



Received on 21 November, 2014; received in revised form, 24 January, 2015; accepted, 20 March, 2015; published 01 July, 2015

SPECTROPHOTOMETRIC DETERMINATION OF CARISOPRODOL IN PURE AND PHARMACEUTICAL FORMS USING TRIPHENYL METHANE DYES

M. Ravi ¹, T. Veeraiah ^{1*} and Ch.Venkata Ramana Reddy ²

Department of Chemistry ¹, SAP College, Vikarabad-501101, Ranga Reddy Dist. Telangana, India

Department of Chemistry ², JNTUH College of Engineering, Kukatpally Hyderabad-500 085, Telangana, India

Keywords:

Spectrophotometry,
carisoprodol, bromocresol green,
bromothymol blue, bromophenol
blue, ion-pair complex,
ICH validation

Correspondence to Author:

T. Veeraiah

Department of Chemistry, SAP
College, Vikarabad - 501101, Ranga
Reddy District, Telangana State,
India

E-mail: tadooru_veeraiah@rediffmail.com

ABSTRACT: New simple and sensitive extractive spectrophotometric methods have been developed and described for the determination of carisoprodol in pure form and in pharmaceutical formulations. The developed methods involve formation of coloured chloroform extractable ion-pair complexes of carisoprodol with triphenyl methane dyes *viz.*, bromocresol green (BCG), bromothymol blue (BTB) and bromophenol blue (BPB) in acidic medium. The extracted complexes showed absorbance maxima at 420, 417 and 413 nm with use of BCG, BTB and BPB respectively. The stoichiometry of the complex in three cases is found to be 1:1. Beer's law is obeyed in the concentration ranges: 2.5-25, 2.5-30 and 3.0-30µg/ml with BCG, BTB and BPB respectively. The effect of concentration of dye, pH and interference of excipients have been studied and optimized. The limits of detection and quantification have been determined for all the three methods. These methods have been validated as per the guidelines of International Conference on Harmonization (ICH) and have been applied to the determination of carisoprodol in commercial tablets and results of analysis were validated statistically through recovery studies. Thus the newly developed methods are accurate, efficient and stable.

INTRODUCTION: Carisoprodol, chemically, N-isopropyl-2-methyl - 2 - n - propyl - 1, 3-propanedioldicarbamate (**Fig. 1**), is a centrally acting muscle relaxant, with analgesic properties, making it a popular drug of abuse, whose chief application is in the treatment of acute muscular spasm associated with craniomandibular disorder, lumbago, sciatica, and other lower back syndromes ^{1, 2}. Carisoprodol is a pharmaceutical active agent and structurally related to its metabolite, meprobamate ³. Carisoprodol is marketed as a muscle relaxant and dispensed by prescription under the trade name of Soma.

Carisoprodol produces weak anticholinergic, antipyretic and analgesic effects ⁴. The effect of carisoprodol, which includes sedation, loss of balance, confusion and increased reaction time are similar to those of alcohol, benzodiazepines and other CNS depressants and well documented to decrease human performance and adversely affect driving effect ⁵.

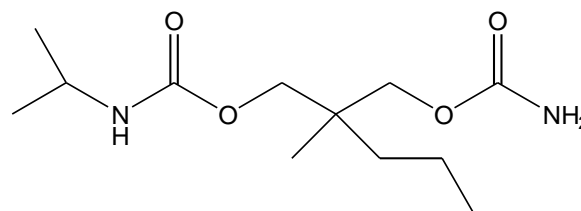



FIG. 1: STRUCTURE OF CARISOPRODOL

Clinicians have reported a possible withdrawal syndrome consisting of insomnia, nausea, vomiting, tremors and anxiety in patients who discontinue the use of carisoprodol ⁶ and in at least

QUICK RESPONSE CODE 	DOI: 10.13040/IJPSR.0975-8232.6(7).2936-43
	Article can be accessed online on: www.ijpsr.com
DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.6(7).2936-43	

one case, withdrawal has been mistaken for a psychotic disorder⁷. The abuse of carisoprodol has increased substantially in many areas in the United States^{8,9} and there have been recommendations to place it into the Controlled Substances Act as a scheduled drug¹⁰.

Several methods, such as Titrimetry¹¹, GC^{12,13,14}, LC-MS^{15,16}, GC-MS^{17,18}, IR Spectrometry¹⁹, Visible absorbance densitometry²⁰ are available in the literature for the determination of carisoprodol. Carisoprodol and its metabolite, meprobamate present in oral fluid were determined using solid-phase extraction and liquid chromatography with tandem mass spectral detection²¹. Validation of a new homogeneous immunoassay for the detection of carisoprodol in urine²² and method development and validation of carisoprodol and its impurities by UV-HPLC²³ were also reported.

