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Estimates of the element copper

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Abstract

In the introduction, this research deals with the discussion of the copper element and its effect on the environment and living organisms, its benefits, harms, and its chemical and physical properties. Then the methods of chemical analysis and estimation of the copper element according to these methods were discussed in detail each separately. For example, in the quantitative analysis method, the copper element was estimated in human brain tumors, and in the qualitative and quantitative analysis method, the copper element in the biological material was estimated by benzoin oxide, and the same was applied to other chemical analysis methods.

Analytical chemistry [١]can be classified according to the purpose of the analysis into:

First: Qualitative analysis :

is a group of processes in which the composition of materials, compounds, or elements included in the composition of a particular substance or mixture of substances, whether in a solid state or in a solution in a specific solvent, is detected. This analysis is not subjected to the quantities of these. Ingredients.

Second: Quantitative analysis :

is the analysis that searches for estimating the quantities of the components or elements involved in the composition of the chemical compound or mixture, and it appears from this that the qualitative analysis of a substance of unknown composition usually precedes the quantitative analysis of it, because it is not permissible to quantitatively estimate a specific substance unless it is confirmed. Its existence is descriptive and the quantitative analysis includes:

١-Gravimetric analysis

The quantitative analysis is carried out by weight by sedimentation of the substance to quantify it in the form of a single element or a specific derivative of known composition. It is separated from the solution by sedimentation or centrifugation, and then washing, drying and weighing it. The weight of the material to be estimated is calculated from our knowledge of the precipitating weight and composition of the precipitant. For example, the percentage of chlorine in table salt can be determined, for example, by dissolving a certain weight of salt in the water, then adding an extra amount of silver nitrate to it, then it precipitates in the form of silver chloride, then the sediment is filtered, washed and dried, and then weighed to find out the amount and percentage of chlorine in the salt. The gravimetric analysis includes the methods in which weights of materials or some of their components are carried out in two ways:

A - the direct method:

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

B - the indirect method:

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

٢-Volumetric analysis methods

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

A- 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 solution that is known to concentrate is called the standard solution, which is a solution in which a certain volume of it contains a known weight of the solute. The process of adding the standard solution from the burette to a certain volume of the solution of unknown concentration in the conical flask or vice versa until the reaction is completed is called the titration process.

B- Gas analysis

[٢]The amount of consumed gases is measured in this way, and the substance is estimated by estimating the volume of the gas, which may be the substance to be estimated or the result of the interaction of that substance with other materials so that it gives a gas that can be estimated. It must not be understood that the quantitative and qualitative analysis processes can only be carried out by means of chemical reactions. And the separation processes by natural methods have a clear effect in building the most stages of the chromatographic analysis of the components of the mixture, followed by the distinction by chemical methods.

Third: instrumental methods of chemical analysis

The material is estimated by measuring some of its physical or chemical properties such as density, color, refractive index, electrical conductivity, thermal and electrical changes ... etc., and these methods mainly depend on the following measurements:

A- Emission of photoenergy

This measurement includes exciting material to the high levels of energy - powered optical or electrical and then re - entry at a low power level Venbos of which absorbed energy is a measure of the amount of material by means of the following ways:

a- Methods of recording spectrum Alanavata Emission spectrography:

Where the material is excited using an electric arc.

B- Flame photometr:

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.

C- X-ray flash, 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.

B-Absorption of photo energy:

It includes measuring the amount of light energy at a certain wavelength that is absorbed by the material to be analyzed, and for this purpose the following can be used:

١-Colorimetric methods
٢-Ultra-violet spectroscopic methods
٣-Infra-red spectroscopic methods
٤-X-Ray methods

٥-Nuclear magnetic Resonance (NMR) This method involves the interaction between radio waves and the nuclei of atoms that are in a magnetic field.

C- Electro chemical methods:

١-Conductimetry analysis

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

٢-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.

٣-Colorimetric methods:

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

٤-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.

