




ST. XAVIER'S COLLEGE
(AUTONOMOUS)
5, Mahapalika Marg, Mumbai - 400 001,
INDIA.
☎ 2262 0661/65

**3.4.4 NUMBER OF BOOKS AND CHAPTERS IN EDITED
VOLUMES/BOOKS PUBLISHED PER TEACHER DURING THE LAST
FIVE YEARS**

❖ 2020-21 (8)




PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.




ST. XAVIER'S COLLEGE
(AUTONOMOUS)
5, Mahapalika Marg, Mumbai - 400 001,
INDIA.
☎ 2262 0661/65

**3.4.4 NUMBER OF BOOKS AND CHAPTERS IN EDITED
VOLUMES/BOOKS PUBLISHED PER TEACHER DURING THE LAST
FIVE YEARS**

Sl. No.	Name of the Teacher	Title of the Book published	Title of the Chapter published	Year and month of publication	ISBN of the Book/Conference Proceeding	Affiliating Institute of the teacher at the time of publication	Name of the Publisher	weblinks
1	Pundalik A., Nikalje S., Samant A., Samant H	Structural Geology and Tectonics Field Guidebook - Volume 1. Mukherjee eds.	Geological Field Guide: Malvan (Maharashtra, India). pp 495- 528	2021	Print ISBN 978-3-03 0-60142-3 Online ISBN 978-3-03 0-60143-0;	St. Xavier's College	Springer Geology. Springer, Cham	https://doi.org/10.1007/978-3-030-60143-0_17
2	Alok Gude, Kalpit Mhatre	Applied research in Botany Volume-1 by Anil Laxman Bhalerao and Rajesh Shrirangrao , First Edition:	Floristic Diversity of Plateaus in Devgad, Sindhudurg, Maharashtra and Need for Their Conservation , Pg 95-96	2021	ISBN: 978-93-9 0651-59-7	St. Xavier's College	Mahi Publication, Office No.1, Krishnasagar Society, Nr. Shivsagar sharda Mandir Road, Ahmedabad-380007, www.mahipublication.com	

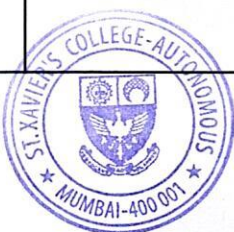


AQAR 2020-2021:
3_4_4_Weblinks_Books_Chapters


PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.



3	Kalpiti Mhatre, Rajendra D. Shinde	Applied research in Botany Volume-1' by Anil Laxman Bhalerao and Rajesh Shrirangrao Gaikwad, First Edition: 2021,	'Exploration of emergency herbal food resources of tribal people from the Raigad district of Maharashtra state, India' ,pgs. 25-28	2021	ISBN: 978-93-9 0651-59- 7	St. Xavier's College	Mahi Publication, Office No.1, Krishnasagar Society, Nr. Shivsagar sharda Mandir Road, Ahmedabad- 380007, www.mahipu blication.com ;
4	Sachin D. Kuvar, Rajendra D. Shinde`	Applied research in Botany Volume-1' by Anil Laxman Bhalerao and Rajesh Shrirangrao Gaikwad, First Edition: 2021,	'Ethnomedici nal plants used by Kokni tribals of Nasik and Dhule districts for treatment of piles (Maharashtra) , pgs 60-65.	2021	ISBN: 978-93-9 0651-59- 7		Mahi Publication, Office No.1, Krishnasagar Society, Nr. Shivsagar sharda Mandir Road, Ahmedabad- 380007, www.mahipu blication.com ;
5	Kalpiti Mhatre, Alok Gude	Applied research in Botany Volume-1 by Anil Laxman Bhalerao and Rajesh Shrirangrao Gaikwad, First Edition:	Investigation of Physico-Che mical and Bioactive Properties of Honey from the Raigad District of Maharashtra State, Pg 137-142	2021	ISBN: 978-93-9 0651-59- 7	St. Xavier's College	Mahi Publication, Office No.1, Krishnasagar Society, Nr. Shivsagar sharda Mandir Road, Ahmedabad- 380007, www.mahipu blication.com ;





ST. XAVIER'S COLLEGE
(AUTONOMOUS)
5, Mahapalika Marg, Mumbai - 400 001,
INDIA.
☎ 2262 0661/65

6	Jotiram Gaikwad	Emotions A Multidisciplinary Inquiry,	The Role of Emotions in Second Language Acquisition, Chapter 32, pp 379-388	2020	9781954467002	St. Xavier's College	Aura Books International, California	
7	Kulkarni A		Quantity vs. Quality trade off in Higher Education: Challenges & Consequences in India', monograph article in 'Higher Education in India: Retrospect & Prospect'		ISBN – 978 – 93 – 89951 – 65 – 3	St. Xavier's College	Himalaya Publication	
8	Pralhad Rege, Vaibhav Salvi and Abhishek Tiwari	Current Advances in Chemistry and Biochemistry Vol. 4	Simultaneous Determination of Ofloxacin and Tinidazole from Pharmaceutical Dosage Formulation by Two Spectrophotometric Methods, Chapter 5	5th May 2021	Print ISBN: 978-93-90888-00-9, eBook ISBN: 978-93-90768-97-4	St. Xavier's College	B. P International	https://doi.org/10.9734/bpi/cacb/v4/1904F



AQAR 2020-2021:
3_4_4_Weblinks_Books_Chapters

Shinde

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.



ST. XAVIER'S COLLEGE

(AUTONOMOUS)

5, Mahapalika Marg, Mumbai - 400 001,
INDIA.

☎ 2262 0661/65

9	Pralhad Rege, Kyle Meyers and Neha Kapadia	Trends in Pharmaceutic al Research and Development Vol.4,	Simultaneous Estimation of Ofloxacin and Ornidazole from Pharmaceutic al Dosage Form by Spectropho metric Methods, Chapter 3	5th May 2021	Print ISBN: 978-93-9 0206-65- 0, eBook ISBN: 978-93-9 0206-66- 7	St. Xavier's College	B. P International	http:// bp.bo okpi.o rg/ind ex.ph p/bpi/ catalo g/boo k/269
---	--	--	--	--------------------	--	----------------------------	-----------------------	---



PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

Springer Geology Field Guides

Soumyajit Mukherjee *Editor*



Structural Geology and Tectonics Field Guidebook— Volume 1

MOREMEDIA



Springer

Springer Geology

Springer Geology Field Guides

Series Editor

Soumyajit Mukherjee, Department of Earth Sciences, Indian Institute of
Technology Bombay, Mumbai, Maharashtra, India

Springer Geology Field Guides is a book series that provides the details of both well-known and little known transects to discover the beauty and knowledge of Geology, worldwide. Springer Geology Field Guides aims to bring geology field trips to professionals, students, and amateurs to find the most interesting geology worldwide. This series includes carefully crafted guidebooks that help generations of geologists explore the terrain with minimum or no guidance. In this series, the audience will also find field methodologies and case studies as examples.

This book series will welcome both authored and edited field guides of all geology disciplines, including structural geology, tectonics, sedimentology, stratigraphy, paleontology, economic geology, among others. Photo-atlases are also welcome.

More information about this subseries at <http://www.springer.com/series/16656>

Soumyajit Mukherjee
Editor

Structural Geology
and Tectonics Field
Guidebook—Volume 1

 Springer

Editor

Soumyajit Mukherjee
Department of Earth Sciences
Indian Institute of Technology Bombay
Mumbai, Maharashtra, India

ISSN 2197-9545 ISSN 2197-9553 (electronic)
Springer Geology
ISSN 2730-7344 ISSN 2730-7352 (electronic)
Springer Geology Field Guides
ISBN 978-3-030-60142-3 ISBN 978-3-030-60143-0 (eBook)
<https://doi.org/10.1007/978-3-030-60143-0>

© Springer Nature Switzerland AG 2021

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

*Dedicated to all fieldwork-based mappers,
geoscientists and surveyors*

Preface

Despite the explosive growth of structural geology and tectonics in the last few decades, structural geological and tectonic fieldwork remain indispensable components of geosciences education in Bachelor's and Master's level worldwide. A (new) field instructor might be in search for (new) terrains close to her institute to explore and demonstrate structures to students. This book fills up that requirement. Through **26 main chapters, 84 authors and co-authors** from **13 countries**, the book presents few well-known and several rather unknown transects where exciting structures exist, and field-programs can be established.

Cite individual chapters in the following format:

Kaplay RD, Babar Md, Mukherjee S, Wable D, Pisal K. 2021. Granitic rocks underlying Deccan trap along the margin of east Dharwar craton, Muntyal (Maharashtra)—Bhaisa (Telengana), India—general description and deformation. In: Mukherjee S. (Ed) Structural Geology and Tectonics Field Guidebook—Volume 1. Springer Nature Switzerland AG. Cham. pp. 599-620. ISBN: 978-3-030-60142-3.

Cite this book in the following format:

Mukherjee S. (2021) Structural Geology and Tectonics Field Guidebook—Volume 1. Springer Nature Switzerland AG. Cham. pp. 1-723. ISBN: 978-3-030-60142-3.

Mumbai, India
February 2021

Soumyajit Mukherjee
soumyajitm@gmail.com
smukherjee@iitb.ac.in

Acknowledgements

Dripta Dutta (IIT Kanpur), **Mohamedharoon A. Shaikh** (MS University Baroda), **Mohit Kumar Puniya** (National Geotechnical Facility, Dehradun), and **Narayan Bose** (IIT Kharagpur) assisted profusely in preparing this book. The Springer (proofreading) team, especially **Boopalan Renu**, **Alexis Vizcaino**, **Doerthe Mennecke-Buehler**, **Marion Schneider**, **Monica Janet Michael** and **Annett Buttener** helped a lot in different stages of this book preparation and publication. I thank the **contributing authors** and the **reviewers** for participation. I am especially thankful to the staff members of my Department for always cooperating. They are **Nilesh K. Borkar**, **Dr. Trupti V. Chandasekhar**, **Shamit N. Karnekar**, **Ramu K. Khandagale**, **Rajesh Y. Manjrakar**, **Dr. Shilpa V. Netravali**, **P. S. Sawant**, **Javed M. Saikh**, **Srikanth Jonnala**, **Staphen T.**, **Mary Thomas**, **N. N. Vengulakar** and **Premkumar R. Verma**.

Introduction to Structural Geology and Tectonics Field Guidebook

This book consists of 26 main chapters.

Chapter “Creating Geologic Maps in the Twenty-First Century: A Case Study from Western Ireland”: Swanger and Whitmeyer (2021) discuss the modern techniques of field mapping and the creation of geologic maps using recent software. The authors also elaborate the same using a case study from Western Ireland.

Chapter “Strain Softening in a Continental Shear Zone: A Field Guide to the Excursion in the Ferriere-Mollières Shear Zone (Argentera Massif, Western Alps, Italy)”: Simonetti et al. (2021) field trip in the Western Alps shows evidences of strain softening from ten field stops in the central portion of the Ferriere-Mollières shear zone. The authors further constrain the shearing event between 340 and 320 Ma using in situ U-Th-Pb petrochronology on monazite.

Chapter “The Geometry and Kinematics of the Southwestern Termination of the Pyrenees: A Field Guide to the Santo Domingo Anticline”: Field trip to the Santo Domingo anticline in the Pyrenees by Pueyo et al. (2021) reveals complex fold kinematics from the fold-thrust belt.

Chapter “Miocene-Quaternary Strain Partitioning and Relief Segmentation Along the Arcuate Betic Fold-and-Thrust Belt: A Field Trip Along the Western Gibraltar Arc Northern Branch (Southern Spain)”: Jiménez-Bonilla et al. (2021) discuss the strain partitioning modes from the hinge to the lateral zones of the Western Gibraltar Arc (southern Spain). Two separate itineraries are presented for the same.

Chapter “The Southern Iberian Shear Zone (SW Spain): Inclined Transpression Related to Variscan Oblique Convergence in a HT/LP Metamorphic Belt”: Díaz-Azpiroz and Fernández (2021) present the ductile mesostructures from the boundary between the Ossa-Morena and South Portuguese Zones of the Iberian Massif (Huelva Province, SW Spain). This boundary developed during the Upper Paleozoic due to the sinistral oblique collision between Avalonia and Armorica.

Chapter “A Field Guide to the Spectacular Salt Mines of the Transylvanian Basin and Romanian Carpathians”: Tămaş et al. (2021) describe field trips in the Romanian Carpathians and the Transylvanian Basin to study the 3D structural

features of the salt domes and diapirs in the abandoned salt mines. They propose a route with five stops to explain the link between hydrocarbon and salt tectonics.

Chapter "Spectacular Sandstone Rock Cities in the Czech Republic": Novakova and Novak (2021) describe sandstone rock cities from the Czech Republic. The Cretaceous sandstones are broken into blocks during the Alpine orogenesis and subsequently eroded to form these spectacular exposures.

Chapter "Field Guide to RODS in the Pireneus Syntaxis, Central Brazil": Martins-Ferreira and Rodrigues (2021) present a field guide focussing the linear structural features from the Pireneus Range in Central Brazil. They describe the occurrences as observed at the ten field stations from the Three Peaks area (TrêsPicos) to the Mocó Boulders.

Chapter "Low Baric Metamorphic Belts in the Northern Tip of the Arabian–Nubian Shield: Selected Examples from the Eastern Desert/Midyan Terranes, Egypt": Shallaly and Abu Sharib (2021) explore the pelitic metasediments from the LP/HT andalusite-sillimanite-type metamorphic belts of the Arabian–Nubian shield in Egypt. They report multiple phases of deformation in such belts.

Chapter "Review of the Geometric Model Parameters of the Main Himalayan Thrust": Ansari (2021) reviews geometric model parameters of the Main Himalayan Thrust along different portions of the Himalaya. He compiles variation in the dip-slip and strike-slip rates of this thrust along the Himalayan belt. This chapter is not a field guide strictly speaking, but keeping this work in mind will be important for the Himalayan field geologists.

Chapter "Traverses Through the Bagalkot Group from North Karnataka State, India: Deformation in the Mesoproterozoic Supracrustal Kaladgi Basin": Patil Pillai and Kale (2021) conduct fieldwork along four different traverses within the Balakot Group of the Kaladgi Basin. They report several mesoscale structural features, primary sedimentary structures and bedding plane characters.

Chapter "Tectonic Framework of Northern Pakistan from Himalaya to Karakoram": Ali et al. (2021) explore the rocks along the Islamabad–Khunjerab transect of the Pakistan Himalaya. They describe the lithounits encountered over a period of four days that comprise 27 field stops.

Chapter "Structures of Lesser/Greater Himalaya in and Around an Out-of-Sequence Thrust in the Chaura-Sarahan Area (Himachal Pradesh, India)": Ghosh and Mukherjee (2021) present detail field structural features near an out-of-sequence thrust in the Western Himalaya in India. Such thrusts have been studied so far mainly from geochemical perspectives, and field data were so far missing. This chapter presents a good example of ductile and brittle shear sense indicators, so the reader is referred to few recent publications": Mukherjee (2011, 2013, 2014a, b, 2015, in press) and Mukherjee et al. (2020).

Chapter "Structural Geology Along the Nainital-Pangot Road (Kilbari Section), Nainital Lesser Himalaya (Uttarakhand, India): Focus on Back-Structures": Puniya and Mukherjee (2021) study the structural geology along the Nainital–Pangot road (Kilbari section) in the Nainital Lesser Himalaya, Uttarakhand, India. The authors report several mesoscale back structures. Such structures have increasingly been

reported from the Himalaya (e.g., Mukherje 2013; 2019; Bose and Mukherjee 2019a, b).

Chapter “Geology, Structural, Metamorphic and Mineralization Studies Along the Mandi-Kullu-Manali-Rohtang Section of Himachal Pradesh, NW-India”: Singh et al. (2021) present lithounits and structures along the Mandi-Larji-Kullu-Manali-Rohtang La transect in the NW Indian Himalaya.

Chapter “Tectonics and Channel Morpho-Hydrology—A Quantitative Discussion Based on Secondary Data and Field Investigation”: Biswas et al. (2021) compute 30 geomorphic indices to describe the river channel morphologies and their tectonic controls. They choose three study sites from India: the NE foreland basin of North Bengal, the Singbhum Shear Zone (SSZ) and the Janauri-Chandigarh anticline.

Chapter “Geological Field Guide: Malvan (Maharashtra, India)”: Pundalik et al. (2021) present detail of fieldworks from Malvan (Maharashtra, India) from the lithologic, geomorphic and structural perspectives.

Chapter “A Field Guide to the Champaner Region, Southern Aravalli Mountain Belt (SAMB), Gujarat, Western India”: Joshi and Limaye (2021) discuss the structural features in the Paleoproterozoic basement gneisses to the recent sediments of the Champaner region in Eastern Gujarat (India). They elaborate the lithounits and structures encountered from 15 field stops along four different traverses.

Chapter “Importance of Fracturing in Uranium Mineralization in Gulcheru Quartzite Host: A Case from Ambakapalle Area, Cuddapah Basin, Andhra Pradesh, India”: Goswami et al. (2021a) map the fault zone in the Ambakapalle area within the Cuddappah Basin. They focus on fractures and their influence on uranium mineralization. The authors also discuss two phases of the alteration of rocks.

Chapter “Granitic Rocks Underlying Deccan Trap Along the Margin of East Dharwar Craton, Mutnyal (Maharashtra)—Bhaisa (Telangana), India—General Description and Deformation”: Kaplay et al. (2021) study the structural features from the contact between the Eastern Dharwar craton and the Deccan Volcanic Province. They detail shear tectonics along the contact.

Chapter “Structural Analyses of the Lunavada–Santrampur Area (Gujarat, India) Using Remote Sensing Images”: Chauhan et al. (2021) analyze the folds and lineaments from the Santrampur area (NE Gujarat, India) using remote sensing images. They use Google Earth for identifying various folds geometries, viz. polyclinal folds, second-order folds and superposed folds. This chapter will enable field geologist to get into the detail of the terrain.

Chapter “Fundamentals of Lithostructural Mapping: Example from the SW Part of the Proterozoic Bhima Basin, Karnataka, India: A Note on Dharwarian Crustal Evolution”: Goswami et al. (2021b) explore the geodynamic evolution of the Eastern Dharwar craton with the help of GPS-aided lithostructural mapping of the SW part of the Proterozoic Bhima Basin.

Chapter “A 3D Photogrammetric Approach in Mapping Meso-Scale Folds and Shears in Structurally Controlled Syngenetic Mn-Mineralised Zones of Shivrajpur Region, Eastern Gujarat, India”: Joshi (2021) describes an innovative technique of mapping mesoscale structures using 3D photogrammetry. The author maps an

outcrop scale fold from an abandoned mine from the Mn-mineralized zones of the Shivrajpur region (Eastern Gujarat, India).

Chapter “Vein Geometry Around Bhuj (Gujarat, India)”: Omid et al. (2021) present diverse vein geometries from Bhuj area, Kutch Basin, Gujarat, India. Detail field-based and geochemical studies can be taken up in this hitherto unknown area of structures.

Chapter “Oriented Rock Samples for Detailed Structural Analysis”: Gaidzik and Zaba (2021) discuss how to collect oriented rocks from field for structural geological analyses. This chapter is particularly important to undertake kinematic analyses of shear zone rocks under an optical microscope.