Simultaneous determination of carisoprodol and aspirin in human plasma using liquid chromatography – tandem mass spectrometry in polarity switch mode was carried out by Sreenivasulu et al²⁴. Carisoprodol and its metabolites were determined quantitatively in equine urine and serum by the same method²⁵. Thorough literature survey revealed that carisoprodol was identified and determined in tablets by liquid chromatography / mass spectrometry²⁶. Development and evaluation of carisoprodol tablets with improved dissolution efficiency using solid dispersion technology was reported²⁷. Formulation of carisoprodol topical gel along with its evaluation was also recently reported²⁸. Reports on kinetic analysis of non-isothermal carisoprodol reaction in nitrogen atmosphere²⁹ and diazotization of carisoprodol as skeletal muscle relaxant by derivatization spectrometry³⁰ are also available in the literature.

The chemical structure of carisoprodol molecule offers a lot of scope for the development of new methods for its determination with better sensitivity, specificity, precision and accuracy. The reported methods including chromatographic techniques require expensive experimental set-up and are not affordable in every laboratories for routine analysis. Spectrophotometry is considered as the most convenient analytical technique

because of its inherent simplicity, low cost and wide availability in most quality control laboratories. Because of its physiological significance, the quantitative determination of carisoprodol attracted the attention of analytical chemists and almost all analytical methods have been applied to accomplish the purpose. However methods on spectrophotometric determination of this drug involving ion-pair complexes with common and versatile acidic dyes *viz.*, bromocresol green (BCG), bromothymol blue (BTB) and bromophenol blue (BPB) are not reported yet. This prompted the authors to develop extractive spectrophotometric methods for the determination of carisoprodol using above mentioned dyes.

In this paper we report three simple and sensitive extractive spectrophotometric methods for the assay of carisoprodol. These methods are based on ion-pair complexation of drug with dyestuffs such as BCG, BTB and BPB and subsequent extraction into chloroform and to measure the absorbance of colour complex. The proposed methods have the advantages of speed and simplicity besides being accurate and precise and can be adopted by the pharmaceutical laboratories for industrial quantitative analysis.

MATERIAL AND METHODS: Carisoprodol was procured from Sрни Pharmaceuticals Limited, Hyderabad as a gift sample. The dyestuffs *viz.*, BTB, BPB, BCG (AR grade) supplied by SD Fine Chemicals Ltd. Mumbai, were used without any further purification. The dyestuffs were used as 0.025% solutions in doubly distilled water. Sodium acetate-hydrochloric acid buffers³¹ of pH 2.5, 2.8 and 3.5 were prepared by mixing 50ml of 1.0M sodium acetate solution with calculated volume of 1.0 M HCl solution and diluted to 250 ml with doubly distilled water. The pH of each solution was adjusted to an appropriate value with the aid of a pH meter. Chloroform (HPLC grade) supplied by SD Fine Chemicals Ltd. Mumbai was used throughout the work.

The spectra (**Fig. 2A, 2B and 2C**) of ion-pair complexes have been recorded on Elico double beam SL 210 spectrophotometer using quartz cells of 10 mm path length. An Elico model Li-120 pH meter was used for pH measurement.

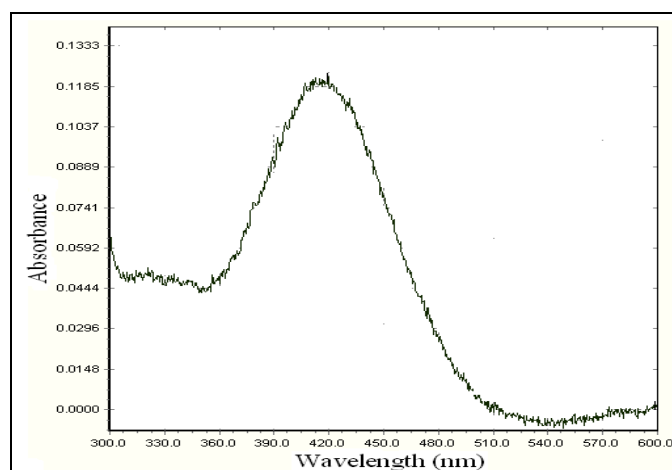


FIG. 2A: ABSORPTION SPECTRUM OF CARISOPRODOL-BROMOCRESOL GREEN (BCG) COMPLEX EXTRACTED INTO 10 ML CHLOROFORM [drug] = 25 $\mu\text{g ml}^{-1}$ + 5 ml of 0.025% BCG + 5 ml of pH 3.5 buffer

