of dissolved metals, in addition the analysis is sensitive, meticulous, and relatively simple working.

One of the producers uses materials that contain metal compounds because metal compounds provide brighter colors to cosmetic products, such as cadmium metal. It can replace the yellow pigment that present in oranges. The use of cosmetics contaminated with heavy metals is harmful for health because if used in the long term will cause damage to the skin, such as allergies, irritation can cause skin cancer (Sukendar, Jaspreet, Sneha, & Munish, 2012).

Samples in this research are several brands of face moisturizing cream. To determine the cadmium content in the sample, the first step is destruction of sample. The destruction in this research is wet destruction. Wet destruction is the reshuffling of organic metal samples into free inorganic samples, using strong acids either singly or mixed, then it is oxidized by an oxidizing agent. In this research used concentrated oxidizing acids such as HCl, and HNO<sub>3</sub> with heating to clear as well as H<sub>2</sub>O<sub>2</sub> as a catalyst to accelerate the reaction of cadmium disconnection (Cd) from organic compounds present in the sample. Hydrochloric acid is often used in samples to help accelerate the occurrence of oxidation reactions. HCl is a strong oxidizing agent, though the time required for decomposition is long enough. Therefore, in this research used a mixture of HCl and HNO<sub>3</sub> to speed up the process of decomposition. Both are strong oxidizing agents. With the addition of this oxidizer, it can decrease the temperature of the material digesti at 350°C. Thus the components can evaporate or decomposed at high temperature can be maintained.

The type of catalyst used in this research is the catalyst that affects the environment, so the catalyst does not participate reacts. The reactions that occur in this wet decomposition process are:



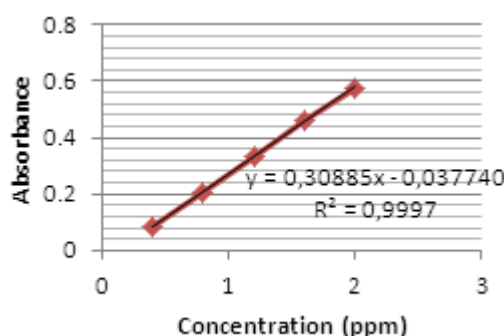
The next step is heating process to complete the process of decomposition. Heating provides a number of energies to break the chemical bond, so the metal Cd can be released from sample. The perfection of the wet destruction is characterized by the presence of a clear solution to the decomposition solution, indicating that all existing constituents are completely dissolved or the reshuffling of organic compounds has proceeded well. The salt compounds formed in the decomposition process are stable salt compounds and can be stored within a few days. Further decomposition results were analyzed using atomic absorption spectrophotometry method. This method is chosen because it has high selectivity and accuracy for both qualitative and quantitative analysis.

Qualitative analysis for cadmium is done by operating sample on the AAS with wavelength of 228.8 nm. If the sample shows absorption, it is certain that the sample contains cadmium metal. Quantitative analysis is used to determine the level of cadmium contained in the sample. In determining cadmium absorbance, a standard solution is required. The standard solution is made with concentrations of 0.4 ppm, 0.8 ppm, 1.2 ppm, 1.6 ppm, and 2.0 ppm. the data as shown in the Table 1 below.

**Table 1.** The absorbance of various standard solutions of Cd

No.	Concentration (ppm)	Absorbance
1.	0.4	0.0864
2.	0.8	0.2050
3.	1.2	0.3345
4.	1.6	0.4638
5.	2.0	0.5747

From the data above, we can make a curve of the relationship between absorbance versus the concentration of cadmium standard solution at various concentrations to obtain linear regression equation,  $Y = 0,30885x - 0,037740$ . The absorbance relationship curve versus the concentration of standard cadmium solution can be seen in Figure 1 below.

**Figure 1.** the calibration curve of standard solution of Cd

To determine whether there is correlation between absorbance and concentration of standard solution of cadmium, then tested correlation by using product moment  $r$  and then tested its linearity with F test. Number of  $r$  table at significance level 1% about 0.959 and the number of  $r_{xy}$  from experiment about 0.9997. This shows that the  $r$  table number is less than the  $r_{xy}$  number, so there is the significant correlation between absorbance and the concentration of cadmium standard solution.

From the calculation obtained the number of regression F equal to 1943.86. It is bigger than the number of F table at the significance level 1% with db 1 versus 3 equal to 34.21. Thus the regression line equation  $Y = 0.30885x - 0.037740$  is linear.

The results of measurement of Cadmium metal (Cd) in facial moisturizing cream using atomic absorption spectrophotometer can be seen in Table 2 below.

**Table 2.** The concentration of Cadmium metal in facial mousturizing cream

Sample	Measurement (ppm)			
	1	2	3	Average
A	0.1403	0.1371	0.1394	$0.1389 \pm 2.7817 \times 10^{-3}$
B	0.1339	0.1316	0.1309	$0.1321 \pm 2.6468 \times 10^{-3}$

Based on the theory, the value of cadmium metal threshold in cosmetic products that is still declared safe according to BPOM is 1 ppm, so that the six brands of facial moisturizer products are still below the threshold, so that the products can be declared safe from the danger of cadmium metal content.

#### 4. Conclusion

The conclusions obtained from the research of cadmium metal content analysis (Cd) in samples of face moisturizing cream with Atomic Absorption Spectrophotometry (AAS) method, is the content of cadmium metal (Cd) in each sample with the average cadmium metal (Cd) in sample A is  $0.1389 \pm 2.7817 \times 10^{-3}$  ppm and  $0.1321 \pm 2.6468 \times 10^{-3}$  ppm in product B.

#### REFERENCES

- Barbulova, A., Colucci, G., & Apone, F. (2015). New Trends in Cosmetics: By-Products of Plant Origin and Their Potential Use as Cosmetic Active Ingredients. *Cosmetics*, 82-92.
- Farr, G. (2009). *The Hair Tissue Mineral Analysis/Why Heavy Metals Are A Hazard to Your Health*. Retrieved August 19, 2017, from <http://www.becomehealthynow.com/ebookprint.id>
- Jaishankar, M., Tseten, T., Anbalagan, N., Mathiew, B., & Beerogowda, K. N. (2014). Toxicity, mechanism and health effects of some heavy metals. *Interdiscip Toxicol*, 60-72.
- Okereke, J., Udebuani, A., Ezeji, E., Obasi, K., & Nnoli, M. (2015). Possible Health Implications Associated with Cosmetics: A Review. *Science Journal of Public Health*, 58-63.
- Sahu, R., Saxena, P., & Johmson, P. (2014). *Heavy Metals in Cosmetics*. New Delhi: Centre for Science and Environment.
- Sukendar, K., Jaspreet, S., Sneha, D., & Munish, G. (2012). AAS Estimation of Heavy Metals and Trace elements in Indian Herbal Cosmetic Preparations. *Research Journal of Chemical Sciences*, 46-51.

