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COPPER DETERMINATION REVIEW

Saja Fadhil Abbas Alwan
Department of Chemistry, College of Sciences, University of Babylon
sajaf5478@gmail.com

Rana Saad Fadhil Abdul Hussain
Department of Chemistry, College of Science, University of Baghdad

Muhammad Jawad Kazem Sultan
Department of Chemistry, College of Sciences, University of Babylon

Tabarak Salah Hadi Abd
Department of Chemistry, College of Science, University of Al-Mustansiriya

Abstract:

Parkinson's disease (PD) is an advancing neurodegenerative condition characterized by the deterioration of dopaminergic neurons within the substantia nigra of the brain, resulting in a range of motor and non-motor symptoms that worsen gradually over time. The hallmark Tremors, rigidity, bradykinesia, and postural instability are among the motor symptoms, while cognitive impairment, mood disturbances, autonomic dysfunction, and sleep disturbances are considered non-motor symptoms.The diagnosis of PD relies on clinical assessment, often involving a thorough medical history, neurological examination, and supportive diagnostic tests such as neuroimaging. Despite ongoing research efforts, a definitive cure for PD remains elusive, and present interventions prioritize symptom management and enhancing quality of life."

Keywords: Parkinson's disease (PD)

Introduction

1- Copper

It's a [1] chemical substance represented by the symbol Cu and positioned as number 29 in the periodic table of elements

s, Moreover, it is an excellent electrical conductor , copper is used today in the manufacture of wires, electric cables and electronic devices, and it is used in building materials because of its resistance to corrosion , and it is also used in the manufacture of metal money And since it is a widely used material, there are many actual sources of copper waste. It naturally resides in the environment around us. And man has used copper on a large scale since ancient times and where it has been applied in the field of industry and agriculture, and it is considered as a pollutant for food and drink due to the provision of food, drink and water in utensils made of copper, so the human body absorbs this mineral daily through drinking And eat food and breathe as well.

Copper plays a vital role in maintaining, the health of different living organisms, such as humans and plants .animals, and microorganisms. It is crucial for organ functionality and metabolic processes, akin to other essential elements and nutrients. However, an excess of copper in the body can have adverse effects on health, posing significant risks.

Copper serves as a crucial trace mineral, pivotal for catalyzing heme synthesis and facilitating iron absorption. Ranking third in abundance among trace elements in the body, following zinc and iron, copper shares noble metal characteristics akin to silver and gold.

Copper [2] is among the heavy elements, which constitute natural constituents of the Earth's crust and represent some of the most significant environmental contaminants, being widely distributed. Heavy element pollution pervades our living spaces, stemming from diverse human activities such as industrial waste, mining, paint production, automotive emissions, and the leather industry, as well as occurring naturally through the weathering of Earth's crust rocks. These heavy metals present a risk of infiltrating the human food chain and have the capability to persist in the environment without degradation over extended periods.



Figure 1: copper element

1-1 The impact of copper on the environment:

Copper, while essential for human health, can also irritate the stomach and intestines. Individuals with Wilson's disease are particularly susceptible to the health repercussions associated with copper exposure,

especially from alloys. Copper contamination commonly arises in drinking water due to leaching from pipes, as well as from materials employed to manage algae proliferation.

1-2 The impact of copper on humans:

Prolonged exposure to copper can result in irritation of the nose, mouth, and eyes, accompanied by symptoms such as headaches, stomach pain, dizziness, vomiting, and diarrhea. Furthermore, deliberate ingestion of excessive amounts of copper may induce kidney and liver damage, potentially leading to fatalities. Occupational exposure to copper fumes can cause metallic fume fever, characterized by alterations in the nasal mucous membranes. Wilson's disease manifests with symptoms like cirrhosis, brain damage, kidney disorders, and copper accumulation in the cornea.