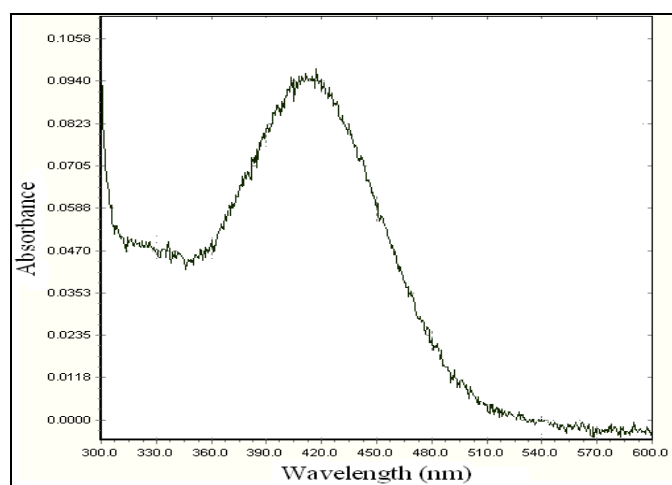


FIG. 2B: ABSORPTION SPECTRUM OF CARISOPRODOL-BROMOTHYMOLO BLUE (BTB) COMPLEX EXTRACTED INTO 10 ML CHLOROFORM [drug] = 25 $\mu\text{g ml}^{-1}$ + 5 ml of 0.025% BTB + 5 ml of pH 2.8 buffer

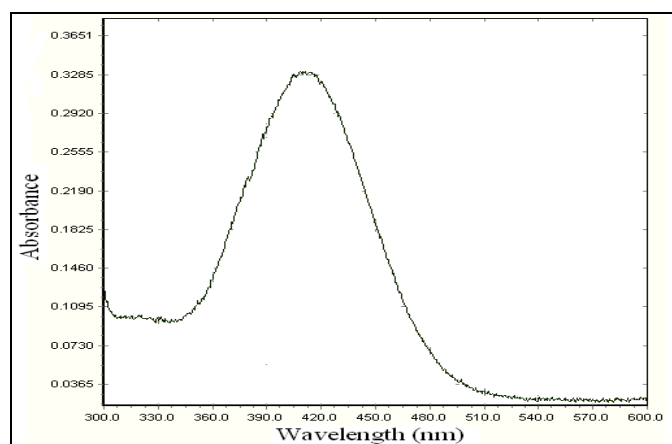


FIG. 2C: ABSORPTION SPECTRUM OF CARISOPRODOL-BROMOPHENOL BLUE (BPB) COMPLEX EXTRACTED INTO 10 ML CHLOROFORM [drug] = 25 $\mu\text{g ml}^{-1}$ + 5 ml of 0.025% BPB + 5 ml of pH 2.5 buffer

Calibration curve: Different aliquots of drug solution were transferred into 125ml separating funnel. To this 5ml of buffer (pH 2.5, 2.8 and 3.5), 5ml of dye were added and total volume was made up to 20ml with water. 10ml of chloroform was added and the contents were shaken for 5min. The two layers were allowed to separate for 5min. The organic layer was separated and absorbance of yellow colored solution which is stable at least for 3 hrs is measured at 420nm against blank similarly prepared. The same procedure of analysis is followed either for assay of pure drug or for dosage form. The calibration graphs (**Fig. 3**) are linear over the concentration ranges and are within the permissible range. The optical characteristics and statistical data for the regression equation of the proposed methods are presented in **Table 1**.

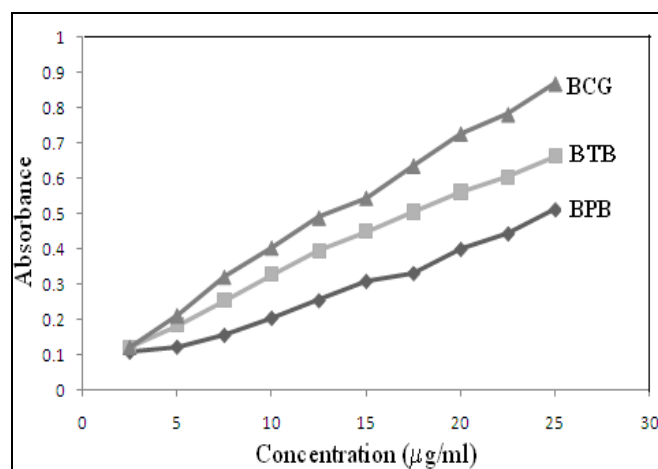


FIG. 3: CALIBRATION GRAPHS FOR CARISOPRODOL-BCG, BTB, & BPB ION-PAIR COMPLEXES

Procedure for the assay of pure drug:

Five different solutions of pure drug in the range of calibration curve were selected and the recovery experiments were performed. The recoveries and their relative standard deviations are tabulated in **Table 2**.

