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Low cost spectro photometric determination of paraquat in environmental and biological sample

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Abstract
An extractive, sensitive spectrophotometer method has been developed for the detection and determination of paraquat using glucose (as easily available reducing agent). Paraquat is reduced with glucose in alkaline medium to give a blue colored ion with an absorbance maxima at 610 nm. Beer's law is obeyed in the range 0.5-5.0 µg of paraquat in 10ml of the final solution (ppm). The important analytical parameters and the optimum reaction conditions were evaluated. The method was applied successfully to the determination of paraquat in water, grain, plant material and biological sample.

Keywords: spectrophotometer, paraquat, biological samples.

INTRODUCTION

Paraquat (1,1-Dimethyl-4,4-Bipyridinium Dichloride ion), also known as Methyl Violegen, is a defoliant and desiccant agent used to control herbal growth in terrestrial and aquatic environments(1). Paraquat is a non-selective acutely toxic herbicide and one of the most commonly used herbicide in the world with a variety of agricultural uses, because of its rapid action, relatively low cost and broad spectrum of its activity(2). It is used to control weeds and grasses in many agricultural and non-agricultural areas. For instance, it used for pre-plant or pre emergence on vegetables grains, potatoes, and peanut areas; post emergence around fruit crops and soyabeans during the dormant season on clover and other legumes(3). Paraquat an oxidative stress inducing substance is a herbicide which is very toxic to all animals and to man as it is well characterized pneumotoxicant. It generates free radical and leads to multi-organ toxicity with necrotic damage to the lung, myocardial muscles, liver and kidney. Paraquat also induce extensive hemorrhagic incidents throughout the body and consequently leads to death(4).

Because of the toxicity and significance of paraquat, several methods, based on different analytical techniques have been reported for the detection and determination of paraquat i.e. Gas chromatography-ion trap mass spectrometry[(6)], enzymatic-spectrophotometer determination [(7)], spectroflurometric determination by manual and flow injection methods[(8)], long-wavelength fluorescence detection method[(9)], matrix assisted laser desorption/ionization mass spectrometry [(10)], time – resolved fluoroimmunoassay[(11)], differential pulse voltammetry[(12)], High performance liquid chromatographic method[(13)], etc. Many of the earlier reported spectrophotometeric methods are less sensitive and suffer from many drawbacks . A method for the determination of paraquat using sodium borohydride in an alkaline medium was reported.

Property

Common Name[(2)]	: Paraquat
Molecular formula [(2)]	: $C_{12}H_{14}Cl_2N_2$
Chemical Name[(2)]	: 1,1-dimethyl-4,4-bipyridinium
Chemical group[(2)]	: Bipyridyl
Half life in Soil[(5)]	: 644 Days
Solubility[(5)]	: Soluble in water

Structural formula

METHOD

In the present work, a new extractive, sensitive spectrophotometer method has been developed for the detection and determination of paraquat using glucose (as easily available reducing agent). Paraquat is reduced with glucose in alkaline medium to give a blue colored ion with an absorbance maxima at 610 nm . Beer's law is obeyed in the range .5 -5 µg of paraquat in 10ml of the final solution (ppm). The important analytical parameters and the optimum reaction conditions were evaluated. The method was applied successfully to the determination of paraquat in water, grain, plant material and biological sample.

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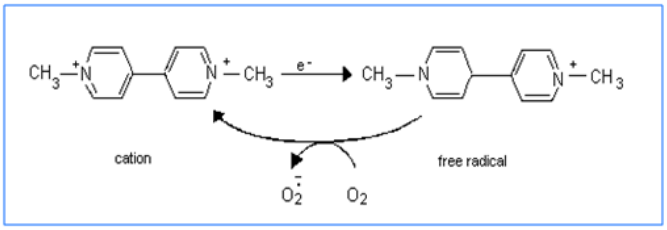
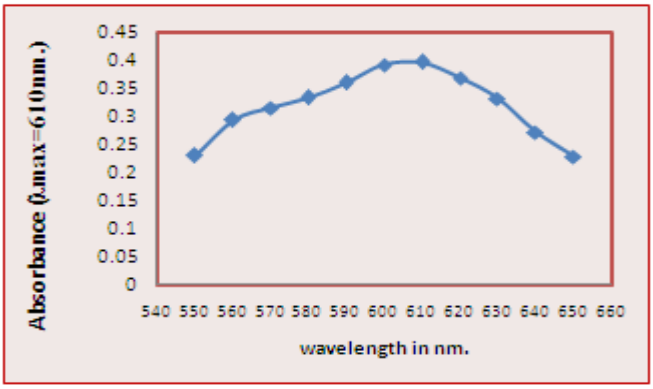
Reaction Mechanism:Paraquat
Formation of blue-coloured monocation radical

