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Spectrophotometric Study of Amlodipine Complexation with Some Transition Metal Ions

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Abstract

The present work involves the physicochemical study of the interaction of Amlodipine with some transition metal ions Co (II), Ni (II), and Cu (II). Amlodipine belongs to a class of drugs known as calcium channel blockers and used to treat chest pain (angina), high blood pressure (hypertension) and kidney problems. Stoichiometry of Amlodipine complexes formed in the solution was determined spectrophotometrically applying mole ratio method. The logarithmic constants (log K_f) and the free energy changes (ΔG) of the formed complexes were calculated from the data of mole ratio methods Amlodipine complexes in the UV-Vis region exhibit maximum absorption at 300, 350, 450 nm for Co(II), Ni(II), Cu (II) complexes respectively using same amount of metal ion as a blank. The stability constant were found in the order Co < Ni < Cu which obey the Irving-William natural order.

Keywords
Complexation, Stability Constant, Antihypertensive, Amlodipine

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INTRODUCTION

Complexation is the combination of individual atom, groups, item or molecules to create a large ion or molecule. In complex central atom contains empty electron orbital that enable bonding with other atoms as well as unshared electrons. The last stage in complexation involved the sum of individual components charges. Therefore, there can be zero, negative and positive charges in a complex with in a solution [1]. Complexes are formed because of the donor acceptor mechanism donor is the neutral molecule or ion of non-metallic substances that can donate lone pair of electrons. Acceptor is the metallic ion or sometimes it might a neutral atom. Transition metals exhibit different oxidation states and can interact with a number of inorganic or organic molecules or ions (negatively or occasionally a positive ion) functions as ligand. [2]

In present study Amlodipine besylate [3ethyl - 5methyl - 2 - [(2- aminoethoxy) methyl] - 4 – (2-chlorophenyl) – 6 methyl – 1, 4 – dihydropyidine -3, 5 – dicorboxylate benzene sulfonate] drug is used as ligand which is a prescription drug. It is available as the brand name Norvasc. It is also available as a generic drug. Amlodipine is used to treat chest pain

(angina) and other condition caused by coronary artery disease and is also used to treat high blood pressure (hypertension) and kidney problems. Amlodipine belongs to a class of drugs known as calcium channel blockers. It works by relaxing blood vessels so blood can flow more easily [3].

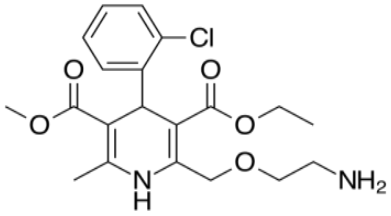

Figure 1 Structure of Amlodopine

MATERIAL AND METHODOLOGY

Apparatus:

A Systronic UV/Vis spectrophotometer with 1 cm quartz cells was used to measure the absorbance. The pH measurements were made with systronic pH meter model 371 All measurements were performed at (30 ± 0.01°C).

Reagents:

Amlodipine was purchased from Sigma Aldrich as benzene sulphonate form Metal nitrates and other chemicals used were of analytical grade purchased from Merck Germany. Metal salts were taken in an accurate amount and standardized by recommended method.

Preparation of 1×10^{-1} M metal solution [4]

Co $(NO_3)_2$ $6H_2O$ (2.91 g, 20 m mol, M. Wt. = 291.031 $gmol^{-1}$) was dissolved in freshly distilled and dry methanol in a beaker and was made up to the mark in a 100 mL volumetric flask.

Ni $(NO_3)_2$ $6H_2O$ (2.90 g, 20 m mol, M. Wt. = 290.791 $gmol^{-1}$) was dissolved in freshly distilled and dry methanol in a beaker and was made up to the mark in a 100 mL volumetric flask.

Cu $(NO_3)_2$ $6H_2O$ (2.95 g, 20 m mol, M. Wt. = 295.644 g mol^{-1}) was dissolved in freshly distilled and dry methanol in a beaker and was made up to the mark in a 100 mL volumetric flask.

Preparation of 1×10^{-1} M Amlodipine [5]

Amlodipine (5.67 g, 20 m mol, M. Wt. = 567.05g mol^{-1}) was dissolved in freshly distilled and dry methanol in a beaker and was made up to the mark in a 100 mL volumetric flask.