Procedure for the assay of dosage forms:

Ten tablets of Soma 250mg each are powdered and dissolved in doubly distilled water and stirred thoroughly, filtered through a Whatman No. 42 filter paper. This solution was transferred into 100 ml standard volumetric flask and diluted with doubly distilled water as required. Different solutions of drug in the range of calibration curve were chosen and the assay was estimated using the calibration curve. The results of the recovery experiments are tabulated in **Table 3**.

TABLE 1: OPTICAL CHARACTERISTICS AND STATISTICAL ANALYSIS FOR THE REGRESSION EQUATION OF THE PROPOSED METHODS

Parameters	Extraction methods with ^b		
	BCG	BTB	BPB
λ_{\max} (nm)	420	417	413
Beer's law limit ($\mu\text{g ml}^{-1}$)	2.5-25	2.5-30	3.0-30
Molar absorptivity ($\text{L mol}^{-1} \text{cm}^{-1}$)	18225	20540	23630
Formation constant, K, M^{-1}	1.55×10^6	1.61×10^6	1.71×10^6
Sandell sensitivity ($\mu\text{g cm}^{-2}$)	0.0168	0.0162	0.0142
Slope (specific absorptivity), b	0.0595	0.0615	0.0702
Intercept (a)	0.0068	-0.0235	-0.0211
Correlation coefficient (r)	0.998	0.999	0.999
Standard deviation of intercepts (% n=6)	0.0043	0.0081	0.0112
Limit of detection, μgml^{-1}	0.2384	0.4346	0.5234
Limit of quantification, μgml^{-1}	0.7226	1.3170	1.5954
Regression equation ^a	$Y=0.0595C \pm 0.0068$	$Y=0.0615C \pm 0.0235$	$Y=0.0702C \pm 0.0211$

^aWith respect to $Y=bc+a$, where C is the concentration ($\mu\text{g ml}^{-1}$) and Y is absorbance

^bSix replicate samples

TABLE 2: APPLICATION OF PROPOSED METHODS FOR THE ANALYSIS OF CARISOPRODOLE IN PURE FORM

Taken ($\mu\text{g ml}^{-1}$)	Proposed methods						Reference method Recovery (%)
	Found ($\mu\text{g ml}^{-1}$)			Recovery (%)			
	BCG	BTB	BPB	BCG	BTB	BPB	
5	5.08	4.98	5.05	101.6	99.6	101.0	99.8
10	10.15	9.98	9.96	101.5	99.8	99.6	101.2
15	15.15	14.95	15.25	101.0	99.66	101.66	101.5
20	19.95	20.12	19.85	99.75	100.6	99.25	101.12
25	24.98	25.25	25.15	99.92	101.0	100.6	101.25
							99.98
							101.25
							99.96
RSD (%)				0.8686	0.6293	0.9892	0.7039
Mean \pm SD				100.75	100.13	100.42	100.75
				± 0.8712	± 0.6301	± 0.9934	± 0.7092
t-test				0.3098	0.1849	0.4944	
F-test				0.6626	1.2667	0.5096	

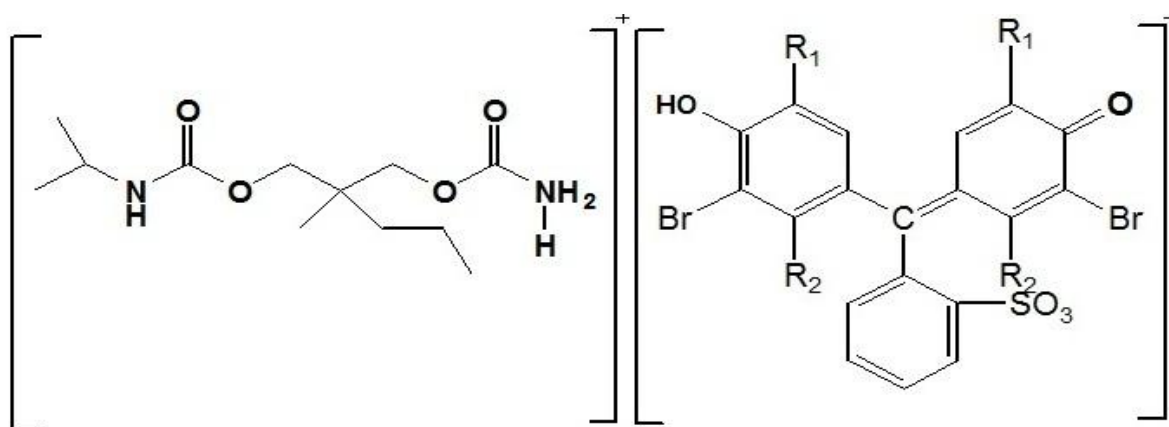
TABLE 3: APPLICATION OF PROPOSED METHODS FOR THE ANALYSIS OF CARISOPRODOL IN PHARMACEUTICAL FORM

