INTERNATIONAL JOURNAL IN PHARMACEUTICAL SCIENCES

Journal Homepage: http://ijpsjournal.com/

OPEN ACCESS

Review Article

A Review on Various Analytical Methodologies for Buspirone

Vikas R. Patil[1]*, Vinay V. Sarode[2], Samir B. Tadvi[3], Bhushan P. Patil[4], Vaishali Badgujar[5], Shweta V. Rane[6], Kunal M. Jadhav[7]

[1]*Assistant Professor, Department of Pharmaceutical Chemistry, Smt. Sharadchandrika Suresh Patil College of Pharmacy, Chopda, Maharashtra, India.*

[2]*Research Scholar, Department of Pharmacology, VYWS, Institute of Pharmaceutical Education and Research, Borgaon (Meghe), Wardha, Maharashtra, India.*

[3]*Assistant Professor, Department of Pharmaceutics, Smt. Sharadchandrika Suresh Patil College of Pharmacy, Chopda, Maharashtra, India.*

[4]*Assistant Professor, Department of Pharmacognosy, Smt. Sharadchandrika Suresh Patil College of Pharmacy, Chopda, Maharashtra, India.*

[5]*Assistant Professor, Department of Pharmaceutical Chemistry, TSPM's Trimurti Institute of Pharmacy, Paldhi, Jalgaon, Maharashtra, India*

[6]*Research Scholar, Department of Pharmaceutical Chemistry, LTJSS, Priyadarshini J. L. College of Pharmacy, Nagpur, Maharashtra, India.*

[7]*Student, TSPM's Trimurti Institute of Pharmacy, Paldhi, Jalgaon, Maharashtra, India.*

ARTICLE INFO

Received: 27 May 2023
Accepted: 28 May 2023
Published: 13 June 2023

Keywords:
Buspirone, Psychotropic, Anxiolytic drug, USFDA, Analytical method, High-performance liquid chromatography.

DOI:
10.5281/zenodo.8033198

ABSTRACT

Buspirone is a psychotropic drug which belongs to the class of compounds known as azaspirodecanediones. Buspirone used primarily as an anxiolytic. It specifically used for generalized anxiety disorder. As an anxiolytic drug buspirone is as potent as benzodiazepines, but it does not cause the adverse side effects, for example sedation, anti-convulsion or muscle relaxation. Buspirone was first approved in 1986 by USFDA. Therefore, the main objective of this analysis of Buspirone in pharmaceutical and biological formulation is in both qualitative and quantitative terms. In this review article, we have summarized UV/Vis spectroscopy, high- performance liquid chromatography (HPLC), High-performance thin-layer chromatography (HPTLC), Liquid chromatography-mass spectroscopy-mass spectroscopy (LC-MS/MS) etc. based methods for estimation of Buspirone. In addition to that, we have discussed the bioanalytical methods for Buspirone analysis. In conclusion, this review article will help to research scholars for further method development for drug estimation in pharmaceutical dosage forms and biological fluids.

***Corresponding Author:** Vikas R. Patil

Address: *Department of Pharmaceutical Chemistry, Smt. Sharadchandrika Suresh Patil College of Pharmacy, Chopda, Maharashtra, India*

Email : vikaspatil259@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

INTRODUCTION

Buspirone is the member of azapirone group of anxiolytic agents which is widely used in anxiolytic therapy [1]. BSP does not cause sedation or depression of central nervous system. Buspirone is chemically known as 8-{4-[4-(2-pyrimidinyl)-1-piperazinyl] butyl}-8-azaspiro [4,5]decane-7,9-dione **(Figure 1)** [2]. It contains the pyrimidinylpiperazine and azaspirodecanedione linked together [3]. BSP is used in several psychological disorders, including generalized anxiety disorder and also treat non-specific anxiety symptoms with or without associated symptoms of depression [4]. BSP having anxiolytic, anticonvulsant, hypnotic, and also muscle relaxant properties [3]. Buspirone is belongs to the widely investigated arylpiperazine class of serotonin 5HT1A receptor ligands [4].