D- 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 the methods of chromatographic analysis are divided into:

A- Adsorption Chromatography:

which is intended for chromatographic analysis by adsorption on the surface.

B- Ion-exchange:

chromatography, which means the chromatographic analysis by means of the exchange of ions between the material of the estimation and the ions of the surface that occurs on the exchange, which is a resin chemical substance.

C- Partition Chromatograph:

which means the chromatographic analysis by the fractional separation of a mixture of several materials. This method is divided into column partition, in which the analysis is performed on a column filled with a specific material.

D- Thin layer:

chromatography, in which the chromatographic analysis is carried out by adsorption or distribution on glass panels on which a porous material is spread over which separation and analysis are performed.

E - Gas Chromatography:

This includes chromatographic analysis using a carrier gas that carries the fumes of the dissolved materials, so the vapors of these materials are contacted according to their boiling points, i.e. the substances with low boiling points appear first, followed by the materials with high boiling points and these vapors are released to organize into the carrier gas and then it can be Separating and identifying these materials from each other. Gas chromatography can also quantify these separate materials.

E - Various methods

A- Polarometry:

This measures the amount of deflection produced when polarized light passes through a solution.

B- Refractometry analysis

measures the refractive index that determines the chemical composition of the mixture .

C- 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.

D- Thermal Conductivity

The thermal conductivity is measured and inferred from the material composition.

E - Radiochemical methods of analysis

in which the material radiates to become radioactive, and then the rays or particles flowing from it are prepared for the purpose of quantitative evaluation.

Copper

It is a [٣]chemical element that has the symbol **Cu** and the atomic number ٢٩ in the periodic table of elements, and because it is a **good conductor of electricity** , **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 is an indispensable element for the health of all living organisms **(humans, plants, animals and micro-organisms)** as **copper** is essential for organ functions and metabolism processes like all the essential elements and nutrients , but its increase in the body leads to opposite results from the increase of **copper** in the body, especially from the health point of view. Harmful.

Copper is an essential trace element, which is an important catalyst for heme synthesis and iron absorption. Following zinc and iron, copper is the third most abundant trace element in the body. Copper is a noble metal, like silver and gold.

Copper is one of heavy elements ,**Heavy elements** are one of the natural components of the earth's crust and one of the most important environmental pollutants and the most widespread of them. Pollution with heavy elements is spread everywhere in our house, and it results from various human activities such as waste from factories, mining, paint industry, cars, leather industry, and naturally from weathering the rocks of the earth’s crust. Heavy elements are the possibility of their transmission to humans through the food chain, in addition to their ability to remain for a long time in the environment without disintegration.

The effect of copper on environment -:

Copper is an essential [٤]substance for human life, and it irritates the stomach and intestines. People with Wilson's disease are at greater risk for the health effects found in alloys. Copper usually occurs in drinking water from pipes, as well as from materials designed to control algae growth.

The effect of copper on humans- :

Long-term exposure to copper causes nose, mouth, and eye irritation, headache, stomach ache, dizziness, vomiting, and diarrhea. Also, deliberately consuming large quantities of copper may lead to kidney and liver atrophy and then cases of human death. Industrial exposure to copper fumes leads to a person being infected with metallic smoke fever with a change in the mucous membranes of the nose. Wilson and its symptoms are cirrhosis, brain cell damage, kidney disease, and copper deposits in the cornea.

The effect of copper on plants- :

The 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
٠.٥ 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.

The effect of copper on animals- :

The importance [٥]of heavy elements lies in their presence in very low concentrations 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 digestive system, or the respiratory system, causing functional toxic effects 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 lead to their accumulation in the environment, contamination of foodstuffs, and diseases such as cancer, thus reaching milk, one of the animal food products for humans. Causing harm to the consumer.

Determination of copper

١-The determination of copper by atomic absorption spectrophotometry

The []investigation of various factors affecting the determination of copper by atomic absorption spectrophotometry, and the application of the method to the analysis of various agricultural materials are described. Recoveries are given for the determination of copper in plants, soils, soil extracts and fertilizers.