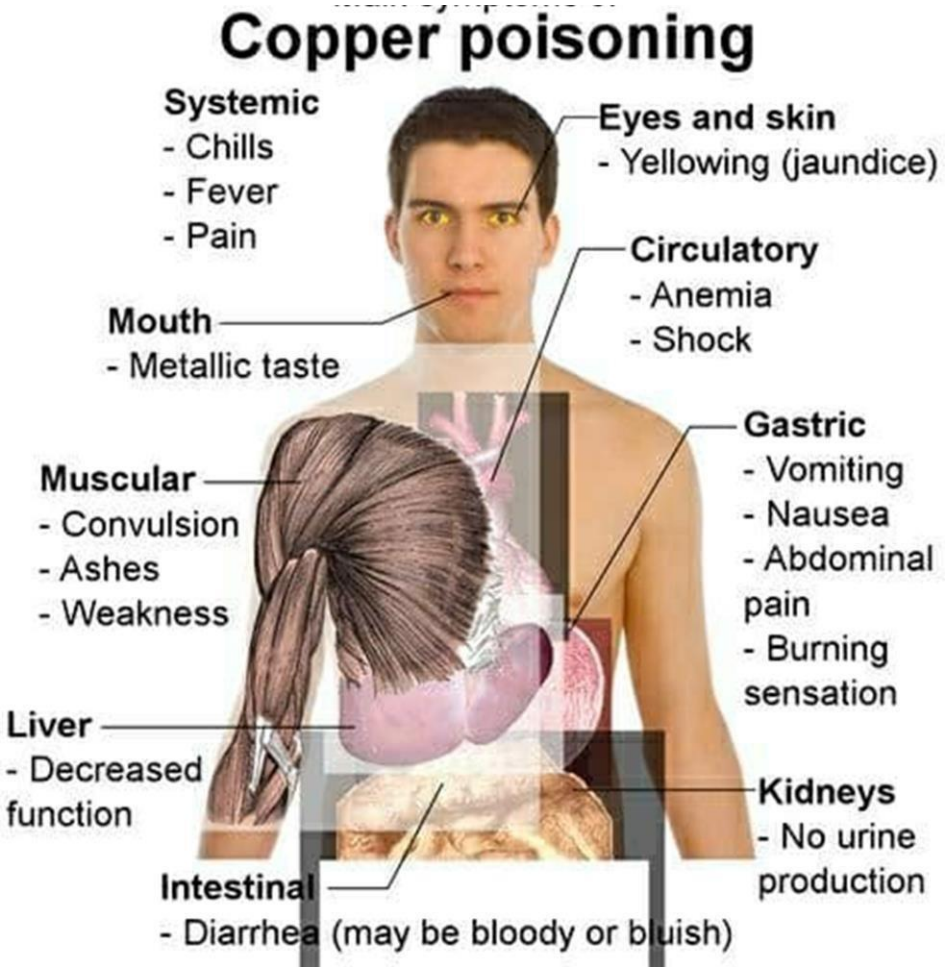

Figure 2: The effect of copper on human

1-3 The impact of copper on plants:

The [3] toxicity of copper has been known for many years and has exploited this trait in the use of copper as a fungicide and for its resistance to many pests harmful to plants and animals, and the large amount of

copper is harmful to high-end plants, as it reduces the detection of fibrous roots and reduces plant production, when the concentration of copper increases more than 0.5 ppm in water, the plant growth decreases. A slight rise above that causes the plant to become paler, such as pallor caused by iron deficiency. To iron.



Figure 3: The effect on plants (copper deficiency)

1-4 The consequences of copper on animals:

The relevance of heavy metals lies in their existence in extremely low sums. of no more than parts per million in animal and human tissues. Some of them are necessary, such as copper, to perform the vital processes of metabolism, growth and reproduction, but the excess of these elements beyond the normal limit makes them toxic and harmful and affects animal and human health, as they enter the animal's body from Through the skin, the gastrointestinal tract , or the respiratory apparatus , producing useful harmful consequences. as a result of their interference with the vital metabolic processes in the cells of the animal's body, and their danger arises because they are not chemically or thermally decomposed as well as they accumulate in the environment, pollution of foodstuffs, and disorders like cancer., thus reaching milk, one of the animal food products for humans. Causing harm to the consumer.

1-5 Copper has several advantages.:

Copper has remarkable [4] qualities, which also application to a copper P/M (powder metallurgy) gadgets, which have excellent electrical and thermal conductivity, flexibility, and corrosion resistance. A variety of uses for copper and its alloy P/M parts benefit from these characteristics.

Commercially available copper powder that is more than 99% pure, yields parts with electrical conductivities ranging from 80% to 95% IACS (International Annealed Copper Standard) after pressing and sintering. Further densification can achieve even higher conductivities, nearing 100% IACS. High thermal conductivity is a direct result of this high electrical conductivity. Consequently, in the manufacturing of electrical and electronic components where thermal or electrical conductivity is essential, copper P/M parts provide a notable benefit.

Copper is a particularly malleable and ductile metal, and products made from powdered copper and copper alloys exhibit excellent ductility. Parts sintered and pressed from steel, nickel silver, and P/M copper can elongate by up to 35% in just one inch. In addition, copper and its alloys are resistant to any kind of corrosive environments.

making P/M components suitable for various applications where corrosion resistance is vital.

Powder metallurgically manufactured parts made of qualities that are nearly equivalent to their wrought or cast counterparts. Copper, bronze, brass, the nickel metals such as silver and copper-nickel are corrosion resistant.



Figure 4: advantages of copper in making copper roofs

1-6 Among copper's drawbacks are:

Copper [7] is far more expensive than fiber optic cable. Its pricing is highly impacted by Latin American foreign trade, making it a more unpredictable market than locally made fiber optic networks. Copper wire's high cost is partly due to its expensive storage requirements. as it must be protected from exposure to oxygen. Additionally, its heavier weight results in increased shipping costs.

One of the most significant [8] problems of wire made of copper is its vulnerability to corrosion, specifically oxidation, which results in a shorter service life than fiber optic cables. As a result, the difficulties involved with keeping copper are strongly related to its ability to oxidize even at relatively normal temperatures.

oxidation. As a result, its life expectancy is shorter than that of fiber optic cables. As a result, the problem with copper storage stems from its proclivity to oxidize at very typical temperatures.

Shock Risk:

Fiber optic cable presents a reduced shock risk than copper wire. Copper is more vulnerable to electrical interference, which results in a less clear signal than fiber optics. Copper wire, in short, is more hazardous than fiber optic cable.

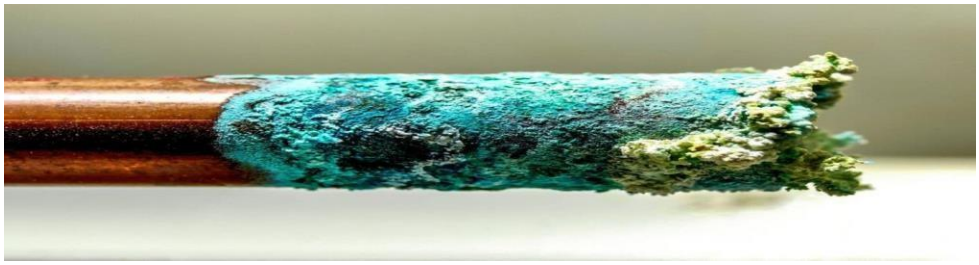

Figure 5: copper corrosion

1-7 The Chemical and physical properties of copper:

Copper is a glossy reddish-brown mineral with a face-centered cubic (fcc) crystal structure It has an average density of 8.9 grams per cubic centimeter. It melts at 1083°C and boils at 2360°C. Copper chemical substances can be either bivalent or monovalent. For instance, it is mixed in $CuSO_4$ but monovalent in CuS.