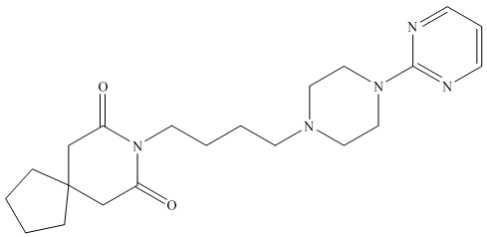

Figure 1: Chemical structure of BSP

MECHANISM OF ACTION

In the generalized anxiety disorder the therapeutic action of buspirone is to be mainly interaction with two major subtypes of 5-HT1A receptor. These receptors are involved in the brain's anxiety and fear circuitry which enhances the serotonergic activity in the brain areas. At presynaptic 5-HT1A receptors or at 5-HT1A auto receptors BSP acts as a full agonist, while at the postsynaptic 5-HT1A receptors acting as a partial agonist. 5-HT1A receptors is inhibitory auto receptors which is G-protein coupled receptors that couple to Gi/Go proteins. When the presynaptic 5-HT1A auto receptors activates it causes neuron hyperpolarization and it reduces the firing rate of the serotonergic neuron, it decreases the extracellular serotonin levels in the neuron's projection areas. Activated 5-HT1A receptors present in postsynaptically promotes hyperpolarization to released serotonin neurons. The main pharmacological action of Buspirone i.e. anxiolytic action is arises due to presynaptic 5-HT1A auto receptors. BUSP act as a potent agonist of presynaptic 5-HT1A auto receptors, it initially causes activation of these auto receptors and inhibits the release of serotonin [5].

PHARMACOKINETICS

Absorption

Buspirone is rapidly absorbed in empty stomach. Due to extensive first pass metabolism its bioavailability is low and variable (approximately 5%). While taken with food the absorption of buspirone is decreased, the first-pass metabolism of the BSP is also decreases, which results the bioavailability increases as well as Cmax and AUC also increases [5].

Distribution

The volume of distribution of buspirone was 5.3 L/kg. The buspirone bound to plasma proteins is approx. 86%. BSP is mainly bound to human serum albumin and alpha-1-acid glycoprotein [6].

Metabolism

Buspirone is highly metabolized after administered orally, where BSP primarily undergoes hepatic oxidation which is CYP3A4 enzyme mediated. After that metabolism hydroxylated derivatives are produced, including 1-pyrimidinylpiperazine (1-PP) which is a pharmacologically active metabolite. In the studies of animals, 1-PP possessed about 1/4th pharmacological activity of buspirone [6].

Elimination

29-63% of administered dose of buspirone was excreted in the urine within 24 hours, primarily in the form of metabolites. About 18% to 38% of the dose of buspirone was excreted via fecal elimination [5].

PHARMACODYNAMICS

Buspirone has high affinity with agonistic action of the serotonin 5-HT1A receptor [7]. At presynaptic 5-HT1A receptors or at 5-HT1A auto receptors BSP acts as a full agonist, while at the postsynaptic 5-HT1A receptors acting as a partial agonist [5]. The main actions of buspirone are mediated by the interaction with the presynaptic serotonergic (5-HT1A) receptor, which reduces the firing of serotonin producing neurons. Buspirone also have lower affinities for the serotonin 5-HT2A, 5-HT2B, 5-HT2C, 5-HT6, and 5-HT7 receptors.

In addition to that buspirone has also an antagonistic property on the dopamine D2 receptor with weak affinity. It blocks inhibitory presynaptic D2 auto receptors preferentially, and postsynaptic D2 receptors antagonizes only at higher doses. At low doses the buspirone increase dopaminergic neurotransmission in the nigrostriatal pathway. At higher dose of buspirone it blocks the postsynaptic and produces anti-dopaminergic effects. Buspirone has also antagonistic action at the dopamine D3 and D4 receptors with higher affinity [7].