٢-Determination of copper in water samples by atomic absorption spectrometry after cloud point extraction

Cloud point extraction employing the new reagent ٦-[٢′-(٦′-methyl-benzothiazolylazo)]-١,٢-dihydroxy-٣,٥-benzenedisulfonic acid as complexing agent and Triton X-١١٤ as the surfactant is proposed for copper determination. A sample volume of ١٠ mL was used. Dilution of the surfactant-rich phase with acidified methanol was performed after phase separation, and the copper contents were measured by flame atomic absorption spectrometry. Variables affecting the system were optimized using factorial design and Doehlert matrix. Signals were measured as peak height using an instrument software. Using the experimental conditions defined in the optimization, the method allowed copper determination with a detection limit of ١.٥ μg L−١. The calculated enrichment factor is ١٤. The effects of foreign ions are reported. The accuracy of the procedure was tested by analyzing certified reference material. The method was successfully applied to copper determination in natural and drinking water samples.

٣-Determination of copper in biological materials by atomic absorption spectrometry

Dry ashing in muffle furnace and ashing in low pressure oxygen plasma were compared with acid digestion in pressure vessels, solubilization with tetramethylammonium hydroxide and slurry sampling for the determination of copper in animal liver tissue samples by atomic absorption spectrometry. The ashing in the muffle furnace and in the oxygen plasma were proposed for decomposition of small pieces of liver. These samples were inserted in quartz micro bowls and imitated the human liver tissue by biopsy.

٤-Determination of copper status in ruminants

The Cu status in healthy ruminants depends on species, age, and Cu intake. The limit value of ٣٥ mg/kg liver dry matter for a sufficient Cu supply in sheep and cows is much higher than in some wild ruminants and goats. Red deer, sika deer, roe deer, aoudads, and domestic goats did not suffer from Cu deficiency at the same liver Cu concentration level as that at which sheep and cows die from Cu deficiency. Therefore, a limit value as low as ٢٠ mg Cu/kg liver dry matter is assumed for roe deer, ١٥ mg for red deer and aoudads, ١٠ mg for sika deer, and ٨ mg for domestic goats. Furthermore, roe and red deer stored less than ٩ mg Cu/kg dry matter in the cerebrum, which is regarded as a limit value in sheep and cows. ٥ and ٨ mg Cu/kg cerebrum dry matter are regarded as sufficient for roe and red deer, respectively. The cerebrum is the best indicator organ of the Cu status in goats under condition of Cu deficiency, followed by liver, blood plasma, and hair with decreasing reliability. A high Cu intake is reflected best by liver whereas cerebrum and hair cannot accumulate such high Cu amounts. The mean Cu content of the liver in ruminants varied between ١٠ and ٥٩٢ mg Cu/kg dry matter.

These values are influenced by both, the species and the Cu intake. It seems that the capacity of liver to accumulate Cu differs among the ruminants.

٥-Colorimetric determination of copper with ammonia

Among the first workers to use it was Heine (١١) in ١٨٣٠, followed by Dehms (٦) and Bischof (٣). More recently it has been applied to the determination of copper in peas (If; in blast slags and tailings (١); in preserves (١٩); in marine organisms (١٧); in the human body (٢); in iron, steel, and slag (٢٠); in vege-tables (. ٩); and in rubberized fabrics (١٨). Snell (٢١) has claimed that the method is most sensitive when ٠.٠١٢٧٤ mg. of copper per milliliter is present and that at this concentration the addition of ٠.٠٠٠٠٠١٦ mg. of copper can be detected. It is doubtful, how-ever, if the method is as sensitive as these figures would imply, for Yoe and Grumpier (٢٧), using a roulette comparator, found that a solution containing ٨ ppm. of copper could be distinguished only with

difficulty from one containing ٧ or ٩ ppm. and with certainty from one containing ٦ or ١٠ p. p. m. The purpose of the work described in this paper was to make a critical study of this method by means of the photoelectric recording spectrophotometer (١٤), with particular attention to the effect of diverse ions upon the color

٦-Determination of Copper in Ores by Iodide Method

The estimation of Copper in Ores by the Iodide method.—The standard solution is again used, and needs no further checking. The student may take for analysis a sample of copper pyrites, portion of which he may reserve (after reduction and sampling) for subsequent estimation by the Cyanide method.

