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Sulfanilamide, Sulfadoxine And Sulfamethoxazole As New Spectrophotometric Reagents For The Determination Of Cardanol-An Agriculture By-Product

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ABSTRACT

Sulfanilamide(SAA), sulfadoxine(SDX) and sulfamethoxazole(SMX), the widely used sulfa drugs are proposed as new coupling agents for the spectrophotometric determination of cardanol, a phenolic compound found in cashew nut shell liquid which is a by-product of cashew industry. The methods are based on the interaction of diazotized sulfa drugs with cardanol to produce a yellow coloured product with a maximum absorption at 415 nm. The colour developed was stable up to 24h. The methods obey Beer's law. The methods can be successfully employed for the determination of cardanol in presence of common excipients like glucose, lactose, dextrose, starch, sodium alginate and sodium lauryl sulphate, which do not interfere in the proposed methods.

KEYWORDS

Cardanol;
Diazotization;
Sulfanilamide;
Sulfadoxine;
Sulfamethoxazole;
Spectrophotometry.

INTRODUCTION

One of the frontiers of sustainable development is the utilization of agricultural by-products-a field of paramount importance in the domain of biodegradability and the use of agricultural waste and by-products, in place of toxic chemicals-an area of current interest in environmental management.

Cardanol holds considerable promise because of its abundant availability in tropical areas, low cost, biodegradability[1] and structural characteristics[2]. Cardanol is commonly found in cashew nut shell liquid(CNSL), a by-product of cashew industry. CSNL is an alkyl phenol oil which constitutes 25% of the total weight of cashew nut(Anacardium occidentale)[3].

Cardanol(3-pentadecenyl phenol) is a phenolic compound with C_{15} aliphatic chains in the meta po-

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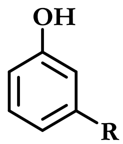

1. R=8Z, 11Z, 14 Pentadecatrienyl (% composition: 29.3, Mol. Wt.:283.43)
2. R=8Z, 11Z Pentadecadienyl (% composition: 16.8, Mol. Wt.:285.45)
3. R-8Z Pentadecenyl (% composition: 48.5, Mol. Wt.:287.46)
4. R=Pentadecyl (% composition: 5.4 , Mol. Wt.:289.43)

Figure 1 : Structures of cardanol

sition. It is a mixture of saturated and unsaturated (mono-, di- and tri-) compounds[4](Figure). The nonlinear structure, unsaturation in the alkyl chain and substitution to phenolic group opens up new vistas in its inmumerable applications including dyestuff, food, flavour, ionexchange resin, paints, plasticizers and polymers[5]. Significant studies have also been made in the technological applications of cardanol and its derivatives as pesticides[6], surface-active agents[6], in ceramics[2] and composites[1].

Sulfanilamides are commonly used as antibacterials that are aniline substituted sulfonamides. Though, a large number of sulfanilamide derivatives synthesized are reported in the literature, only about two dozens have been used in clinical practice[7]. Despite the toxicity observed with some patients and the existence of sulfanilamide-resistant bacterial strains the use of these drugs in combination especially sulfonamide-trimethoprims has been extensively used for opportunistic infections in patients with AIDS, pneumonia(Pneumocystis carinii) treatment and prophylaxis, cerebral toxoplasmosis treatment and prophylaxis, urinary tract infection and burn therapy[8-10]. Sulfanilamide(SAA), sulfadoxine(SDX) and sulfamethoxazole(SMX) are the chemicals which contain aromatic primary amino group. SDX is a long-acting sulfanilamide; used in the treatment of various types of infections. It exhibits synergistic effect with pyrimethamine, which acts against folate metabolism at different points of the metabolic cycle. SMX is commonly used to treat uncomplicated urinary tract infection, more particularly those caused by *Escherichia coli.*

This paper is an attempt to develop simple, sensitive, rapid and reliable spectrophotometric methods for the determination of newly introduced agri by-product by exploring wide range of pharmaceuticals as new coupling agents. Survey of literature revealed that no sulfa drugs and their derivatives have been used for the spectrophotometric determination of cardanol. The methods reported here involve coupling of diazotized sulfanimides with cardanol in alkaline medium to produce yellow colour. The proposed methods have distinct advantages of sensitivity and stability. Besides, the methods do not require heating or distillation and exhibit reliability due to reproducibility.

