

Review Article about Analytical Chemistry Study

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Received: 2024 25, Jul

Accepted: 2024 21, Aug

Published: 2024 21, Sep

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Annotation: Coronary Artery Disease (CAD) remains a significant contributor to global morbidity and mortality. It is characterized by the progressive narrowing of coronary arteries due to the formation of atherosclerotic plaques, resulting in compromised blood flow to the heart muscle and ischemic events such as angina and myocardial infarction. This overview provides a succinct examination of CAD, focusing on its etiology, risk factors, clinical manifestations, and contemporary treatment modalities. The development of CAD involves a multifaceted interplay of genetic predisposition, conventional risk factors (including hypertension and dyslipidemia), and lifestyle variables. Despite its insidious onset, CAD can manifest through symptoms such as angina, dyspnea, or asymptomatic ischemia. Early detection is pivotal and can be facilitated by stress testing, coronary angiography, and non-invasive imaging techniques. Management strategies for CAD encompass lifestyle modifications, pharmacological interventions, and invasive procedures. Lifestyle adjustments entail dietary enhancements, regular physical activity, and cessation of tobacco use, all proven to attenuate CAD progression. Medications such as

antiplatelets, statins, and beta-blockers target risk factors and ameliorate symptoms. Invasive interventions, including percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG), aim to restore coronary blood flow, thereby enhancing quality of life and augmenting survival rates. In summary, the pervasive prevalence of CAD and its clinical ramifications underscore the imperative for proactive prevention and evidence-based management. Ongoing advancements in diagnostic modalities and therapeutic strategies continue to refine CAD care, fostering optimism in combating this formidable cardiovascular ailment.

Keywords: Heart, Coronary artery, Lifestyle, medications.

Introduction:-

Chemicals are everywhere – they keep our clocks ticking, our cars running. They are in the medicines we buy, the food we eat, and the clothes we wear.

In some ways, chemicals are tangible manifestations of human progress, human development, scientific, technological, and agricultural innovation. The use of nitrogen in fertilizers allows farmers to grow more food. With chemical pollutants ubiquitous in our daily lives, we have reached a point where the limits of what our planet can tolerate are being tested, with the overuse of some chemicals causing far more harm than good. When mismanaged, toxic chemicals cause an alarming number of premature deaths and cause significant damage to human health and the planet. Exposure to toxic chemicals reduces life expectancy and impacts human well-being. Pollution, along with climate change and the loss of nature, is a major obstacle to ending poverty on a liveable planet. Pollution, along with climate change and the loss of nature, is a major obstacle to ending poverty on a liveable planet. New research shows the magnitude of the risks posed by chemical pollution. The evidence suggests that exposure to lead caused the premature death of more than 5.5 million people in 2019, 90% of whom died in low- and middle-income countries. The research also found that children under five lost an estimated 765 million IQ points due to lead poisoning in the same year. This loss of human capital has serious consequences for quality of life, learning and school outcomes, productivity and, ultimately, economic development and growth. The economic cost of health damage is estimated to have reached \$6 trillion in 2019, equivalent to 6.9% of global GDP.

Nitrogen fertilizers, often used to enrich agricultural soils with nutrients, are another example of a chemical that has a harmful impact on people and the planet. Only 40% of nitrogen is actually absorbed by crops, with the remaining 60% either going into the air or being dissolved and leaking into water. This can create large dead zones in water bodies, killing wildlife. Additionally, when nitrogen fertilizers such as ammonia are volatilized into the air, they can turn into secondary fine particles and nitrogen oxides, which are partly responsible for millions of premature deaths from air pollution. Some of the nitrogen volatilized into the air is converted into nitrogen oxides, a greenhouse gas 300 times more potent than carbon dioxide. Chemical pollution is linked to the climate crisis, as climate change can increase the amount of unsafe chemicals in the environment.

Other chemicals in our everyday lives are equally worrisome. Cadmium, a chemical found in batteries, electronics and paints – as well as some foods – affects cardiovascular health and can cause kidney failure and cancer. Asbestos, known to cause lung cancer and banned in most high-income countries, is still commonly used as an insulation material in some countries, including India, Sri Lanka and Indonesia.