Acknowledgements The Springer (proofreading) team, especially Boopalan Renu, Alexis Vizcaino, Doerthe Mennecke-Buehler, Marion Schneider and Annett Buttener, helped a lot in different stages of this book preparation and publication.

Dripta Dutta
Soumyajit Mukherjee
Department of Earth Sciences
Indian Institute of Technology Bombay
Powai, Mumbai
Maharashtra, India
e-mail: soumyajitm@gmail.com
smukherjee@iitb.ac.in

References

- Ali, A., Ahmad, S., Khan, M. A., Khan, M. I., Rehman, G. (2021). Tectonic framework of Northern Pakistan from Himalaya to Karakoram. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 367-412. ISBN: 978-3-030-60142-3.
- Ansari, K. (2021). Review of the geometric model parameters of the Main Himalayan Thrust. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 305-324. ISBN: 978-3-030-60142-3.
- Bose, N., Mukherjee, S. (2019a). Field documentation and genesis of the back-structures from the Garhwal Lesser Himalaya, Uttarakhand, India. In Sharma, I. M. Villa, S. Kumar (Eds.), *Crustal architecture and evolution of the Himalaya-Karakoram-Tibet Orogen*. Geological Society of London Special Publications 481, 111–125.
- Bose, N., Mukherjee, S. (2019b). Field documentation and genesis of back-structures in ductile and brittle regimes from the foreland part of a collisional orogen: Examples from the Darjeeling–Sikkim Lesser Himalaya, India. *International Journal of Earth Sciences*, 108, 1333–1350.
- Biswas, M., Pal, A., Jamal, M. (2021). Tectonics and Channel Morpho-Hydrology—A Quantitative Discussion Based on Secondary Data and Field Investigation. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*, Switzerland AG: Springer Nature. Cham. pp. 461-494. ISBN: 978-3-030-60142-3.

- Chauhan, G. H., Rao, G. S., Mukherjee, S. (2021). Structural analyses of the Lunavada-Santrampur area (Gujarat, India) using remote sensing images. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 621-638. ISBN: 978-3-030-60142-3.
- Díaz-Azpiroz, M., Fernández, C. (2021). The Southern Iberian Shear Zone (SW Spain): Inclined transpression related to Variscan oblique convergence in a HT/LP metamorphic belt. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 137-166. ISBN: 978-3-030-60142-3.
- Ghosh, R., Mukherjee, S. (2021). Structures of Lesser/Greater Himalaya in and around an out-of-sequence thrust in the Chaura-Sarahan area (Himachal Pradesh, India). In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 413-428. ISBN: 978-3-030-60142-3.
- Goswami, S., Shrivastava, S., Das, S., Bhattacharjee, P. (2021a). Fundamentals of litho-structural mapping: Example from the SW part of the Proterozoic Bhima basin, Karnataka, India: A note on Dharwarian Crustal evolution. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 639-684. ISBN: 978-3-030-60142-3.
- Goswami, S., Upadhyay, P. K., Natarajan, V. (2021). Importance of fracturing in uranium mineralization in Gulcheru Quartzite host: A case from Ambakapalle area, Cuddapah Basin, Andhra Pradesh, India. In Mukherjee S. (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 577-598. ISBN: 978-3-030-60142-3.
- Gáidzik, K., Žaba, J. (2021). Oriented Rock Samples for Detailed Structural Analysis. In S. Mukherjee (Ed) *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. pp. 715- 723.
- Jiménez-Bonilla, A., Díaz-Azpiroz, M., Expósito, I., Balanyá, J. C. (2021). Miocene-Quaternary strain partitioning and relief segmentation along the arcuate Betic fold-and-thrust belt: A field trip along the Western Gibraltar Arc northern branch (southern Spain). In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 103-136. ISBN: 978-3-030-60142-3.
- Joshi, A. U., Limaye, M. A. (2021). A field guide to the Champaner Region, Southern Aravalli Mountain Belt (SAMB), Gujarat, Western-India. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 529-576. ISBN: 978-3-030-60142-3.
- Joshi, A. U. (2021). A 3D photogrammetric approach in mapping meso-scale folds and shears in structurally controlled syngenetic Mn-mineralized zones of Shivrajpur region, Eastern Gujarat, India. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 685-706. ISBN: 978-3-030-60142-3.
- Kaplay, R. D., Babar, Md., Mukherjee, S., Wable, D., Pisal, K. (2021). Granitic rocks underlying Deccan trap along the margin of east Dharwar craton, Muntyal (Maharashtra)—Bhaisa (Telengana), India—general description and deformation. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 599-620. ISBN: 978-3-030-60142-3.
- Martins-Ferreira, M. A. C., Rodrigues, S. W. (2021). Field guide to RODS in the Pireneus Syntaxis, central Brazil. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 221-264. ISBN: 978-3-030-60142-3.
- Mukherjee, S. (2013). Higher Himalaya in the Bhagirathi section (NW Himalaya, India): Its structures, backthrusts and extrusion mechanism by both channel flow and critical taper mechanisms. *International Journal of Earth Sciences*, 102, 1851–1870.
- Novakova, L., Novak, P. (2021). Spectacular sandstone rock cities in the Czech Republic. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 189-220. ISBN: 978-3-030-60142-3.

- Omid, M. W., Mukherjee, S., Dasgupta, S. (2021). Vein geometry (Bhuj, Gujarat, India). In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 707-714. ISBN: 978-3-030-60142-3.
- Patil Pillai S., Kale, V. S. (2021). Traverses through the Bagalkot Group from north Karnataka state, India: Deformation in the Mesoproterozoic supracrustal Kaladgi Basin. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 325-366. ISBN: 978-3-030-60142-3.
- Puniya, M. K., Mukherjee, S. (2021). Structural geology of the Nainital-Pangot road (Kilbari section), Nainital Lesser Himalaya (Uttarakhand, India): Focus on back-structures. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 429-436. ISBN: 978-3-030-60142-3.
- Pundalik, A., Nikalje, S., Samant, A., Samant, H. (2021). Geological fieldguide: Malvan (Maharashtra, India). In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 495-528. ISBN: 978-3-030-60142-3.
- Shallaly, N. A., Abu Sharib, A. S. A. A. (2021). Low baric metamorphic belts in the northern tip of the Arabian Nubian Shield: selected examples from the Eastern Desert/Midyan terranes, Egypt. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 265-304. ISBN: 978-3-030-60142-3.
- Simonetti, M., Carosi, R., Montomoli, C. (2021). Strain softening in a continental shear zone: A field guide to the excursion in the Ferriere-Mollières shear zone (Argentera Massif, Western Alps, Italy). In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 19-48. ISBN: 978-3-030-60142-3.
- Singh, P., Ao, A., Thakur, S. S., Rana, S., Sharma, R., Singh, A. K., Singhal, S. S. (2021). Geology, structural, metamorphic and mineralization studies 2 along the Mandi-Kullu-Manali-Rohtang section of Himachal Pradesh, NW-India. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 437-460. ISBN: 978-3-030-60142-3.
- Swanger, W. R., Whitmeyer, S. J. Creating geologic maps in the 21st century: A case study from Western Ireland. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 1-18. ISBN: 978-3-030-60142-3.
- Tămaş, D. M., Tămaş, A., Jüstel, A. M., Passchier, M., Chudalla, N., Gotzen, J., Wagner, L. A. P., Taşcu-Stavre, T., Schlöder, Z., Krézsek, C., Filipescu, S., Urai, J. L. (2021). A fieldguide to the spectacular salt mines of the Transylvanian basin and Romanian Carpathians. In S. Mukherjee (Ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*. Springer Nature Switzerland AG. Cham. pp. 167-188. ISBN: 978-3-030-60142-3.

Contents

Creating Geologic Maps in the Twenty-First Century: A Case Study from Western Ireland	1
W. R. Swanger and S. J. Whitmeyer	
Strain Softening in a Continental Shear Zone: A Field Guide to the Excursion in the Ferriere-Mollières Shear Zone (Argentera Massif, Western Alps, Italy)	19
M. Simonetti, R. Carosi, and C. Montomoli	
The Geometry and Kinematics of the Southwestern Termination of the Pyrenees: A Field Guide to the Santo Domingo Anticline	49
E. L. Pueyo, B. Oliva-Urcia, E. M. Sánchez-Moreno, C. Arenas, R. Silva-Casal, P. Calvín, P. Santolaria, C. García-Lasanta, C. Oliván, A. Gil-Imaz, F. Compaired, A. M. Casas, and A. Pocoví	
Miocene-Quaternary Strain Partitioning and Relief Segmentation Along the Arcuate Betic Fold-and-Thrust Belt: A Field Trip Along the Western Gibraltar Arc Northern Branch (Southern Spain)	103
Alejandro Jiménez-Bonilla, Manuel Díaz-Azpiroz, Inmaculada Expósito, and Juan Carlos Balanya	
The Southern Iberian Shear Zone (SW Spain): Inclined Transpression Related to Variscan Oblique Convergence in a HT/LP Metamorphic Belt	137
Manuel Díaz-Azpiroz and Carlos Fernández	
A Field Guide to the Spectacular Salt Mines of the Transylvanian Basin and Romanian Carpathians	167
Dan Mircea Tămaş, Alexandra Tămaş, Alexander Magnus Jüstel, Martijn Passchier, Nils Chudalla, Lina Gotzen, Luis Alberto Pizano Wagner, Teodora Taşcu-Stavre, Zsolt Schléder, Csaba Krézsek, Sorin Filipescu, and Janos L. Urai	

Spectacular Sandstone Rock Cities in the Czech Republic	189
Lucie Novakova and Petr Novak	
Field Guide to RODS in the Pireneus Syntaxis, Central Brazil	221
Marco Antonio Caçador Martins-Ferreira and Sérgio Wilians de Oliveira Rodrigues	
Low Baric Metamorphic Belts in the Northern Tip of the Arabian–Nubian Shield: Selected Examples from the Eastern Desert/Midyan Terranes, Egypt	265
N. A. Shallaly and A. S. A. Abu Sharib	
Review of the Geometric Model Parameters of the Main Himalayan Thrust	305
Kutubuddin Ansari	
Traverses Through the Bagalkot Group from North Karnataka State, India: Deformation in the Mesoproterozoic Supracrustal Kaladgi Basin	325
Shilpa Patil Pillai and Vivek S. Kale	
Tectonic Framework of Northern Pakistan from Himalaya to Karakoram	367
Asghar Ali, Sajjad Ahmad, Sajjad Ahmad, Mohammad Asif Khan, Muhammad Irfan Khan, and Gohar Rehman	
Structures of Lesser/Greater Himalaya in and Around an Out-of-Sequence Thrust in the Chaura-Sarahan Area (Himachal Pradesh, India)	413
Rajkumar Ghosh and Soumyajit Mukherjee	
Structural Geology Along the Nainital–Pangot Road (Kilbari Section), Nainital Lesser Himalaya (Uttarakhand, India): Focus on Back-Structures	429
Mohit Kumar Puniya and Soumyajit Mukherjee	
Geology, Structural, Metamorphic and Mineralization Studies Along the Mandi-Kullu-Manali-Rohtang Section of Himachal Pradesh, NW-India	437
Paramjeet Singh, Aliba Ao, S. S. Thakur, Shruti Rana, Rajesh Sharma, A. K. Singh, and Saurabh Singhal	
Tectonics and Channel Morpho-Hydrology—A Quantitative Discussion Based on Secondary Data and Field Investigation	461
Mery Biswas, Ankita Paul, and Mostafa Jamal	
Geological Field Guide: Malvan (Maharashtra, India)	495
Ashwin Pundalik, Shiba Nikalje, Arnav Samant, and Hrishikesh Samant	

A Field Guide to the Champaner Region, Southern Aravalli Mountain Belt (SAMB), Gujarat, Western India	529
Aditya U. Joshi and Manoj A. Limaye	
Importance of Fracturing in Uranium Mineralization in Gulcheru Quartzite Host: A Case from Ambakapalle Area, Cuddapah Basin, Andhra Pradesh, India	577
Sukanta Goswami, P. K. Upadhyay, and V. Natarajan	
Granitic Rocks Underlying Deccan Trap Along the Margin of East Dharwar Craton, Mutnyal (Maharashtra)—Bhaisa (Telangana), India—General Description and Deformation	599
R. D. Kaplay, Md. Babar, Soumyajit Mukherjee, Deepak Wable, and Kunal Pisal	
Structural Analyses of the Lunavada–Santrampur Area (Gujarat, India) Using Remote Sensing Images	621
Geetika H. Chauhan, G. S. Rao, and Soumyajit Mukherjee	
Fundamentals of Lithostructural Mapping: Example from the SW Part of the Proterozoic Bhima Basin, Karnataka, India: A Note on Dharwarian Crustal Evolution	639
Sukanta Goswami, Shivam Shrivastava, Suman Das, and Purnajit Bhattacharjee	
A 3D Photogrammetric Approach in Mapping Meso-Scale Folds and Shears in Structurally Controlled Syngenetic Mn-Mineralised Zones of Shivrajpur Region, Eastern Gujarat, India	685
Aditya U. Joshi	
Vein Geometry Around Bhuj (Gujarat, India)	707
Mohammad Walid Omid, Soumyajit Mukherjee, and Sudipta Dasgupta	
Oriented Rock Samples for Detailed Structural Analysis	715
Krzysztof Gaidzik and Jerzy Żaba	

Geological Field Guide: Malvan (Maharashtra, India)



Ashwin Pundalik, Shiba Nikalje, Arnav Samant, and Hrishikesh Samant

Abstract We present a geological field guide for a lesser known location to (Indian) geologists from Maharashtra (India): Malvan. Geomorphological and structural geology exercises have been explained, and a few results have been shown from the 2016 field report of the third author.

1 Introduction

Fieldwork has been conducted by faculty members of the Department of Geology at St. Xavier's College (Mumbai) in Malvan for the last 25 years. Yet this exciting field location is much less known among geologists in India and abroad. One of the reasons is being that there have been no major research publications on this area despite there being a very good scope of undertaking structural geology and geomorphological studies. Various types of geological training can be conducted with students in and around this area. The place is free from political disturbance and is relatively less known to tourists. Through this chapter, we publish to the "world" an exciting field location and encourage researchers and academicians to explore it. One can watch the YouTube video (<https://www.youtube.com/watch?v=Fpd84rADuC8>) to have a more vivid look.

Third Year B.Sc. fieldwork is conducted over a period of 12 days out of which 10 days are allotted for the actual fieldwork and two days for travelling between Mumbai and Malvan by train. Some M.Sc. part 2 students also go to Malvan if they choose this area for their dissertation. The fieldwork is mandatory and is spread across fifth and sixth semester. In fifth semester, students prepare a pre-field report, which is evaluated out of 100 marks equivalent to 4 credits (spread across all courses). In the sixth semester, students are evaluated for actual performance during field work and the field report that they generate later on.

Malvan is situated on the Indian west coast within the Konkan coastal belt and comes under Sindhudurg district of Maharashtra. The extent of Malvan taluka may be

A. Pundalik · S. Nikalje · A. Samant · H. Samant (✉)
Department of Geology, St. Xavier's College, Mumbai, Maharashtra 400001, India
e-mail: hrishikesh.samant@xaviers.edu

© Springer Nature Switzerland AG 2021
S. Mukherjee (ed.), *Structural Geology and Tectonics Field Guidebook—Volume 1*,
Springer Geology, https://doi.org/10.1007/978-3-030-60143-0_17

APPLIED RESEARCH IN BOTANY

VOLUME - 1

Dr. Anil Laxman Bhalerao
Dr. Rajesh Shrirangrao Gaikwad



ABOUT THE AUTHORS



Dr. Anil Laxman Bhalerao is Assistant Professor in Botany at Chikitsak Samuha's S.S. & L.S. Patkar and V.P. Varde College Goregaon Mumbai, Maharashtra India. He has perceived M. Sc. and Ph. D. in Botany from Dr. Babasaheb Ambedkar Marathwada University Aurangabad, Maharashtra, India. He was awarded as J.R.F. and S.R.F. by University Grants Commission (UGC) during the tenure of his Ph.D. degree. He has 15 years of teaching and research experience. He has published 22 research papers in various peer reviewed, UGC care listed International and National journals and conference proceedings. He has given invited talk in 07 colleges. He is a member of Board of studies in Botany. He has attended 25 National and International conferences.



Dr. Rajesh Shirangrao Gaikwad is Assistant Professor, Swami Vivekanand Senior College, Mantha, Jalna Maharashtra, India since 2010. He obtained his M.Sc and Ph.D in Botany from Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra, India. He also obtained his M.Sc Enviornmental Science from Yashwantrao Chavan Maharashtra Open University, Nashik, Maharashtra, India. He was awarded J.R.F and S.R.F by University Grants Commission (UGC), New Delhi, India during his research. He has ten years of teaching and 15 years of research experience. He has published about 30 research articles in various prestigious international and national journals and He has authored 04 textbooks with reputed publishers. He is life member of various associations of plant sciences. He has attended and presented his research findings in 60 national and international conferences.

 **mahi
Publication**

Office No.1, Krishnasagar Society,
Nr. Shivsagar sharda Mandir Road,
Ahmedabad-380007

✉ mahibookpublication@gmail.com
☎ + (91) 798 422 6340
🌐 www.mahipublication.com



₹ 399/-

APPLIED RESEARCH IN BOTANY VOLUME-1

Dr. Anil Laxman Bhalerao
[M.Sc. Ph.D.]

Dr. Rajesh Shrirangrao Gaikwad
[M.Sc. Ph.D.]


ISBN: 978-93-90651-59-7

First Edition: 2021

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, resold, hired out, or otherwise circulated without the publisher's prior written consent in any form of binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser and without limiting the rights under copyright reserved above, no part of this publication may be reproduced, stored in or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying or recording) otherwise without the prior written permission of both the copyright owner and the above-mentioned publisher of this book.

