

Determination of Copper and Study Its Poisonous Effects in Drinking Water in Baghdad area

Khalid N. Jassim

Dept. of Basic Science, College of Dentistry, University of Al Mustansiriyah

Abstract:

The objective of this study is to determine the concentration of copper(mg/L) in drinking water by using chromogenic agent from different area in Baghdad & with different intervals , The results show that the concentration of copper (mg\L) in tap water which remains motionless in plumbing system for following periods one hours, 3 hours, 6 hours, 12 hours, 24 hours, 7 days and 14 days are 1, 2.2, 4, 5.3, 7.5, 10 and 16 mg\L respectively.

From these results it clear that a high levels of copper occur if corrosive water comes in contact with copper plumbing and copper-containing fixtures in the water distribution system. If corrosive water remains motionless in the plumbing system for some time.

These amounts of copper are believed to have given rise to the symptoms of chemical food poisoning precipitated by the ingestion of alcohol on an empty stomach. Also children under one year of age are more sensitive to copper than adults. Long-term exposure (more than 14 days) to copper in drinking water which is much higher than 1,000 ug/l has been found to cause kidney and liver damage in infants.

Keywords: Spectrophotometry; 1-(2-pyridylazo)-2-naphthol; copper determination.

الخلاصة:

الهدف من هذه الدراسة هو قياس تركيز النحاس (ملغم/لتر) في ماء الشرب بواسطة طريقة التحليل الطيفي باستخدام عامل مولد الصبغة، وقد تم اخذ عينات من ماء الشرب من مناطق مختلفة من بغداد من نظام الاسالة وتم قياس تركيز النحاس بواسطة جهاز التحليل الطيفي وبفترات زمنية مختلفة وهي (ساعة واحدة، 3 ساعات، 6 ساعات، 12 ساعة، 24 ساعة، 7 أيام و 14 يوم) وبدون استخدام الماء لهذه الفترات وكانت نتائج التحليل هي (1، 2.2، 4، 5.3، 7.5، 10 و 16 ملغم/لتر نحاس) وعلى التوالي.

ان سبب ارتفاع نسبة النحاس يعود الى تماس الماء مع انابيب نقل المياه التي تحتوي على النحاس في تركيبها وتتناسب هذه النسبة طرديا مع فترة التماس، ويعتقد ان هذه النسب قد تسبب اضرار جديّة للاطفال حديثي الولادة وتلف الكلى والكبد للاجنة، وقد تسبب هذه النسب ايضا تسمم اذا تناولت على معدة فارغة عند تناول الكحول بسبب ترسيب مركبات الكحول النحاسية طبقا لمنظمة الصحة العالمية.

Introduction:

Copper occurs naturally in plants and animals. It is an essential element for all known living organisms, including humans. However, very large single or long-term intakes of copper may harm the health. Copper is a reddish metal that occurs naturally in rock, soil, water, sediment, and air. Its unique chemical and physical properties have made it one of the most commercially important metals. Since copper is easily shaped or molded, it is commonly used to make pennies, electrical wiring, and water pipes. Copper compounds are also used as an agricultural pesticide, and to control algae in lakes and reservoirs.

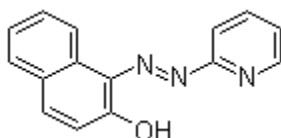
Copper and its compounds are common in the environment. The body may be exposed to copper by breathing air, eating food, or drinking water containing copper. Also be exposed by skin contact with soil, water, or other copper-containing substances [1-5]. Levels of copper found naturally in ground water and surface water are generally very low; about 4 micrograms of copper in one liter of water (4ug/l) or less. However, drinking water may contain higher levels of a dissolved form of copper [6, 7].

High levels of copper occur if corrosive water comes in contact with copper plumbing and copper-containing fixtures in the water distribution system. If

corrosive water remains motionless in the plumbing system for six hours or more, copper levels may exceed 1.000 ug/l. The level of copper in drinking water increases with the corrosivity of the water and the length of time it remains in contact with the plumbing. Copper is necessary for good health. The body got about 1,000 micrograms (1.000 ug) of copper per day by eating and drinking^[8,9]. Drinking water normally contributes approximately 150 ug/day. Immediate effects from drinking water which contains elevated levels of copper include vomiting, diarrhea, stomach cramps and nausea; the seriousness of these effects can be expected to increase with increased copper levels or length of exposure^[10]. Children under one year of age are more sensitive to copper than adults. Long-term exposure (more than 14 days) to copper in drinking water which is much higher than 1.000 ug/l has been found to cause kidney and liver damage in infants. Other persons who are highly susceptible to copper toxicity include people with liver damage or Wilson's disease because copper

exhibits these harmful health effects, and because drinking water may be a significant route of exposure to copper^[11-15]. It is important to determine the amount of copper in drinking water.

