International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 6 Issue 11, November - 2022, Pages: 1-6

Analyzing, Preparation and Methods Sampling in Analytical Chemistry

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Abstract: *In any such procedure, the specific analytical method selected depends on how much sample is available and how much analyte is present. This article used the Systematic Literature Review (SLR) method to review eleven articles published from 2000 to 2021 and focused on Analyzing, Preparation, Methods, Sampling then for next we call it Fundamental In Analytical Chemistry using various source. The articles are systematically obtained from the online article database ERIC, Scopus, and SINTA. The purpose of a review is to give information to readers about the definition of Analyzing, Preparation, Methods, Sampling, the important things to know it in analytical chemistry, and how to implement it in research especially in analytica chemistry. The review results showed that these topic is important to know for college student so they know what they gonna do in Analytical Chemistry. Also, it referred to the use of various media We discuss here a general classification of the types of determinations based on these factors. after selecting the particular method to be used, a representative sample must be acquired. In the sampling process, we make every effort to select a small amount of material that accurately represents the bulk of the material being analyzed. We use statistical methods to aid in the selection of a representative sample. Once the analytical sample has been acquired, it must be processed in a dependable manner that maintains sample integrity without losing sample or introducing contaminants. Many laboratories use the automated sample handling methods discussed here because they are reliable and cost effective. Because analytical methods are not absolute, results must be compared with those obtained on standard materials of accurately known composition. Some methods require direct comparison with standards while others involve an indirect calibration procedure. Mastery of these fundamental knowledge in analytical chemistry will serve you well in chemistry courses and in related scientific fields. In addition, your efforts will be rewarded with the consider- able satisfaction of having completed an analysis with high standards of good analytical practice and with levels of accuracy and precision consistent with the limitations of the technique. Much of our discussion focuses on Analyzing, Preparation and Methods Sampling in Analytical Chemistry. We conclude this chapter with a literature that reviewed from research that has been conducted to summarize the fundamental aspects of sample preparation and anticipate future developments and research needs*

Keywords— Analyzing, Preparation, Methods, Sampling, Fundamental Analytic

1. INTRODUCTION

Sample preparation and analysis methods often involve an extraction process that results in the isolation and enrichment of components of interest from the sample matrix. Extraction can vary in the degree of selection, speed and quality and depends not only on the methods and conditions used, but also on the geometrical structure of the extraction time. The introduction of non-traditional extraction technologies has led to increased interest in sample preparation research (Zgorelec et al. 2019). These technologies address the need to reduce solvents, automation and miniaturization and ultimately lead to site and in vivo implementation. These mining methods are generally easy to use, but present the best challenges. More important knowledge is required by the surveyor not only of the measurement conditions, but, more importantly, of the mass transfer process and the extraction system (Li et al. 2020). Optimizing this extraction process results in a more detailed analysis. The proper design of the device and the extraction process makes its implementation effective on site, integration and sampling and separation / quantity, automation, or both (Skoog, D. A., West, D. M., Holler, F. J., & Crouch 2004). Key to rational selection, optimization and design is an understanding of the basic principles that govern the transfer of analytical parameters to multiple time systems. The purpose of this concept is to summarize the main aspects of sample preparation and to anticipate future developments and research needs.

We calculate the results of the two-factor analysis by two measurements. One is the size or volume of the analyzed sample. A secondary measurement is one in which some quantity corresponds to an analytical quantity in the sample, such as mass, volume, heat, or electric charge. This second measurement completes the analysis, and we organize the analysis process according to the nature of this final measurement. In the gravimetric method, we determine the mass of the analyte or its chemical composition. In the volumetric method, we measure the volume of the solution containing enough reagent to react with the assay (Acharya et al. 2013). In electronics, we measure electrical properties such as power, current, resistance, and electric current. In spectroscopic methods, we analyze the relationship between electromagnetic radiation and analyte atoms or molecules or the emission of radiation through analysis (Etikan and Bala 2017). Finally, in a different way, we measure quantities such

as mass-to-charge of ions by mass spectrometry, the rate of radioactivity, the temperature of the reaction, the rate of the reaction, the thermal conductivity of the sample, optical function and refraction. index