PRICE ₹ 399/-

**PUBLISHER
MAHI PUBLICATION**

 Office No.1, Krishnasagar Society, Nr. Shivsagar sharda Mandir Road,
Ahmedabad-380007

 mahibookpublication@gmail.com

 +(91) 798 422 6340

 www.mahipublication.com

Copyright © 2021\ MAHI PUBLICATION

INDEX

SR. NO.	TITLE OF THE RESEARCH PAPER	NAME OF AUTHOR	PAGE NO.
1	EFFICIENCY OF MYCORRHIZAE AND PGPF FOR GROWTH PERFORMANCE ON CHILI CV SITARA	PROF. DR. UDHAV N. BHALE	9
2	EFFECT OF MYCORRHIZA ON CHEMICAL COMPOSITION OF THE <i>TAJETES ERECTA</i> . L AND <i>CATHARANTHUS ROSEUS</i> . L	PRINCIPAL DR. RANGNATH AHER	19
3	EXPLORATION OF EMERGENCY HERBAL FOOD RESOURCES OF TRIBAL PEOPLE FROM THE RAIGAD DISTRICT OF THE MAHARASHTRA STATE, INDIA.	DR. KALPIT MHATRE AND PRINCIPAL DR. RAJENDRA SHINDE	25
4	EFFECT OF GA+ IAA AND GA+ NAA PRE-TREATMENTS ON SEED GERMINABILITY AND ROOTING OF STEM CUTTINGS OF JATROPHA SPECIES.	DR. RAJESH SHRIRANGRAO GAIKWAD	29
5	GENETICALLY MODIFIED DISEASE RESISTANT FRENCH BEANS (<i>PHASEOLUS VULGARIS</i> L.) AS AN IMMUNE BOOSTER- A REVIEW	SHREYA DOGRA & NARAYAN TOTEWAD	37
6	EFFECT OF PEG-6000 INDUCED WATER STRESS ON PHYTOCHEMICALS IN WHEAT CULTIVARS (<i>TRITICUM AESTIVUM</i> L.).	DR.DESHMUKH R.N. & SAWANT K.S.	48
7	COMPARATIVE STUDY ON DIFFERENT CLEARING METHODS FOR THE PREPARATION OF LEAF VENATION OF LEAVES.	SAIMA RASHID MIR, B.M. SHINDE AND M.M JANA	55
8	ETHNOMEDICINAL PLANTS USED BY KOKNI TRIBAL OF NASIK AND DHULE DISTRICTS FOR TREATMENT OF PILES (MAHARASHTRA)	SACHIN D. KUVAR AND DR. RAJENDRA D. SHINDE	60
9	EFFECT OF MEDICINAL PLANTS ON PATHOGENIC FUNGI	RAFI AHMED, SACHIN CHAVAN AND RUKHSAR BANO ANSARI	66
10	ADDITION OF SACRED GROVE FROM RAIGAD DISTRICT FOR THE STATE OF MAHARASHTRA	DR. KALPIT MHATRE	75
11	EFFECT OF NITROGENOUS WASTE WATER OF BUFFALO STABLE ON GROWTH PARAMETERS OF SOME VEGETABLES IN MUMBAI	NISHA SUTAR AND ANIL BHALERAO	82
12	FLORISTIC DIVERSITY OF PLATEAUS IN DEVGAD, SINDHUDURG, MAHARASHTRA AND NEED FOR THEIR CONSERVATION	DR. ALOK GUDE AND KALPIT MHATRE	95

13	USE OF NATURAL FLORAL EXTRACTS AS PH INDICATORS	ANKIT YADAV, NIKUNJ SULE AND PRATIKSHA KARADE	97
14	FUNGAL CONTAMINATION OF PAPER CURRENCY POSSESSED BY DIFFERENT OCCUPATIONERS AND ITS CONTROL	DR. RAJENDRA B. KAKDE	103
15	EFFECT OF NITROGENOUS WASTE WATER OF BUFFALO STABLE ON NUTRIENTS OF SOME VEGETABLES	NISHA SUTAR AND ANIL BHALERAO	111
16	OCCURRENCE OF AM FUNGI IN <i>CASSIA TORA L.</i> PLANTS OF OSMANABAD DISTRICT	PRAKASH SARWADE, SHAHAJI S. CHANDANSHIVE, VIKAS P.SARWADE AND KAVITA N. GAISAMUDRE	118
17	EFFECT OF COOKING AND STORAGE CONDITIONS ON THE NUTRITIVE VALUE OF <i>DOLICHOS</i> BEANS.	SURVE SHIVANI A. AND BHAGAT SACHIN S.	123
18	STUDY OF SEASONAL VARIATION IN LEAF CHLOROPHYLL CONTENT OF SOME TREE SPECIES OF HINGOLI REGION (M.S.)	DR. KIRANKUMAR KHANDARE	128
19	USE OF <i>POLYALTHIA LONGIFOLIA</i> AS BIOPESTICIDE: ADVANCEMENT TO TREAT FUNGAL DISEASE OF SOME MEDICINAL PLANTS	DR. MANISHA S. SUTARE	133
20	INVESTIGATION OF PHYSICO-CHEMICAL AND BIOACTIVE PROPERTIES OF HONEY FROM THE RAIGAD DISTRICT OF MAHARASHTRA STATE	KALPIT MHATRE AND ALOK GUDE	137
21	PROXIMATE ANALYSIS OF <i>PORTULACARIA AFRA.</i> JACQ.	RUCHIRA JAVKAR AND ANIL AVHAD	143
22	DIVERSITY OF MANGROVES AT JAITAPUR (RATNAGIRI DISTRICT), MAHARASHTRA STATE	DR. KALPIT MHATRE, RAJENDRA SHEVDE AND MAHADEO BADGE	149
23	PRODUCTION OF CYANOBACTERIAL BIOFERTILIZER AND ITS APPLICATION IN PADDY FIELDS.	A. A. ATNOORKAR	155
24	TRADITIONAL USES OF MEDICINAL PLANTS BY RURAL ZONE OF SAIKHEDA TAL-NIPHAD, DIST-NASHIK (MS)	S.V. GOSAVI	163
25	EFFECT OF STORAGE CONTAINER AND STORAGE PERIOD ON INCIDANCE OF FUNGI OF FOODGRAINS	ANIL U. KULKARNI, AND ASHOK M. CHAVAN	171
26	EFFECT OF MEDICINAL PLANTS LEAF EXTRACTS ON GROWTH AND SPORULATION OF FUNGI.	ANIL N. KORPENWAR AND DEEPMALA A . GAIKWAD	188
27	CURRENT STATUS OF RESEARCH ON MUSHROOM CULTIVATION IN INDIA	YUVRAJ D. KENGAR ILAH I. MUJAWAR AND NARAYAN D. TOTEWAD	195

3. EXPLORATION OF EMERGENCY HERBAL FOOD RESOURCES OF TRIBAL PEOPLE FROM THE RAIGAD DISTRICT OF THE MAHARASHTRA STATE, INDIA.

KALPIT MHATRE

Department of Botany, Arts, Commerce and Science College, Lanja-Ratnagiri

RAJENDRA SHINDE

Department of Botany, St. Xavier's College, Mumbai

ABSTRACT

The present paper deals with an enumeration of emergency food resources of tribal people in the Raigad district of Maharashtra State, India. While conducting an ethno botanical survey of the district, authors came across with few plants whose fruits have been widely used by tribal people as a source of emergency food. In the present study sixteen plant species have been collected and reported as an emergency food resource of tribal in the district.

KEYWORDS

Tribal, Food, Raigad.

INTRODUCTION

Raigad district in the state of Maharashtra lies between 17°51' - 19°80' N latitude and 72°51' - 73°40' E longitude. It covers an area of 7162 sq. km. The district is bounded on the west by Arabian sea, Thane district lies to the north, Pune district to the east, Ratnagiri district to the south while Satara district shares a boundary in south-east. Raigad district forms an important part of the traditional Konkan region. There are several hill ranges stretching out from the main Sahyadri range which runs almost parallel to the west coast. On the north-east boundary of the district, the Sahyadri range is crossed by several passes or ghats. Interesting forest vegetation is reflected due to varied physiological, geological, edaphic and climatic conditions.

Raigad district consist of dark coloured volcanic lava flows and laterites. On plateau, basalt lava forms dominant 'Basaltic composition'. Next to that is a little softer, purple to grayish, usually showing rounded or elongated or tubular cavities and geode with infillings of secondary mineral occupying the portion of slopes and valleys.

Soil in the district is Murum, grayish to dirty green in colour which on decomposition gives reddish-brown to black soil. Rice soil and coastal alluvial soils are also present.

There are three types of tribal communities in the district:

1. Katkari or Kathodi
2. Thakar or Thakurs
3. MahadeoKoli

The Katkari or Kathodi lives in the mountain range of Sahyadris. Their name is derived from their occupation of preparing "Katha" from "Khair" trees. Katkari are agricultural labors and firewood sellers. They are dark complexioned, sturdy in their physique and are hot-tempered by nature. Katkari women are hardworking and help their men by carrying head loads of firewood. They eat field rats, squirrels, peacocks, fish, various types of roots, nachani, vari etc. The tribe is divided into 4 endogamous sub-groups viz. i) DhorKatkari ii) DhorKathodi iii) Son Katkari iv) Son Kathodi. Out of these four sub-groups, Son Katkari are superior among all and are mainly found in Raigad district. DhorKatkari are not found in Raigad district. Katkari lives in huts which are mud-daubed with a roof of palm leaves. In their hut, generally the cooking room is separate. They have several hens, dogs and few fishery traps.

Thakar or Thakur also lives in Sahyadri mountain range. The hutment of Thakar or Thakur is known as Thakurwadi. There houses are built at some distance from each other. These houses are rectangular in shape and has only one pillar at the middle. Wall are made up of sticks of Karvi (*Strobilanthes callosus* Nees) and plastered with dung. People in this community are firewood sellers, honey sellers and agricultural labors. Thakar are normally of medium height and are less angry.

MahadeoKoli is the third tribe found in the district. It has less population as compared to Katkari and Thakar. MahadeoKoli are dark complexioned people and earned their livelihood from agriculture, animal husbandary etc.

MATERIALS AND METHODS

For the collection of ethno-medicinal data, number of tribal, 'vaidus', 'hakims', Mid-wife, traditional healers were interviewed regarding the uses of plant they use in their day-to-day life. These interviews have been taken with the help of standard formats given by (Jain & Goel 1995) with modifications. Necessary permissions have been taken from the Forest Department for the collection of plant specimens. Plants collected during present study have been properly processed and herbarium sheets have been prepared as per the standard methods given by (Jain and Rao 1978) and (Bridson and Forman 1998). Critical studies of collected plants have been done at the Blatter Herbarium. Collected plants are identified with the help of standard floras and manuals. Correct identity of plant specimens has been confirmed by matching them with authenticated specimens at Blatter herbarium (Mumbai) and Botanical Survey of India Herbarium (Pune). Nomenclature of all plants has been updated as per

International Code of Nomenclature for algae, fungi and plants (Melbourne Code, 2012).

RESULTS AND DISCUSSION

In the present study seventeen plant species belonging to fourteen families have been studied from Raigad district of Maharashtra state. Which are as follows:

Sr. No.	Family	Plant Name	Common Name	Habit	Parts Used	Voucher
1	Anacardiaceae	<i>Buchanania cochinchinensis</i> (Lour.) M. R. Almeida	Charoli	Tree	Fruits	KGM - 637
2	Anacardiaceae	<i>Spondias pinnata</i> (L. f.) Kurz.	Ambada	Tree	Fruits	KGM - 545
3	Apocynaceae	<i>Carissa carandas</i> L.	Karvanda	Shrub	Fruits	KGM - 546
4	Begoniaceae	<i>Begonia crenata</i> Dryand.	Motiya	Herb	Leaves	KGM - 419
5	Capparidaceae	<i>Capparis moonii</i> Wight	Garabadudi	Shrub	Fruits	KGM - 242
6	Ehretiaceae	<i>Cordia dichotoma</i> Forst. f.	Bhokar	Tree	Fruits	KGM - 693
7	Fabaceae	<i>Aeschynomene indica</i> L.	Chichani	Herb	Fruits	KGM - 159
8	Lecythidaceae	<i>Careya arborea</i> Roxb.	Kumbhi	Tree	Fruits	KGM - 156
9	Moraceae	<i>Ficus racemosa</i> L.	Umbar	Tree	Fruits	KGM - 473
10	Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Jambhul	Tree	Fruits	KGM - 101
11	Rhamnaceae	<i>Ventilago maderaspatana</i> Gaertn.	Khandvel	Climber	Fruits	KGM - 745
12	Rhamnaceae	<i>Zizyphus mauritiana</i> Lam.	Bor	Tree	Fruits	KGM - 221
13	Rubiaceae	<i>Meyna spinosa</i> Roxb. ex Link.	Alu	Tree	Fruits	KGM - 553
14	Rubiaceae	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Neev	Tree	Fruits	KGM - 587
15	Sapindaceae	<i>Cardiospermum hallicacabum</i> L.	Kanphuti	Herb	Fruits	KGM - 806
16	Tiliaceae	<i>Grewia asiatica</i> L.	Dhaman	Shrub	Fruits	KGM - 643
17	Vitaceae	<i>Ampelocissus latifolia</i> (Roxb.) Planch	Ran-draksha	Climber	Fruits	KGM - 191

CONCLUSION

In the present study seventeen plant species belonging to fourteen families have been reported as an emergency food resources.

ACKNOWLEDGEMENTS

Authors would like to thank principal of Arts, Commerce and Science College, Lanja and St. Xavier's College, Mumbai for providing the necessary laboratory facilities.

REFERENCES

1. **Agharkar, S.P. (1953).** *Gazetteer of the Bombay State, part - 1 Botany - Medicinal Plants.* Government Central Printing Press, Bombay.
2. **Bridson Diane and Leonard Formann (1999).** *The Herbarium Handbook.* Royal Botanic Gardens, Kew.
3. **Campbell, J.M. (1989).** *Gazetteer of the Bombay Presidency - Kolaba District.* Government Photozinc Press, Pune.
4. **Chaudhary K.K. (1993).** *Maharashtra State Gazetteer - Raigad District.* Government Central Printing Press, Mumbai
5. **Jain, S.K. (1995).** *A manual of Ethnobotany.* Scientific Publishers, Jodhapur.
6. **Jain, S.K. & R.R. Rao (1978).** *A Handbook of Field and Herbarium Methods.* Today and Tomorrow Publishers, New Delhi.
7. **Kothari, M.J and S.V. Moorthy (1993).** *Flora of Raigad District, Maharashtra State.* Botanical Survey of India, Calcutta.
8. **McNeill, J., N.J. Turland, F.R. Barrie, W.R. Buck, V. Demoulin, W. Greuter, D.L. Hawksworth, P. S. Herendeen, S. Knapp, K. Marhold, J. Prado, W. F. Prud'homme van Reine, G.F. Smith & J.H. Wiersma (2012).** *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code).* Regnum Vegetables. Pp 154.
9. **Palekar, R.P. (1993).** *Ethno-medicinal traditions of Thakur tribals of Karjat Maharashtra.* Ancient Science of Life 7 (3&4): 388-393.
10. **Walunjkar (2009).** *Maharashtra State Gazetteer- Maharashtra: Land and Its People.* Gazetteers Department, Mumbai. (Repr. ed.).

8. ETHNOMEDICINAL PLANTS USED BY KOKNI TRIBAL OF NASIK AND DHULE DISTRICTS FOR TREATMENT OF PILES (MAHARASHTRA)

Dr. Sachin D. Kuvar Department of Botany, Siddharth College of Arts, Science & Commerce, Fort, Mumbai

Dr. Rajendra D. Shinde Department of Botany, St. Xavier's College, Mahapalika Marg, Mumbai - 400001, Maharashtra

ABSTRACT

An ethno-botanical survey was undertaken to collect information on the use of medicinal plants for the treatment of Piles and Fistula by Kokni tribal community of Nasik and Dhule Districts of Maharashtra. In the present work information on 42 plant species used especially for the treatment of Piles and Fistula, as the traditional herbal remedies are based on ancestral knowledge and empiric experiences. Apart from efforts are ruined to educate the further generations about their importance, it may be missing in future. This diversity of information might contribute comprehensively in modern drug conniving or in government policies to advancement contemporary innovative drug design systems in rural, folkloric areas, and in the enhancement of advance formulas with reference to indigenous remedial medicinal plants. The rural and tribal communities still continue to depend on medicinal plants, this wealth of traditional knowledge needs to be collected and preserved which may help to understand remedial plant metabolites for development of novel herbal medicines and for the betterment of the mankind.

KEYWORDS Kokni, Piles, Fistula, Nasik, Dhule, Maharashtra

Introduction:

The consequence of indigenous remedial medicinal plants in indulgence piles has not been acknowledged perfectly from rural, folkloric background of Indian society. India has been considered a rich in biodiversity of medicinal plants and their indigenous cleverness.

Piles are inflammation of the blood vessel that generally occurs nearby in anal canal. The piles are producing when the anal cushions are disrupted by the power of defecation. The stool uniformity and defecator routine for countless wounded are almost positively to clam. The smash up is increases due to hard stools which is vigor of shearing.

The majority of the people that living in villages have been using the home-grown

plants for medicinal purpose. In vision of the fact that ages because the information on the subject of local plants is transfers from generation to generation and it is based on the experiences lifelong. The people living in villages mostly have less suitable physical condition services because villages have long distance far away from the central cities.

The present exertion is an effort to document and analyze the ethnic facts relating to the custom and exploit of indigenous remedial therapeutic plants in healing in treating piles. So the present work was carried out in Kokni tribal dominated villages of Nasik and Dhule districts of Maharashtra. The Kokni are one of the important tribes of Maharashtra. The Kokni tribe had migrated from the Konkan region of Maharashtra during the famine of 1396 - 1408. It is because of this they got the name 'Kokni' and the 'Kankan' armllet worn by the tribe. They are also known as Kokna or Kukna. It is an independent tribe and does not have sub-tribes. In the list of Scheduled Tribes all the three names are included in the same group.

Materials and Methods:

Different tribal localities of Nasik and Dhule district were surveyed during the ethnobotanical research work on Kokni tribal during the year 2014 to 2019. The information on the uses of plants used in treatment of Piles is collected from tribal people of these districts. The digital photos of the plant were taken in their natural habitat and plant specimens were collected for proper authentication. The fresh specimens were compared with the earlier collected herbarium from different parts of country for authentication in Blatter herbarium, St. Xavier's College (Autonomous), Mumbai, Maharashtra. The plants Global Position System (GPS coordinates) location was also recorded for further reference. The plant specimens were preserved and housed in Blatter herbarium, St. Xavier's College (Autonomous), Mumbai, Maharashtra.

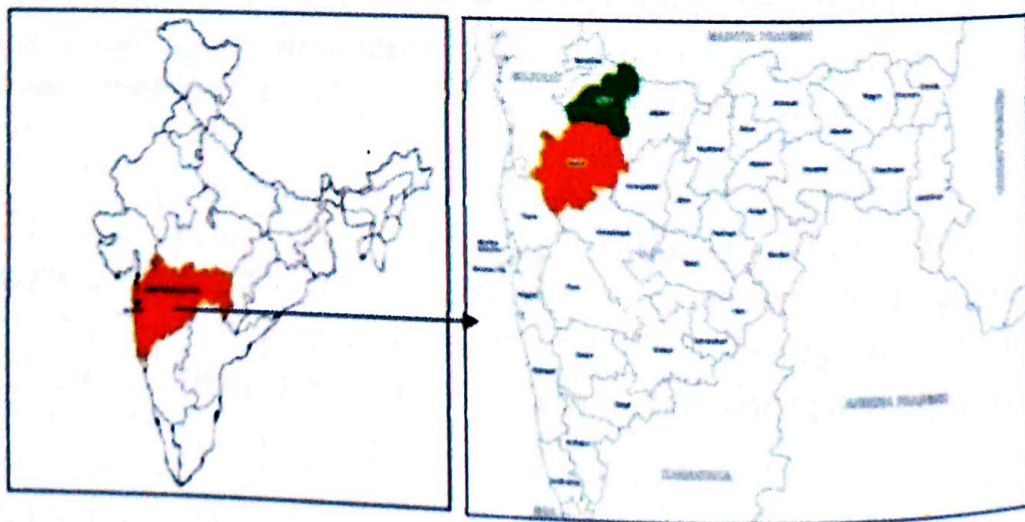


FIG 1 . STUDY AREA - NASIK AND DHULE DISTRICTS IN MAHARASHTRA

Result and discussion:

The study reveals 42 plant species used for the treatment of Piles by Kokni tribal community of Nasik and Dhule districts of Maharashtra reveals utilization of majority of plant remedies which are prepared in the form of juice followed by powder and paste form, from freshly collected plant parts. For few remedies, medicines are prepared after drying. Using a single plant part or a combination of several plant parts usually makes the preparations. Medical administration includes inhalation, oral administration, paste or applying plant part directly on piles which is given in Table No. 1. Further extensive Ethnobotanical and Ethno-pharmacological study may lead to the exploitation of plants and compounds for treatment of Piles.