The chemical electrical potential of copper ions is positive:

$Cu \longrightarrow Cu^{2+} + 2e^{-}$ $E° = 0.337$ Volt

$Cu \longrightarrow Cu^{+} + e^{-}$ $E° = 0.521$ Volt

Due to this, copper does not displace hydrogen in acids but only dissolves in them when there is an oxidizing agent present. Copper also does not react with basic solutions. Notably, copper salts like blue vitriol or aqueous copper sulfate ($CuSO_4 \cdot 5H_2O$) find applications in chemistry, leather tanning, fur and artificial silk production, as well as dyeing processes.

Summary Copper's chemical and physical attributes encompass its unique characteristics in terms of both its composition and its behavior under different conditions.

One intriguing aspect not always emphasized online is the connection between copper and microbial activity.

Copper possesses antimicrobial characteristics, which have been recognized and utilized for ages.

Copper's ability to inhibit the growth of bacteria, viruses, and fungi makes it valuable in various applications.

Its innate property of hindering the proliferation of antibiotic-resistant bacteria has gained renewed attention recently.

Copper surfaces can develop a distinct greenish-blue patina over time due to exposure to environmental factors.

The development of this patina not only enhances the visual appeal of copper objects but also acts as a protective layer.

The electrical conductivity of copper is remarkably high, making it one of the most commonly used materials in electrical applications.

Copper's exceptional electrical conductivity arises from the unique arrangement of its atoms in its crystalline structure.

As a result, copper plays an indispensable role in modern electrical and electronic systems, facilitating the efficient flow of electrons with minimal resistance.

Analytical chemistry [10] can be classified according to the purpose of the analysis into:

2- Qualitative analysis:

This method involves identifying the composition of materials, compounds, or elements within a substance or mixture, regardless of their quantities. Whether the substance is in a solid state or dissolved in a specific solvent, qualitative analysis focuses on detecting the presence or absence of particular components. This approach provides valuable information about the composition and characteristics of a sample without quantifying the amounts of its ingredients.

2-1-1 Qualitative and quantitative estimation of copper in biological material by benzoin oxime:

Benzoin [11] oxime, when reacted with copper (Cu), forms a derivative that is insoluble in water, distinguishing it from reactions with other metals. This insoluble compound facilitates the gravimetric determination of copper in rabbit livers. Furthermore, the compound is soluble in chloroform, producing a green solution. This characteristic reaction serves as a qualitative test specifically for the presence of copper. This method, as described by C.E. Edgar, provides a reliable means of detecting copper ions in biological samples such as rabbit livers.ve analysis:

This type of analysis aims to determine the amounts or concentrations of the components or elements present in a chemical compound or mixture. Typically, qualitative analysis, which identifies the presence or absence of specific substances, precedes quantitative analysis. This sequential approach ensures that the substances are identified before their quantities are measured accurately. Quantitative analysis provides numerical data regarding the composition of a substance, complementing the descriptive information obtained from qualitative analysis.

2-1 Quantitative examination of copper, zinc, and copper/zinc ratio in selected human brain tumors.:

Serum copper and zinc concentrations [12], as well as The copper/zinc ratios have observed. to rise in a range of malignant cancers, including brain tumors. In an analysis of 29 individuals with primary and

metastatic brain tumors, atomic absorption analysis was performed to detect \ Copper and zinc concentrations in connective tissue and capillary samples.

The findings indicated that spreading carcinomas and gliomas that are malignant have much higher tissue levels of copper than controls tissues and meningiomas. Malignant gliomas showed significantly higher tissue copper/zinc ratios. In relation to serum stages, ranging the metastatic cancer survivors had significantly greater copper and copper/zinc rates than the controls.Nevertheless, serum copper levels found in malignant gliomas did not differ significantly from those in healthy tissue.The amounts of these trace elements in serum or tissue samples from meningiomas were identical to those in controls.

These data indicate that copper, which is involved in angiogenesisrises in malignant organs of cancer that has spread and malignant glioma, but not in cancers of the men Malignant results may give light on the genic processes that underpin malignant tumors.

and the quantitative analysis includes:

3- Gravimetric analysis:

Quantitative analysis is conducted by weighing the sedimented substance to quantify it as either a single element or a specific derivative with a known composition. This process involves separating the substance from the solution to determine its quantity accurately

Gravimetric analysis involves several steps to determine the weight of a substance or its components accurately. After sedimentation, the substance undergoes washing, drying, and weighing. The weight of the substance to be estimated is calculated based on our knowledge of the precipitating weight and composition of the precipitant.

For example, the percentage of chlorine in table salt can be determined by dissolving a known weight of salt in water, then adding excess silver nitrate. This causes precipitation of silver chloride. The precipitate is then filtered, washed, dried, and weighed to measure the concentration and percentage of chlorine in the salt.

Gravimetric analysis includes methods in which the weights of materials or some of their components are determined in two main ways:

3-1 A - the direct method:

in which the measurements of weights are determined for the products of the analytical process known as the composition.

3-2 B - the indirect method:

With it, measurements of lost or underweight weights are determined as a consequence of volatilization species.