Taken ($\mu\text{g ml}^{-1}$)	Proposed methods						Reference Method Recovery (%)
	Found ($\mu\text{g ml}^{-1}$)			Recovery (%)			
	BCG	BTB	BPB	BCG	BTB	BPB	
Soma 250mg							
4	3.96	4.06	4.05	99.0	101.25	101.25	98.98
8	7.98	8.02	8.02	99.75	100.25	100.25	101.25
12	12.04	12.04	11.95	100.33	100.33	99.58	99.92
16	15.96	15.95	16.08	99.75	99.68	100.5	99.85
20	20.02	20.05	19.85	100.1	100.25	99.25	101.05
							100.25
							99.98
							101.48
							99.75
RSD (%)				0.5047	0.5633	0.7853	0.8154
Mean \pm SD				99.78	100.38	100.16	100.27
				± 0.5037	± 0.5655	± 0.7867	± 0.8177
t-test				0.7511	0.5767	0.0648	
F-test				0.3794	0.4781	0.9255	

RESULTS AND DISCUSSION: Carisoprodol forms ion-pair complexes in acidic buffer with dyestuffs such as bromocresol green (BCG), bromothymol blue (BTB) and bromophenol blue (BPB) and these complexes are quantitatively extracted into chloroform. Ion-pair complexes of drug with BCG, BTB and BPB absorbed maximally at 420, 417 and 413 respectively (**Fig. 2A, 2B and 2C**). The reagent blank under similar conditions showed no absorption.

Carisoprodol molecule has two amide nitrogen atoms on both sides of the chain, one of which is alkylated as N-isopropyl amido group. The protonation takes place preferably on free amido

nitrogen since the approach of dye molecule to drug molecule from N-alkylated amido side prevents the protonation to some extent due to steric factors. The sulphonic acid group present in BCG, BTB and BPB, undergoes dissociation in the pH range 1-5. The colour of such dyes is due to the opening of lactoid ring and subsequent formation of quinoid group. It is supposed that the two tautomers are present in equilibrium but due to strong acidic nature of the sulphonic acid group, the quinoid body must predominate. Finally the protonated carisoprodol forms ion-pairs with the dyestuffs which are quantitatively extracted into chloroform. The possible structure of ion-pair complex is proposed and given in **Chart 1**.



Bromocresol green : $R_1 = -\text{Br}$, $R_2 = -\text{CH}_3$
 Bromothymol blue : $R_1 = -\text{isopropyl}$, $R_2 = -\text{CH}_3$
 Bromophenol blue : $R_1 = -\text{Br}$, $R_2 = -\text{H}$

CHART 1: CARISOPRODOL - DYE ION-PAIR COMPLEX

Stoichiometry: In order to establish molar ratio between carisoprodol and dyestuffs used, the Job's method of continuous variation³² has been applied. In this method, solutions of drug and dyestuff with identical molar concentrations ($8 \times 10^{-5} \text{M}$) were mixed in varying volume ratios in such a way that the total volume of each mixture was the same. The absorbance of each solution was measured and plotted against the mole fraction of the drug, $[\text{drug}] / [\text{drug}] + [\text{dyestuff}]$ (**Fig.4**).

This measurement showed that 1:1 complex was formed with each dyestuff. The formation constants³³ were also estimated and found to be 1.55×10^6 , 1.61×10^6 and $1.71 \times 10^6 \text{ K M}^{-1}$ for complexes with BCG, BTB and BPB respectively.

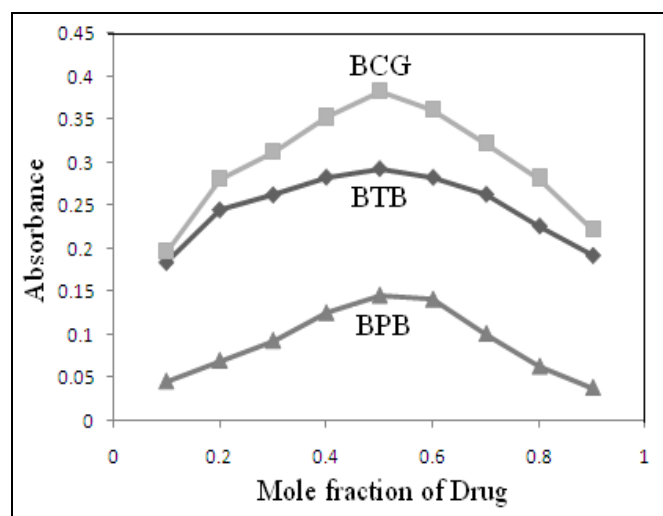


FIG. 4: CONTINUOUS-VARIATIONS STUDY OF DRUG-DYE SYSTEMS
 $[\text{Drug}] = [\text{Dye}] = 8 \times 10^{-5} \text{M}$