The Analysis.—Powder the sample to pass an ٨٠ sieve, and from this by quartering obtain a sample of a few grams. Grind this further in an agate mortar, and from this sample weigh out .٥ gm. The subsequent treatment as modified by A. H. Low (Jour. Amer. Chem. Soc., xviii., No. ٥, and contribution to Peters' Copper) is as follows—:

Transfer the ore to a ٢٥٠ c.c. flask. Add ١٠ c.cs. ١٦E. $HNO_{٣}$ and boil nearly to dryness. Add ١٠ c.cs. ١٦E. HCl and again boil. After ٢ or ٣ minutes add ١٠ c.cs. ٣٦E. $H_{٢}SO_{٤}$ and heat strongly till white fumes rise freely from the liquid. Cool. Add ٤٠ c.cs. water and heat to boiling. Filter through a ٧.٥ cm. paper. Wash, and endeavour to keep the washings under ٧٥ c.cs.

Proceed now with the aluminium precipitation as before described, except that in the case of ores Low strongly recommends the addition of about ١ gm. $KClO_{٣}$ before evaporating down to between ١ and ٢ c.cs. This oxidises any arsenic present to arsenic acid, which is inert. The titration is performed as usual. The student may later on check the results obtained here by means of the Cyanide method or the Electrolytic method. According to Low the Iodide method is equal in accuracy to the almost perfect Electrolytic method.

٧-Determination of copper in tea using an atomic absorption device

Theoretical part

In this experiment, the copper element is estimated, and this method can be applied to estimate other elements such as nickel, copper and nickel salts. Several are used to protect tea intentions from agricultural pests and sores that occur from fungi that affect Tea, and these elements are appreciated to ensure the quality of tea samples. Standard solutions in this experiment must contain the same medium in order to get rid of the entrails of elements such as: sodium, potassium and aluminum.

Chemicals required:

- A sample of tea
- concentrated nitric acid
- Copper sulfate.
- Sodium chloride
- Potassium chloride
- Aluminum chloride
- Distilled water

Tools used:

- Well balance.
- Electric heater.
- ٣-cup S ٢٥٠ capacity.
- Cup of capacity ml [١٠٠].
- standard beaker of volume ml ٢٥.
- standard teardrops seven a In [١٠٠]ml.
- **Procedure**
- **First: Preparing the sample,** weigh ١٥ g of the tea sample in a cup, add ٥ ml of concentrated nitric acid to the contents of the cup, then stir the solution so that the acid interacts with the sample in a cupboard of vases. Put the solution on an electric heater and evaporate the acid until the volume of the solution becomes mil ١ approx.