Table 1: Plants species used by Kokni tribal to cure Piles

Sr. No.	Botanical Name	Family	Part Used	Uses
1	<i>Aloe vera</i> L.	Liliaceae	Leaf pulp	Leaf pulp is consumed orally to cure jaundice and piles.
2	<i>Argemone mexicana</i> L.	Papaveraceae	Root	Roots are chewed 5 times a day for 5 days to cure piles.
3	<i>Balanites aegyptiaca</i> (L.) Del.	Zygophyllaceae	Fruit	The fruit paste is applied on piles 4 to 5 times to reduce burning and pain.
4	<i>Biophytum sensitivum</i> (L.) DC.	Oxalidaceae	Entire plant	Plant extract is given orally daily twice for curing piles.
5	<i>Caesalpinia bonduc</i> (L.) Roxb.	Caesalpiniae	Seed	Seeds are roasted and crush to make powder. This powder is applied on piles to reduce inflammation.
6	<i>Caesulia axillaris</i> Roxb.	Asteraceae	Root	Roots are chewed twice a day for the treatment of piles. Entire plant is crushed and given in sugar once a day for 5 days for bleeding piles.
7	<i>Calotropis gigantea</i> (L.) R. Br.	Asclepiadaceae	Root	Root paste is applied externally on piles to reduce inflammation.
8	<i>Calotropis procera</i> (Ait.) R. Br.	Asclepiadaceae	Root	Root paste is applied externally on piles to reduce inflammation.
9	<i>Cardiospermum halicacabum</i> L.	Sapindaceae	Root	Root decoction is given twice a day to reduce bleeding piles.
10	<i>Careya arborea</i> Roxb.	Lecythidaceae	Bark	Bark is crushed and extract is given twice, daily for curing piles.

11	<i>Carissa carandas</i> L.	Apocynaceae	Latex	Latex is applied on piles to reduce pain and burning.
12	<i>Celastrus paniculatus</i> Willd.	Celastraceae	Seed	Seeds are crushed and paste is applied on painful piles to reduce inflammation.
13	<i>Cleome viscosa</i> L.			Leaf extract is administered orally for piles.
14	<i>Coccolushirsutus</i> (L.) W. Theob	Menispermaceae	Leaf	Root decoction is used as a laxative and to cure piles.
15	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Root	Roots are crushed and extract is consumed to cure bleeding piles.
16	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Root	Roots are crushed and paste is applied to cure piles.
17	<i>Dendrocalamus strictus</i> (Roxb.) Nees.	Poaceae	Tuber	Latex is applied on piles to reduce inflammation.
18	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Latex	Latex is applied on piles to reduce burning.
19	<i>Ficus benghalensis</i> L.	Moraceae	Latex	Seeds are crushed and paste is applied on painful piles.
20	<i>Holarrhenapubescentis</i> Wall.	Apocynaceae	Seed	Dried leaves are rolled and smoked to reduce piles and bleeding piles. The leaves are burnt and the persons suffering from piles are asked to take smoke of the dried leaves.
21	<i>Indigofera cassioides</i> Rottl. ex DC.	Papilionaceae	Leaf	Leaves are heated and kept in underwear to reduce inflammation due to piles for 10-15 days. Every day new leaf is used which is effective remedy for piles.
22	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	Leaf	Roots are chewed to cure piles.
23	<i>Ipomoea turbinata</i> Lag.	Convolvulaceae	Root	Leaf juice is applied externally for curing piles.
24	<i>Lagenaria siceraria</i> (Molina) Standl.	Cucurbitaceae	Leaf	The leaves are crushed and paste is applied on piles to cure it.
25	<i>Lantana camara</i> L.	Verbenaceae	Leaf	Leaves are eaten to reduce piles.
26	<i>Launae procumbens</i> (Roxb.) Ramayya & Rajagopal.	Asteraceae	Leaf	The roots are overnight soaked in water and juice is consumed orally to stop bleeding piles.
27	<i>Lepidagathis trinervis</i> Nees.	Acanthaceae	Root	Root paste is used for piles.
28	<i>Luffa acutangula</i> (L.) Roxb.	Cucurbitaceae	Root	

29	<i>Mallotus polycarpus</i> (Benth.) Kulju & Welzen.	Euphorbiaceae	Leaf	Leaves are dried and burnt to ash. This ash is applied on piles to reduce pain.
30	<i>Mimosapudica</i> L.	Mimosaceae	Leaf	Leaves are crushed by hand and paste is applied on piles.
31	<i>Ocimum gratissimum</i> L.	Lamiaceae	Leaf	Paste of leaves is applied on piles.
32	<i>Pergularia daemia</i> (Forssk.) Chiov.	Asclepiadaceae	Leaf	The young leaves are crushed with ghee and eaten to stop bleeding piles.
33	<i>Persicaria glabra</i> (Willd.) M. Gomez.	Polygonaceae	Leaf Inflorescence	Leaves and inflorescence are crushed together and paste is applied on piles.
34	<i>Pongamia pinnata</i> (L.) Pierre.	Papilionaceae	Leaf	Fresh leaves are chewed for curing piles.
35	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Root	The dried roots are burnt and the smoke is given to reduce piles.
36	<i>Saccharum spontaneum</i> L.	Poaceae	Leaf	The leaves are crushed and paste is applied externally to cure piles.
37	<i>Schleichera oleosa</i> (Lour.) Merr.	Sapindaceae	Bark	Decoction of bark is used for reducing piles.
38	<i>Semecarpus anacardium</i> L.f.	Anacardiaceae	Fruit	The juice of nut shell is applied on piles.
39	<i>Sesamum indicum</i> L.	Pedaliaceae	Seed	Oil extracted from seeds is applied on piles.
40	<i>Tamarindus indica</i> L.	Caesalpiniaceae	Leaf	Leaves are boiled in water and extract is given to cure piles.
41	<i>Terminalia chebula</i> Retz.	Combretaceae	Fruit	Powder of fruits is used as a laxative for piles.
42	<i>Woodfordia fruticosa</i> (L.) Kurz.	Lythraceae	Leaf & Flower	The leaves and flowers are crushed together and paste is applied on piles.

Conclusion

The study concludes that the role of herbal plants as medicine for the treatment of piles among the tribes is crucial. They use many wild plants, weeds, flowers, seeds, bark in their traditional treatment. The collected information not only shows that many preparations are made from single plant but rarely mixture of several plants is also used. Majority of the preparations are taken orally and applied on the piles. In the studied area, many people still have faith in the herbal remedy which plays an important role in the life of this tribal community. Further investigation and pharmacognostic studies on these plants will open up new avenues in the field of herbal medicine which will be beneficial for the future generation.

Acknowledgement

The authors are thankful to Principal, St. Xavier's College, Mumbai for providing necessary facilities. Authors are thankful to Shri Abhiman Bagul, Varya Thakare, Anil Bagul, Devidas Chaure, Ramesh Suryavanshi, Chintaram Pawar and Shri Punaji Bhoys the Kokni informant, for providing Ethnomedicinal information about plant uses on piles from Nasik and Dhule districts of Maharashtra.

References

1. **Bridson D and Fomann(1999)** L. "The Herbarium Handbook". Royal Botanic Gardens, Kew. (Repr. ed.).
2. **Lakshminarasimhan P and Sharma, BD(1991)**. "Flora of Nasik district", BSI, Flora of India, Series 3. Deep printers, New Delhi.
3. **Marathe CL and Bhaskar VV (2011)**. Traditional methods of healing practiced by Warli tribes in Thane district of Maharashtra state. *International Journal of Pharmacy and Life sciences*..2 (7) 884-893.
4. **Patil MV and Patil DA. (2006)** "Ethnobotany of Nasik District". Maharashtra, Daya Publishing House, Delhi.
5. **Patil DA. (2003)** "Flora of Dhule and Nandurbar districts". Maharashtra, Bishen Singh Mahendra Pal Singh, Dehra Dun.
6. **Patil MB. (2003)** "Ethnomedicines of Nandurbar district". Maharashtra, Laxmi Book Publication, Solapur, Maharashtra.
7. **P. Shrivakumar Singh, M. Sureshkumar & G. M. Vidyasagar(2019)**. Indigenous curative plants used in curing of piles from Mahabubnagar District of Telangana State, India. *World Scientific News*, An international scientific journal. WSN 115 149-159
8. **Rakhi Gupta, MG Valrale, RR Deshmukh, PR Chaudhary & SR Wate (2010)**. Ethnomedicinal uses of some plants used by *Gond* tribe of Bhandara district, Maharashtra. *IJTK* Vol. 9 (4), October, pp 713-717
9. **Reddy ES & Bembrekar SK (2016)**. Traditional medical plants used for Piles and Fistula by Tribes of Mahur Taluka of Nanded District, Maharashtra, India. *WWJMRD*; 2(12): 34-36.
10. **Yadav S and Dhanke PB (2010)**. "A check list of plants of Nashik District". Nashik Forest Circle. Orient Press Ltd. Mumbai.

12. FLORISTIC DIVERSITY OF PLATEAUS IN DEVGAD AND SINDHUDURG (M.S.) AND NEED FOR THEIR CONSERVATION

Alok Gude Arts, Commerce and Science College, Lanja, Dist: Ratnagiri (MS)

Kalpiti Mhatre Arts, Commerce and Science College, Lanja, Dist: Ratnagiri (MS)

ABSTRACT

The present paper deals with the study of floristic diversity of different plateaus in Devgad taluka of Sindhudurg district, Maharashtra State. Konkan, a coastal plain of western India, lying between the Arabian Sea (west) and the Western Ghats (east) is considered as one of the biodiversity hotspots. Generally, uneven terrain is composed of eroded remnant ranges of the Ghats that form low lateritic plateaus in the west and terminate in a coastline of alternating bays and headlands. Plateaus in Konkan are diverse in different types of herbs, shrubs, trees, climbers, aquatic plants, insectivorous plants as well as grasses. The present paper focuses on the biodiversity of those plateaus in the Devgad Taluka of Sindhudurg District. For the study of floristic diversity, regular field visits have been conducted for the continuous 3 years on different plateaus of Devgad Taluka. In the present paper, a total of 215 plant species have been recorded for their distribution on the Plateaus

KEYWORDS

Plateau, Diversity, Conservation.

INTRODUCTION:

Konkan, a coastal plain of western India, lying between the Arabian Sea (west) and the Western Ghats (east). The plain stretches approximately 330 miles (530 km) from the Daman Ganga River north of Mumbai (Bombay) to the Terekhol River between Maharashtra and Goa states and Daman and Diu union territory in the south. Between 28 and 47 miles (45 and 76 km) in width, the Konkan includes the regions of Thane, Greater Mumbai, Raigarh, and Ratnagiri. The region is traversed by seasonal rivers that drain the heavy monsoonal rainfall from the crest of the Sahyadri Hills. Generally, uneven terrain is composed of eroded remnant ranges of the Ghats that form low lateritic plateaus in the west and terminate in a coastline of alternating bays and headlands. Only about one-third of the land is cultivable, and the population lives mainly in the relatively fertile river valleys near the coast and in the newly developed industrial belts around Mumbai, Thane, Khopoli, and Panvel. The barren hills are occupied by the pastoral Bhil, Kathkari, and Kokana peoples. The main crops are rice, pulses (legumes), vegetables, fruits, and coconuts; fishing and salt manufacture are also important. The most important part of Konkan is Plateaus. Sindhudurg district

shows several plateaus that show luxuriant growth of number of plants including rare, endangered as well as threatened species during monsoon season.

MATERIALS AND METHODS:

To study the diversity of plants on different Plateaus, total of 34 plateaus of Devgad taluka have been selected for the present study. Regular and seasonal visits to all the plateaus have been conducted for a period of 3 years. The quadrat analysis was done on all the Plateaus. Distribution studies were carried out using random quadrat sampling (10m X 10m, 10 quadrats/Plateau). GPS coordinates of the mid-point of the Plateau were taken with the help of Garmin eTrex Vista Hcx model. The flowering twigs of plant species were collected and the herbariums were prepared according to the method suggested by Jain & Rao (1972). The plants were then identified with the help of standard floras and manuals Jain & Rao (1972). Regarding the local uses of the plant species, interviews with local inhabitants were taken. Total of 42 inhabitants were interviewed. The parameters such as density, frequency and abundance, Simpson index, dominance index and Shannon frequency were calculated by using standard formulas by using references from Naskar and Mandal (During quadrat analysis, the digital images with the help of Nikon Coolpix 5 of the plants have been taken to show habit, habitat, flowers, fruits and other pre-diagnostic characters.

RESULTS AND DISCUSSION:

In the present paper, a total of 34 plateaus (Covering entire taluka) have been studied and a total of 215 plant species have been recorded for their distribution on the Plateaus. Out of 215 plant species, 46 are rare, 8 are critically endangered, 10 are threatened and 4 are on vulnerable. We have reported the species *Dipcadiconcanense* (Dalzell) Baker which is considered as Threatened species as per IUCN growing most common on the laterite Plateaus of Devgad taluka. Infact, it has also been observed that local inhabitant sell Garland which they make by using *Dipcadi* flowers. This observation really focuses the importance of Plateaus for the development of vegetation.

REFERENCES:

1. Amit Mirgal 2016. Extended distribution of *Dipcadiconcanense* (Dalzell) Baker - a highly threatened plant taxon of the family Asparagaceae. Journal of threatened taxa.
2. Jain, S.K. and R.R. Rao. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow Publications, New Delhi.
3. Lugo, A.E. and S.C Snedakar. 1974. The Ecology of Mangroves. Annals Rev. Ecol. System 5: 39-64.

20. INVESTIGATION OF PHYSICO-CHEMICAL AND BIOACTIVE PROPERTIES OF HONEY FROM THE RAIGAD DISTRICT OF MAHARASHTRA STATE

KALPIT MHATRE	Department of Botany, Arts, Commerce and Science College, Lanja, District Ratnagiri
----------------------	---

ALOK GUDE	Department of Botany, St. Xavier's College, Mumbai
------------------	--

ABSTRACT

Honey is defined as the natural sweet substance produced by honey bees from the nectars of plant flowers and honey dew. The present paper deals with the investigation of physico-chemical and bioactive properties of different honey samples collected from different parts of the district. Raigad district shows presence of 15 tehsils. Honey samples from the wild were collected from all the 15 tehsils and investigation of parameters such as viscosity, specific gravity, electrical conductivity, glucose, sucrose, fructose, pH, colour intensity, moisture, ash, total protein content was done. The present study reveals that all the honey samples collected from 15 tehsils in the Raigad district of the Maharashtra State are of good quality and hence suitable for consumption. This type of study will definitely be helpful in understanding the characteristics of local honey and thus would help in commercialization of honey in the local market. Commercialization will lead to the skill development program among the individuals and thus will help in generating income thus contributing the economy of the country.

KEYWORDS

Honey, Physical properties, Chemical analysis, Wild sample.

INTRODUCTION

Honey is defined as the natural sweet substance produced by honey bees, from the nectars of plant flowers and honey dew (Codex Alimentations, 2001). Properties and compositions of bee honey depend on its geographical floral origin, season, environmental factors and treatment of beekeepers (Da Costa Leite *et al.*, 2000; Kaškonienė *et al.*, 2010 ; EL-Metwally, 2015). Bee honey is one of the few virtually totally non-allergic foods that body easily assimilates. It contains nutrients especially as energy provider Rahman *et al.* (2010), it is a high-energy carbohydrate food (80-85%) and the honey sugars are easily digestible as those in many fruits (White and Doner, 1980). Bogdanov *et al.* (2004) found more than 22 sugars in honey; however, fructose and glucose are the major sugar content. Primary sugars existed in honey are fructose and glucose, and in nectar honey the fructose content should exceed that of glucose Zafar *et al.* (2008). Furthermore, the sum of fructose, glucose, fructose/glucose ratio and glucose/water ratio are

other important factors related to honey quality. Fructose/glucose ratio indicates the ability of honey to crystallize (White and Doner, 1980; Manikis and Thrasivoulou, 2001; Kaškonienė *et al.*, 2010 ; Buba *et al.*, 2013). Honey contains more than 180 substances, including amino acids, enzymes, protein, vitamins, minerals, ash, organic acids and phenol compounds Ouchemoukh *et al.* (2007). Moisture content of bee honey represents a major importance to its stability against fermentation and granulation. The low moisture content protects honey from microbiological activity and thus it can be preserved for longer periods (AL-Naji and Hujazy, 1982; Cantarelli *et al.*, 2008; Bogdanov, 2009; Buba *et al.*, 2013 ; Akhtar *et al.*, 2014 and El-Metwally, 2015).

Raigad district in the state of Maharashtra lies between 17°51' - 19°80' N latitude and 72°51' - 73°40' E longitude. It covers an area of 7162 sq. km. The district is bounded on the west by Arabian sea, Thane district lies to the north, Pune district to the east, Ratnagiri district to the south while Satara district shares a boundary in south-east. Raigad district forms an important part of the traditional Konkan region. There are several hill ranges stretching out from the main Sahyadri range which runs almost parallel to the west coast. On the north-east boundary of the district, the Sahyadri range is crossed by several passes or ghats. Interesting forest vegetation is reflected due to varied physiological, geological, edaphic and climatic conditions. Number of rivers and streams originate in the Sahyadri and flow towards the Arabian sea. The major rivers in the district are Ulhas, Patalganga and Amba in the northern part, Kundalika in central part and Savitri and Kal in the southern part. River Ulhas flows 21 kms in the district and enters in the region of Thane district. The district has 240 km long sea coast and has Bagmandala, Dighi (Shreevardhan), Revdanda and Revas (Alibag), Mora and Nhava-sheva (Uran) ports. Nhava-sheva is the most advanced port in India. Varied physiographical, geological, climatic and edaphic conditions are reflected in diverse vegetation types. A total of 2864 sq. km. area in the district is under forests. Raigad district consist of dark coloured volcanic lava flows and laterites. On plateau, basalt lava forms dominant 'Basaltic composition'. Next to that is a little softer, purple to grayish, usually showing rounded or elongated or tubular cavities and geode with infillings of secondary mineral occupying the portion of slopes and valleys. Soil in the district is Murum, grayish to dirty green in colour which on decomposition gives reddish-brown to black soil. Rice soil and coastal alluvial soils are also present. Raigad district has varied physiographical, geological, edaphic and climatic conditions and hence has developed interesting vegetation.

MATERIALS AND METHODS

Honey samples were collected from the wild from all the 15 tehsils of the Raigad

district. For the collection of original wild honey localities with an adequate honey comb were finalized with the help of tribal people. All the samples were raw and unprocessed and collected from wall hives of *Apis dorsata*. The samples were collected in sterilized polythene bottles from the place of honey extraction. Honey was filtered through single thickness fine cloth for the removal of suspended particles such as dirt, bee wax, and other impurities. Later on it was stored in airtight containers at room temperature. The collected samples were analyzed for physio-chemical and bioactive properties like pH, electrical conductivity, colour intensity, moisture, ash content, total protein content, glucose, fructose, sucrose, viscosity and specific gravity.