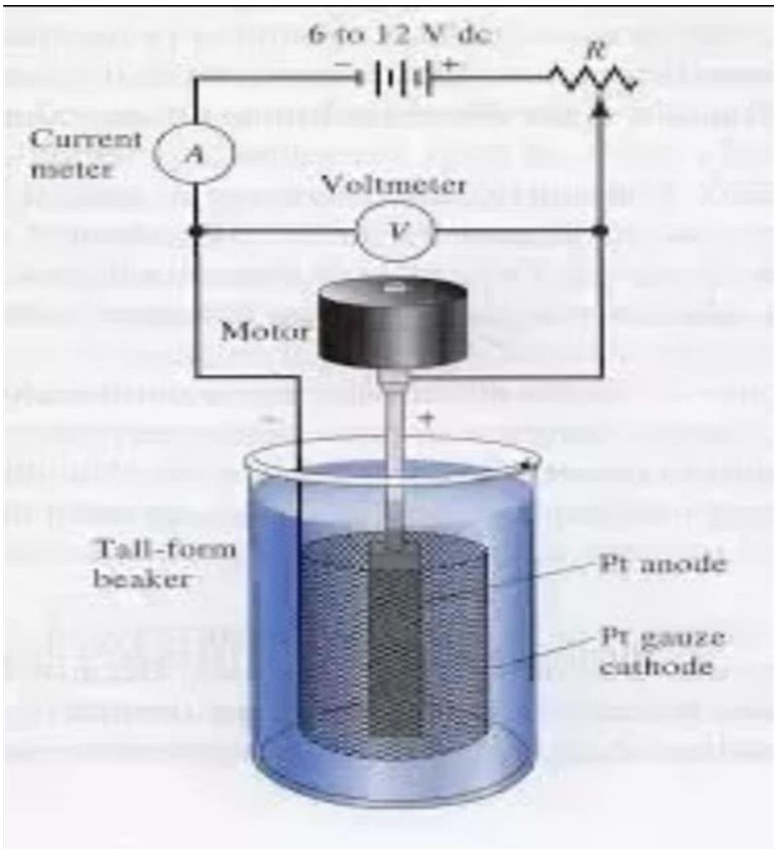

Figure 7: Gravimetric determination of copper

4- Volumetric analysis:

In this case, direct and indirect methods are used to determine the weights of materials or some of their components



Figure 8: volumetric analysis

4-1 Titanous chloride can be used to estimate the amount of copper and iron.:

During [16], a research investigation that included numerous studies of cupric chloride solutions, the copper content of the solutions was measured using titration with titanous chloride. To help this process, a predetermined amount of ferric ammonium sulphate was introduced, coupled with an excess of potassium thiocyanate, which served as an indication. This method is well known and has been thoroughly discussed by Knecht and Hibbert in their work "modern" Elimination Techniques in Volumetric Analysis" (1918), as well as by other scholars in the field.

4-2 New way presents a new volumetric method for the estimation of copper:

The investigations mentioned in reference [17] focused on Using Thiocyanates in Volumes Processes and were drove out in the laboratory over a two-year period. While the findingshave been pleasant in a variety of ways, with a special emphasis on one use that is really useful. The conventional chlorine and chemical methods for measuring copper have been deemed insufficient. Two recent procedures suggested in the journal include precipitating copper as cuprous thiocyanate., indicating a significant development in methodology. The presented procedure improves on this by precipitating copper as cuprous thiocyanate, oxidizing copper without decomposing the alkali thiocyanate, and titrating the acidified thiocyanate with standard permanganate. In reality, these final processes are merged, needing only one filtration, and a determination usually takesthirty to forty minutes from sample weighing to final titration.

Beforehand precipitated copper as cuprous thiocyanate., pay close attention to the state of the solution. Solutions containing free sulphuric acid should not exceed 1 or 2 percent, as stronger solutions tend to liberate, Pure sulfur; when subjected to heat with thiocyanate reducing precipitate purity and resulting in varied final readings. Similarly, the addition of hydrochloric acid might produce comparable results. However, nitric acid produces no free sulphur. Nonetheless, an overabundance of acid hinders reduction and full precipitation.

5- Titration method:

It includes the use of solutions with a known concentration and measuring the volumes of such solutions that interact quantitatively with the solution of the substance to be assessed to a certain point called the equivalent point or the end point of the reaction that can be detected by means of indicators that include a sharp change in the properties of the solution such as the color or turbidity that you observe. With the naked eye, or it is measured by chemical-physical methods, such as measuring the potential difference or electrical conductivity.

The standard solution is a solution that is known to concentrate and has a certain weight of the solute in a specific volume. Titration is the process of introducing the standard solution from the burette to a specific volume of the solution of unknown concentration in the conical flask or vice versa until the reaction is completed..

5-1 Copper Determination in Ores using Iodide Method:

The iodide technique was used to determine the presence of copper itself in ores [18].The standard solution remains unaltered. and requires No even more verification. A learner can choose a sample of copper pyrites

for examination, saving a part (Following reduction and sampling) for later evaluation using The cyanide Technique.

Grind the sample collection. until it passes through an 80-mesh screen, then quarter it to yield a. Little grams Blend them using an agates crusher and weigh out 0.5g..

Place the ores to a 250-c.c. flask. Add 10 c.cs. of 16E. HNO_3 and boils until almost dry. Add 10 c.c. of 16E. HCl and boiling again. After two to three minutes, add 10 c.cs. of 36E. H_2SO_4 and vigorously heat until white fumes arise from the liquid. Let it to cool. Bring 40 cups water to a boil. Filter Assembly using 7.5 cm of filtration paper.

Wash, striving to maintain the temperature below 75 c.c.

Begin with the aluminum precipitating as previously mentioned, adding approximately 1 gm of $KClO_3$ before condensing to 1 to 2 c.cs. This transforms any arsenic present to arsenic acid, making it inactive. The process of titration is carried out as usual. The student can later check the results produced here by using the Cyanide or Electrolytic procedures. Based on Low, the Iodide procedure is as precise as the nearly flawless Electrolytic process.

5-2 Idometric Determination of Copper:

The [19] rapid method for producing arsaniloazo p-cresol produces a coefficient of extinction that is almost identical to the one of the purified product. The molecule extinction coefficient of arsaniloazotyrosine has been identified. This quantity can be used to compute the total amount of azo molecules for any arsaniloazo protein where the extinction parameter has been established. As a result, the number of connected azo groups in this kind of protein can be calculated through comparing its ray absorbance to that of the same diazotized amine combined with a high amount of tyrosine.