- Cool the solution, add ١٠ ml of distilled water, then filter the solution into a standard ٢٥ ml beaker, and continue to the mark with distilled water.
- **Second: Preparation of standard solutions**
- Prepare a standard solution of copper with a concentration of ١٠٠ ppm of copper sulfate salt in a standard flask of capacity ١٠٠ ml.
- Prepare a standard solution containing: Na, K, A in a standard flask of ١٠٠ ml capacity and ask the practical trainer how to prepare it .
- Using the dilution law, prepare the following standard solutions: (ppm ١٠, ٨, ٢,٤,٦) in standard flasks with a capacity of ١٠٠ ml from a solution of copper p.p.m (١٠٠ with a note of addition of ml | of the solution that contains: Nak , A
- **Third: Finding the concentration of the unknown**
- start the device according to the steps provided with the device in the absorption of the standard solution in the absorption capacity of the unknown opening and calculations. ١٠٠ ml Find the weight of copper sulfate needed to prepare ppm (١) | Of copper in Doff together: Find the Abbasid volumes taken from the base solution ppm (١) ١ to prepare standard solutions: pp.me ١٠ ٨ ٦ ٢.٤ in ١ ml flasks (٨) In enclose the results and the graph taken from the device and record the copper concentration and Find the copper concentration in the tea sample in (µg/g) ppm (i).
- **٨- determination of copper in pastures and livers**
- A rapid procedure is described based on the" method of Eden and Green (Abst. ٢٣٢٢, Vol. ١٠). Interference by Fe and Mn was avoided by developing the color with a limited concentration of sodium di-ethyldithiocarbamate in the presence of ammonium citrate and at a pH greater than ٨.٥. The presence of silica or phosphate, when added to solutions of Cu, did not affect the results. The procedure gave satisfactory recovery of Cu added to pasture, even hi the presence of added Fe and Mn, and results for samples of pasture and liver liver Subject Category: Anatomical and Morphological Structures.
- **٩-Spectrophotometric and derivative spectrophotometric determination of copper (II) with dithizone in aqueous phase**
- A Spectrophotometric and derivative Spectrophotometric study of Cu-dithizonate complex in aqueous phase in the presence of Triton X-١٠٠, a neutral surfactant, is reported. The system obeys Beer's law between ١.٠ ×

١٠−٦−٩.٠ × ١٠−٦ mol/l of Cu٢+; detection limit is ١٢ ng/ml. The molar absorption coefficient, specific absorptivity and Sandell's sensitivity of the complex are ٣.٠٦ × ١٠٤ ١ mol−١ cm−١, ٠.٤٨٢٥ ml g−١ cm−١ and ٢.١ × ١٠−٣ μg cm−٢, respectively. The conditional stability constant of the ١ : ٢ complex, calculated considering simultaneously existing equilibria, has been found to be ١.٧٣ × ١٠١١ I٢ mol٢ (I = ٠.٠٧, pH ١.٤, temperature = ١٠ °C). Absorption studies in the derivative mode have been carried out to determine the absorption maximum of the complex and to overcome interference due to the presence of certain metal ions. The method has been validated by determination of copper in beers, wines, human hair, goat liver and fly ash samples.

- **١٠-Electrochemical determination of copper ions in spirit drinks using carbon paste electrode modified with biochar**
- This work describes for first time the use of biochar as electrode modifier in combination with differential pulse adsorptive stripping voltammetric (DPAdSV) techniques for preconcentration and determination of copper (II) ions in spirit drinks samples (Cachaça, Vodka, Gin and Tequila). Using the best set of the experimental conditions a linear response for copper ions in the concentration range of ١.٥ × ١٠−٦ to ٣.١ × ١٠−٥ mol L−١ with a Limit of Detection (LOD) of ٤.٠ × ١٠−٧ mol L−١. The repeatability of the proposed sensor using the same electrode surface was measured as ٣.٦٪ and ٦.٦٪ using different electrodes. The effect of foreign species on the voltammetric response was also evaluated. Determination of copper ions content in different samples of spirit drinks samples was also realized adopting inductively coupled plasma optical emission spectroscopy (ICP-OES) and the results achieved are in agreement at a ٩٥٪ of confidence level.
- **١١-Spectrophotometric determination of copper with α, β, γ, δ-tetraphenylporphine trisulfonate(organic regent)**
- Water-soluble porphyrin, α, β, γ, δ-tetraphenylphorphine trisulfonate (TPPS, H٢R), was found to be a very useful agent for both the direct spectrophotometric determination and the photometric titration of copper(II). The molar absorptivity of H٤R٢+ at ٤٣٤ nm is ٥.٠٠١٠٥ and the spectrophotometric sensitivity is ٠.٠٠٠١٣ μg Cu cm−٢ for A=٠.٠٠١. Beer's law is followed in the range ٠.٠٠٦ μg−٠.٠٦ μg Cu ml−١. Among twenty-two elements examined, only zinc(II) seriously interfered. Acid

dissociation constants and salt effects on the spectra of TPPS were evaluated.

