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UV-Visible Spectroscopic Analysis of Influence of Trace Element Ions on Albendazole

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Prersent work aims to employ UV-Visible spectral analysis of an anthelmentic drug albendazole. This drug falls under the category of WHO's model list of essential drugs for the eradication of helminthiasis. The interaction of this drug with certain ions like sodium, calcium and potassium which are present in blood as trace elements has been studied with the aid of UV-Visible spectroscopy as a tool.

Key Words: Albendazole, UV-Visible spectroscopy, Trace elements, Anthelmentic.

INTRODUCTION

A drug may be defined as a substance used in the prevention, diagnosis, treatment or cure of disease in man or other animals. Fighting disease with drugs is the timeless struggle and man's survival on this planet has depended upon its success[1]. Helminthiasis is a disease caused by infestation with parasitic worms living in the alimentary canal and in the other tisues of the host. These parasites harm the host by depriving them of food, causing blood loss, injury to organs, intestinal or lymphatic obstruction and by secreting toxins. Helminthiasis is rarely fatal, but is a major cause of ill health[2]. The control of worm-induced disease is a highly effective investment in terms of health, education, poverty reduction and development which not only takes the mankind onwards, but also upwards[3]. Deworming helps meet the millennium development goals of the WHO it has urged for the creation of a global network for monitoring anthelmintic drug efficacy and drug resistance as a needed response to this emerging threat[4]. UV-Visible spectroscopy being a simple, robust and widely used tool, it has been employed to study the change in absorbance characteristics of various drugs with ions in recent past[5,6]. In present work, the interaction of an anthelmentic drug albendazole with trace elemental ions present in the blood has been attempted.

EXPERIMENTAL

High grade pure sample of albendazole was procured from reputed pharmaceutical firm in Chennai, India and used for spectral recording as such. The UV-Visible spectral measurements were carried out using Shimadzu-160A spectrophotometer

at Dr. Ceeal Analytical Lab, Chennai. Accurately weighed 100 mg of the drug was taken in a100 mL standard flask to which 10 mL formic acid was added. The solutions are made up to the mark by adding 0.1 M HCl and sonicated to ensure thorough mixing of the contents. This drug solution was transferred into separate test tubes and further diluted to obtain drug concentrations of 2, 4, 6.....20 μg mL^{-1}. The absorption values for various concentrations of the drugs that fall within this linearity range are used to plot the linearity curves. The absorbance value at 291 and 262 nm of albendazole are noted to study the linearity behaviour. After performing the linearity studies, the mid concentration level of 10 μg mL^{-1} was chosen for further interaction studies. The solutions of metal trace elemental ions were prepared by dissolving the appropriate quantities of suitable salts and further diluted to obtain trace elemental concentrations of 10, 20, ... 80 μg mL^{-1}. Each trace elemental ion solutions of different concentrations were made to interact with the albendazole drug solution of 10 μg mL^{-1} concentration level and the absorbance characteristics of the drug solution has been studied.

RESULTS AND DISCUSSION

The drug albendazole, belongs to benzimidazole group of drug and is a broad-spectrum anthelmintics, meaning that it is used to treat a wide range of intestinal worms. Albendazole has the IUPAC name methyl [(5-propylsulfanyl-3*H*-benzoimidazol-2-yl)amino]formate, while the Indian pharmacopoeia[7] mentions it as methyl 5-propylthio-1*H*-benzimidazol-2-yl-carbamate having chemical formula of $C_{12}H_{15}N_3O_2S$. Recently, vibrational spectral and qualitative analysis have been reported on this benzamidazole group drug[8] by employing FTIR, FT-Raman and UV-Visible spectroscopic techniques. Albendazole shows two absorption peaks in UV-Visible region at λ = 291 nm and at λ = 262 nm. UV-Visible spectrum of albendazole is given in Fig. 1. The regression analysis by UV-Visible method done with the absorbance values for various concentrations yield the corresponding regression equations Y = 0.0365X + 0.032 at λ = 291 nm and Y = 0.0278X + 0.0232 at λ = 262 nm. The pearson correlation factor is greater than 0.99 indicating the excellent linear behaviour of the drug in the chosen range of 2, 4, 6.... 20 μg mL^{-1}. The response of the body tissues to the drug is influenced by many factors such as age, body weight, gender, time and place factors, *etc*. The biological activity of the drugs can be considerably reduced or abolished by inducing a chemical change in the drug molecule. Some drugs are chelating agents which are capable of combining with certain metallic ions like lead, mercury, arsenic, copper or iron. The commonly used tetracyclines chelate metal cofactors of bacterial enzymes[5,9]. In present work, in the presence of trace elemental ion, the absorbance value gets altered and as the concentration of trace element increases, this value seems to be decreasing in every case, *viz.*, sodium, potassium and calcium ions. These values are projected in Table-1 and diagrammatically represented in Fig. 2. This is indicative that ions present in the blood may have influential effect on the activity of the drug.

