FI- Spectrophotometric determination of Cu (II) ions in analytical sample Via reaction with a new reagent HPEDN

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Abstract. A new Spectrophotometric flow injection method has been established for the determination of Cu (II) ions in analytical sample . The method is based on the reaction of Cu (II) ions with 1- (4-(1-(2-hydroxy phenyl amino) ethyl ) phenyl diazenyl ) naphthalene-2-ol ( HPEDN) reagent in the presence of a Buffer solution has PH equal to 9 to form a red-water-soluble stable complex, that has a maximum absorbance at 500 nm. Beer's law is obeyed in the range of 0.5-10 μg.ml-1 with a limit of detection (signal/noise=3) of 0.2213 μg.ml-1 and limit of quantification of 0.7377 μg.ml-1 and relative standard deviations of 0.65 %. The effect of chemical and physical parameters have been carefully considered and the proposed procedure was successfully applied to the determination of Cu (II) ions in analytical sample with a good precision and accuracy.

Keywords : Flow injection , Spectrophotometric , Cu(II) copper , HPEDN.

Introduction:
Copper(II) is a reddish-colored metal and a heavy metal whose color and properties changes when it is combined with other elements forming different compounds . Copper is a soft material that can be reacted chemically or physically with the external source [1]. In addition to that, its advantages is a slow rate of reaction with diluted acids. Copper is a fundamental supplementary element to the plants and other living species [2] . Many techniques can be used to determine copper percentage in its compounds [3] . Some of these are atomic absorption spectrometry[4], inductive coupled plasma-emission spectrometry[5], potentiometry [6], derivative potentiometric stripping analysis[7], flow injection catalytic photometric method [8] and inductive coupled plasma-mass spectrometry [9], several studies were published for spectral estimation Cu(II) [10]. The flow-injection technique was defined as (a flow-through technology performed by treatment for the model region in a current stream under certain thermodynamic conditions) and it was also known by the worlds as a method that relies on injecting liquid into a suitable liquid stream that is being continuously separated as the injected sample forms the region of the model moving toward detector that records absorptivity or any other physical variable continuously as a result of the passage of the sample material through the transient flow cell [11].
This method was used to determine many materials in pharmaceutical formulations such as tyramine and potassium metaperiodate via oxidative coupling reaction [12], levo-dopa [13], metoclopramide ·HCl [14], catechol amine Drugs and sodium hydroxide [15].

This study describes FI-spectrophotometric methods for the determination of Cu (II) ions by a new reagent (HPEDN) 1- (4- (1- (2-hydroxyl phenyl amino) ethyl ) phenyl) diazenyl) naphthalene-2-ol in the presence of a buffer solution to form a red-water-soluble stable complex, that has a maximum absorption at $\lambda_{max}$ at 500 nm.

**Experimental:**

**Equipment**

A Shimadzu 260 UV-visible digital double beam spectrophotometer furnished with a (Cecil) 50 µl glide mobile turned into used.

**Manifold:** The waft manifold is display in fig.(1) a channel manifold had been used for the (FI) spectrophotometric willpower of Cu (II) ions. {1} Four channel peristaltic pump [Ismatec, labortechnik-Analytic CH-8152 Glatbrugg-Zurich, Switzerland] minipuls peristaltic pump became employed to transport the service circulate. {2} (rheodyne-united states) injector valve was used for injection of buffer solution. bendy vinyl tubing of 0.8 mm internal diameter turned into used for the peristaltic pump. {3} the reaction coil (Rc) changed into crafted from teflon with an internal diameter of 0.5 mm. in fig. 1, the channel 1 was used to transport HPEDN reagent and channel 2 to introduce Cu (II) ions. the buffer answer changed into injected via the injection valve into the provider circulation of the solution of Cu (II) ions and then combined with a service circulation of HPEDN reagent and have been propelled via the peristaltic pump with an individual glide price of 1.8 ml.min-1 and the absorbance turned into measured at $\lambda_{max}$ 500 nm.

![Manifold](image)

**Reagents and chemical substances**

All reagent and chemical materials used have been of analytical reagent grade except otherwise said.

**Preparation of solutions:**

**Reagent solution (HPEDN):**

The reagent solution was prepared at a concentration of (1×10^{-4} M) by dissolving (0.0381 g) of the reagent in absolute ethyl alcohol and complete by volume (100 mL) with the solvent.
this standard solution, other standard solutions were prepared by successive dilution with the same solvent [16].