- **١٢-Estimation of copper in-use stocks in Nanjing, China**
- Copper (Cu) is an essential but supply-restricted resource in China. Characterization of in-use stocks can provide useful instruction for the future recycling of copper. This article attempts to estimate copper in-use stocks in a Chinese city. To this purpose, an extensive bottom-up estimate of copper stocks in use in Nanjing in the year ٢٠٠٩ was conducted. The results are a total stock estimate of ٢٩٥ gig grams (Gg) of copper or ٤٦.٩ kilograms (kg) of copper per capita for ٢٠٠٩. Infrastructure, equipment, and buildings contain ٤٢.٠٪, ٢٦.١٪, and ٢٨.١٪ of the total stock, respectively, indicating that these three categories are principal potential reservoirs of a secondary copper resource. The copper in transportation amounts to only about ٣.٧٪ of the total amount. The per capita stock was compared with similar studies carried out in other regions of the world, and the results show that the Nanjing level is significantly lower than developed countries. On the whole, our results show that electric power transmission and distribution systems, buildings, household durables, and industrial equipment are the four largest potential reservoirs of copper scrap.
- **١٣-Colorimetric micro-estimation of copper in plants by ٢: ٢'-diquinoline**
- The formation of a pink complex between Cu+ and ٢: ٢'-diquinoline in organic solvents is the basis of this method. Hydroxylamine hydrochloride was used to reduce Cu ٢+ to Cu.+A dried sample of plant material was treated with a mixture of perchloric and nitric acids and the resulting solution was
- neutralized with KOH. Sodium tartrate, hydroxylamine hydrochloride and isoamyl alcohol containing ٢: ٢'-diquinoline were added, the mixture was thoroughly shaken, and after centrifuging the alcohol layer was removed and Cu was estimated colorimetrically. Fe, Mn and Zn in concentrations ١٠ to ٢٠ times that of Cu did not interfere with the estimation. A. Hepburn.
- **١٤-Spectrophotometric Estimation of Copper (I) Using Rubeanic Acid**

- Submicrogram determinations may be affected by sample variation in cations and anions apparently without effect at higher microgram levels. Quantitative separation of the elements concerned from the sample matrix minimizes such effects and may be es-sential for accurate determinations by helping to reproduce standard curve conditions. Extraction of an element, usually in the form of a complex by a solvent immiscible with water, is an especially valuable separation technique, not only because of the selectivity possible with the choice of complexing agents, pH optima, and organic solvents available, but also because the extraction may be repeated several times if the distribution ratio is not particularly favorable.
- **١٥-Spectrophotometric determination of serum copper with biscyclohexanoneoxalyldihydrazone**
- Standard copper colorimetric methods, which com-monly use diethyl dithiocarbamate, give a molar absorbance index of about ٨٠٠٠, in aqueous solution. This low sensitivity makes impractical a reliable determination of copper on trichloroacetic filtrates of human sera. Nilsson (٣) showed that the compound biscyclohexanoneoxalyldihydrazone reacts with the cupric ion in alkaline solution to give a blue color. This copper com-plex has a molar absorbance index of ١٦,٠٠٠ at ٦٠٠ mg. It gives a clear, stable, blue-colored solution with con-stant absorbance with the cupric ion over a pH range of ٧.٠ to ٩.٠. The biscyclohexanoneoxalyldihydrazone does not give a color with any other cations or anions com-monly encountered in biological materials.
- **References:**