ANALYTICAL ACCOUNT OF BSP

For the determination of BSP in bulk and pharmaceutical formulations, an exhaustive literature search found numerous analytical techniques such as UV/Visible Spectrophotometry, HPLC, HPTLC, LC-MS/MS, and bioanalytical approaches. BSP is measured as a single constituent and in combination with fluoxetine (FLU), escitalopram (ESCI), paroxetine (PAR) and buspirone (BSP). **Figure 2** shows different analytical methods implemented for the estimation of BSP.

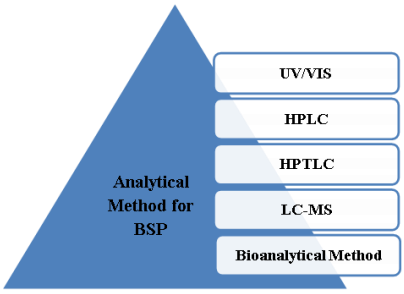

Figure 2: Analytical methods of BSP

BIO-ANALYTICAL METHOD FOR BSP

Bio-analysis is a sub-discipline of analytical chemistry covering the quantitative measurement of xenobiotics (drugs and their metabolites, and biological molecules in unnatural locations or concentrations) and biotics (macromolecules, proteins, DNA, large molecule drugs, metabolites) in biological systems [8]. The summary of the reported bioanalytical methods is shown in **Table 1.**

Table 1: Bioanalytical determination of BSP

Sr. No.	Drug	Sample Matrix	Method	Column	Detection	Internal Standard	Ref
1	BSP	Human Plasma	HPLC	Hypersil BDS CN5 µm	238 nm	1-Phenylpiperazine	9
2	BSP	Human Plasma	HPLC	Nucleosil C18 column	235 nm	Citalopram	10
3	BSP	Human plasma	HPLC	Spherisorb S5 C8 analytical column	240 nm	Quinupramine	11
4	BSP	Human Plasma	HPLC	Carboxypropyl (CBA) solid phase column	***	Desmethylimipramine hydrochloride	12
5	BSP	Human plasma	HPLC	Supelcosil ABZ + plus C18 reversed-phase column	***	Prazosin	13
6	BSP	Human serum	HPLC	C18 column.	235 nm	***	14
7	BSP	Rabbit serum	HPLC	Kromasil C8 column	235 nm	Diltiazem Hydrochloride	15
8	BSP	Rat plasma	HPLC	Kinetex C8 column	237 nm	Naproxen	16

9	BSP	Rat plasma	HPLC	Spherisorb ODS-2 column.	248 nm.	1-phenylpiperazine	17
10	BSP	Rat plasma and brain tissue	HPLC	Cyanonitrile Analytical column	***	Gepirone	18
11	BSP	Rat and dog plasma	HPLC	A stainless-steel column	254 nm	L-phenylpiperazine	19
12	BSP	Human plasma	HPLC-MS	Luna C18 guard column	***	Prazosin	20
13	BSP	Human plasma	LC-MS	Column packed with Luna Phenyl-Hexyl	***	1-(2-pyrimidinyl)-piperazine & 1(2-pyridyl)-piperazine	21
14	BSP	Rat bile, urine and liver S9 samples	LC-MS	Zorbax RX C18 reversed phase Column	260 nm	***	22
15	BSP	Human plasma	LC-ESI-MS/MS	Reversed phase C18 supelco ascentis express Column	***	Buspirone D8	23
16	BSP	Human plasma	GC	C8 Column	***	Zolpidem	24
17	BSP	Rat brain	GC-NPD	A fused-silica capillary column	***	Alprazolam	25

***Not provided

UV-VISIBLE SPECTROSCOPY METHOD FOR BSP

The spectrophotometric methods have been accounted for the determination of BSP. The details of Spectrophotometry determination of basic principle, sample matrix, lambda max, solvent linearity range and the correlation coefficient are summarized in **Table 2.**