RESULTS AND DISCUSSION

pH: pH of all the samples from the district shows a range between 4.34 ± 0.01 to 6.10 ± 0.04 . The pH values of all the 15 samples were measured and it has been found that the pH values are within the standard limits (pH 3.40 to 6.10) (Codex Alimentations, 2001). This within the limit result ensures the honey samples freshness. (Table number 1)

Electrical Conductivity (EC): EC of all the samples ranges between 0.36 ± 0.03 to 3.05 ± 0.01 . The electrical conductivity of seven samples is within the limits (not more than 0.8ms/cm). (Table number 1)

Colour Intensity: Highest colour intensity is 632 ± 1.14 and 268 ± 1.19 is the lowest. Result shows that there is no significant difference in all the 15 samples. (Table number 1)

Moisture Content: The range of the moisture in all the 15 samples is between 12.14 ± 0.28 to 19.54 ± 0.24 . The higher the moisture content is the higher probability of honey fermentation during storage. Lower moisture limits ($<20\%$), elongates honey shelf life which would be met by a large majority of the commercial honeys (Codex Alimentations 2001). Moisture content depends on the temperature and relative humidity in the geographical origin during honey producing in honey colonies (Crane 1979). (Table number 1)

Ash: Ash content for all the samples is within the acceptable limit (1.02 ± 0.03 to 1.20 ± 0.02) except sample number 14 collected from the Shreevardhan tehsil which is 1.32 ± 0.01 . (Table number 1)

Total Protein Content: Total protein content of all the samples ranges between 1.12 ± 0.0172 to 1.98 ± 1.28 . There is no any significant difference between all the honey samples. (Table number 1)

Sugar Composition: Glucose content ranges between 11.43 ± 0.36 to 32.44 ± 0.63 ; Fructose content ranges between 12.39 ± 0.71 to 61.23 ± 0.92 and Sucrose content ranges between 1.19 ± 0.85 to 4.12 ± 0.99 . The result proves that Glucose and Fructose are the dominant sugars in honey samples. (Table number 2)

Specific Gravity: Specific gravity of the honey is always greater than the water. The range is between 1.3259 to 1.4067. (Table number 2)

Viscosity: The range of viscosity is between 10 to 30 poise. (Table number 2)

CONCLUSION

The present study reveals that all the honey samples collected from 15 tehsils in the Raigad district of the Maharashtra State are of good quality and hence suitable for consumption. This type of study will definitely be helpful in understanding the characteristics of local honey and thus would help in commercialization of honey in the local market. Commercialization will lead to the skill development program among the individuals and thus will help in generating income thus contributing the economy of the country.

Table no. 1: Physio-chemical characteristics of honey samples.

Sr. No.	Sample ID	pH	EC (ms/cm)	Colour intensity	Moisture (g/100g)	Ash (g/100gm)	Total protein
1	RGDSUD01	4.34 ± 0.01	1.92 ± 0.02	412 ± 1.03	16.31 ± 0.34	1.17 ± 0.01	1.12 ± 0.0172
2	RGDKHA01	5.12 ± 0.03	0.67 ± 0.03	356 ± 1.12	15.44 ± 0.36	1.02 ± 0.03	1.69 ± 0.034
3	RGDPAN01	4.93 ± 0.02	0.98 ± 0.02	527 ± 1.32	13.66 ± 0.42	1.14 ± 0.04	1.84 ± 0.069
4	RGDKJT01	5.34 ± 0.06	0.73 ± 0.03	632 ± 1.14	16.32 ± 0.24	1.06 ± 0.02	1.23 ± 0.125
5	RGDURN01	6.10 ± 0.04	1.65 ± 0.06	439 ± 1.62	16.96 ± 0.68	1.06 ± 0.02	1.52 ± 0.534
6	RGDPEN01	5.91 ± 0.03	0.68 ± 0.05	489 ± 1.98	15.63 ± 0.14	1.09 ± 0.01	1.64 ± 0.231
7	RGDROH01	5.91 ± 0.03	0.68 ± 0.05	489 ± 1.98	15.63 ± 0.14	1.05 ± 0.02	1.23 ± 0.069
8	RGDMUR01	5.68 ± 0.05	0.77 ± 0.06	532 ± 1.14	18.34 ± 0.63	1.05 ± 0.02	1.23 ± 0.069
9	RGDALI01	5.36 ± 0.05	0.75 ± 0.04	631 ± 2.03	12.61 ± 0.25	1.12 ± 0.01	1.86 ± 0.128
10	RGDMNG01	5.68 ± 0.05	0.77 ± 0.06	532 ± 1.14	12.61 ± 0.25	1.12 ± 0.01	1.86 ± 0.128
11	RGDTLA01	5.68 ± 0.05	0.77 ± 0.06	532 ± 1.14	12.61 ± 0.25	1.12 ± 0.01	1.86 ± 0.128
12	RGDMHD01	5.36 ± 0.05	0.75 ± 0.04	631 ± 2.03	12.61 ± 0.25	1.07 ± 0.03	1.32 ± 0.137
13	RGDPLD01	5.13 ± 0.03	1.26 ± 0.09	523 ± 1.12	12.36 ± 0.24	1.20 ± 0.02	1.45 ± 0.136
14	RGDSHR01	5.34 ± 0.05	1.98 ± 0.02	498 ± 1.16	14.63 ± 0.32	1.20 ± 0.02	1.45 ± 0.136
15	RGDMHS01	5.34 ± 0.05	1.98 ± 0.02	498 ± 1.16	14.63 ± 0.32	1.11 ± 0.02	1.24 ± 0.127

Table no. 2: Sugar composition, specific gravity and viscosity of honey samples.

Sr. No.	Sample ID	Glucose g/100g	Fructose g/100g	Sucrose g/100g	Specific gravity	Viscosity
1	RGDSUD01	26.32±0.69	53.21±0.78	2.96±0.93	1.3651	25
2	RGDKHA01	11.43±0.36	61.23±0.92	2.67±0.08	1.3987	16
3	RGDPAN01	19.63±0.73	21.36±0.68	3.31±0.26	1.3289	10
4	RGDKJT01	22.34±0.21	25.44±0.34	4.12±0.99	1.3264	10
5	RGDURN01	24.52±0.63	42.69±0.99	1.19±0.85	1.3975	16
6	RGDPEN01	13.11±0.98	51.36±0.97	2.25±0.75	1.3742	10
7	RGDROH01	21.96±0.31	12.39±0.71	3.39±0.63	1.3693	16
8	RGDMUR01	18.16±0.52	19.81±0.63	3.87±0.85	1.3259	16
9	RGDALI01	32.44±0.63	47.75±0.52	3.64±0.64	1.3658	16
10	RGDMNG01	25.32±0.12	52.36±0.62	2.98±0.29	1.3398	30
11	RGDTLA01	21.52±0.09	46.28±0.23	2.34±0.87	1.3759	25
12	RGDMHD01	13.68±0.52	26.51±0.58	3.89±0.64	1.3496	10
13	RGDPLD01	16.37±0.42	13.02±0.82	3.85±0.54	1.3289	10
14	RGDSHR01	26.31±0.61	14.65±0.77	3.25±0.63	1.4167	30
15	RGDMHS01	27.41±0.67	59.35±0.29	3.67±0.52	1.3956	16

ACKNOWLEDGEMENTS

Authors extend their sincere thanks to the principal St. Xavier's College, Mumbai and Arts, Commerce and Science College, Lanja for providing us necessary laboratory facilities.

REFERENCES

- Akhtar et al., 2014.** S. Akhtar, J. Ali, B. Javed, S. Hassan, S. Abbas, M. Siddique. Comparative physiochemical analysis of imported and locally produced Khyber Pakhtunkhwa honey. *Global J. Biotechnol. Biochem.*, 9 (3) (2014), pp. 55-59
- AL-Naji and Hujazy, 1982.** L.K. AL-Naji, I.M. Hujazy. Microorganisms of ripe honey produced in northern Iraq and their effects on its physical properties. *Zanco (Iraq)*, 8 (1982), pp. 3-16
- Bogdanov et al., 2004.** S. Bogdanov, K. Rouff, L.P. Oddo. Physico-chemical methods for the characterization of unifloral honey: a review *Apidologie*, 35 (4) (2004), pp. 275-282

Codex Alimentations, 2001. Draft revised standard for standard for honey (at step 10 of the Codex procedure) Alinorm, 01 (25) (2001), pp. 19-26

Crane, 1979. Honey: A Comprehensive Survey. Heinemann, London (1979) pp. 608

Da Costa Leite et al., 2000. J.M. Da Costa Leite, L.C. Trugo, L.S.M. Costa, L.M.C. Quinteiro, O.M. Barth, V.M.L. Dutra. Determination of oligosaccharides in Brazilian honeys of different botanical origin. Food Chem., 70 (2000), pp. 93-98

EL-Metwally, 2015. EL-Metwally, A.A.E., 2015. Factors Affecting the Physical and Chemical Characteristics of Egyptian Beehoney. Ph. D. Thesis, Fac. Agric. Cairo Univ., 320p.

Kaškonienė et al., 2010. V. Kaškonienė, P.R. Venskutonis, V. Čeksterytė. Carbohydrate composition and electrical conductivity of different origin honeys from Lithuania LWT – Food Sci. Technol., 43 (2010), pp. 801-807

Manikis and Thrasivoulou, 2001 Manikis, A. Thrasivoulou. Relation of physicochemical characteristics of honey and the crystallization sensitive parameters. Apiacta, 36 (2001), pp. 106-112

Ouchemoukh et al., 2007. S. Ouchemoukh, H. Louaileche, P. Schweitzer. Physicochemical characteristics and pollen spectrum of some Algerian honeys. Food Control, 18 (2007), pp. 52-58

Rahman et al., 2010. M.M. Rahman, R. Allan, M.S. Azirun. Antibacterial activity of propolis and honey against *Staphylococcaureus* and *Escherichia Coli*. Afr. J. Microbiol. Res., 4 (2010), pp. 1872-1878

White and Doner, 1980. White, J.W., Doner, L.W., 1980. Honey Composition and Properties: Beekeeping in the United States. Agriculture Handbook No. 335, pp. 82-91.

Zafar, M. Safdar, N. Siddiqui, A. Mumtaz, T. Hameed, M.U. 2008 Serial Chemical analysis and sensory evaluation of branded honey collected from Islamabad and Rawalpindi market. J. Agric. Res., 2 (2008), pp. 86-91

EMOTIONS

A MULTIDISCIPLINARY INQUIRY

Editors

*Dr. Uma Rele
Fr. Magi Murzello*

*Dr. Gurudutta Japee
Dr. Preeti Oza*



AURA BOOKS INTERNATIONAL
CALIFORNIA UNITED STATES

© Contributors 2020

First Published 2020

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording without the prior permission in writing of the publisher. Application for such permission should be addressed to the publisher.

Disclaimer-

The author and the publisher have taken every effort to the maximum of their skill, expertise and knowledge to provide correct material in the book. Even then if some mistakes persist in the content of the book, the publisher does not take responsibility for the same. The publisher shall have no liability to any person or entity with respect to any loss or damage caused, or alleged to have been caused directly or indirectly, by the information contained in this book. Hence, the book should be taken as general guide only.

The publisher has fully tried to follow the copyright law. However, if any work found to be similar, it is unintentional and the same should not be used as defamatory or to file legal suit against the author/publisher. If the readers find any mistakes, we shall be grateful to them to point out those to us so that they can be corrected in the next edition.

AURA BOOKS INTERNATIONAL

3842, Carol Ave, Fremont, California 94538 US
www.aurabooksinternational.com
editorial@aurabooksinternational.com

British Library Cataloguing in Publication Data

A catalogue record for this is available from the British Library

ISBN 978-1-954467-00-2

Typeset in Palatino font

Printed on paper from sustainable resources.

INTRODUCTION AND PREFACE

“Emotions ... involve judgments about important things, judgments in which, appraising an external object as salient for our own well-being, we acknowledge our own neediness and incompleteness before parts of the world that we do not fully control.”

— Martha Nussbaum

It is no longer true, as it used to be until quite recently, that the emotions are neglected topic for education consideration. This is especially so in the field of higher education, where there has been an extraordinary increase in interest. In celebrating, as we do, the rediscovery of the importance of the emotions for education, it is important to recognize that there are at least two potential dangers in this rediscovery. The first danger is that the emotions become treated as an isolated object of the study, independent of the phenomena which surround them: phenomena such as imagination, mood, expression, states of character, and so forth. The second, related danger is that one can come to be too procrustean in the treatment of emotions whatever a natural kind might be, and whether or not other psychological categories are natural kinds, emotions are a heterogeneous group. To review this scenario in detail, Grand Academic Portal- GAP, in association with Nalanda Nrityakala Mahavidyalay- Mumbai, and St. Andrew's Educational Foundation- Mumbai had organised an international conference in December 2020. This conference offered a broad variety of research on how adequate and inadequate emotion regulation impact on mental and physical functioning. Emotions- a multidisciplinary inquiry has included cutting-

CONTENTS

- *Introduction and Preface* v
- *Acknowledgement* ix

PART - I

EMOTIONS AND HUMAN LIFE

1. Emotional Maturity and Resilience as Correlates of Psychological Well-Being in Adults
— *Cedila Pereira e Gomes* 3
2. Emotion in Cause Behavior - A Social Psychology Perspective
— *Dr. Anita Patel & Jackson Judan Fernandes* 22
3. Ethics & Emotions — *Dr. Gurudutta P Japee* 41
4. Positive Emotions and Well-Being— *Rashna S. Patel* 51
5. Impacts of Negative Emotions on Oneself and Society
— *Dr. Sai Madhavi* 72
6. Emotion and Law — *Dr. Pareshkumar D. Dobariya* 79
7. Psychology of Emotions — *Pr. Surekha R.Masal* 97
8. The Brutal Traces — *Dr. Anuradha Pagedar* 104
9. Change Your Reality by Changing Your Emotions
— *Kinix Hande* 118

PART - II

EMOTIONS IN ART, MUSIC AND LITERATURE

10. 'Love' as Transcending Milieu of Emotions-
Narratives of Love From Folk and Literature
— *Dr. Preeti Oza* 123

11. Multiple Selves, Desires and Emotions: Reading Manju Kapur's Novel 'A Married Woman'
— *Dr. Anita Sharma* 134
12. A State of Mind: Exploration of Emotional and Psychological Aspects in The Blacker The Berry of Wallace Thurman
— *Anwesha Basu* 155
13. Role of Emotions in Revolution 2020 by Chetan Bhagat
— *Dr. Bhoomi Vamja* 162
14. Role of Emotions and Art in Multicultural Society Like India
— *Prof. Gargi Gohel* 171
15. Anguish : An Emotion Explored Through the Narratives From Indian Mythology, in Classical Indian Dance
— *Ms. Madhuri Deshmukh* 179
16. Various Disciplines and Emotions
— *Dr. Premal S. Yagnik* 186
17. Management of Emotions in Indian Classical Dance
— *Dr. Meenakshi Iyer Gangopadhyay* 193
18. "Emotions" Translated and Interpreted Through the Powerful Medium of Classical Dance Forms of India
— *Manasi Pandya Raghunandan* 202

PART - III

SOCIAL EMOTIONAL LEARNING - SEL

19. SEL and Teacher Education
— *Dr. Anita Sharma* 217
20. Building SEL in Teachers -Social and Emotional Learning and Teachers
— *Prof. Gargi Gohel* 227
21. Building Social Emotional Learning : A Recipe for Success in College Students
— *Ritu R. Agarwal* 237
22. Social Emotional Learning : An Analysis
— *Dr. Rupal S. Patel* 248
23. Challenges of Implementing SEL Initiatives in Indian Classrooms
— *Dr. Lila Simon* 263

PART - IV

CASE STUDIES RELATED TO EMOTIONS IN LIFE

24. Physiology of Emotions and Women Health : A Review Study
— *Dr. Jasmine Gujarathi* 277
25. Impact of Non-Consented CCTV Surveillance on The General Emotional Health of The Public
— *Madhvi Prasad* 286
26. Family Nearness & Family Separation Affects Happiness, A Study on Children of Bhopal City!!!
— *Aakriti Pillai & Avani Shrivastava* 296
27. A Comparative Study of Gender Differences on The Effect of Fear Strategies Used By Media on Mental Imagination Level of Urban Adult
— *Smita Ghosh* 308
28. Impact of Sleep on Emotions: A Study Amongst College Students
— *Shelfali Sahu* 327
29. Parental Meta Emotional Philosophy and Its Impact on Preadolescents' Emotional Intelligence
— *Dr. Shobha Bharat* 333
30. A Comparative Study on Emotion Regulation in Adolescent Boys & Girls
— *Dr. Asha Menon* 349
31. A Study on Effect of Overthinking on Individual's Emotions
— *Ankita Sitaria* 368
32. The Role of Emotions in Second Language Acquisition
— *Dr. Jotiram Janardan Gaikwad* 379
33. Positive Emotions Nutrient of Well Being Life
— *Prof. Smita Arjun Borade* 389
- *Contributors* 397

16. Tracy Catherine (2018), Perfectionism, Overthinking and Emotions in Youth Footballers <http://etheses.whiterose.ac.uk/23223/>
 17. Domina Petric, Emotional knots and overthinking http://www.academia.edu/download/56789096/Emotional_knots_and_overthinking.pdf
 18. Funda Gençođlu, Overthinking? Maybe it is what we need <https://jnp.journals.yorku.ca/index.php/default/article/download/104/101>
 19. Progress in Brain Research, Volume 174, 2009, A conceptual framework for studying emotions–cognitions–performance linkage under conditions that vary in perceived pressure <https://www.sciencedirect.com/science/article/pii/S0079612309013144>
 20. Overthinking and Other Minds: The Analysis Paralysis Bonnie Talbert, 17 Jul 2017 <https://www.tandfonline.com/doi/abs/10.1080/02691728.2017.1346933>
-

THE ROLE OF EMOTIONS IN SECOND LANGUAGE ACQUISITION

— *Dr. Jotiram Janardan Gaikwad*

Abstract:

The word 'emotion' is defined in Oxford English Dictionary as 'a strong feeling such as love, fear or anger; the part of a person's character that consists of feeling'. As the definition highlights the role of emotion in the person's character, emotion plays a very important role in learning any language and second language is not an exceptional. Chomsky saying 'the truth of the matter is that 99% of teaching is making the students feel interested in the material' (Chomsky, 1988) stated the importance of emotional aspect of language learning. The present study deals with the role of emotions in second language acquisition (SLA). The purpose of the present study was to examine the relations between the emotions and second language acquisition. The study was undertaken on twenty students of First Year of Bachelor of Commerce class of St. Xavier's College - Autonomous, Mumbai. Most of the students had migrated from Village/tehsil to District place areas or to the Metropolitan city at junior college level. The medium of instruction was regional language for all the subjects in school but medium of instruction at junior college level was English for the majority of students. These students worked during the day and came

to college to attend classes in the evening. These students faced many difficulties in learning English and avoided to speak in front of fluent speakers. English was taught to them considering emotional involvement with the help of teaching/learning module (TLM) developed by the present researcher. Data was collected through written and oral tests. After discussing the concepts – ‘emotion’ and ‘second language acquisition’, explaining the research design; the present paper analyses the collected data and discusses the results. The results of the present study highlight the role of emotions in second language acquisition (SLA).