METHOD

A series of solutions containing up to 4.0 ml of buffer solution, 4 ml (0.1 M) of the metal ions and 0 to 6 ml (0.1 M) of drugs were mixed in 50 ml measuring flask and then diluted up to the mark with water. The mixture was allowed to stand for 05 min. The absorbance was measured at the maximum wavelength (λ_{max}) at 303K and 313K against a blank solution prepared in the same manner but not contains metal ions. The calibration graphs were prepared by using the same procedure (at least seven concentration points) and were linear passing through the origin. Stoichiometry of Amlodipine complexes formed in the solution was determined spectrophotometrically applying mole ratio methods. The obtained results revealed the formation of 1:1 (M: L) Amlodipine complexes with Co, Ni and Cu (II) metal ions. The logarithmic constants (log K_f) and the free energy changes (ΔG) of the formed complexes were calculated from the data of mole ratio methods applying equations 1 and 2. [6]

$$K_f = \frac{[A/\varepsilon b]}{[C_M - A/\varepsilon b] \times [C_L - A/\varepsilon b]} \quad \ldots\ldots\ldots\ldots (1)$$

$$\Delta G = -2.303\ RT \log K_f \quad \ldots\ldots\ldots\ldots (2)$$

RESULT AND DISSCUSION

Metal Ions	λ max (nm)	M/L Ratio	Log K_f (at 303K)	Log K_f (at 313K)	-ΔG(at 303K)	-ΔG (at 313K)
Co	300	1:1	0.7086	0.7090	4112.26	4117.96
Ni	350	1:1	0.8030	0.8051	4659.22	4671.26
Cu	450	1:1	0.9256	0.9270	5370.15	5381.54

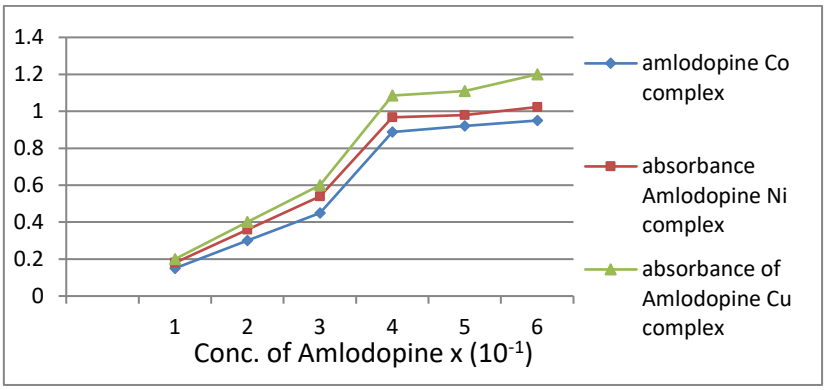

Figure 2. Mole Ratio method curves at 303K for Co (II)-Amlodipine (λ = 300 nm), Ni (II)–Amlodipine (350) and Cu (II)-Amlodipine (λ = 450 nm) complexes.

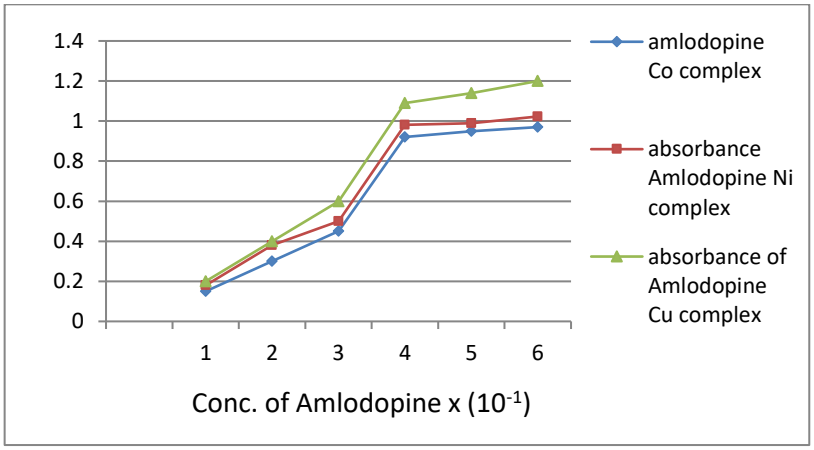

Figure 3. Mole Ratio method curves at 313K for Co (II)-Amlodipine (λ = 300 nm), Ni (II)–Amlodipine (350) and Cu (II)-Amlodipine (λ = 450 nm) complexes.

The value of formation constant for complexation of Amlodipine with Co (II), Ni (II) and Cu (ll) ions by spectrophotometric method have been presented in Table (1). Amlodipine complexes in the UV-Vis region exhibits maximum absorption at 300, 350 and 450nm for Co (II), Ni (II) and Cu (II) complexes respectively using same amount of metal ion as a blank. These longer wavelengths peaks have been used in all subsequent measurements of the absorbance. At these wavelengths the absorption of both ligand and metal solution were negligible.

The curves of this drug show the formation of 1:1 complexes with all the metal ions in presence of borate buffer [7]. There is minute change in formation constant with increasing temperature.

CONCLUSIONS

The stability constant values for metal Amlodipine complexes indicates that complexes are stable and have been found to be in order Co(II) < Ni(II) < Cu(II) [8]. The values of free energies of formation of the complexes have found negative. This indicates that complex formation is spontaneous.

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CONFLICTS OF INTEREST

There is no conflict of interest associated with this research.

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