Spectrophotometric method has been used to determine the amount of the copper in drinking water in this work; Spectrophotometry is essentially a trace-analysis technique and is one of the most powerful tools in chemical analysis. 1-(2-pyridylazo)-2-naphthol (PAN) has been used for the spectrophotometric determination of copper. This is a sensitive, highly specific spectrophotometric method for the trace determination of copper. The method is based on the reaction of non-absorbent (PAN) in a slightly acidic solution (0.02-0.4 mol L⁻¹) with copper (II) to produce a highly absorbent red chelate product followed by a direct measurement of the absorbance in an aqueous solution with suitable masking, the reaction can be made highly selective and the reagent blank solution do not show any absorbance^[16-20].



Molecular structure of 1-(2-Pyridylazo)-2-naphthol (PAN)

Material & Methods:

Instrumentation:

GBC (Australia) (Model: Cintral-6) double beam UV/VIS the recording spectrophotometer. Chem. Tech. Anal. (U.K.) (Model-ALPHA 4) atomic absorption spectrophotometer equipped with a microcomputer controlled air-acetylene flame at 324.7nm was used for comparing the results. (Experimental conditions were: Slit width, 2 nm; lamp current, 3 mA; wavelength, 324.7; flow rate of carrier gases are- air, 6.5 L min.⁻¹;

acetylene, 2 L min.⁻¹; sample volume, 10 μL.

All of the chemicals used were of analytical reagent grade or the highest purity available. Doubly distilled deionized water, which is non-absorbent under ultraviolet radiation, was used throughout.

PAN solution 1-(2-Pyridylazo)-2-naphthol (Aldrich A.C.S) was prepared by dissolving the requisite amount of it in a known volume of distilled deionized water. More dilute solution of the reagent was prepared as required.

Copper (II) standard solution 1.57×10^{-2} mol L⁻¹

A 100-mL amount of stock solution (1 mg mL⁻¹) of Cu (II) was prepared by dissolving 392.9 mg of copper sulfate pentahydrate (CuSO₄. 5 H₂O) in doubly distilled deionized water. Aliquots of this solution were standardized by iodometric titration. Working standard solution was prepared by suitable dilutions of the stock solution.

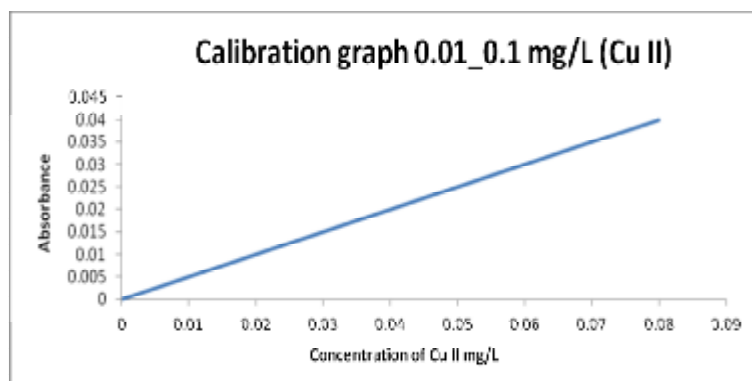
Procedure:

Drinking water samples were collected in polythene bottles from tap of plumbing system from different regions of Baghdad. After collection, HNO₃ (1 mL L⁻¹) was added as preservative.

A volume of 0.1-1.0-mL of neutral aqueous solution containing 0.1-70 µg of copper (II) in a 10-mL volumetric flask was mixed with a 1:5 to 1:100 fold molar

excess of 1- (2-pyridylazo)- 2- naphthol (PAN) reagent solution (preferably 1-mL of 4×10^{-3} mol L⁻¹) followed by the addition of 0.1 – 2.0-mL of 0.2 mol L⁻¹ sulfuric acid. The mixture was diluted to the mark with deionized water. After 1 min the absorbance was measured at 560 nm against a corresponding reagent blank. The copper content in an unknown sample (drinking water) was determined using a concurrently prepared calibration graph.

Spectrophotometric analysis in a very dilute solution was derived from Beer's law. Set of solutions were prepared by dilution of stock solution (0.1 mg L⁻¹) to construct the calibration graph, The absorbance of the calibration and sample solutions were measured at wavelength 560nm , the absorbance to zero was setted with blank deionized water.