Key words: emotion, second language, second language acquisition (SLA), teaching/learning module (TLM)

1. Introduction:

Though Oxford English Dictionary defines the word ‘emotion’ as ‘a strong feeling such as love, fear or anger; the part of a person’s character that consists of feeling’, there is no agreement on definition of emotion.

“An emotion is a complex psychological state that involves three distinct components: a subjective experience, a physiological response, and a behavioral or expressive response.” (Hockenbury and Hockenbury, 2007)

“Emotion is an acute disturbance of the individual as a whole, psychological in origin, involving behavior, conscious experience and visceral functioning.” (Young, 1961)

“The term emotion denotes a state of being moved, stirred up or aroused in some way.” (Jersild, 1960)

Human emotion involves “physiological arousal, expressive behavior and conscious experience.” (Myers, 2004)

These definitions state emotion as a feeling of happiness, love, joy, fear, hate or anger created by the situation. It is a conscious process of strong feeling towards a specific object or person which brings physiological or behavioural changes in the person. It is a very complex phenomenon. And, as it is a part of the person’s character, emotion plays a very

important role in learning any language and second language acquisition is not an exceptional.

Second language acquisition (SLA) is a process of acquiring second language. It deals with the learners who attempt to learn an additional language after acquiring the first language. Ritchie and Bhatia (1996) define second language acquisition as, “the acquisition of a language after the native language has already become established in the individual”. Like other factors, emotions play a very significant role in the process of language acquisition. Emotions are said to be a result of the evaluation students make of particular situations while learning (Pekrun, 2000). These evaluations are influenced by previous experiences, the social context and their personal goals (Pekrun et al., 2002). Thus, the process of evaluation helps students to acquire second language. Hence, the present study was undertaken to examine the relations between the emotions and second language acquisition.

2. Research Design:

This section describes the subjects of the study, teaching/learning module (TLM), and the techniques employed for data collection and data analysis.

2.1 Subjects of the Study:

The present study was conducted at St. Xavier’s College - Autonomous, Mumbai on twenty students of First Year of Bachelor of Commerce (F.Y.B.Com.) class. The study was conducted on limited number (20 students) as they were trained for the period of three months using teaching/learning module (TLM).

Most of the students had migrated from Village/tehsil to District place areas or to the Metropolitan city at junior college level. The medium of instruction was regional language for all the subjects in school but medium of instruction at junior college level was English for the majority of students. These students worked during the day and came to college to attend classes in the evening. These students faced many difficulties

in learning English and avoided to speak in front of fluent speakers. English was taught to them considering emotional involvement with the help of teaching/learning module (TLM) developed by the present researcher.

2.2 Teaching/Learning Module (TLM):

The present teaching/learning module developed by the researcher was a working plan for teaching English. It was prepared on the basis of the subject 'Communication Skills in English' of F.Y.B.COM. It included the following components:

1. Brief overlook of grammar: parts of speech, tense, articles, sentence construction
2. Language Skills: listening, speaking, reading, writing
3. Conversational (Situational) Activities: greeting and introducing, making requests, asking for and giving permissions, offering a help, giving instructions and directions, making requests through telephone
4. Professional activities: group discussion, interviews, public speaking

English was taught using teaching/learning module (TLM). While teaching English, importance was given for practicing English than just teaching and lecturing as Harmer (1983) states that the language activities are important factors in teaching language for communication. As activities provide practice, students acquire language as said by Pekrun (Pekrun et al., 2002) with "previous experiences, the social context and their personal goals".

2.3 Data Elicitation Tools:

Data was collected through oral and written tests before and after the teaching. Oral data was collected by asking participants to speak on any one of the given topics for five minutes in the pre-test as well as the post-test. The topics given for the pre-test were:

- My favourite actor/hero/movie/sport/sportsman

The topics given for the post-test were:

- A place I visited in the Christmas vacations
- My favourite personality

Written data was collected by asking participants to write an essay of about one page on any one of the given topics for the pre-test and the post-test. The topics given for the pre-test were:

- If I were the PM
- What I plan to do after graduating
- An accident I witnessed

The topics given for the post-test were:

- If I become the Manager
- The things I want to do in the summer vacation
- A person I met recently

2.4 Data Analysis Tools

The collected data of both the tests is analysed quantitatively. It is analysed to check the increase in number of words used from the pre-test to the post-test. The main aim of the analysis is to see to what extent the teaching module designed and activities conducted could improve the performance of the students in English.

3. Analysis:

Figure-1 presents the number of words used by the subjects in the pre-test and the post-test in essay writing task.

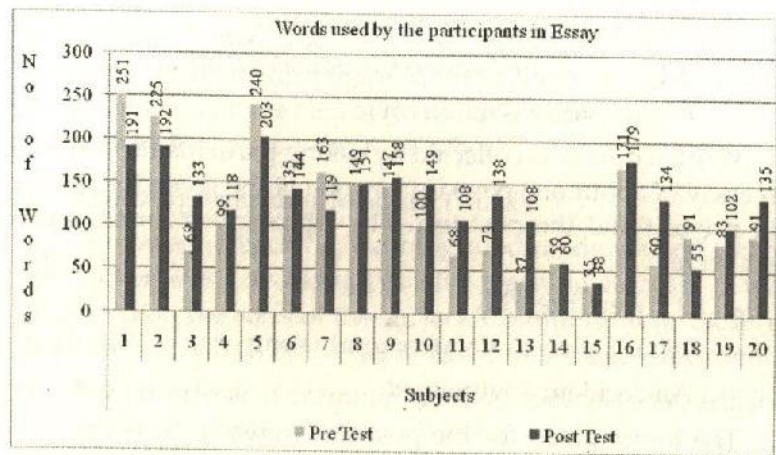


Figure-1: Words used by the participants in Essay

The use of words from the pre-test to the post-test has decreased in the case of five participants (01, 02, 05, 07 and 18) and has increased in that of the remaining fifteen participants. Though the use of words has decreased in five participants, the total number of words used by the participants has increased from 2346 words in the pre-test to 2615 words in the post-test as shown in the Figure-2.

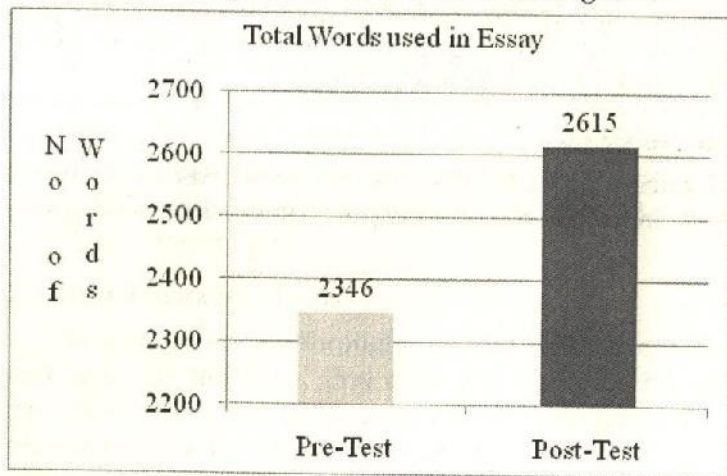


Figure-2: Total words used by all participants in essay writing task

Figure-3 presents the number of words used by the subjects in the pre-test and the post-test in speech.

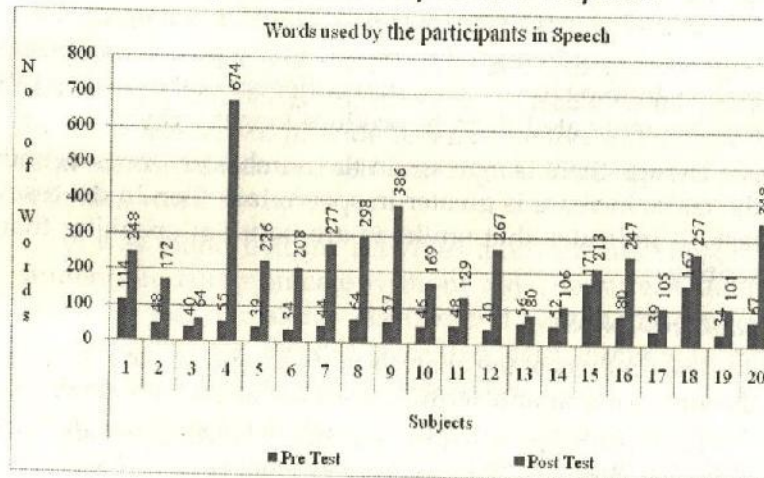


Figure-3: Words used by the participants in Speech

The use of number of words has increased from the pre-test to the post-test in all the participants. Next figure (Figure-4) presents the total number of words used by the participants in the pre-test and the post-test in speech task.

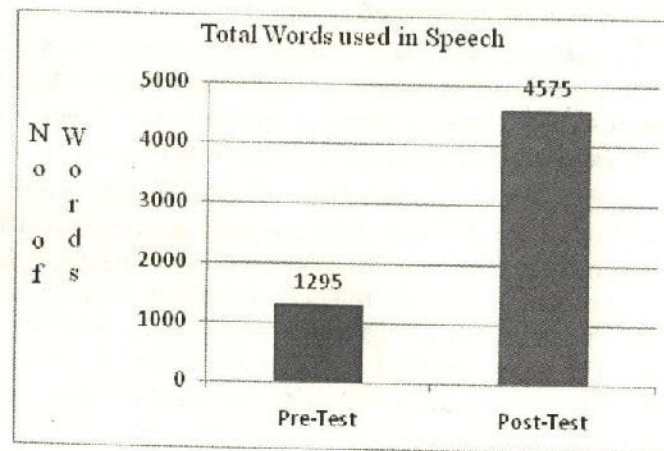


Figure-4: Total words used by all participants in speech task

The total number of words used by the participants while giving speeches has increased from 1295 words in the pre-test to 4575 words in the post-test. The increase in the use of number of words from the pre-test to the post-test indicates that the training has boosted the confidence of the participants and has motivated them to produce longer strings.

Though there is increase in the number of words in both the tasks, increase is greater in speech task than in the essay task. It indicates that students are better at speaking than writing.

4. FINDINGS:

The findings of the analysis of the language data collected through the oral and written tasks are as stated below:

The teaching/learning module (TLM) used and the activities conducted for teaching English have had a positive impact and this is supported by the following observations:

- The use of words from the pre-test to the post-test has increased in most of the participants in essay writing task and in all participants in speech task.
- The use of total number of words has increased from the pre-test to the post-test in both the given tasks.

The increase in the use of number of words from the pre-test to the post-test indicates that the training has boosted the confidence of the students to engage in communication in English and has motivated them to produce longer strings.

Though marked improvement is noted in the increase in the number of words used from the pre-test to the post-test, their performance in grammar doesn't show the same level of improvement. Even with the help of activity-based practice sessions, it is difficult to notice a change through short-term courses. The researcher concludes that the training was not sufficient in terms of the length of the course to improve their grammatical competence.

It was found that when teaching is done for small groups of students, the results are better. Language skills can be

developed as per the learners' interests. Teacher can come to know the students' interest, motivation, and then guide and encourage them according to their needs and interest.

Most of the learners lack motivation to speak English. However, skills are developed when the learner is motivated. So, it is necessary to provide constant motivation in order to promote confidence and self-learning. And, conduct of small activities work for it.

It was found that the activities motivate and encourage students to communicate without any pressure. Students overcome fear of making mistakes and perceive language as a natural process. Besides, activities help students to gain confidence and to believe in themselves.

It was found that the teaching could be successful when we teach with practical exposure. Teaching combined with practical exposure is likely to produce positive results in all language skills as it gives practical and emotional experience.

5. Conclusion:

The overall performance of the students in acquiring second language through the training was found satisfactory. There is an improvement in the performance from the pre-test to the post-test. It shows that the teaching/learning module (TLM) developed by the present researcher and activities conducted have had a positive impact in teaching English language. Thus, the results of the present study highlight the role of emotions in second language acquisition (SLA).

References:

- Chomsky, N. (1988). *Language and problems of knowledge*. Cambridge, MA: The MIT Press.
- Harmer, J. (1983). *The practice of English language teaching* (6th). New York: Longman Group.
- Hockenbury, D. H. & Hockenbury, S. E. (2007). *Discovering psychology*. New York: Worth Publishers.

Higher Education in India: Retrospect and Prospect

Editors

Dr. Suchitra A. Naik

Dr. Jayshree Singh

Dr. Prashant P. Dharmadhikari



Himalaya Publishing House

ISO 9001:2015 CERTIFIED

© No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording and/or otherwise without the prior written permission of the authors.

ISBN: 978-93-89951-65-3

Edition : March 2020

Information contained in this work has been received from respective research scholars/paper author/s. For information published herein, *VPM's Joshi-Bedekar College and Himalaya Publishing House Pvt. Ltd. are not responsible. Authors are solely responsible for any damages arising out of use of this published information work.*

Printed and Published by:

Mrs. Meena Pandey

HIMALAYA PUBLISHING HOUSE PVT. LTD.,

“Ramdoot”, Dr. Bhalerao Marg, Girgaon,

Mumbai - 400 004. Phones: 23860170 & 23863863, Fax: 022-23877178

E-mail: himpub@bharatmail.co.in, **Website:** www.himpub.com

For:

Vidya Prasarak Mandal's

K.G. JOSHI COLLEGE OF ARTS &

N.G. BEDEKAR COLLEGE OF COMMERCE

Re-accredited with 'A' Grade by NAAC in third cycle

"Best College Award" by University of Mumbai (2011-12)

Community College (University of Mumbai)

ISO 9001:2015

Creek Land, Chendani Bunder Road, Thane (W) 400601.

E-mail Id: joshibedekar@gmail.com/vpm_joshibedekar_office@yahoo.co.in

Printed at:

CONTENTS

<i>Sr. No.</i>	<i>Title Name</i>	<i>Page No.</i>
1	Education in Ancient India <i>Dr. Vijay V. Bedekar</i>	1 – 9
2	The Seven Steps to Excellence <i>Dr. Shirish Chindhade</i>	10 – 13
3	Higher Education: Opportunities and Challenges <i>Dr. A.B. Dhopeshwarkar</i>	14 – 20
4	Amalgamation of Research in Higher Education: Some Thoughts <i>Dr. Sudhakar Agarkar</i>	21 – 24
5	A Report of Educational Odyssey to Oxford, Cambridge and London: Some Observations <i>Dr. Prashant P. Dharmadhikari</i>	25 – 30
6	The ‘Flip’ Side of Classroom Learning <i>Rishikesh KB and Sharon Lewis</i>	31 – 33
7	Prioritising Philosophy of Education in Higher Education in India <i>Dr. (Mrs.) Suchitra A. Naik</i>	34 – 40
8	Quantity vs. Quality Trade-off in Higher Education: Challenges and Consequences in India <i>Aparna Kulkarni</i>	41 – 45
9	Challenges and Opportunities in Higher Education in India: A Perspective <i>Dr. Pramod T. Kharate</i>	46 – 51
10	Language and Literature in Higher Education <i>Dr. Manoj Patharkar</i>	52 – 56
11	Rejuvenating the Youth through Swami Vivekananda’s Value Education <i>Dr. Indrani Roy</i>	57 – 61
12	सा विद्या या विमुक्तये <i>डॉ. श्यामसुंदर पाण्डेय</i>	62 – 67
13	मूल्य शिक्षण : आवश्यकता और चुनौतियाँ <i>डॉ. मथिलेश शर्मा</i>	68 – 74

Quantity vs. Quality Trade-off in Higher Education: Challenges and Consequences in India

Aparna Kulkarni*

Abstract

Higher education is expected to be a 'public good' to become timely accessible and universal, wherein the state apparatus has a major role in its provision. With this view, democratic countries like India make huge investments in education through public sector. As a result, Indian education system is characterised by coexistence of private and public sector institutions. In some cases, PPP (public-private partnership) model has also been implemented in India. So, it is obvious that public and private institutions can take care of quantity aspect of higher education. Undoubtedly, there have been evidences of quantitative improvement in higher education considering the indicators like, technological advancement, increasing number of state and private sector universities, teacher-pupil ratio, infrastructural development, etc. But at the same time, there are serious concerns about the quality aspect of higher education in India. This paper is an attempt to examine the quality aspect of higher education in India.

Keywords: *Outbound mobility, higher education, personality development.*

Introduction

As Swami Vivekananda has rightly pointed out, "We want that education by which character is formed, strength of mind is increased, the intellect is expanded, and by which one can stand on one's own feet." A nation can be built only if the character, skills and capabilities of its people are levelled up. Education is the key to nation-building in the true sense if it is accessible to all at all levels. Higher education in particular can shape the future of a country if universalised and rightly offered to those who deserve it. Hence, access to higher education becomes crucial for character-building and national development. Ensuring good quality education is something very essential that a nation can do for its future generations.

As it is well known, higher education in particular, is expected to be a 'public good' to become timely accessible and universal, wherein the state apparatus has major role in its provision. With this view, democratic countries like India make huge investments in education through public sector. As a

* Assistant Professor, Department of Economics, St. Xavier, College, Mumbai.
Email: aparna.kulkarni@xaviers.edu

result, Indian education system is characterised by coexistence of private and public sector institutions. In some cases, PPP (public-private partnership) model has also been implemented in India. Supposedly, it is understood that public and private institutions can take care of quantity aspect of higher education. Undoubtedly, there have been evidences of quantitative improvement in higher education considering the indicators like, technological advancement, increasing number of state and private sector universities, teacher-pupil ratio, infrastructural development, etc. So it is clear that 'quantity' aspect of higher education in India is definitely a satisfactory factor but at the same time, there are serious concerns about the quality aspect of higher education in India.

Modern India still follows the colonial method of education, i.e., 10+2+3 comprising of primary, higher secondary schooling and graduation level degree. Also, our system is inflexible in terms of selection of courses, course structure, and lack of interdisciplinary, multidisciplinary approach, and so on. Dropout rate, lack of well-equipped libraries and laboratories across the country, deficiency of public investment in higher education, incompetent university campuses, and insufficient research expenditure are the serious challenges before the higher education in India. Obviously, there is a growing tendency among the students to go abroad for higher education. With an average increase of 7 per cent to 10 per cent in number of students going abroad every year, there are several pertinent issues about the quality aspect of higher education in India which must be addressed.

Let us first look into the data that justifies the quantity and quality aspects of higher education in India:

Growth in Universities and Colleges in India

The following table shows the quantitative increase in number of universities and colleges in India:

Institutions	2008	2016	Increase in Number	Increase in %
Central Universities	25	47	22	88
State Universities	228	345	117	51
State Private Universities	14	235	221	1579
Deemed Universities	103	123	20	19
Total	370	750	380	103
Colleges	23209	41435	18229	79

Source: UGC India Report, 2017.

The above data shows that the decadal growth (2008 to 2016) in number of state and private universities and colleges in India is excellent and it has definitely improved the accessibility of higher education in India with an effective penetration ratio.