2. METHOD

The method used in this article is systematic literature review (SLR). Xiao & Watson (2019) explained that Systematic Literature Review (SLR) is a literature review process that follows standard rules to identify and develop important research topics and determine what is known about the subject being studied. The articles analyzed in this literature review were obtained by searching the online databases ERIC, Scopus and SINTA (Indonesian Research database). Literature and analysis were collected from September 24 to September 28, 2022. In this study, the keywords used are " Analyzing, Preparation and Methods Sampling in Analytical Chemistry After searching for a keyword, the researcher reads the title of the article to select articles that meet the following inclusion criteria: (1) relate to the defintion; (2) the year of publication articles; (3) articles from reputable journals that indexed internationally by Scopus or indexed nationally by SINTA. Based on the article search results, there were 49 titles suitable with inclusion criteria. By then, the abstracts of those 49 articles were analyzed. The result of the abstract analysis was 25 articles following the fundamental on analytic chemistry. Meanwhile, the other 24 articles were inappropriate because three articles were out of topic and specific mention to object. Furthermore, all content of 25 articles was read. Finally, these 25 articles provided suitable information on what will be discussed.

3. RESULTS AND DISCUSSION

3.1 DEEP DIVE WITH FUNDAMENTAL

The purpose of a research study is to obtain information about something or an object. Matter can be solid, liquid, gas or organic matter. The information to be received may vary. It can be a chemical or physical composition, a structural or surface structure, or a protein sequence in a gene (Horwitz 1990). Despite the large arsenal of research methods available, it is not possible to find all the information, even with a small number of samples. For the most part, the current state of the equipment has not developed to the extent that we can bring the equipment and materials and get all the necessary information (Situmorang 2010). Although there is great interest in these non-invasive devices, many tests are still carried out by taking a portion (or part) of the object being studied (called a sample). and verify it in the lab (or on the website). . Some common steps in this process are shown in Figure 1.1 (Mitra and Brukh 2003).

3.2 Sample Preparation

Analytical chemistry is applied throughout industry, medicine, and all the sciences. To illustrate, consider a few examples. The concentrations of oxygen and of carbon dioxide are determined in millions of blood samples every day and used to diagnose and treat illnesses(Pawliszyn 2003). Quantities of hydrocarbons, nitrogen oxides, and carbon monoxide present in automobile exhaust gases are measured to deter- mine the effectiveness of emission-control devices. Quantitative measurements of ionized calcium in blood serum help diagnose parathyroid disease in humans(Luis and Moncayo n.d.). The quantitative determination of nitrogen in foods reflects their protein content and therefore their nutritional value. Analysis of steel during its production allows to change the combination of elements such as carbon, nickel and chromium to obtain the required strength, hardness, corrosion resistance and ductility.(Neolaka et al. 2018). The mercaptan content of natural gas is continuously analyzed to ensure that the gas has an unpleasant smell to warn of dangerous leaks (Fumes et al. 2015). Farmers adjust fertilization and irrigation systems to meet the changing needs of plants during the growing season, assessing these needs through plant and soil analysis.

3.3 Sampling

A chemical analysis is most often performed on only a small fraction of the material of interest, for example a few milliliters of water from a polluted lake. The composition of this fraction must reflect as closely as possible the average composition of the bulk of the material if the results are to be meaningful. This process of obtaining representative samples is called sampling (Mitra and Brukh 2003). Often times, sampling is the most difficult step in the entire research process and the most limiting step in the process. This statement is especially true if the object to be analyzed is a large inhomogeneous liquid, such as a pond, or an inhomogeneous solid, such as metal, soil, or animal parts. the body. Sampling for chemical analysis requires the use of statistics because large-scale conclusions must be drawn from the analysis of small laboratory samples.(Horwitz 1990). This is the same process that we dis- cussed in Chapters 6 and 7 for examining a finite number of items drawn from a population. From the observation of the sample, we use statistics, such as the mean and standard deviation, to draw conclusions about the population

The first step is sampling, where the sample is obtained from the object to be analyzed. This is collected such that it represents the original object. Sampling is done with variability within the object in mind. For example, while collecting samples for determination of $Ca2^{+}$ in a lake, it should be kept in mind that its concentrations can vary depending on the location, the depth, and the time of year(Fumes et al. 2015). The next step is to save the sample. This is an important step, since there is often a delay between sample collection and analysis. Sample preservation ensures that the sample retains its physical and chemical characteristics so that the analysis represents the actual substance being studied..