**Buffer Solutions:**
The buffer solutions were prepared with a concentration of (0.01M) of dissolving (0.7708g) of ammonium acetate in (1000mL) of distilled water in a volume vessel of 1 L volume.) Several solutions were prepared from this solution with a wide range of acidic functions ranging between (PH = 4-12 By adding concentrated ammonia solution or concentrated acetic acid to the prepared ammonium acetate solution [17].

**CuCl2.2H2O :**
The solution was prepared at a concentration of (1×10-4 M) by dissolving (0.0170 g) of copper (II) dichloride compound in distilled water and complete the volume (100 mL) in the solvent. From this standard solution, other standard solutions were prepared by successive dilution with distilled water [18].

**Procedure for the FIA Method**
Samples containing one-of-a-kind concentrations of cu (II) ions had been prepared by using simple dilution with distilled water to prepare isolation with concentration of the inventory solution (0.5 - 10 μg.ml-1). the FIA spectrophotometric measurements have been accomplished the use of the manifold display in fig. 1, using (1×10-4 M) m of HPEDN reagent and buffer solution of PH identical to 9 with a float price of 0.0 e ml.min -1 in each channel. the absorbance of the ensuing pink complex turned into measured at λmax 500 nm.

**Results and discussion**
The solution of Cu (II) ions reacted with HPEDN reagent in presence of Buffer solution to form an intense red colored complex product that can be measured at 500 nm. fig.2 showed the spectrum of the complicated product. the absorbance of the pink complicated is at once associated with the concentration of Cu(II) ions and can be used for its spectrophotometric determination. It was found that the sensitivity of the colored complex depends on the reaction conditions and were optimized as follow.

![Fig 2. Absorption spectrum of Copper complex (II) at a concentration of (1×10 -4 M) with ligand (HPEDN) at a concentration of (1×10 -4 M)](image-url)
**Effect of the HPEDN reagent concentration:**

The effect of diverse awareness of HPEDN reagent was investigated. A attention of \((1 \times 10^{-4} \text{ M})\) gave the highest absorbance and have been used for further experiments. the effects acquired are proven in Fig.3.

![Fig.3 Effect of the HPEDN reagent concentration](image)

**Effect of flow rate:**

The effect of flow rate on the sensitivity of the colored complex product turned into investigated. the outcomes obtained showed that a glide price of \((1.9 \text{ ml.min}^{-1})\) gave the very best absorbance as shown in fig.4 and become utilized in all subsequent experiments.

![Fig 4. Effect of total flow-rate](image)

**Effect of reaction coil length:**

the coil length is an critical parameter that affected at the sensitivity of the coloured complicated product and became investigated inside the variety of 50-125 cm. the effects obtained showed that a coil period of \((75 \text{ cm})\) gave the highest absorbance as shown in fig.5 and have been used in all subsequent experiments.
Effect of injected loop extent:
The impact of loop extent become investigated by means of injection of a extent of difference length of loop. The consequences obtained confirmed that an injection buffer of 50 μl gave the fine absorbance for a red complicated as shown in fig.6 and were used in the fashionable endorsed system.

Calibration graph for the determination of Cu (II) ions:
Under the superior condition a linear calibration graph. Fig.7 was acquired over the attention variety of (0.5 – 10 μg.ml⁻¹). The restriction of detections (signal/noise=3) were 0.2213 μg.ml⁻¹. The correlation coefficients had been 0.9996. The relative preferred deviation of the approach changed into higher than 1.104 % (Table.1)
Fig. 7: Calibration graph for the dedication of Cu (II) ions

Table 1: The data for the determination of Copper ion (II) with reagent (HPEDN) using FI-spectrophotometric methods.

| Nature of the complex product: |
|------------------------------|
| The stoichiometry of the reaction between Cu (II) ions and HPEDN reagent was investigated using the slope analysis method [19] under the optimized conditions. The results obtained (Fig.3, 7), show a 1:2 Metal to reagent product was formed. The formation of the complex may probably be occur as follows. |

\[
M + L \rightarrow ML
\]

\[
\frac{M}{L} = \frac{Sm}{SL}
\]

Table 2: Analytical slope of metal ions complexes (II) with reagent (HPEDN).

| Metallic ion complex | Cu(II) |
|----------------------|--------|
| SM                   | 0.0244 |
| SL                   | 0.0475 |
| SM/SL                | 0.5136 |

S: Analytical slope, M: metallic ions (II), L: reagent
Conclusions

A simple accurate and touchy fi-spectrophotometric approach for the dedication of Cu(II) ions in analytical samples has been advanced. The technique desires neither temperature nor extraction steps. The technique was applied effectively.

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