Optimization of the factors affecting the absorbance: The influence of pH on the ion-pair formation of carisoprodol with various dyestuffs has been studied using sodium acetate-hydrochloric acid buffer. The results are shown in **Fig.5**. It is evident that absorbance of complexes with BCG, BTB and BPB was found to be constant within the pH ranges 3.3-3.8, 2.6-3.0 and 2.3-2.7 respectively. Thus, all the absorbance measurements were made at pH 3.5, 2.8 and 2.5 with BCG, BTB and BPB respectively.

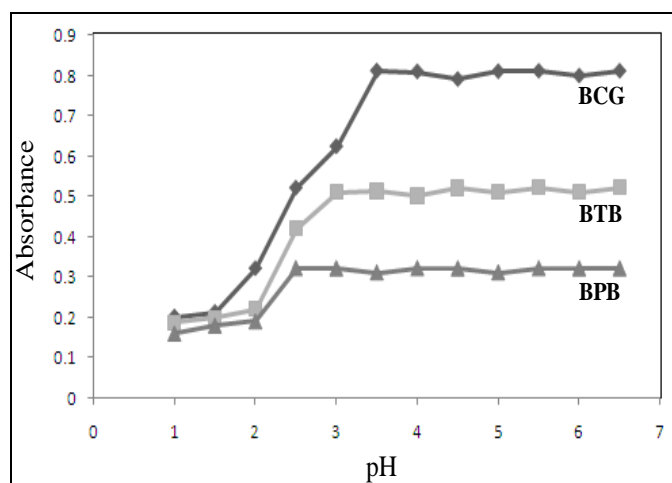


FIG. 5: EFFECT OF pH

[Drug] = $8\mu\text{g ml}^{-1}$, [Dye] = 5ml of 0.025%

The effect of dyestuff concentrations was also studied by adding different volumes of dyestuff to a constant amount of carisoprodol ($8\mu\text{g ml}^{-1}$). It is apparent from **Fig.6** that the maximum absorbance, in each case, was found with 3.0ml of dyestuff, beyond which absorbance was constant. Thus, 5ml of each dyestuff was used for ion-pair formation throughout the experiment.

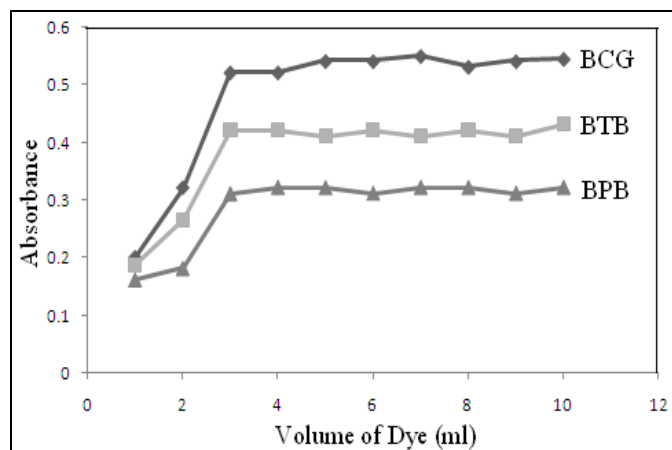


FIG. 6: INFLUENCE OF THE VOLUME OF 0.025% DYE

[Drug] = $8\mu\text{g ml}^{-1}$

A systematic study of the effect of foreign species present along with carisoprodol on the determination of carisoprodol at $8\mu\text{g ml}^{-1}$ levels was undertaken. This study was carried out by following the proposed procedures for a 10 ml sample system, by adding a known amount of foreign species to a carisoprodol solution of $8\mu\text{g ml}^{-1}$. **Table 4** summarizes the results obtained. However, the drug content from the powdered capsules was extracted into chloroform, which completely removes any interference by the common excipients found in formulations.