- [١] D.G Barceloux, Donald Barceloux
- Journal of toxicology: clinical Toxicology ٣٧ (٢), ٢١٧-٢٣٠, ١٩٩٩.
- [٢]M. V Twigg, M.l S Spencer , Applied Catalysis A: General ٢١٢ (١-٢), ١٦١-١٧٤, ٢٠٠١.
- [٣]Brazilian Journal of Plant Physiology ١٧ (١), ١٤٥-١٥٦, ٢٠٠٥.
- [٤]Giri, S .; Singh, G .; Jha, V .; Tripathi, RM (٢٠١١). Risk assessment due to ingestion of natural radionuclides and heavy metals in the milk samples: acase study from aproposed uranium mining area, Jharkhand. Environ Monit Assess, ١٧٥, ١٥٧-١٦٦.
- [٥]GISBERT, C .; ROS, R .; DE HARO, A .; WALKER, DJ; PILAR BERNAL, M.; SERRANO, R .; AVINO, JN A plant genetically modified

that accumulates Pb is especially promising for phytoremediation . Biochem Biophys Res Commun. ٣٠٣ (٢): ٢٠٠٣,٤٤٠--٤٤٥.

- [٦]KRISHNA, PV; JYOTHIRMAYI, V. MADHUSUDHANA, K. Human health risk assessment of heavy metal accumulation through fish consumption, from Machili patnam Coast, Andhra Pradesh. International Research Journal of Public and Environmental Health, India, Vol.١ (٥), ٢٠١٤, ١٢١-١٢٥.
- [٧]Markwiese, J. T. and PJS Colbery (٢٠٠٠). Bacterial reduction of cooper –contaminated ferric oxide: coper toxiexy and the interaction between fermentative and iron reducing bacteria, Archives of Environmental contamination and toxicology.
- [٨]MISHRA, A .; SK, S. Heavy Metal Toxicity: A Blind Evil . J Forensic Res India, (٢٠١٤) ٥: ٢.
- [٩ كتاب النحاس و سبائكه الفصل الاول صفحة ٥٨ [الاستاذ المتمرس الدكتور جعفر الح دُري المهندس عماد الد نٌ ابراه مٌ و
- المهندس محمد عل ذ ٍأب الجامعة التكنولوج ةٌ قسم هندسة الانتاج و المعادن بغداد –العراق الطبعة الاولى ٢٠١٣ م – ١٤٣٤ ه.
- [١٠] تصن فٌ الك مٌ اًء التحل لٌ ةٌ – الباب الأول من كتاب أسس الك مٌ اًء التحل لٌ ةٌ)التحل لٌ الوصف والكم والآل (للمؤلف / محمد
- مجدي عبدالله واصل
- [١١]Z Gruzewska, G Roussel Compte rendu des seances de la Societe de biologie ١٢١, ٢٨٩-٢٩١, ١٩٣٦
- [١٢]D. Yoshida, Y. Ikeda, S. Nakazawa Journal of neuro-oncology ١٦ (٢), ١٠٩-١١٥, ١٩٩٣.
- [١٣]RP Singh Current Science ٢٤ (٦), ٢٠٨-٢٠٩, ١٩٥٥.
- [١٤]J. Byun, K. Hawn Kim, B. Keun Kim, J.Woong Chang, S. Ki Cho, J. Jeong Kim
- RSC Advances ٩ (٦٥), ٣٧٨٩٥-٣٧٩٠٠, ٢٠١٩.
- [١٥]KR Paul, VK Gupta Croatica Chemica Acta ٥٣ (٣), ٤٦٥-٤٦٩, ١٩٨٠.
- [١٦]J. Byun, K. Hawn Kim, B.Keun Kim, J. Woong Chang, S. Ki Cho, J. Jeong Kim
- RSC Advances ٩ (٦٥), ٣٧٨٩٥-٣٧٩٠٠, ٢٠١٩.
- [١٧] SW Parr Journal of the American Chemical Society ٢٢ (١٠), ٦٨٥-٦٨٩, ١٩٠٠.