Table 2: Summary of UV methods for the determination of BSP

Sr. No.	Drug	Matrix	Solvent	Lambda Max (nm)	Linearity (µg/mL)	Correlation Coefficient(R2)	Ref.
1	BSP	Bulk and Pharmaceutical Dosage	Chloroform at pH 3.4	408 nm	2.5 - 25 µg/ml	0.997	26
2	BSP	Solid dosage form	Chloroform at pH 2.3	415 nm	1.5 - 6 µg/ml	0.9991	27
3	BSP	Bulk and tablets	**Method A** - Water **Method B** - Methanol	236 nm	5 - 25 µg/ml 10- 50 µg/ml	0.9866 0.9905	28
4	BSP	Bulk and tablet	Water	531 nm	10 - 100 µg/ml	0.999	29
5	BSP HCl	Commercial Dosage Form	disodium hydrogen phosphate and citric acid buffer solution of pH 4.0	412 nm	1.25-30 µg/ml	0.9999	30

***Not provided

HPLC METHOD FOR BSP

The specificity of the HPLC method is excellent and simultaneously sufficient precision is also attainable. However, it has to be stated that the astonishing specificity, precision, and accuracy are attainable only if wide-ranging system suitability tests are carried before the HPLC analysis. For this reason, the expense to be paid for the high specificity, precision, and accuracy is also high. The summary of the reported HPLC methods is shown in **Table 3.**

Table 3: Summary of HPLC methods for the determination of BSP

Sr. No.	Drug name	Column	Mobile phase	Lambda max (nm)	Linearity (µg/mL)	Retention time (min)	Flow rate (mL/min)	Detector	Ref.
1	BSP	C_{18}	Water : Acetonitrile : Methanol (45 : 35 : 20) (V/V)	210 nm	5.0 - 25.0 µg/ml	7.057 min	1.0 ml/min	UV	31
2	BSP	RP C18 column	70:30 (v/v) Methanol - 0.01 M Sodium dihydrogen phosphate buffer (pH 3.5)	244 nm	0.05 - 20 µg/ml	7.72 min	0.8 ml/min	UV	32
3	BSP	Semi-micro xterra MS C18	0.010M Ammonium acetate (pH 4.0) Methanol (55:45 v/v)	245 nm	1.00 to 5.00 µg/ml	7.72 min	0.30 ml/min	UV	33
4	BSP	Ultra sphere C_{18} column	Acetonitrile - Methanol mixture (13:17)	244 nm	5 and 200 ng/µl	23.60 min	1.4 ml/min	DAD	34
5	BSP	Reversed Phase C18 column	70:30 (v/v) methanol- 0.01M NaH2PO4 buffer	240 nm	0.5-20 µg/ml	***	0.8 ml/min	UV	35

***Not provided

LIQUID-CHROMATOGRAPHY-MASS SPECTROSCOPY METHOD (LC-MS) FOR BSP

In recent years, the combination of LC/MS has gained a lot of attention for the analysis of interest analytes in complex samples with improved performance. In brief, after a thorough examination, LC/MS interfaces are divided into two categories namely interfaces for indirect and direct input of column effluent. Murat Kartal et. al., established Liquid Chromatographic Method for the Analysis of Buspirone HCl and Its Potential Impurities. The separation was carried out by stationary phase µ Bondapack C18 column with 90:10 (v/v) 10mM KH2PO4 (pH 6.1)-acetonitrile as a mobile phase. Detection was carried out Lambda max at 210 nm [36].