5-3 Determining the copper and zinc levels in brass plating solutions through titrimetric analysis:

is essential, as [20] the composition and color of electroplated brass are influenced by these metals. Hence, it's imperative to rigorously monitor the contents of copper and zinc using an analytical method that guarantees precise results and can be universally applied to any brass solution, regardless of its composition (whether copper, zinc, cyanide, etc.).

Numerous titrimetric methods detailed in literature for assessing copper and zinc content in brass plating baths exhibit procedural flaws or are limited in their applicability to specific types of plating baths. This paper offers a brief overview and critical evaluation of these methods, establishing appropriate methodologies for determining these metal contents in brass plating baths. Direct analyses for copper (utilizing iodometric titration) and zinc (employing EDTA complexometric titration with xylenol orange indicator) have proven highly effective, providing accurate results across a wide range of cyanide brass plating bath compositions



Figure 9: Determination of copper in brass

6- Flame photometer:

where the material is excited using different types of flame, and after the material is returned to a low

energy edge, the amount of light emitted is measured.

6-1 Copper estimation using flame photometry:

Copper in [21] plant tissue is recovered from a 0.1 N hydrochloric acid solution using a chloroform-kerosene dithizone solution and quantified in this organic combination using a flame photometer. The results obtained using this quick approach show a reasonable correlation with those obtained using the AOAC method.

6-2 The goal of this investigation is to examine the copper levels in veterinary medicinal products using flame atomic absorption spectrometry (f_AAS):

This determination [24] is conducted post-mineralization of samples in a HCl:HNO3 mixture (20:1, v:v), followed by instrument quantification and result validation. The validation process confirms that interferences from the entire analytical system and their measurement do not affect the results and ensures that no other unconsidered effects are present.

7- X-ray fluorescence:

where the material is excited by X- rays of a certain wavelength, and after returning to a low-energy state, the emitted rays are measured, which distinguishes the element.

7-1 X-ray fluorescence spectroscopy provides exact copper estimate:

8- Electro chemical method:

This work [25] offers a fast and accurate method for determining copper concentration with a technique known as X-ray fluorescence (XRF). When compared to traditional laboratory techniques, our methodology increases accuracy and reduces measurement time from hours to 30 seconds.

The mathematical models have been calibrated & verified with the coefficients of correlation (Rc^2 and Rv^2), error in predictions (RMSEP), and calibration error (RMSEC). Calibration and validation have been carried out with copper concentrations ranging from 0.04 to 2.9%. This method precisely predicts the level of copper in actual time and through the internet, with a Rv^2 value of 0.9886 and an RMSEP value of 0.0890.

Electrochemical methods refer to analytical procedures which employ possibility, charge, or current to determine an analyte's concentration or chemical reactivity.

This work describes using biochar as a conductor enhancer when coupled with the differential pulsed adsorptive stripping voltammetric (DPAdSV) approach to preconcentrate and quantify copper (II) ions in spirits drink samples (such as Cachaça, Vodka, Gin, and Tequila). Copper ions had a linear response at levels ranging from 1.5 × 10−6 to 3.1 × 10−5 mol L−1, with an upper limit of detection (LOD) of 4.0 × 10−7 mol L−1.

The suggested sensor had a reproducibility of 3.6% when utilizing the same surface of the electrode and 6.6% when employing different electrodes. Furthermore, the impact of foreign fauna on the voltammetric reaction was studied. Moreover, the quantity of the copper ions in different

The spirit drink samples were identified employing the inductively coupled plasma optical emission spectroscopy technique (ICP-OES), with results commensurate with a 95% confidence level.

Conductimetry analysis:

In which the change in the electrical conductivity coefficient of the model solution is measured.

8-1-1 Conductometric estimation of copper with resacetophenoneoxime:

It is [26] evident from the analyses that the compounds conform to the formulas CoTu3X2 (X= Cl or Br). They exhibit characteristics of being non-electrolytes, monomeric, and paramagnetic, indicating the presence of 3 unpaired electrons. Thus, they are unequivocally five-coordinated cobalt (II) complexes, involving the utilization of 4s4p34d bonding orbitals.

As per the arguments proposed by Daudel and Bucher, the utilization of (nl) dns np3 bonding orbitals leads to a square pyramid configuration, while nsnpsnd bonding orbitals result in a trigonal bipyramidal arrangement. Consequently, these compounds exhibit such arrangements.

8-1-2 Conductometric and voluminous. studies of the sulfate of copper in aqueous ethanol solutions. various temperature:

Anton Par [27]. The density of the copper sulfate solutions in H2O and EtOH-H2O were determined using a Model 55 densimeter at temperature of 298.15 K, 303.15 K, 308.15 K, and 313.15 K. The acquired results assisted in determining apparent molar quantities, limiting fractional molar volumes, and transferring portion molar amounts of copper sulphate. These computed values were then utilized to explore the interactions between solute-solute and solute-solvent in the presence of copper sulfate in an aqueous ethanol solution.

Furthermore, the ion solvation behaviour of copper sulfate was examined utilizing the electrical conductivity principle throughout a temperature range of 298.15-313.15 K. The collected. The conductance data was evaluated using both Kraus-Bray & Shedlovsky conductivity models. Data analysis revealed key characteristics Examples of important thermodynamic characteristics restrict decimal resistance (λ°m), associating factor (KA), rating system energy of activation (Ea), and others. The Walden ratio (λ°mη0) was also calculated.

Additionally, The typical thermodynamics parameters associated with association (ΔG°A and ΔH°A) have been established and explained. The growing values of restricting molar conductance with higher ethanol concentrations suggest better ion-solvent and solvent-solvent interaction. In all examined systems, negative ΔG°A values indicate spontaneous association processes, whereas negative ΔH°A estimations indicate exothermic associations.