EXPERIMENTAL

Apparatus

UV-VIS spectrophotometer UVIDEC-610 type with 1.0-cm matched cell (Jasco, Tokyo, Japan)was employed for measuring the absorbance values.

Reagents

Cardanol (Vittal Mallya Scientific Research Foundation, India), sulfanilamide(SAA), sulfadoxine (SDX)and sulfamethoxazole(SMX)(Glaxo Smithkline Pharmaceuticals, India), sodium nitrite, suplhamic acid, sodium hydroxide (Ranbaxy, India) were used. All other chemicals and solvents used were of analytical reagent grade. Double distilled water was used throughout.

Cardanol(100mg) was dissolved in isopropyl alcohol in a 100ml volumetric flask and made up to the mark. The stock solution was further diluted with isopropyl alcohol to get solutions of required strength.

Aqueous solutions of 1.0%(w/v) sodium nitrite, 1.0%(w/v) sulphamic acid and 0.5N sodium hydroxide solutions were prepared in distilled water. Aqueous solutions of 0.25%(w/v) sulfanilamide, sulfadoxine and sulfamethoxazole were prepared in distilled water. Ten ml of 2N hydrochloric acid was added during the preparation of sulfadoxine and sulfamethoxazole to improve its solubility.

Two ml of SAA, SDX or SMX, 1.0ml each of sodium nitrite and sulphamic acid solution were transferred into a series of 25ml-calibrated flask. To this aliquots of standard solution of cardanol were added and 1.0ml of sodium hydroxide was added and the contents were shaken well, and diluted to mark using distilled water. The absorbance was then measured against the corresponding reagent blank at 415nm. The optical characteristics are shown in TABLE 1.

RESULTS AND DISCUSSION

Aromatic diazonium ions couple with active substrates such as amines and phenols[

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TABLE 2: Recovery of cardanol in the presence of excipients and other substances using sulfanilamide

Material	Amount (mg)	% Recovery of cardanol*±RSD**
Glucose	50	100.3±0.9
Lactose	50	98.9±0.7
Dextrose	50	99.3±0.7
Starch	50	99.7±1.0
Sodium alginate	50	99.0±0.9
Sodium lauyrl sulphate	50	99.6±1.3
Vitamin C	10	>50<60$^{\nabla}$

*7.0μg ml^{-1} of cardanol taken, **relative standard deviation. (n=5)∇erratic values

SMX. It was found that 1.0-3.0ml(0.25% w/v) of SAA, SDX and SMX were found to give maximum colour intensity. Hence, 2.0 ml each of SAA, SDX and SMX were found appropriate.

TABLE 1 shows the linear calibration ranges and equation parameters for these methods. Separate determinations at different concentrations of each reagent gave a coefficient of variation not exceeding ±2%.

Interference

The interference if any, by various substances was studied as per the procedure. Excipients such as glucose, lactose, dextrose, starch, sodium alginate and sodium lauyrl sulphate did not interfere in the determination, while vitamin C was found to interfere(TABLE 2).

CONCLUSION

The procedures described in this paper are the first-ever use of sulfa drugs containing amino group as spectrophotometric reagents for the determination of cardanol, a phenolic compound found in agriculture by-product cashew nut shell liquid. Two important dimensions of this study include the success in finding new spectrophotometric reagents amongst the available myriad molecules in the field of pharmaceuticals which has a variety for the functional groups and molecular structure. Second, it will open up a new area of research on the dyes produced in the reaction of cardanol with sulfa drugs. Further, a value addition to this method can be achieved if the procedure is made on-line or at-line system and this possibility is currently under investigation.

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