Analytical chemistry is the study of the chemical composition of natural and synthetic materials. It is concerned with the quantitative and qualitative estimation of the elements and compounds that make up the material to be analyzed. Unlike other branches of chemistry such as inorganic chemistry or organic chemistry, analytical chemistry is not limited to a specific type of compounds or a specific type of chemical reactions. The properties studied in analytical chemistry include geometric properties such as the shape of molecules and the distribution of atoms in them to properties such as structure and the identification of components from elements. Analytical chemistry was developed by analytical chemists and its development contributed to the advancement of many other sciences: especially chemistry and life sciences in its branches and earth and soil sciences: from the development of theories and research methods (pure sciences) to the development of applications such as biomedical applications, environmental and monitoring environmental and climatic developments and human impacts on the environment, quality control in industry, especially the pharmaceutical industry, and even genetic and hereditary analyses in biology and forensic medicine research.

Classically, analytical chemistry methods and approaches are classified into two types: qualitative and quantitative.

Qualitative inorganic analysis: seeks to prove the presence of chemical elements in a compound or the presence of an inorganic compound in a sample.

Qualitative organic analysis: seeks to confirm the presence of a functional group or an organic compound in a sample.

Quantitative analysis: seeks to determine the exact amounts of an element or compound in a sample taken. That is, the weight of the compound or element is determined in grams or milligrams.

Modern analytical chemistry is divided into two parts: analytical targets (the purpose of the analysis), or analytical methods (inventing new methods of analysis).

After collecting the information resulting from the analysis of the samples, it is used to form a calibration curve, and an internal standard (internal control) may be used, which is added in known quantities to the analyzed sample to help determine the quantities in the analysis. The amounts present of the substance to be analyzed are determined as a ratio compared to the internal or external control as a calibration method, especially in modern methods

The methods of qualitative and quantitative analysis are very diverse. Therefore, a substance can be studied in different ways. Analytical chemistry is the science that deals with methods of analysis. In a broader sense, analytical chemistry is a science that is not limited to methods of analyzing the composition of the analyte to be analyzed, but also includes methods of studying the multifaceted chemical aspects of the materials around us on Earth and the planets that we can observe.

Analytical chemistry helps solve many problems, including:

Clarifying the nature of the studied sample (analyte), i.e. proving whether the substance in question is of organic or inorganic origin.

Determining the forms of existence of independent components in the sample (for example, the presence of S_0 , S^{-2} , SO^{-23} , or SO^{-24}) and the degree of oxidation of elements (Fe^{+2} , Fe^{+3} , Cr^{+2} , Cr^{+3} , etc.).

Determining the composition and quantity of each of the main component (gold in the form of an

innate metal, for example) and foreign impurities in it (copper and silver in a gold sample, for example), as well as the quantity of fine impurities (i.e. those present in very small quantities) and their local distribution in highly pure technical samples (such as boron in graphite, iron, semiconductors, etc.).

Determining the formula of an unknown compound (such as a metal, a newly synthetic substance, a pharmaceutical preparation extracted from a plant, etc.).

Detecting certain structural elements in the compound in question and then determining the structure of this compound (such as detecting certain hydroxyl or carboxyl groups, double bonds, hydrocarbon moieties, or the like in the compound under study). Analytical chemistry forms part of chemistry, along with general chemistry, inorganic chemistry, organic chemistry, and physical chemistry.

Analytical chemistry is the theory and application of various methods of analysis. Its tasks are as follows:

Multifaceted development of the theory of analytical methods, Improvement of existing analytical methods and their scientific justification, Development of new methods of analysis that meet the requirements of advanced science and modern industry, Analysis of natural materials and the surrounding environment (atmosphere, hydrosphere and land) as well as technical materials, Ensuring analytical chemical control over industry and scientific research in the field of chemistry, chemical industry, biochemistry, agricultural chemistry, geochemistry, metallurgy, biology, medicine, etc.

Classification of analytical methods: -

According to the objectives of the analysis

Analytical biochemistry

Analysis of materials

Chemical analysis

Environmental analysis

Forensic chemistry

Chromatographic analysis

According to the method of analysis

Traditional methods: volumetric titration and gravimetric analysis

Spectroscopy: spectrophotometry and colorimetry

Mass spectrometry

Thermogravimetric analysis

Separation processes: such as chromatography or chromatography and electrophoresis

Crystalline

Microscopic

Electrochemical analysis using a battery for example.

A complete list and a list of methods for analyzing materials or combining several hybrid techniques:

Calculating the concentration of reactants.

C- Analysis by measuring the electrical quantity, where the electrical quantity is measured in coulombs required to complete the electrochemical reaction.

D- Polarography, where the value of the electrical current is measured as it is proportional to the concentration of the substance that is reduced or oxidized in an electrochemical reaction at the micron electrode.