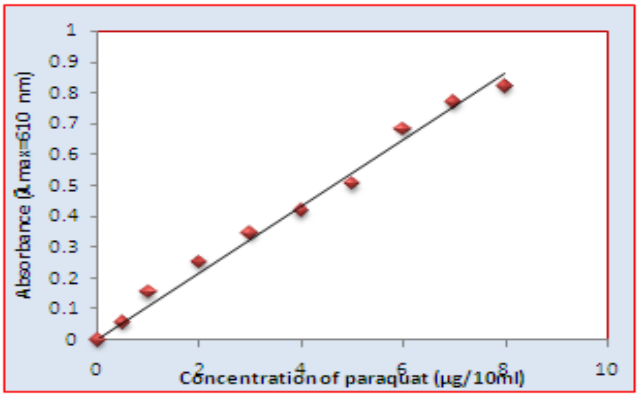


Scheme:1 Paraqaut Reduction Oxidation

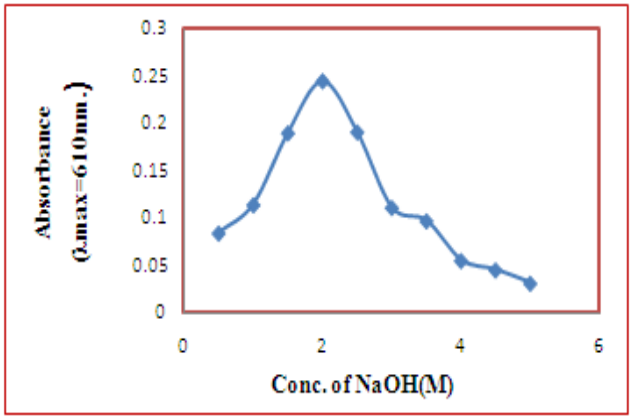
RESULT AND DISCUSSION



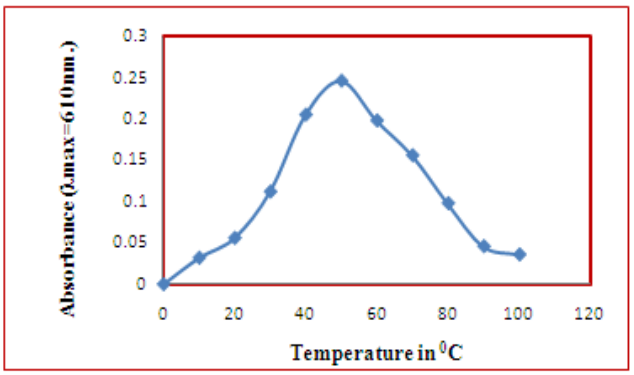
Absorbance curve of the Paraquat.



Caliberation Curve for the determination of Paraquat.



Effect of pH



Effect of Temperature

Table. Recovery of Paraquat in Water and Vegetables

Sample	Paraquat added µg b	Paraquat obtained in present method* c	C/ b	% Recovery (c/b)×100
Water**	1	0.98	0.98	98
	2	1.99	0.99	99
Potato***	1	0.98	0.98	98
	2	1.95	0.97	97
Apple***	1	0.99	0.99	99
	2	1.95	0.97	97
Rice***	1	0.98	0.98	98
	2	1.97	0.98	98
Urine**	1	0.96	0.96	96
	2	1.95	0.97	97
Blood**	1	0.97	0.97	97
	2	1.95	0.97	97

*Mean of three replicate analysis
**Amount of sample 10ml
***Amount of sample 5mg

CONCLUSION

The present method is cheapest and more sensitive and extractive than the other spectrophotometer methods reported for the determination of paraquat. It can be successfully applied for the determination of paraquat in water, fruits, vegetables, cereals and biological sample.

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