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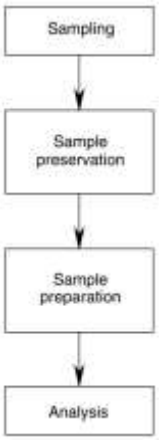

Figure 1.1. Steps in a measurement process

The sample preparation step in an analytical process typically consists of an extraction procedure that results in the isolation and enrichment of components of interest from a sample matrix(Kratochvil, Wallace, and Taylor 1984). Extraction can vary in degree of selectivity, speed, and convenience and depends not only on the approach and conditions used but on the geometric configurations of the extraction phase. The introduction of non-traditional extraction techniques has led to increased interest in sample preparation research. These technologies address the need for solvent reduction, automation and miniaturization and ultimately lead to in vivo implementation at site and location(Pawliszyn 1995). These mining methods are generally easy to use, but present the best challenges. More important knowledge is required by the analytical chemist not only of equilibrium conditions but, more importantly, of mass transfer processes in the extraction process. Optimizing this extraction process results in a more detailed analysis. The proper design of the device and the extraction process makes its implementation effective on site, integration and sampling and separation / quantity, automation or both. Key to rational selection, optimization and design is an understanding of the fundamental principles that govern transfer analysis in multiphase systems.(Pavlović et al. 2007).

Once the sample is ready for analysis, sample preparation is the next step. Most samples are not ready for direct introduction into instruments. For example, in the analysis of pesticides in fish liver, it is not possible to analyze the liver directly. The pesticides have to be extracted into a solution, which can be analyzed by an instrument. There might be several processes within sample preparation itself. Some steps commonly encountered are shown in Figure 1.2(Mitra and Brukh 2003). However, they depend on the sample, matrix and concentration level that will be analyzed. For example, exploratory research requires more intensive sample preparation than primary resource research.

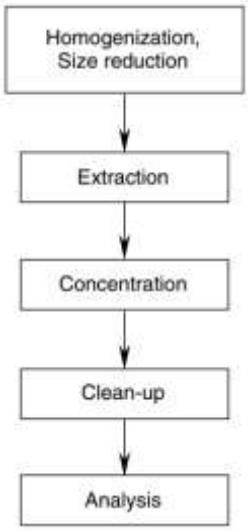

Figure 1.2. Possible steps within sample preparation

3.4 Analysis method in analytical chemistry

Once the sample preparation is complete, the analysis is carried out by an instrument of choice. A variety of instruments are used for different types of analysis(Jungnickel and Forbes n.d.), depending on the information to be acquired: for example, chromatography for organic analysis, atomic spectroscopy for metal analysis, capillary electrophoresis for DNA sequencing, and electron microscopy for small structures(De La Guardia 1999). Common test tools and their associated sample preparation are listed on Table 1.1(Mitra and Brukh 2003)

Sample preparation depends on the analytical methods to be used and their strengths. For example, only a few microliters can be injected into a gas chromatograph. Therefore, in the example of the analysis of pesticides in fish liver, the final product is a solution of a few microliters that can be injected into a gas chromatograph.(Pavlović et al. 2007). Sampling, sample preservation, and sample preparation are all aimed at producing those few microliters that represent what is in the fish. It is obvious that an error in the first three steps cannot be rectified by even the most sophisticated analytical instrument(Kratochvil et al. 1984). So, the importance of the prior steps, in particular the sample preparation, cannot be under stressed

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Table 1.1. Common Instrumental Methods and the Necessary Sample Preparation Steps Prior to Analysis

Analytes	Sample Preparation	Instrument[a]
Organics	Extraction, concentration, cleanup, derivatization	GC, HPLC, GC/MS, LC/MS
Volatile organics	Transfer to vapor phase, concentration	GC, GC-MS
Metals	Extraction, concentration, speciation	AA, GFAA, ICP, ICP/MS
Metals	Extraction, derivatization, concentration, speciation	UV-VIS molecular absorption spectrophotometry, ion chromatography
Ions	Extraction, concentration, derivatization	IC, UV-VIS
DNA/RNA	Cell lysis, extraction, PCR	Electrophoresis, UV-VIS, florescence
Amino acids, fats carbohydrates	Extraction, cleanup	GC, HPLC, electrophoresis
Microstructures	Etching, polishing, reactive ion techniques, ion bombardments, etc.	Microscopy, surface spectroscopy