Chromatographic analysis

This type of analysis depends on the difference between materials in their tendency to adsorption, fragmentation or exchange through a surface coated with a suitable solvent or through a chemical substance, and then these materials can be separated. Chromatographic analysis methods are divided into:

Adsorption chromatography: This means chromatographic analysis by adsorption on the surface.

Ion exchange chromatography: This means chromatographic analysis by exchanging ions between the estimation material and the ions of the surface that causes the exchange process, which is a resinous chemical substance.

Fractional chromatography: It means chromatographic analysis by fractional separation of a mixture of several materials. This method is divided into fractional column chromatography, in which the analysis is carried out on a column packed with a specific material.

Thin layer chromatography: In which chromatographic analysis is carried out by adsorption or distribution on glass plates on which a porous material is spread, on which the separation and analysis is carried out.

5. High performance liquid chromatography HPLC:

High-performance liquid chromatography (HPLC) methods are preferred over other methods used in quantitative analysis. This is due to their ideal quality for the analyte or analytes to be separated, so that we obtain a qualitative and accurate separation of the components of the mixture to be identified. HPLC devices are readily available because they are used in many fields, including biotechnology, clinical medical technology, and pharmaceutical analysis. In addition to their use in chemistry, cosmetics, energy, the environment, and food industries. The availability of affordable, efficient, and reliable devices has made HPLC devices the preferred method in pharmaceutical analysis, starting from creating the drug synthesis, separating its components, or controlling its quality. The use of HPLC has developed significantly over the past decades. In the sixties, the foundations and theoretical principles of this technology were laid, and the development of chromatography column filling materials in the seventies led to the development of reversed-phase chromatography. In the eighties, the development of computers and automation led to the ease of using HPLC. In the nineties, micron (small) chromatography columns and specialized chromatography columns for specific use, fixed detectors, in addition to the capabilities of obtaining, storing and retrieving integrated data, led to a significant increase in the effectiveness and speed of HPLC devices.

Gas chromatography: This chromatographic analysis includes using a carrier gas that carries the vapors of the analyzed materials. The vapors of these materials are connected according to their boiling points, i.e. the materials with low boiling points appear first, followed by the materials with high boiling points. These vapors come out to join the carrier gas, and then these materials can be separated from each other and identified. The quantitative estimation of these separated materials can also be done using gas chromatography.

Different methods

1:- Analysis using a polarometer: The amount of deflection resulting from the passage of polarized light through the solution is measured.

2:- Analysis by measuring the refraction of light: The refractive index is measured, which determines the chemical composition of the mixture.

3:-Mass Spectrometer: This method can measure the ratio between the mass charge of different

ions resulting from the breakdown of large molecules, and from this the molecular weight and concentration can be found.

4:-Thermal conductivity: In this method the thermal conductivity is measured and the composition of the material is inferred from it.

5:-Methods of analyzing radioactive materials: In this method the material is irradiated to become radioactive, then the rays or particles flowing from it are counted for the purpose of quantifying them.

Determining the point of completion of the reaction

By self-color

The method of determining the point of completion of the reaction is used by manganese titration (KMnO_4) or iodine titration, where a little starch is used with iodine, where iodine with starch is a colored compound. Both the manganese method and the iodine method are used in titration because the intrinsic color of the solution changes suddenly at the point of completion of the reaction.

By using a color indicator

Color indicators of the type of oxidation-reduction indicators can be used, which are characterized by a change in their color with oxidation or reduction, such as Ferroin, which is a compound of iron acetate. Ordinary indicators can also be used, such as in the bromatometry method, where the change in the color of the indicator determines the point of completion of the reaction.

Voltage measurement method

Plots showing measurements of a potentiometric titration with the first and second derivative of the curve.

The voltage changes between the solution and a standard electrode (such as a glass electrode) during the titration process. When doing this, we read and record the potential during the titration and its dependence on the volume of the burette solution used, so we get from these values a titration curve, and from it we get the point of completion of the reaction.

Potentiometric titration is a technique in analytical chemistry used to titrate oxidation-reduction reactions without using an indicator, but rather by relying on measuring the electrical potential in the substance to be analyzed, which is often an electrolyte solution.

To do this, two electrodes are used, one called the indicator electrode (indicator) and the other is the standard (or reference) electrode. The indicator electrode with the ions under study forms half of an electrochemical cell, which forms the other half with the standard electrode. Examples of standard electrodes include the standard hydrogen electrode, the saturated calomel electrode, and the silver chloride electrode.