Growth in Enrolment of Students

The other parameter of higher education can be the enrolment of students at different levels of education. The following data will show the status:

Level of Education	2008	2016	Increase in Number	Increase in %
Graduate	11908151	24592421	12685170	107

Postgraduate	1489675	2764886	1275201	86
Doctorate	95872	180957	85085	89
Others	148100	945582	797482	538
Total	13641808	28484746	14842938	109

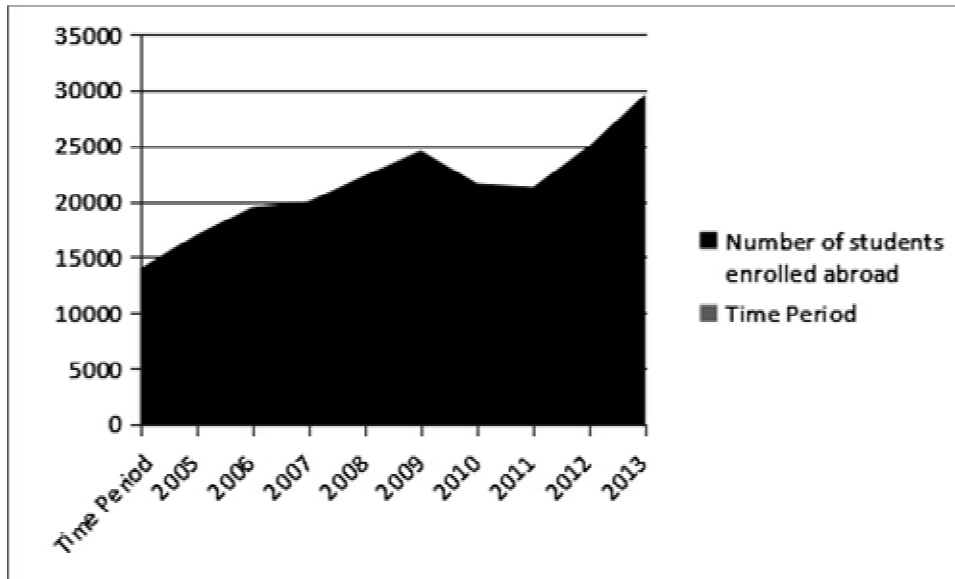
Source: UGC Report, 2017.

Considering the above statistics, it is clear that at different levels of higher education, there has been an increase in India which shows that higher education has become important for people even though the opportunity cost is high and private cost is far more than public cost.

At the same time this data shows that at postgraduate level of higher education, the dropout rate is very high. This gap indicates several policy implications as well as quality dimensions of higher education. According to the same report, the proportion of students enrolled for science subjects has increased by 107 per cent, whereas for arts and humanities it is just 75 per cent. The same for engineering and technology is 272 per cent. This is a clear indicator of a transition that the higher education system in India is going through.

After understanding the quantity aspect of higher education, it is pertinent to look at the quality aspect of it. Some of the qualitative indicators of education as a socially necessary service are proper infrastructure, advanced libraries with e-resources, well-equipped laboratories, conducive research environment, etc. Unfortunately, the percentage of public expenditure on higher education in India is less than 1 per cent which is lessening the possibility of India becoming a world-class education hub. There are less than ten universities in India which can match with the global standards, according to the global ranking of higher education. The ever-increasing percentage of students willing to go abroad for higher education shows that universities in West are definitely assuring better quality of education along with academic freedom for research. Due to this, outbound mobility of Indian students has become a crucial fact which is raising several issues for diaspora culture and educational migration. Simultaneously, the population in the age group of 15 to 25 is adding one million students every year to higher education system in India which is creating pressure for already heavily burdened educational institutions that causes outbound mobility. Another factor that contributes to this is the emerging middle class in the country which can afford the expenses of higher education abroad. India is the number two sender (after China) of qualified students to the top universities including US, Canada and Australia. India's demographic status and growth trajectory show that India will remain as a top sender of students to different destinations for higher education.

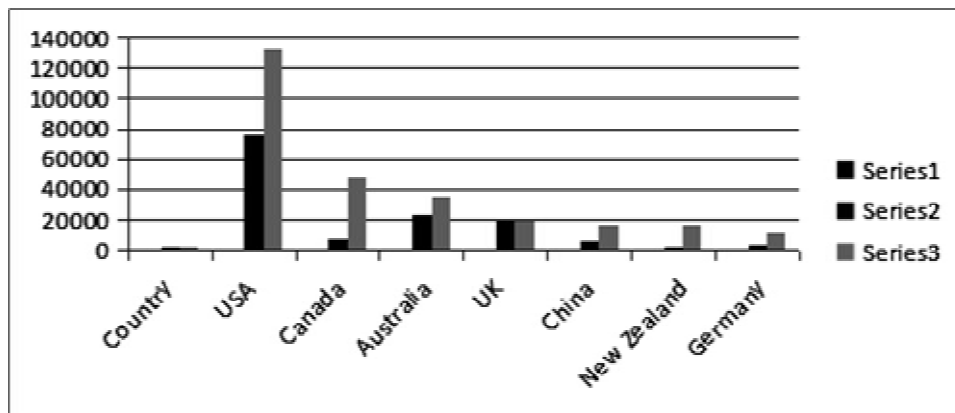
The following graph shows the status of outbound mobility of Indian students:



Source: IIE, UNESCO, 2017.

Also, most interesting and explanatory are the percentage changes in Indian student enrolments in top seven countries over the decade. It is shown below.

Number of Indian students enrolled abroad:



Source: IIE, UNESCO, 2017.

Affordability of middle class, growing aspirations of Indian students, employability of education abroad, telecommunication facilities, safety and excellent work culture are some of the driving forces for such outbound mobility. While India is still concerned with quantity aspect of education at all levels, the efforts for qualitative improvement are insufficient. Higher education abroad is surely causing severity of brain drain issue of Indian intellect. This is an alarming factor for Indian education system which can no more enjoy the memories of past legacy of world-class ancient universities, like Nalanda and Takshashila. The present scenario is indicating unhappy trend of educational migration causing academic damage to Indian society.

Conclusion

1. Public investment in higher education in India needs exponential increase to create world-class infrastructure.
2. There is a clear quantity-quality trade-off in higher education. So, the government has to balance out the nexus.
3. Encouragement to research, academic autonomy, industry-university partnership, innovation, infrastructural development can be some of the ways to improve the status.
4. Foreign collaborations, joint ventures and students exchange programmes will alter the educational migration.

Bibliography

1. All India Survey of Higher Education, 2017.
2. IIE, UNESCO Report, 2017
3. UGC Report, 2017.



Simultaneous Determination of Ofloxacin and Tinidazole from Pharmaceutical Dosage Formulation by Two Spectrophotometric Methods

Pralhad Rege^{1*}, Vaibhav Salvi² and Abhishek Tiwari¹

DOI: 10.9734/bpi/cacb/v4/1904F

ABSTRACT

Two simple, sensitive, accurate, precise, rapid and economical methods were developed for the estimation of Ofloxacin and Tinidazole from combined tablet dosage form. First method is based simultaneous equation and second method is based on Q-analysis (absorbance ratio method). Ofloxacin and Tinidazole show λ_{\max} at 300 nm and 275 nm in 0.1N Methanolic-HCl (20:80) respectively. The linearity was obtained in the concentration ranges of 1 – 20 $\mu\text{g/ml}$ for Ofloxacin and 3 – 60 $\mu\text{g/ml}$ for Tinidazole with Regression Coefficient (R^2) greater than 0.999. In the first method concentration and subsequently amount of drug determined by using simultaneous equations and in second method concentration and amount of drug determined by using ratio of absorbance at Iso-absorptive point (which was found to be 286 nm) and at λ_{\max} of one of the drugs. The results of analysis have been validated statistically and subsequently by assay and recovery studies.

Keywords: Ofloxacin; tinidazole; absorbance ratio; iso-absorptive point; regression coefficient.

ABBREVIATIONS

OF : Ofloxacin
TNZ : Tinidazole
SEM : Simultaneous Equation Method
ARM : Absorbance Ratio Method

1. INTRODUCTION

In the tropical countries like India, the major problems of health arise due to improper lifestyle, unhealthy environmental conditions, unhygienic and substandard food. Infections caused by the microorganisms like, fungi, protozoa, are most common. Drugs with antifungal and antiprotozoal activity have been used in the treatment of the same.

Ofloxacin $\text{C}_{18}\text{H}_{20}\text{FN}_3\text{O}_4$ is used as an antibacterial drug. (Molecular weight: –361.368 g/mol).

Ornidazole, $\text{C}_7\text{H}_{10}\text{ClN}_3\text{O}_3$ is used as an antiprotozoal drug. (Molecular weight: –219.625 g/mol). Both the drugs in combined dosage formulations are available in the market and has gained great acceptance in diarrhea, bacterial and protozoal infections as this combination is broad spectrum antibiotic. In many cases, drugs with two active ingredients are prescribed to the patients to have an added advantage. Many of these antibacterial drugs are found in combination with antifungal and antiprotozoal drugs which are highly effective against fungal and protozoal infections. It is highly effective for bacterial and protozoan infections and is available in the tablet form.

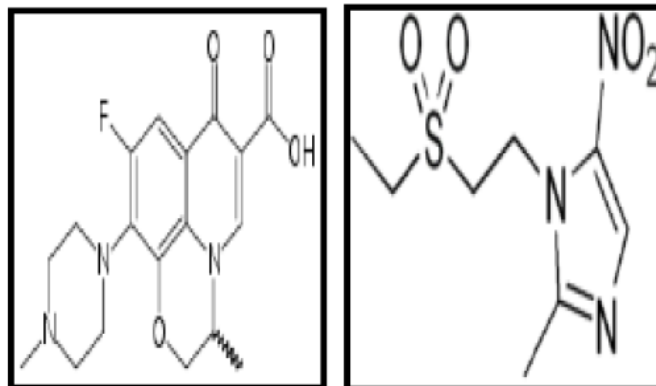
¹Department of Chemistry, St. Xavier's College, Mumbai, India.

²Department of Chemistry, Ruia College, Mumbai, India.

*Corresponding author: E-mail: pralhad1806@gmail.com;

The present study a successful attempt has been made to quantify both these drugs i.e., Ofloxacin and Tinidazole simultaneously in pharmaceutical dosage formulation by two spectrophotometric methods namely, simultaneous equations and Q-analysis (absorbance ratio method). The proposed methods have been validated as per ICH guidelines.

STRUCTURE



Ofloxacin

Tinidazole

2. MATERIALS AND METHODS (EXPERIMENTAL)

2.1 Instruments

Systronics UV—VIS spectrophotometer type 118, single beam spectrophotometer with spectral width of 2.0 nm. Wavelength accuracy is + 1.0 nm and a pair of 10 mm matched quartz cells were used to measure the absorbance. The wavelength ranges from 200—1000 nm obtained by a 1200 grooves/mm grating with Czerny—Turner Mount. Fused Silica deuterium lamp and tungsten iodide sources are used to cover the wavelength range. High sensitivity, wide range, reliable silicon photocell is used as the detector. The photometric readings of %T (Percent Transmittance), ABS (Absorbance) and CONC (Concentration) are displayed on an electronic display. Stray light corrections are made using a built-in filter wheel containing four filters. There is a built-in 4-position sample changer provided for 10 mm cuvettes. The instrument runs on 230 V, 50 Hz.

2.2 Materials

Pure standard of ofloxacin and tinidazole was obtained from Cipla Pharmaceutical Pvt. Ltd. The tablet formulations of the said combination were purchased from a local pharmacy (The label claim contained 200 mg of ofloxacin and 600 mg of tinidazole.) All the solutions were prepared in double distilled water. All the reagents used were of AR grade.

2.2.1 Preparation of standard solution

10 mg of standard Ofloxacin and 30 mg of standard Tinidazole was accurately weighed and dissolved in 0.1N Methanolic-HCl (20:80) and made up to a volume of 50 ml in standard flask to give stock solution (200 µg/ml of ofloxacin and 600 µg/ml of tinidazole respectively). Further all the standard solutions containing the mixture of ofloxacin and tinidazole were prepared by using this stock solution.

2.2.2 Preparation of sample solution

Ten tablets of a combined formulation were weighed and powdered. Average weight of tablet has been taken. From this 45 mg of the powder (which amounts to 10 mg of Ofloxacin and 30 mg of

Tinidazole) was transferred to 50 ml flask. The powder was dissolved and diluted up to the mark using the solvent. The solution was then allowed to settle at room temperature and was then filtered using Whatman Filter paper no. 41 to remove the additives which did not dissolve in the solvent used.

From this 10 ml of the solution was pipette out into 100 ml flask and was diluted to the mark using the solvent. Absorbance of this solution was made appropriately at 300 nm and at 275 nm which are the λ_1 and λ_2 respectively.

2.2.3 Simultaneous equation method [1,2,3]

Working standard solutions were scanned in the entire range of 200-800 nm to determine λ_{\max} of both the drugs. The λ_{\max} of ofloxacin and tinidazole were found at 300 nm and 275 nm respectively. A series of standard solutions were prepared from the working standard solution. Absorbances of resulting solutions were measured at their λ_{\max} and calibration curve was plotted.

The absorptivity coefficients of these two drugs were determined by using calibration curve equation. Two simultaneous equations were constructed using same.

$$A_1 = 0.106 C_X + 0.0142 C_Y \quad (1)$$

$$A_2 = 0.0348 C_X + 0.0261 C_Y \quad (2)$$

Where, A_1 and A_2 are the absorbances of sample at 300 nm and 275 nm respectively. C_X and C_Y are the concentration ($\mu\text{g/ml}$) in of Ofloxacin and Tinidazole in sample respectively. From the resulting concentration obtained after solving above equations, then amount of both the drugs present in the given sample was calculated.

2.2.4 Analytical method validation [4,5]

2.2.4.1 System suitability

System suitability test is used to ensure reproducibility of the equipment. The test was done with a solution containing 10 $\mu\text{g/mL}$ of OF and 30 $\mu\text{g/mL}$ of TNZ i.e. at the working concentrations of OF and TNZ. These solutions were analyzed with five replicates and the mean was used for the whole calculation.

2.2.4.2 Linearity and range

A good linearity was achieved for OF and TNZ in the concentration ranges of 1 – 20 $\mu\text{g/ml}$ and 3 – 60 $\mu\text{g/ml}$ respectively. The calibration curves were constructed with concentration (C) against absorbance of both the drugs.

2.2.4.3 Limit of detection and limits of quantitation

For LOD and LOQ analysis twenty readings for blank recorded then their standard deviation calculated i.e., for LOD = (SD \times 3 + Mean absorbance of Blank) and for LOQ = (SD \times 10 + Mean absorbance of Blank).

2.2.4.4 Intra-day and inter-day precision/ruggedness

The intra-day and inter-day precision was used to study the variability of the method. Ruggedness is the degree of reproducibility of the results obtained under variety of test conditions. It is expressed as percent RSD. It is also called as reproducibility or intermediate precision. It is the analysis of same sample under variety of normal test condition such as different laboratories, different analysts, different instruments, different lots of reagents, different days etc.

It was checked by recording the absorbance as well as spectra of standard solutions of ofloxacin and tinidazole i.e. at working concentrations for OF (8 µg/ml, 10 µg/ml, 12 µg/ml) and for TNZ (24 µg/ml, 30 µg/ml and 36 µg/ml) with five replicates (both at intra-day (five times within 24 hour) and inter-day (two times each. during 3 days intervals) to check the precision.

2.2.4.5 Assay

For estimation of drugs from commercial formulations, 45 mg of powder which is equivalent to (10 mg of ofloxacin and 30 mg of tinidazole) was accurately weighed and transferred to 50 ml volumetric flask and dissolved in 25 ml of 0.1N Methanolic-HCl (20:80) and sonicated for 10 mins. The solution was filtered through Whatman filter paper No.41 and residue was washed thoroughly with given solvent. The filtrate and washings were combined in 50 ml volumetric flask and diluted with same solvent. The spectra were obtained and absorbance was measured at 300 nm and 275 nm and finally concentration of both the drugs was calculated using equations 1 and 2. The amount of ofloxacin and tinidazole present in the given sample found out. Assay studies were carried out at three different levels i.e. 80%, 100%, 120% level.

The validated spectrophotometric method was used for the simultaneous quantitative determination of OF and TNZ from the tablet formulation. Quantification has been done by simultaneous equation method (SEM). The absorptivity coefficients of these two drugs were determined by using calibration curve equations 1 and 2 mentioned earlier.

Further two more equations were derived with the equations (1) and (2) which are given below:

$$C_O = \frac{(\lambda_2^{\epsilon_2} \times A\lambda_1) - (\lambda_1^{\epsilon_2} \times A\lambda_2)}{(\lambda_1^{\epsilon_1} \times \lambda_2^{\epsilon_2}) - (\lambda_1^{\epsilon_2} \times \lambda_2^{\epsilon_1})} \quad (3)$$

$$C_T = \frac{(\lambda_1^{\epsilon_1} \times A\lambda_2) - (\lambda_2^{\epsilon_1} \times A\lambda_1)}{(\lambda_1^{\epsilon_1} \times \lambda_2^{\epsilon_2}) - (\lambda_1^{\epsilon_2} \times \lambda_2^{\epsilon_1})} \quad (4)$$

C_O and C_T were calculated where C_O = Concentration of standard OF and C_T = Concentration of standard TNZ. From their concentration the amount of OF and TNZ in the tablet formulation is calculated, where,

$$\lambda_1^{\epsilon_1} = 0.106 \text{ (OF at 300 nm)}, \lambda_2^{\epsilon_1} = 0.0348 \text{ (OF at 275 nm)}, \lambda_1^{\epsilon_2} = 0.0142 \text{ (TNZ at 300 nm) and}$$

$$\lambda_2^{\epsilon_2} = 0.0261 \text{ (TNZ at 275 nm).}$$

$$A\lambda_1 = \text{Absorbance of OF at 300 nm } A\lambda_2 = \text{Absorbance of TNZ at 275 nm}$$

2.2.4.6 Accuracy (Recovery)

The recovery was used to evaluate the accuracy of the method. Accuracy of the method was determined using the method of standard addition. A fixed volume of standard tinidazole solution was mixed with different concentrations of preanalyzed sample solutions and mixtures were analyzed by proposed method. The percent recovery was determined at different levels i.e., from 80% to 120% level.

2.2.4.7 Sensitivity

Sensitivity refers to the smallest quantity that can be accurately measured. It also indicates the capacity of the method to record or measure small variations in concentrations. In the case of Spectrophotometric methods, a parameter known as "Sandell's Sensitivity" is used to evaluate the sensitivity of the method. It is the amount required to give an absorbance of 0.001 units in one square centimeter path.

2.2.4.8 Method-2: Absorbance ratio method (Q-analysis) [6,7,8]

Absorbance ratio method uses the ratio of absorbance at two selected wavelengths one at iso-absorptive point and other being the λ_{\max} of one of the components. From the overlay spectra of two drugs, it is evident that Ofloxacin and Tinidazole show Iso-absorptive point at 286 nm and the second which is the λ_{\max} of Ofloxacin (300 nm). The quantification of both drugs was carried out at the selected wavelengths. i.e., 286 nm and 300 nm.