The objective of research can be qualitative or quantitative (Booksh and Kowalski 1994). For example, the presence of pesticides in fish is a concern. The question may be: Are there pesticides in the fish? If yes, which ones? The study designed to answer these questions is a qualitative study (Trullols, Ruisánchez, and Rius 2004), where the researcher looks for the presence of certain antibiotics. The next obvious question is: how many pesticides are there? This type of research, quantitative research, not only looks at the presence of the pesticide, but also at its concentration (Etikan and Bala 2017). Another important aspect is the medium analysis. The concern here is not exactly how much they are, but whether it is above or below a certain point. An example is the prostate-specific antigen (PSA) test for screening for prostate cancer. A PSA value of 4 ng/L (or more) indicates a high risk of prostate cancer. The goal here is to determine whether the PSA is above or below 4 ng/L. Once the objectives of the research and the prospective studies are determined, the methods of conducting the research will be evaluated taking into account accuracy, precision, cost and other important constraints (Andersen and Hinthorne 1973). The number of tasks, the time required to perform the analysis and the degree of automation may also be important (Currie 1968).

3.5 Qualitative and Quantitative Analysis

There is rarely one way to design a measurement system. Even well-defined research can be approached in different ways. Different studies have different goals, different financial problems, staff with different skills and personal interests. The most important step in designing a study is determining the objectives and at least some idea of the end results. It should generate data that provides useful information to solve the problem at hand

Almost all measurement procedures, including sample preparation and analysis, require calibration against chemical standards. The relationship between the detection signal and the number of tests is obtained by recording the response from the known number (Augusto, Leite e Lopes, and Zini 2003). Similarly, if an extraction method is involved, it is necessary to add a known amount of analysis to the matrix and measure its recovery. These methods require standards, which can be prepared in the laboratory or obtained from commercial sources. An important consideration in choosing a pattern is the matrix. For some diagnostic tools, such as X-ray fluorescence, the matrix is very important, but it may not be critical for others (Ellison and Fearn 2005). Sample preparation is often matrix-based. It may be easy to remove polycyclic aromatic hydrocarbons from sand by critical extraction, but not from aged soils with high organic content.

3.6 Methods of Quantitation

The best planning method is to prepare a standard of known concentrations, covering the expected concentration in the sample. The standard matrix should be as close to the sample as possible. For example, if the sample is to be extracted in some organic solvent, the standard must be fixed in the same solvent (Currie 1968). The classification system is a detection response scheme as a function of concentration. The calibration process is shown in Figure 1.3. It is used to determine the number of tests in an unknown sample. Classification can be done in two ways, the best of which is using examples (Situmorang 2010). Let's say that the amount of lead in the soil is measured. The analytical procedure involves sample preparation by acid extraction followed by absorption analysis (AA) (Currie 1968). Patterns can be made by doping pure soil with known conductivity. Then, the values are taken from all the steps of extraction and analysis. Finally, the response of the instrument is estimated as a function of concentration (Andersen and Hinthorne 1973). Another option is to take numerical extraction and these values are used to make AA only. The first way is better; the latter is simple (Hatfield et al. 1987)

4. CONCLUSION

Based on studies from the articles obtained systematically, the definition of Analyzing, Preparation and Methods Sampling in Analytical Chemistry refers to the fundamental aspects of sample preparation and anticipate future developments and research needs.It can also refer to various instrument and their role, but these instrument are used to measure and gettin data from reasearch that was conducted. The three keys of fundamental in chemical analytic has a positive influence for student, including improving understanding of concepts for the theory, improving performance on the laboratory during research, reducing error, improving self- efficacy, making cognitive structures develop for the better, and improving skill and ability, and can reduce misconceptions. The results showed that three keys of fundamental in chemical analytic is Analyzing, Preparation and Methods Sampling in Analytical Chemistry effectively improved learners' mastery or understanding of concepts. Based on the results of the article review that has been done, it is essential to to learn and understand this thing so student can follow the analytical chemistry course properly. Teachers should teach this topic at first in chemistry learning because, through these three fundamental keys, the abstractness of chemistry skill will become more real and easier to understand for learners. As a result, their understanding of chemistry concepts can increase, and the impact of their learning outcomes can also increase. In addition, involving Analyzing, Preparation and Methods Sampling in Analytical Chemistry in learning can reduce learners' assumptions about chemistry analytic as hard subject to understand..

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