TABLE 4: INTERFERENCE STUDY

Sl. No.	Excipients	Tolerance limit ($\mu\text{g ml}^{-1}$)
1	Microcrystalline cellulose	98
2	Starch	145
3	Lactose	116
4	Povidone	62
5	Silicon dioxide	79
6	Titanium dioxide	53

Validation of the proposed method:

All the three proposed methods have been validated in terms of guideline proposed by International Conference on Harmonization³⁴ viz. selectivity, specificity, accuracy, precision, limits of calibration curve, LOD, LOQ, robustness, ruggedness and regression equation. The student t-test and variance F-test have been performed in comparison with a reference method. **Table 1** summarizes the values for Beer's law limits, molar absorptivity, regression equation, correlation coefficients, relative standard deviation and recoveries. To test the reproducibility of the proposed methods, six replicate determinations of $10\mu\text{g ml}^{-1}$ of carisoprodol were made. The coefficient of variation was found to be less than 1.2% for all the procedures. The proposed methods have been successfully applied to the determination of carisoprodol in pharmaceutical preparations. The performance order of the proposed methods is BCG > BTB > BPB. The results obtained and shown in **Table 2** and **Table 3** were compared to those obtained by a reference method²⁷ by means of t-test at 95% confidence level. In all cases, the average results obtained by proposed methods and reference method were statistically identical, as the difference between the average values had no significance at 95% confidence level.

CONCLUSION: Carisoprodol forms ion-pair complexes with acidic triphenylmethane dyes viz., bromocresol green, bromothymol blue and bromophenol blue in 1:1 proportion. These complexes are extractable into chloroform and offer a basis for assay of the drug. The developed methods are simple, sensitive, and reproducible and can be used for routine analysis of carisoprodol in pure and formulation forms.

ACKNOWLEDGEMENTS: The authors are grateful to Prof. G. Venkateshwarlu, Department of Chemistry, Osmania University, Hyderabad for helpful discussion and to Sri M. Ravindra Reddy, Chairman, Managing Committee & Sri P. Shivaprakash, Principal of SAP College Vikarabad for providing facilities. The authors are thankful to the UGC for financial assistance under Major Research Project.

REFERENCES:

1. Stanko JR: A review of oral skeletal muscle relaxants for the craniofacial disorder (CMD) practitioner. *Journal of craniomandibular Practice* 1990; 8(3):234-243.
2. US Patent no, US 7,550, 509 2009: B2 Date Jun, 23.
3. J.K. Elenbaas JK: Centrally acting oral skeletal muscle relaxants. *American Journal of Hospital Pharmacy* 1980; 37: 1313-1323.
4. Montvale NJ: Physicians, Desk reference, 54thEd; Medical Economics, Thomson Healthcare 2000.
5. Goldberg D: Carisoprodol toxicity. *Military Medicine* 1969; 134: 597-601.
6. Reeves RR and Burke RS: Carisoprodol: Abuse potential and withdrawal Syndrome. *Current Drug Abuse Reviews* 2000; 3: 33-38.
7. Reeves RR and Ladner ME: Carisoprodol withdrawal syndrome misdiagnosed as a psychotic disorder. *Annals of Clinical Psychiatry* 2008; 20: 173-174.
8. Forrester MB: Carisoprodol abuse in Texas 1998-2003. *Journal of Medical Toxicology* 2006; 2: 8-13
9. Reeves RR, Henderson RH and Ladner ME: Carisoprodol abuse in Mississippi. *Journal of the Missouri State Medical Association* 2007; 48: 363-365.
10. Fass JA: Carisoprodol legal status and patterns of abuse. *Annals of Pharmacotherapy* 2010; 44: 1962-1967.
11. Delisa D, Kelsie S, Kenji O and Sarah K: Quantitative analysis of carisoprodol and meprobamate in whole blood using benzylcarbamate and deuterated meprobamate as internal standards. *Journal of Analytical Toxicology* 2009; 33: 278-282.
12. Kintz P, Marigin P, Lugnier AAJ and Chaumont AJ: A Rapid and sensitive gas chromatographic analysis of meprobamate or carisoprodol in urine and plasma. *Journal of Analytical Toxicology* 1988; 12: 73-74.
13. Kucharczyk N, Segelman FH, Kelton E, Summers J, Sophia RD, Mahrous H and Heath E: Gas chromatographic determination of carisoprodol in human plasma. *Journal of chromatography and biomedical applications* 1986; 377: 384-90.
14. Douglas JF, Smith NB and Stockage JA: Gas-chromatographic determination of mebutamate, carisoprodol and tybamate in plasma and urine. *Journal of pharmaceutical sciences* 1969; 58: 145-146.
15. Miksa IR and Poppenaga RH: Direct and rapid determination of baclofen and carisoprodol in bovine serum by liquid Chromatography-mass spectrometry. *Journal of Analytical Toxicology* 2003; 27: 275-283.
16. Tomohiro M, Toshiyuki S, Toshiyasu M, Minoru A, Yoshitaka M and Manasa N: Simultaneous determination of carisoprodol and acetaminophen in an attempted suicide by liquid chromatography-mass spectrometry with positive electrospray ionization. *Journal of Analytical Toxicology* 2003; 27: 118-122.
17. Jin young kim, Moon kyo in, Ki-jung paeng and Bong Chul Chung: Simultaneous determination of Carisoprodol and meprobamate in human hair using solid-phase extraction and gas chromatography/mass spectrometry of the trimethylsilyl derivatives. *Rapid communications in mass spectrometry* 2005; 19(21): 3056-3062.
18. Sandrine D, Damien R, Bertrand S, Alain E and François C: A One-Step and Sensitive GC-MS Assay for Meprobamate determination in emergency Situations. *Journal of Analytical Toxicology* 2006; 30: 302-305.
19. Lewis Allen: Quantitative determination of carisoprodol, phenacetin, and caffeine in tablets by near- IR spectrometry and their identification by TLC. *Journal of pharmaceutical science* 1974; 63: 912-916.
20. Fisher J and Sherma J: Analysis of carisoprodol tablets by HPTLC with visible absorbance densitometry. *Acta chromatographica* 2001; 11: 96-101.
21. Cynthia C, Margaux G, James T, Jonathan O Jr and Christine M: Determination of Carisoprodol and Meprobamate in oral fluid. *Journal of Analytical Toxicology* 2012; 36: 217-220.
22. Guohong W, Kim H, Rekha B, Warren R, Christine M, Cynthia C, Michael V and James S: Validation of a new Homogeneous Immunoassay for the detection of carisoprodol in urine. *Journal of Analytical Toxicology* 2011; 3: 108-112.
23. Rohith T, Ananda S, and Netkal M. Made Gowda: Method development and validation of carisoprodol and its impurities by ultra-violet-high performance liquid chromatography. *Advances in Analytical Chemistry* 2013; 3(2): 15-19.
24. Sreenivasulu V, Ramesh M, Kumar IJ, Vasu Babu R, Nageswara Rao P and Krishnaiah A: Simultaneous determination of carisoprodol and aspirin in human plasma using liquid chromatography – tandem mass spectrometry in polarity switch mode: Application to a human plasma pharmacokinetic study. *Biomedical Chromatography* 2013; 27(2):179-185.
25. Skinner W, McKenie and Stanley S: Quantitative determination of carisoprodol and its metabolites in equine urine and serum by liquid chromatography – tandem mass spectrometry. *Chromatographia* 2004; 59(1):S61-S67.
26. Angela SM and Samuel RG: Identification and determination of carisoprodol in tablets by liquid chromatography / mass spectrometry. *Microgram Journal* 2004; 2(1-4):36-41.
27. Daya Sagar M, Shahidullah M, Rabbani BS, Shahnaz S and Harish G: Development and evaluation of carisoprodol tablets with improved dissolution efficiency using solid dispersion technology. *Indian Journal of Pharmacy and Biotechnology* 2013; 1(4):484-487.
28. Suresh K, Sangeetha G, Gnanaprakash K, Harikrishna G, Balaji G and Anudeep K: Formulation and evaluation of