HPTLC METHOD FOR BSP

Thin-layer chromatography is a popular technique for the analysis of a wide variety of organic and inorganic materials, because of its distinctive advantages such as minimal sample clean-up, a wide choice of mobile phases, flexibility in sample distinction, high sample loading capacity and low cost. Pilvenytė Greta, Kazlauskienė Daiva, Marksa

Mindaugas and Bezruk Ivan established HPTLC method Determination of buspirone, fluoxetine, escitalopram and paroxetine by HPTLC after SPE extraction. They analyses buspirone (BUSP), fluoxetine (FLU), escitalopram (ESCI) and paroxetine (PAR). TLC was carried out by stationary phase silica gel 60 F254 plates with acetonitrile: methanol: 25% ammonia solution (85:10:05) as mobile phase. The HPTLC determination was made with UV detector at 254 nm [37].

CONCLUSION

The present review article provides comprehensive data of various analytical and bioanalytical methods developed for BSP alone and in combinations. For analysis purpose, different analytical methods have been reported that includes HPLC, HPTLC, LC-MS and UV spectroscopy, etc. The method along with their details concerning the mobile phase, stationary phase, retention time, etc., have been summarized in tabular form that will more helpful for the researchers for further analytical method development for estimation of BSP in dosage form and pure form. In the future, enlisted data can be used for the development of analytical methods bio-analysis of BSP in pharmaceutical and biological formulations. Finally, it presents an opportunity for greater information on what has already been done and what new methods and changes can be developed to get a better estimation of BSP.

ACKNOWLEDGMENTS

Authors are thankful to Smt. Sharadchandrika Suresh Patil College of Pharmacy, Chopda and also thankful to VYWS, Institute of Pharmaceutical Education and Research, Borgaon (Meghe), Wardha, Maharashtra, India for providing necessary library facilities.

CONFLICT OF INTEREST

The authors declare that no conflict of interest.

ABBREVIATION

1) BSP - Buspirone
2) USFDA - United states of Food and Drug Administration
3) UV/VIS - Ultra violet/visible spectroscopy
4) HPLC - High-performance liquid chromatography
5) HPTLC - High-performance thin layer chromatography
6) LC-MS/MS - Liquid chromatography-mass spectroscopy-mass spectroscopy
7) RP - Reverse phase
8) nm - Nanometer
9) µg/mL - Micro gram per Milliliter
10) DAD - Diode array detector
11) FLU - Fluoxetine
12) ESCI – Escitalopram
13) PAR - Paroxetine

REFERENCES

1. Zayed MA, Fahmey MA, Hawash MA and El-Habeeb AA. Mass spectrometric investigation of buspirone drug in comparison with thermal analyses and MO-calculations. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 2007; 67(2): pp.522-530.
2. Ary K, Rona K, Ondi S and Gachalyi B. 1998. High-performance liquid chromatographic method with coulometric detection for the determination of buspirone in human plasma by means of a column-switching technique. Journal of Chromatography A, 1998; 797(1-2): pp.221-226.
3. Patil, V., Labade, S., Khilare, C. and Sawant, S. A Molecular Bridge-Like Binding Mode of Buspirone to BSA: Multispectroscopic and Molecular Docking Investigation. Chemical Data Collections 2022; 40: p.100892.
4. Kartal M, Khedr A and Sakr A. Liquid chromatographic method for the analysis of buspirone HCl and its potential impurities. Journal of chromatographic science, 2000; 38(4): pp.151-156.