9- Potentiometry:

where the changing electrical potential during the reaction is measured when placing the electrode in the solution, and the end of the reaction can be known, and then the concentration of the reactants can be calculated.

9-1 Stripping potentiometry with medium exchange can be used to determine total copper content in white wine:

A study [28] tested stripping potentiometry (SP) with medium exchange to detect total copper in white wine. Medium exchange increased the long-term endurance of the the mercury film, particularly when mercury(II) was included in the encapsulation solution. The medium exchange SP and ICP-AES findings revealed a significant relationship (r=0.9964) when comparing a purification solution consisting of 1.0 M HCl and 20 μg ml−1 mercury chloride as the solvent and 4.0 M ammonium acetate were utilized as the stripping solution.

The four-fold assessment of the wine sample, together with single point regular addition calibration, permitted 32 enrichment-stripping rounds to be accomplished on a single film. However, using traditional SP, which requires an excessive amount of mercury(II) in the material being studied matrix for rapid

stripping, the quantity of copper was greatly overstated. The benefits of medium transfer SP over ordinary SP were highlighted in this study.

10- Colorimetric method:

The amount of electrical coulombs needed to complete the electrochemical reaction is measured.

10-1 Colorimetric Copper determined using ammonia:

Heine (11) was Among the initial individuals [29] to utilize it in 1830 were Dehms (6) and Bischof e (3). Recently, it has been employed to detect metal in peas (If), blast slags and wastes (1), jellies (19), marine life (17), the body of humans (2), iron, steel, as well as slag (20), veggies (9), and rubberized fabrics (18). According to Snell (21) the technique becomes most sensitive when there is 0.01274 mg of metal per milliliter, and at this amount, an increase of 0.000016 mg of metal can be seen. However, questions have been raised about the method's sensitivity, since Yoe and Grumpier (27), employing an electronic roulette comparator, discovered that a solution containing 8 ppm of copper could only be distinguished Holding 7 or 9 ppm is difficult. to determine, however one with 6 or ten parts per million is certain.

The goal of this article was to conduct a critical investigation of this technology using a photonic recorder spectrometer (14), with a focus on the influence of multiple ions on color.

10-2 Polyamine-functionalized gold nanoparticles probe can be used to colorimetrically detect copper (II):

A branching [30] Polyethyleneimine was utilized to functionalize gold nanoparticles.

Copper ions were shown to cause AuNPs to aggregate, This results in the shade shifting from reddish to purple.

Cu(II) can be detected either qualitatively or practically by measuring the ratio of absorbance between 650 & 520 Angstroms at pH 4 shortly after seven minutes of incubation.

The method detects Cu(II)

concentrations betweenThe detection limit is 30 nM and the concentration ranges between 0.1 and 10 μM.

It exhibits significant preference over common metal ions. Cu(II) could be determined using the standard addition approach, even with spiked tap and lake waters.

11- Polarography:

It measures the amount of electric current in proportion to the concentration of the substance that is reduced or oxidized in an electrochemical reaction at the micro-electrode.

11-1 The polarographic determination of zinc and copper in plants and soils is discussed:

The procedure described in [39] allows for the most sensitive extraction and polarization of copper and zinc. Extracting with dithizone in the presence of dimethylglyoxime reduces interference caused by cobalt.

A supporting electrolyte of decimolar potassium hydrogen phthalate is used, resulting in adequate waves for both copper and zinc. This electrolyte has a higher sensitivity for copper than the ammonia-ammonium chloride electrolyte.

11-2 Copper can be determined using the polarographic method:

A unique [40] method for detecting copper using A falling mercury electrode was studied with the following kind of controlling aqueous solutions 1 mol potassium salt tartrate as a and 1 normal amount of sodium hydroxide. This method can detect copper even when there is a high concentration of iron.

12- Atomic Absorbent Spectrometry (AAS):

Atomic- absorption Spectroscopy (AAS) Is an analytical approach used to measure element concentrations. It is extremely sensitive, detecting down to µg dm-3 in a sample. This method is based on the wavelengths of light that are absorbed uniquely by an element. These wavelengths correlate The range of energies required to raise electrons from a specific energy level to the next.



Figure 11: Atomic absorption spectrometry device

12-1 An online plasma-excited atomic absorption spectroscopy method (AAS) :

was created in order to find copper in water. Using copper as a representative sample metal, this apparatus and method allow for continuous monitoring of hazardous metal compounds in industrial water samples. In order to dissolve metal compounds dissolved in water, the procedure entails putting water into A sample

line is then fed into a nitrogen-based plasma jet. It catches the monochromatic spectrum that has been successfully transmitted and analyzes its absorption by copper atoms. The sensitivity and detection limits for the metal under inquiry are determined using absorbance and metal concentration. Copper data indicated sensitivity, range of detection, and quantification of 0.45 ± 0.02, 0.25 ± 0.01, and 0.85 ± 0.04 ppm, respectively.

12-2 Analyzing the amoun of copper in bread and pastries utilizing a quick slurry electrothermal atom absorption method t:

A quick method for detecting the quantity of metal in cookie known as loaf, and cereal samples using electrothermal absorption of particles is given. The pulverized samples were placed directly onto the evaporator after being immersed in a 20% water and ethanol mixture including 0.5% nitric acid. Using a fast-program technique, the drying and ashing processes were replaced by a modified curing phase, and furnace temperatures were changed. At 2500°C, atomization took place eliminating the need for clean-out. Water-based standards were used during the calibration process. The outcomes of the slurry approach were quite similar to those of traditional calcination and acid dissolution..