- carisoprodol topical gel. Research Journal of Pharmacy and Technology 2014; 7(1):34-38.
29. Laila Tosson K: The kinetic analysis of non-isothermal carisoprodol reaction in nitrogen atmosphere using the invariant kinetic parameters method. European Journal of Chemistry 2014; 5(3):507-512.
30. Mohamadazhar AP and Salunkhe VR: Diazotization of carisoprodol as skeletal muscle relaxant by derivatization spectrometry. International Journal of Universal Pharmacy and Bio Sciences 2013; 2(4):474-486
31. Britton HTS: Hydrogen Ions, Chapman and Hall, London Vol I, 1942: 301.
32. Vosburgh WC and Cooper GR: The identification of complex ions in solution by spectrophotometric measurements. Journal of American Chemical Society 1941; 63:437-442.
33. Likussar W and Boltz DF: Theory of continuous variation plots and a new method for spectrophotometric determination of extraction and formation constants. Analytical Chemistry 1971; 43: 1265-1272.
34. ICH (International Conference on Harmonization) of Technical Requirement for the Registration of Pharmaceuticals for Human use, Validation of analytical procedures, definitions and Terminology Genera 1996.

How to cite this article:

Ravi M, Veeraiah T and Reddy VR: Spectrophotometric Determination of Carisoprodol in Pure and Pharmaceutical Forms Using Triphenyl Methane Dyes. Int J Pharm Sci Res 2015; 6(7): 2936-43. doi: 10.13040/IJPSR.0975-8232.6(7).2936-43.

All © 2013 are reserved by International Journal of Pharmaceutical Sciences and Research. This Journal licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License.

This article can be downloaded to **ANDROID OS** based mobile. Scan QR Code using Code/Bar Scanner from your mobile. (Scanners are available on Google Playstore)