5. https://pubchem.ncbi.nlm.nih.gov/compound/Buspirone#section=Pharmacology-and-Biochemistry
6. https://go.drugbank.com/drugs/DB00490
7. https://en.wikipedia.org/wiki/Buspirone#Pharmacology
8. Spooner N. Dried blood spot sampling for quantitative bioanalysis, time for a revolution. Bioanalysis, 2010; 2: 1781.
9. DU Q, SUN J, KANG LJ, & YAN GW. Determination of buspirone hydrochloride and its active metabolite in plasma by HPLC. Chinese Journal of Pharmaceutical Analysis, 2003; 23(1): 56-58.
10. Foroutan SM, Zarghi A, Shafaati A R, & Khoddam A. Simple high-performance liquid chromatographic determination of buspirone in human plasma. Il Farmaco, 2004; 59(9): 739-742.
11. Péhourcq F. Rapid high-performance liquid chromatographic measurement of buspirone in human plasma after overdose. Biomedical Chromatography, 2004; 18(9): 637-640.
12. Odontiadis J, & Franklin M. Simultaneous quantitation of buspirone and its major metabolite 1-(2-pyrimidinyl) piperazine in human plasma by high-performance liquid chromatography with coulometric detection. Journal of pharmaceutical and biomedical analysis, 1996; 14(3): 347-351.
13. Ary K, Rona K, Ondi S, & Gachalyi B. High-performance liquid chromatographic method with coulometric detection for the determination of buspirone in human plasma by means of a column-switching technique. Journal of Chromatography A, 1998; 797(1-2): 221-226.
14. Kristjánsson F. Sensitive determination of buspirone in serum by solid-phase extraction and two-dimensional high-performance liquid chromatography. Journal of Chromatography B: Biomedical Sciences and Applications, 1991; 566(1): 250-256.
15. Gannu R, Yamsani SK, Palem CR, Yamsani VV, Kotagiri H, & Yamsani MR. Development of high performance liquid chromatography method for buspirone in rabbit serum: Application to pharmacokinetic study. Analytica chimica acta, 2009; 647(2): 226-230.
16. Kim KT, Lee JY, Park JH, Kim MH, Kim JS, Shin HJ, ... & Kim DD. Development of HPLC method for the determination of buspirone in rat plasma using fluorescence detection and its application to a pharmacokinetic study. Chemical and Pharmaceutical Bulletin, 2016; 64(11): 1582-1588.
17. Aparicio X, Campos A, Gras J, Fernandez E, & Gelpí E. Determination of a buspirone metabolite in plasma samples. Journal of Pharmaceutical and Biomedical Analysis, 1988; 6(6-8): 945-948.
18. Franklin M. Determination of plasma buspirone by high-performance liquid chromatography with coulometric detection. Journal of Chromatography B: Biomedical Sciences and Applications, 1990; 526: 590-596.
19. Diaz-Marot A, Puigdellivol E, Salvatella C, Comellas L, & Gassiot M. Determination of buspirone and 1-(2-pyrimidinyl) piperazine in plasma samples by high-performance liquid chromatography. Journal of Chromatography B: Biomedical Sciences and Applications, 1989; 490: 470-473.
20. Chew WM, Xu MJ, Cordova CA, & Chow HS. Quantification of a cytochrome P450 3A4 substrate, buspirone, in human plasma by liquid chromatography–tandem mass spectrometry. Journal of Chromatography B, 2006; 844(2): 235-239.