12-3 This article describes how to use atomic absorption spectroscopy to determine copper: Atomic absorption is used to analyze copper in ores, concentrates, and tailings. Copper ores can be dissolved more quickly by using acid mixes in an extraction technique that makes it possible to use this technology for production control. The technique shows an accuracy of greater than 7% for concentrations of copper between 0.18 and 24%.

12-4 Use of atomic absorption spectroscopy allowed researchers to identify traces of copper in culinary oils:

The study looked on the measurement of trace copper in fats using atomic absorption spectroscopy. Copper spectral resonant a line at 3248 Å and 3274 Å were found to be the most effective sensitivity for fats and oils made from vegetables, with detection limits as low as 0.15 and 0.25 ppm, respectively. The data showed a direct correlation between the amount of oil added to the flame and copper absorption. As the fat content rose, aspiration rates in mixes of soybean oil and solvent fell both linearly and logarithmically. The exactness and precision of absorption techniques were determined by comparing the findings obtained with two different methods. Error assessments were conducted using low-copper-level dilution copper-hydrogenated soybean oil. Across a range of 0.05-0.40 ppm metal in the oil of soybeans, the mean, standard deviations, absolute average divergence, and analytical error found to be 0.0108 ppm, 5%, and 2.5%, respectively.

13- Analysis conducted through spectrophotometry :

figuring out a substance's composition or amount by seeing how well it absorbs various wavelengths of light.



Figure 12: spectrophotometer device

13-1 Spectrophotometric and modified spectrophotometric analysis of copper (II) employing dithizone in an aqueous environment is carried out.:

A study employing spectrophotometry and derivation spectrophotometry looks at the Cu-dithizonate compound in a solution of water employing Triton X-100, the neutral surfactants. The methodology respects the law of Beer from 1.0 × 10−6 to 9.0 × 10−6 mol/l of copper dioxide and has a detection limit of 12 ng/ml. The complex exhibits a molar absorption coefficient of 3.06 × 104 1 mol−1 cm−1, a specific absorptivity of 0.4825 ml g−1 cm−1, and Sandell's response of 2.1 × 10−3 µg cm−2. The 1 : 2 complex has a precondition stability constant of 1.73 × 1011 I2 mol2 (I = 0.07, pH = 1.4, temperature = 10 °C) based on equilibria analysis. Derivative absorption studies are used to estimate the complex's absorption peak while avoiding interference from individual metal ions. The approach is validated by examining the Copper concentration in wines, beer, hair from people, goats liver function. and fly ash samples.

13-2 Copper content was determined by spectrophotometry with α, β, γ, and δ-tetraphenylporphine trisulfonate (organic agent):

The soluble in water poietic α, β, γ, and δ-tetraphenylphorphine trisulfonate (TPPS, the H2R) has been shown to have a highly efficient when used for indirect spectrophotometric measurement and photometric titration of copper II. At 434 nm, H4R2+ exhibits an average absorbance of 5.0•105 and a spectrophotometric sensibility of 0.00013 µg Cu cm−2 (A=0.001). Beer's law applies in the range of 0.006 µg-0.06 µg Cu ml−1. Only zinc(II) caused considerable influence out of the twenty-two elements tested. likewise the acid dissociation rate constants and salt implications for TPPS spectra were assessed.

14- Chromatographic analysis:

This type of analysis depends on the difference of materials from each other in their tendency to adsorption or partition or exchange through a surface coated with a suitable solvent or through a chemical substance, and then these materials can be separated, and one of the methods of chromatographic analysis is

14-1 Thin layer Chromatography:

Chromatography, wherein the chromatographic examination occurs through adsorption or distribution on glass plates coated with a porous substance, facilitating separation and analysis.

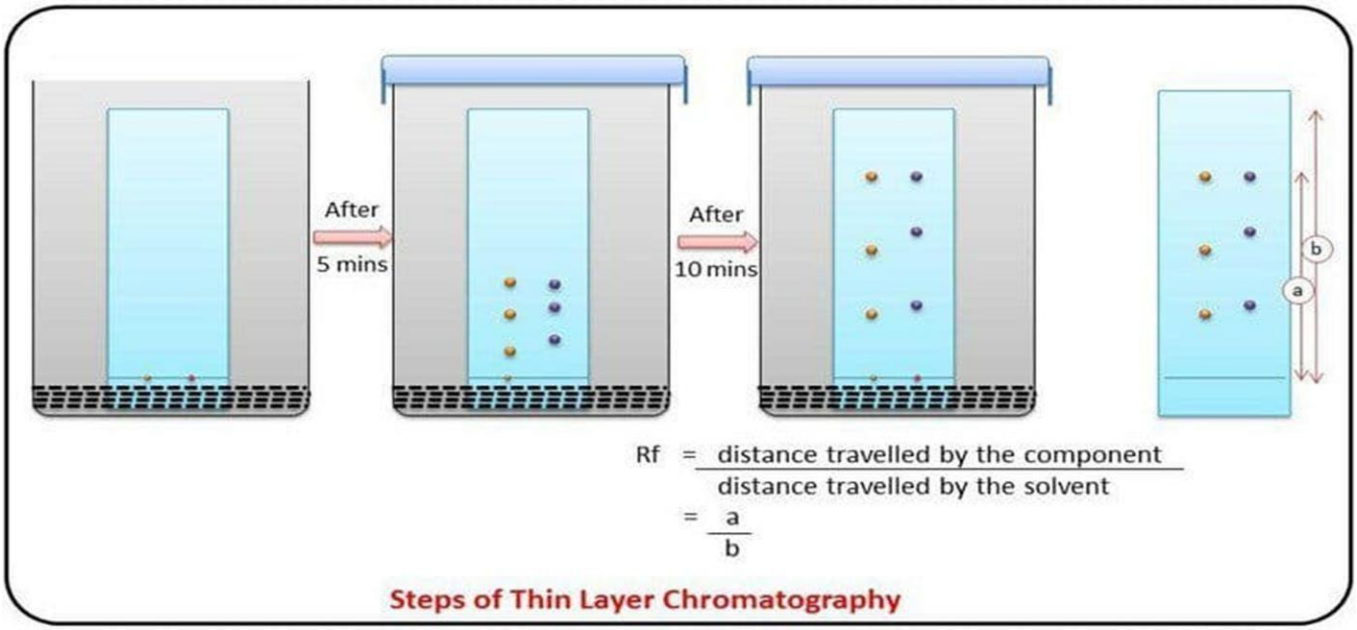

Figure 13: Thin layer chromatography

14-1-1 A method involving thin-layer chromatography for determining small amounts of copper in edible fats.:

To conduct the assessments outlined in the title, the sample matrix underwent initial decomposition through an enhanced incineration method. Minute amounts of copper (not surpassing 0.03 µg/cm in the chromatogram) were gauged by assessing fluorescence subsequent to treatment with an ammonium phosphate reagent. Elevated quantities (up to 0.3 µg/cm) were appraised based on copper-triggered suppression of fluorescence observed upon treating the chromatograms with glucose. In these trials, the metal is identified as non-fluorescent zones against a yellowish-green fluorescent backdrop.

15- Mass spectrometry:

In this way, it is possible to measure the ratio between the charge and mass of different ions resulting

from the crushing of large particles, and from it the molecular weight and concentration can be found

15-1 Copper The toxicity in the case of Wilson's disease was assessed using the method of laser inductively paired plasma mass spectrometry:

A vital trace element for the well-being of all living things is copper (Cu). It performs a variety of functions in biological processes as a transition metal. Based on balance studies, humans may need anywhere between 1.3 and 2 mg of copper each day. Lack of copper can impair neuropeptide production, antioxidant defense, and immune system performance. On the other hand, too much copper can cause mitochondrial structural damage and oxidative stress, which can cause neurological and/or hepatic symptoms, such as those associated with Wilson's disease (WD).

Mutations in the ATP7B gene, which codes for an ATP-dependent, P-type copper transporting ATPase, cause WD, a rare autosomal recessive condition that affects roughly 1 in 30,000 people. The, The deactivation of the Atp7b in gene causes an accumulation of Cu in many organs over a person's lifetime. as demonstrated by experimental models developed for the study of WD. It is still unclear how Cu is distributed precisely inside tissues and how it affects other metals.

New metal bio-imaging approaches in liver & brain tissues have recently been developed employing laser-based inductively coupled mass spectrometry (ICC- (LA-ICP-MS). This review discusses the scientific basis of this novel technique, as well as a review of our findings using LA-ICP-MS examination for natural observing, precise estimation, and spatial the localization of metallic substances in tissues about Atp7b null mice and surgical specimens from WD patients whose genetic makeup has been confirmed. The findings presented suggest that LA-ICP-MS offers multi-element capacity, allowing for reliable evaluation of the metal concentration in tissues, with WD as a case study.

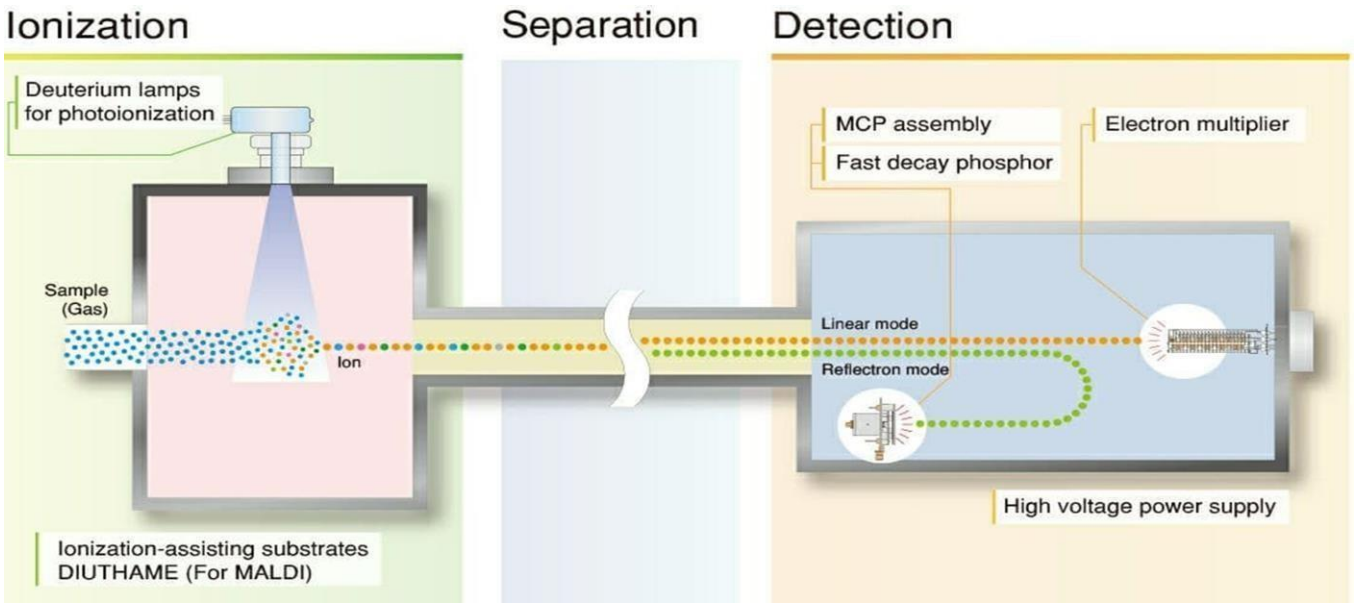

Figure 14: Mass spectrometry

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