The total electrical potential is calculated according to the relationship:

$$E_{\text{cell}} = E_{\text{ind}} - E_{\text{ref}} + E_{\text{sol}}$$

Where: E_{ind} is the potential of the indicator electrode and E_{ref} is the potential of the standard electrode, while E_{sol} is the difference in the potential value of the solution between the two electrodes, which is measured at regular intervals during titration.

A graph of the electrical potential versus the added volume is drawn, and the end of the titration can be determined as the midpoint of the jump in potential on the graph.

Oxidation-reduction reactions or oxidation-reduction are chemical reactions in which a change in the oxidation number of the atoms of the reactants occurs as a result of the transfer of electrons between them.

Oxidation is the process of losing electrons by atoms, molecules or ions resulting in an increase in positive charge or a decrease in negative charge.

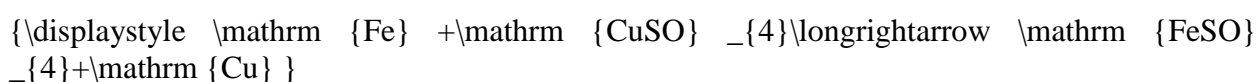
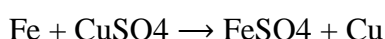
Reduction is the process of gaining electrons by atoms, molecules or ions resulting in a decrease in positive charge or an increase in negative charge.

Combustion - an oxidation-reduction reaction in which oxygen is used as an oxidizing agent.

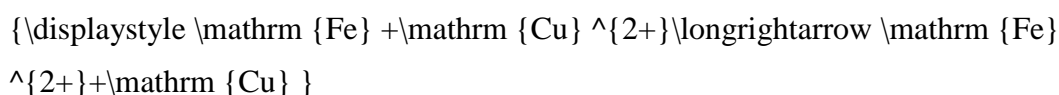
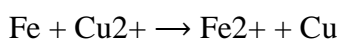
Representation of an oxidation-reduction process: A hydrogen atom donates an electron to a fluorine atom, and then combines with it. More precisely, the oxidation process for an element (or for a molecule containing an element on which this process is performed) can be described as an increase in the oxidation number of that element, while reduction (or reduction) is a decrease in the oxidation number.

Example

As an example of these reactions, the reaction between iron and copper(II) sulfate:



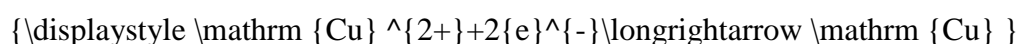
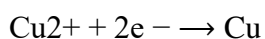
where the ionic reaction is:



where iron is oxidized (iron's oxidation number increased from 0 to +2) :



and copper is reduced (oxidation number of copper decreases from +2 to 0):



The importance of studying analytical chemistry: -

1. The importance of analytical chemistry lies in the fact that it is a basic and necessary tool in all branches of different sciences, such as biology, physics and the environment, which has enhanced its use in several vital fields such as the industrial, agricultural, pharmaceutical and scientific research fields
2. It relies on machines that contribute to isolating materials from each other in order to distinguish the purity of the materials that make up the mixture and to measure the quantity of each material that makes up the mixture
3. It is used in the field of pharmaceutical industry, in chemical and food compounds, in industrial agriculture, in scientific laboratories and others
4. It isolates materials from each other and knows the composition of chemical compounds, which has contributed to strengthening them and is used in chemical compounds for food, for example, or in medical matters to know diseases and in therapeutic matters, as it is used in the manufacture of medicines and has many other uses
5. Analytical chemistry plays an important role in many sciences, and it is also indispensable in biology, as analytical technology is used in the study of living materials and metabolic

processes, and doctors cannot diagnose Diseases without relying on the results of the necessary analyses.

6. Analytical chemistry is important in the manufacture of glass materials
7. Production of medical drugs
8. Production of medical materials in surgery
9. Contributes to the manufacture of industrial toxins
10. Carbohydrate metabolism
11. Antibiotics
12. Penicillin
13. Drug therapy

The most important conclusions from analytical chemistry: -

The role of analytical chemistry is to identify, isolate and measure the quantity of compounds and elements. Analytical chemistry can also participate in the development of new analytical devices. It can play a supporting role in organic chemistry and biochemistry by determining the structure of new molecules.

Theoretical foundations and principles related to quantitative gravimetric and volumetric analysis.

Types of chemical reactions used in quantitative gravimetric and volumetric analysis.

Mathematical calculations related to quantitative gravimetric analysis, equilibrium and precipitation titrations.

How to prepare and discuss results based on the technique used in the analysis.

How to determine the appropriate method for quantitatively analyzing samples by gravimetric analysis or titration.

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