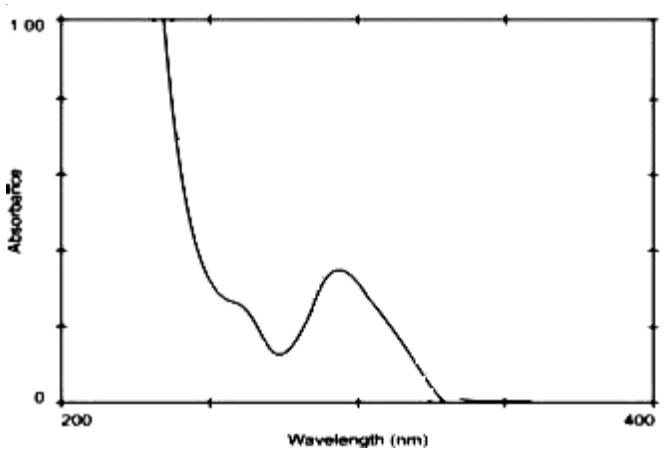

Fig. 1. UV-Visible spectrum of albendazole

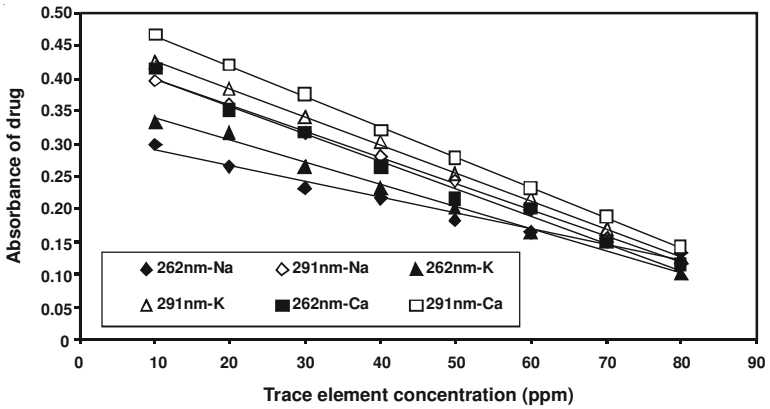

Fig. 2. Variation in absorbance due to interaction with trace elements

TABLE-1
VARIATION OF ABSORBANCE OF ALBENDAZOLE WITH TRACE ELEMENTS

Conc. ($\mu g\ mL^{-1}$)	Absorbance of drug in presence of trace elements					
	Na^+		K^+		Ca^{2+}	
	λ = 262 nm	λ = 291 nm	λ = 262 nm	λ = 291 nm	λ = 262 nm	λ = 291 nm
10	0.300	0.395	0.333	0.424	0.416	0.465
20	0.266	0.359	0.316	0.383	0.350	0.420
30	0.232	0.316	0.266	0.341	0.316	0.375
40	0.216	0.280	0.233	0.301	0.266	0.321
50	0.183	0.244	0.200	0.252	0.216	0.278
60	0.166	0.198	0.166	0.217	0.200	0.232
70	0.150	0.155	0.150	0.172	0.150	0.190
80	0.133	0.116	0.100	0.124	0.116	0.142

Conclusion

The variation in the absorption level of the drug as interacts with various ions has been studied by employing UV-Visible spectroscopy. It is indicative that the absorption characteristics of drug are influenced by the presence of various ions and at various levels in the body.

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