21. Green R, Houghton R, & Jacobs S. Determination of buspirone and its metabolite 1-(2- pyrimidinyl)-piperazine in human plasma by liquid chromatography tandem mass spectrometry. Chromatographia, 2004; 59 (Suppl 2): S197-S201.
22. Kerns EH, Rourick RA, Volk KJ, & Lee MS. Buspirone metabolite structure profile using a standard liquid chromatographic-mass spectrometric protocol. Journal of Chromatography B: Biomedical Sciences and Applications, 1997; 698(1-2): 133-145.
23. Joshi P, Rao S, Singh M, Vig N, Singh AK, Rajawat NS, & Gupta A. A sensitive LC-ESI-MS/MS method for the quantification of low concentrations of buspirone in human plasma. Analytical Methods, 2013; 5(24): 7014-7021.
24. Kivistö KT, Laitila J, Mårtensson K, & Neuvonen PJ. Determination of buspirone and 1- (2-pyrimidinyl)-piperazine (1-PP) in human plasma by capillary gas chromatography. Therapeutic drug monitoring, 1999; 21(3): 317.
25. Lai CT, Véronique AMT, Rauw GA, Bateson AN, Martin IL, & Baker GB. Rapid, sensitive procedure to determine buspirone levels in rat brains using gas chromatography with nitrogen–phosphorus detection. Journal of Chromatography B: Biomedical Sciences and Applications, 1997; 704(1-2): 175-179.
26. Kurien J, Kurian T, & Mathew A. Simple spectrophotometric determination of buspirone hydrochloride in bulk drug and pharmaceutical dosage forms. Science & Society, 2012; 10: 147.
27. Amanlou M, Keivani S, Sadri B, Gorban-Dadras O, & Souri E. Simple extractive colorimetric determination of buspirone by acid-dye complexation method in solid dosage form. Research in Pharmaceutical Sciences, 2009; 4(1): 11-18.
28. Dhandapani H, Hemamrutha S, Lakshmi Sravanthi K, & Swetha J. Spectrophotometric estimation of buspirone hydrochloride in bulk and its pharmaceutical formulation. Int J of Pharma Sciences and Research, 2010; 1(4).
29. Kurien J, & Kurian T. A sensitive spectrophotometric method for the quantitative determination of buspirone hydrochloride in pharmaceutical formulations. Hygeia JD Med, 2012; 4: 6-14.
30. Azmi SNH, Al-Ghafri LT, Al-Ghafri SS, & Al-Haribi MM. Determination of buspirone HCL in commercial dosage forms by extractive spectrophotometric method and comparison by HPLC method. Sci. J. Anal. Chem, 2015; 3: 91.
31. Rao B, Nagendrakumar AVD, Maiti S, & Raja G. Validated RP-HPLC method for the determination of buspirone in pharmaceutical formulations. Chromatography Research International, 2011.
32. Azeem A, Rizwan M, Ahmad FJ, Iqbal Z, Khar RK, Aqil M, & Talegaonkar S. Development and validation of a stability-indicating LC-UV method for rapid analysis of buspirone in pharmaceutical dosage forms. Acta Chromatographica, 2009; 21(2): 283-297.
33. Zaxariou M, & Panderi I. Development and validation of a high-performance liquid chromatographic method for the determination of buspirone in pharmaceutical preparations. Journal of pharmaceutical and biomedical analysis, 2004; 35(1): 41-50.
34. Khedr A, & Sakr A. Stability-indicating high-performance liquid chromatographic assay of Buspirone HCI. Journal of chromatographic science, 1999; 37(12): 462-468.
35. Azmi SNH, Al-Ghafri LT, Al-Ghafri SS, & Al-Haribi MM. Determination of buspirone HCL in commercial dosage forms by extractive spectrophotometric method and

comparison by HPLC method. Sci. J. Anal. Chem, 2015; 3: 91.

36. Kartal M, Khedr A, & Sakr A. Liquid chromatographic method for the analysis of buspirone HCl and its potential impurities. Journal of chromatographic science, 2000; 38(4): 151-156.
37. Pilvenytė G, Kazlauskienė D, Marksa M, & Bezruk I. Determination of buspirone, fluoxetine, escitalopram and paroxetine by HPTLC after SPE extraction. In The 22nd annual international scientific-practical conference„ BaltPharm Forum 2019 "„Pharmacists as drug experts: their role in health care system": April 13-14, 2019 Kaunas, Lithuania: book of abstracts/Lithuanian Pharmaceutical Association. Pharmacists 'Society of Latvia. Pharmaceutical Society of; Edited by: Vilma Petrikaitė. Kaunas: Lithuanian Pharmaceutical Association (LFS), 2019.

HOW TO CITE: Vikas R. Patil*, Vinay V. Sarode, Samir B. Tadvi, Bhushan P. Patil, Vaishali Badgujar, Shweta V. Rane, Kunal M. Jadhav, A Review on Various Analytical Methodologies for Buspirone, Int. J. in Pharm. Sci., 2023, Vol 1, Issue 6, 56-64. https://doi.org/10.5281/zenodo.8033198