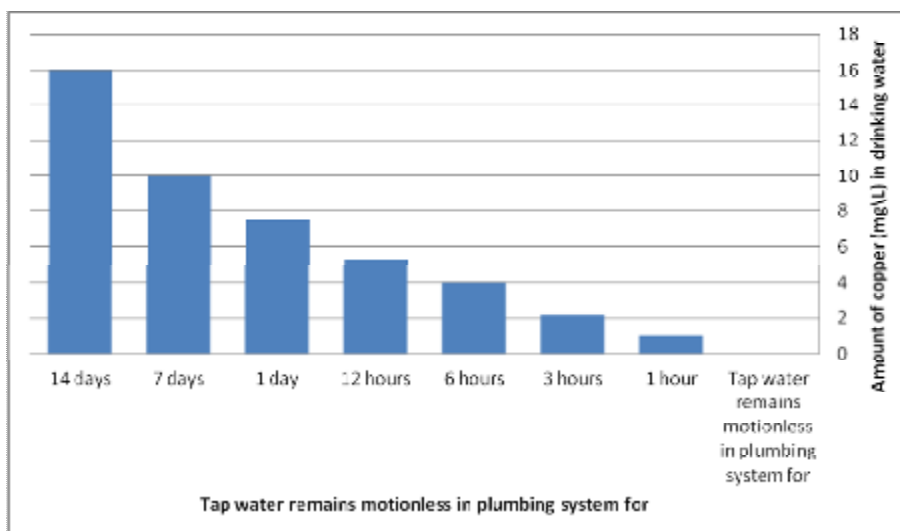


Calibration graph

Result and Discussion:

Table-1: Shows the relationship between the concentration of copper (mg/L) in drinking water and the time of it which remains motionless in plumbing system.

Tap water remains motionless in plumbing system for	Concentration of copper (mg/L) in drinking water
1 hour	1
3 hours	2.2
6 hours	4
12 hours	5.3
1 day	7.5
7 days	10
14 days	16



Graph-1: Shows the relationship between the concentration of copper (mg/L) in drinking water and the time of it which remains motionless in plumbing system.

The determination of copper with this proposed color system 1-(2-Pyridylazo)-2-napho can be directly conducted in an aqueous solution without the need for any separations or clean up step. The reaction is instantaneous and the absorbance remains stable for over 72 h. and the useful concentration range (0.01-0.1 $\mu\text{g mL}^{-1}$) for Beer's law is widened. Finally, with suitable masking, the reaction can be made highly selective and reagent blank solutions do not show any absorbance.

(Table-1) and graph-1 show that the concentration of copper (mg/L) in tap water which remains motionless in plumbing system for following periods (one hours, 3 hours, 6 hours, 12 hours, 24 hours, 7 days and 14 days) are (1, 2.2, 4, 5.3, 7.5, 10 and 16 mg/L) respectively. From these results it is clear that a high levels of copper occur if corrosive water comes in contact with copper plumbing and copper-containing fixtures in the water distribution system. If corrosive water remains motionless in the plumbing system for some time, copper levels may exceed the normal level, the level of copper in drinking water increases with the corrosiveness of the water and the length of

time it remains in contact with the plumbing.

These amounts of copper are believed according to World Health Organization (WHO) to have given rise to the symptoms of chemical food poisoning precipitated by the ingestion of alcohol on an empty stomach. Also children under one year of age are more sensitive to copper than adults. Long-term exposure (more than 14 days) to copper in drinking water which is much higher than 1,000 $\mu\text{g/l}$ has been found to cause kidney and liver damage in infants. Generally the health-based guideline values for copper in drinking water is the concentration of (1.0) mg/L proposed by World Health Organization (WHO) and the US Environmental Protection Agency (EPA) [1-3], in addition to Iraqi standard No. (417) for drinking water.

Conclusions:

The present research indicates that the amount of the copper which was found in drinking water of plumbing system in Baghdad region are believed according to World Health Organization (WHO) to have given rise to the symptoms of chemical food poisoning precipitated by the ingestion of alcohol on an empty

stomach . Also children under one year of age are more sensitive to copper than adults. Long-term exposure (more than 14 days) to copper in drinking water has been found to cause kidney and liver damage in infants.

Recommendations:

Avoiding drinking or cooking with water that has been in contact with house plumbing for more than six hours and using bottled water. Particularly if it will be used by young children as drinking water, or for making infant formula and finally using a plastic tubes instead of steels alloys tubes which are used usually in plumbing system can be recommended as a simple way for reducing exposure the drinking water to copper.

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