2.2.5 Analytical method validation

2.2.5.1 Linearity and range

The linearity was obtained in the concentration ranges of 1 – 20 $\mu\text{g/ml}$ for ofloxacin and 3-60 $\mu\text{g/ml}$ for tinidazole. Absorbance of resulting solution was measured at 286 nm and 300 nm Calibration curves were plotted at these wavelengths. The absorptivity coefficients of these two drugs were determined by using calibration curve equation at 286 nm and 300 nm.

2.2.5.2 Assay

For assay studies, procedure used for sample preparation in absorbance ratio method is exactly similar to that used in simultaneous equation method.

Absorbances were measured at 286 nm and 300 nm and concentration of both the drugs was calculated using equations 5 and 6. Finally the amount of ofloxacin and tinidazole present in the given sample found out. Assay studies were carried out at three different levels i.e. 80%, 100%, 120% level. The validated spectrophotometric method was used for the quantitative determination of OF and TNZ simultaneously from the formulation. Quantification has been done by Absorbance Ratio method (ARM). Two samples of different brands were used for the determination. The Absorptivity coefficients of these drugs were determined at 286 nm and 300 nm.

The concentration of OF and TNZ was found by using the following equations

$$C_O = \frac{Q_m - Q_T}{Q_O - Q_T} \times \frac{A}{A_{O1}} \quad (5)$$

$$C_T = \frac{Q_m - Q_O}{Q_T - Q_O} \times \frac{A}{A_{T1}} \quad (6)$$

Where,

C_O = Concentration of Standard OF and C_T = Concentration of TNZ

Q_m = Ratio of absorbance of mixture (Sample) at λ_{\max} (300 nm) and λ_{iso} (286 nm)

Q_O = Ratio of absorptivity of OF at λ_{\max} (nm) and λ_{iso} (286 nm)

Q_T = Ratio of absorptivity of TNZ at λ_{\max} (nm) and λ_{iso} (286 nm)

A = Absorbance of sample at Iso-absorptive point (286 nm)

A_{O1} & A_{T1} = Absorptivity of pure Ofloxacin and Tinidazole respectively at Iso-absorptive point i.e. 286 nm

3. RESULTS AND DISCUSSION

1. The given methods have been validated as per as ICH guidelines. Method validation parameters for the determination of Ofloxacin and Tinidazole is given in (Table 1) i.e., system suitability, the mean% RSD was found to be less than 1. For both OF and TNZ, which was found to be well within the acceptable limit. Regression analysis (Linearity and Range) for both the drugs was > 0.999 indicates the precision of the validated method. Lower value of LOD and LOQ confirm the sensitivity of the specified method.

- The specificity of method was confirmed by recording and subsequently comparing the spectra obtained for standard and the drug sample, which was found to be identical. The addition of the standard solution to the drug sample solution did not change the characteristics of spectra.
- Lower values of Sandell's Sensitivity and higher values for Molar Absorptivity signifies the effectiveness of the methods for routine use.
- Repeatability, inter and intra-day precision was studied where % RSD was found to be less than 1) for both drugs (Table 1).
- Accuracy was determined for the given method by calculating the percent recovery at different levels i.e., from 80% to 120% level. The percentage recovery at three different was found to be from 98.00% to 102.00% for both the drugs (Table 3).
- Quantification of drugs from formulation was done out by assay analysis for the given method. Assay studies were carried out at three different levels i.e. 80%, 100%, 120% level. The percentage assay at three different levels for OF and TNZ was found to be from 98.00% to 102.00% (Table 2).

Table 1. Method validation parameters for the determination of Ofloxacin and Tinidazole

<u>Parameters</u>	<u>Method 1 (SEM)</u>		<u>Method 2 (ARM)</u>	
	OF	TNZ	OF	TNZ
System suitability (n=5) %RSD	0.69%	0.46%	0.24%	0.51%
Linearity range ($\mu\text{g mL}^{-1}$)	1 to 20 $\mu\text{g/ml}$	3 to 60 $\mu\text{g/ml}$	1 to 20 $\mu\text{g/ml}$	3 to 60 $\mu\text{g/ml}$
Correlation coefficient (R^2)	0.9995	0.9993	0.9997	0.9992
LOD ($\mu\text{g mL}^{-1}$)	0.0625 $\mu\text{g/ml}$	0.5 $\mu\text{g/ml}$	0.0625 $\mu\text{g/ml}$	0.5 $\mu\text{g/ml}$
LOQ ($\mu\text{g mL}^{-1}$)	0.125 $\mu\text{g/ml}$	2 $\mu\text{g/ml}$	0.125 $\mu\text{g/ml}$	2 $\mu\text{g/ml}$
Intraday precision (n=5) %RSD	0.75%	0.65%	0.35%	0.71%
Interday precision (n=5) %RSD	0.60%	0.45%	0.29%	0.54%
Assay	98% to 102%	98% to 102%	98% to 102%	98% to 102%
Recovery	98% to 102%	98% to 102%	98% to 102%	98% to 102%
Sandell's sensitivity ($\mu\text{g /cm}^2$)	0.0089	0.038	0.072	0.0347
Molar Absorptivity (mole/lit/cm)	38419.85	8973.099	25090.25	5763.64

Sample Used:

Brand Name	OFLOX - TZ (Cipla Limited)
Batch No.	DV 3585
A.P.I.	Tinidazole- 600mg Ofloxacin - 200mg
Excipients	q.s.
Colours	Melon Orange

Table 2. Result of assay studies of ofloxacin and tinidazole

	<u>Method 1 (SEM)</u>		<u>Method 2 (ARM)</u>	
	OF	TNZ	OF	TNZ
Labeled claim (mg)	200mg	600mg	200mg	600mg
Drug found in mg	197.8 mg	599.1 mg	202.2 mg	604.0 mg
% Assay	99.4%	99.85 %	101.1 %	100.66%
SD	1.52	0.97	2.01	1.58
% RSD (n=5)	0.31	0.474	0.51	0.46

Table 3. Results of recovery experiment

Method Name	Level of % Recovery	% Recovery Found		Standard Deviation (SD)		Relative Standard Deviation % (RSD) (N=5)	
		OF	TNZ	OF	TNZ	OF	TNZ
<u>SEM</u>	0	100.6%	100.2%	0.037	0.032	0.57	0.73
	80 %	99.8%	99.4%	0.041	0.04	0.35	0.51
	100 %	101.01%	101%	0.051	0.045	0.39	0.50
	120%	100.2%	99.7%	0.01	0.07	0.69	0.79
<u>ARM</u>	0	99.6%	100.0%	0.02	0.056	0.33	0.62
	80 %	99.5%	99.9%	0.025	0.015	0.53	0.22
	100 %	100.3%	100.5%	0.032	0.05	0.52	0.55
	120%	101.7%	100.7%	0.033	0.076	0.44	0.69

Ofloxacin standard (at λ_{\max} 300 nm)

Tinidazole standard (at λ_{\max} 275 nm)

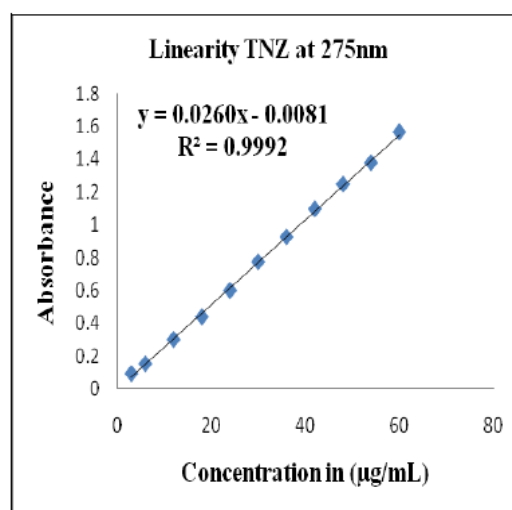
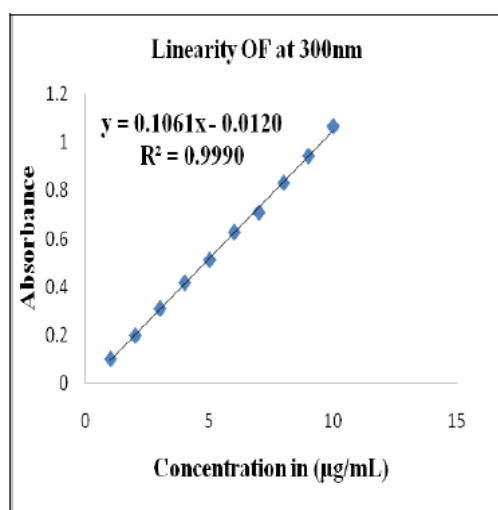


Fig. 1. Linearity graph for: (SEM)

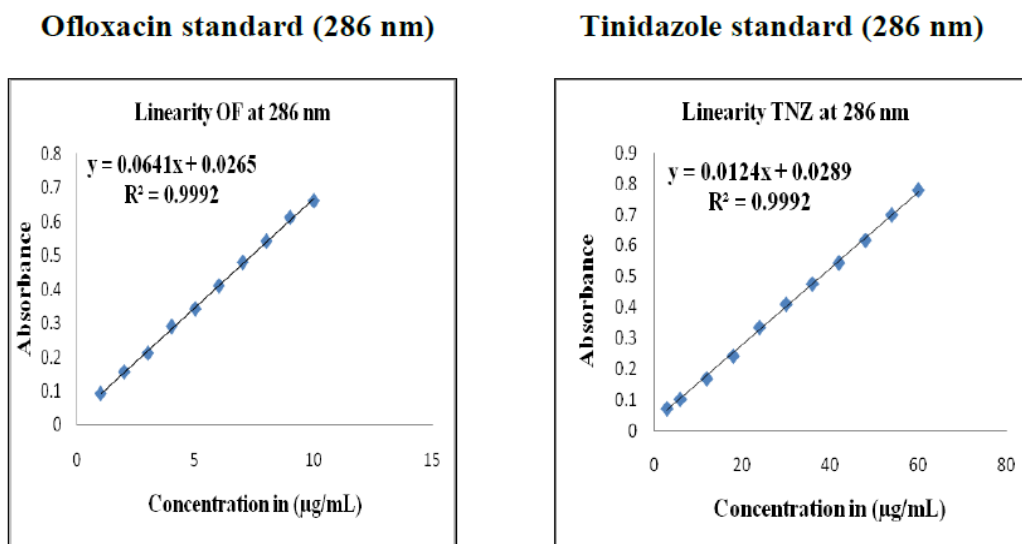


Fig. 2. Linearity graph for: (ARM) Iso-absorptive point

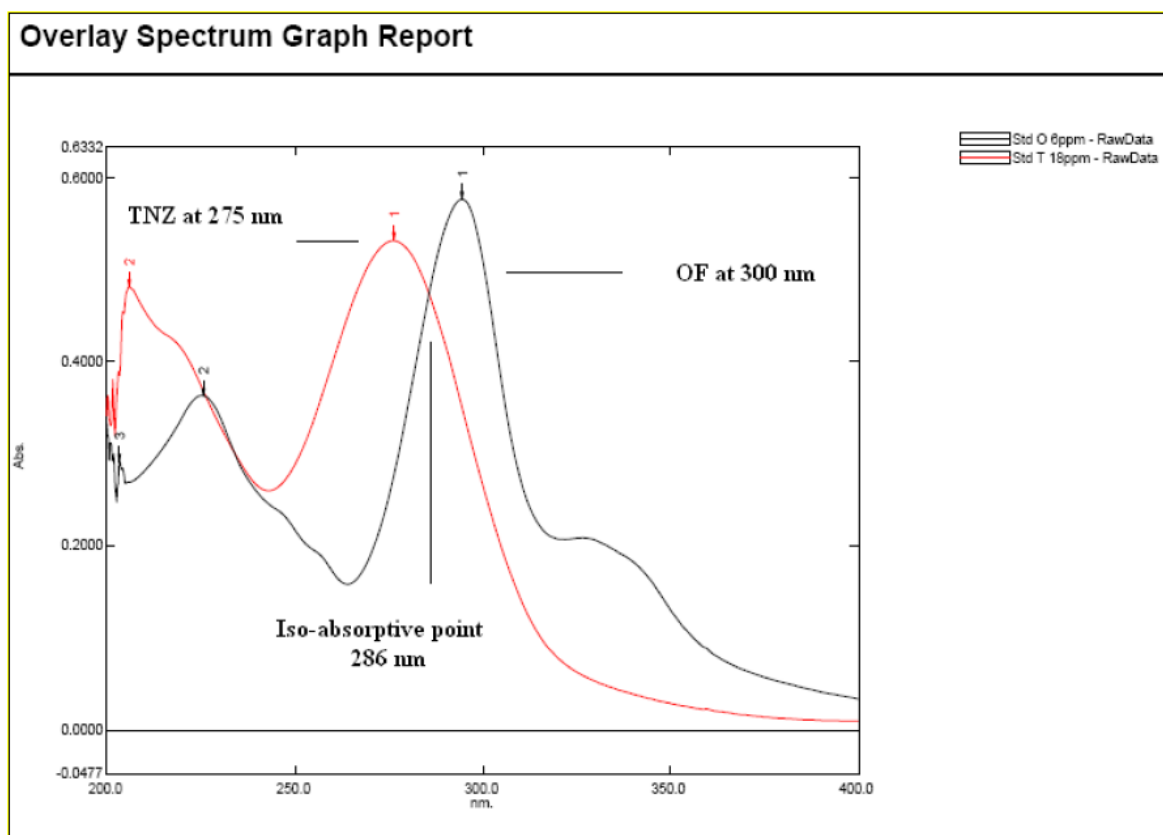


Fig. 3. Overlain spectra of ofloxacin (300 nm), tinidazole (275 nm) and Iso-absorptive point (286 nm)

4. CONCLUSION

All the necessary factors discussed earlier directed to the conclusion that, both the methods described in this paper for simultaneous estimation of OF and TNZ are found to be simple, accurate, precise,

accurate, economical, and rapid, therefore presented methods can be recommended for routine quality control analysis of Ofloxacin and Tinidazole in their combined dosage forms.

ACKNOWLEDGEMENT

We thank Cipla Pharmaceutical Pvt. Ltd (Vikhroli) and our Department of Chemistry, St. Xavier's College, Mumbai for providing us all the Necessary instrumentation facilities and their technical assistance.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Gupta R, Singhai AK, Agrawal RK. Derivative UV spectrophotometric determination of norfloxacin and tinidazole combination in tablets. *Indian-Drugs*. 2000;37(7):348-349.
2. Raj SV, Kapadia SU, Argekar AP. Simultaneous determination of metronidazole and norfloxacin from pharmaceutical preparations by RP-HPLC. *Indian-Drugs*. 1997;34(10):585-589.
3. Nagori BP, Shrivastava B, Sharma V, Rajput AS. Spectrophotometric method for simultaneous estimation of ofloxacin and ornidazole in tablet dosage form. *Indian Drugs*. 2006;43:51-53.
4. ICH Q2A. Validation of analytical procedure: Methodology. In. *Proc. Int. Con. Harmonization, Geneva*; 1994.
5. ICH Q2B. Validation of analytical procedure: Methodology. In. *Proc. Int. Con. Harmonization, Geneva*; 1996.
6. Patel SA, Patel NM, Patel MM. Simultaneous spectrophotometric estimation of ciprofloxacin and ornidazole in tablets. *Indian J. Pharm. Sci*. 2006;68(5):665-667.
7. Sohan S. Chitlange, Soni Ranjana, Sagar B. Wankhede, et al. Spectrophotometric methods for simultaneous estimation of nimesulide and drotaverine. *International Journal of ChemTech Research*. 2009;1(2):135-138.
8. Godse VP, Deodhar MN, Bhosale AV, Sonawane RA, Sakpal PS, et al. Simultaneous spectrophotometric estimation of ezetimibe and atorvastatin in pharmaceutical dosage form. *Asian J. Research Chem*. 2009;2(1):86-89.

Biography of author(s)



Dr. Pralhad Rege

Department of Chemistry, St. Xavier's College, Mumbai, India.

He works in capacity of Assistant Professor in the Department of Chemistry, St. Xavier's College Mumbai. He has completed PhD in Analytical Chemistry. He also holds PGDHRM from Symbiosis, Pune and PG Diploma in Clinico-Regulatory and Patents from Ruia College. His total teaching experience is 14 years and research experience is 12 years. He is a Mumbai University recognized guide for M.Sc by research and PhD. Currently two students for M.Sc by research and three students for PhD are working under him. His area of research interest is Analytical Chemistry, Pharmaceutical Chemistry, Synthetic Chemistry and Herbal Science. He has published 21 research papers in various national and international journals and actively participated in more than 70 conferences, workshops, Seminars and online FDP's. Till date he has Presented 15 research papers in the form of Oral and poster presentations. He has been part of various Departmental and College level committees. He is an Advisory and Editorial member of various National and International journals. He has received Minor Research Grant from University of Mumbai for the Academic year 2016-17. He has Worked as Reviewer for the book titled "Concise Graduate Chemistry –II (ISBN: 978-81-942249-1-4) published by University of Mumbai. He has Written a book (As one of the Authors) titled "Concise Graduate Chemistry –III (ISBN: 978-81-942249-5-2) currently in Press and will be published by University of Mumbai. He is also a visiting faculty in Ruia, K.J.Somaiya, Mithibai, Guru Nanak, Vivekanand and Konkan Gyanpeeth, Karjat College. He has invited as a Recourse Person in Chemistry in the International Junior Science Olympiad-Cum-Selection Camp (OCC) at K.J.Somaiya College. He has worked as a Presiding Officer in various Assembly Parliamentary and Legislative Assembly Elections. His prime objective is to make a significant contribution in the field of Education and Research.



Dr. Vaibhav Salvi

Department of Chemistry, Ruia College, Mumbai, India.

He is currently working as assistant professor in the department of chemistry of Ramnarain Ruia Autonomous College, Matunga, Mumbai. His research area is in the field of voltammetry. He has developed methods for simultaneous determination of active pharmaceutical ingredients using polarographic methods which could be alternative to chromatographic technique. He has two national and one international publication to his credit. He has actively participated in more than 15 conferences, workshops and Seminars.



Abhishek Tiwari

Department of Chemistry, St. Xavier's College, Mumbai, India.

He is associated with Department of Chemistry, St. Xavier's College, Mumbai, India. He obtained BSc. degree in Life Science & Biochemistry, MSc. In Biological Sciences. He served as a BD FACS operator at ICMR-NIRRH He is a Junior Research Fellow

(JRF-GATE) -Biomedical Informatics Centre, Dr Susan Thomas, ICMR- NIRRH, and Title of Project: Elucidating molecular markers of PCOS by analyzing high-throughput data from studies involving lean and obese PCOS patients. He is a Visiting fellow at Molecular and Cellular Biology laboratory, Dr Deepak Modi, ICMR- NIRRH, and Title of Project: Understanding E cadherin dynamics in mouse endometrium. His main research **Interests on** Cell Biology, Molecular Biology, Biochemistry, Developmental Biology. He studies Embryo-endometrial crosstalk in deciphering the molecular cues governing embryo implantation. He has keen interests in unveiling the mechanism of embryo implantation. He wishes to understand the complex assembly of life to decipher the underlying regulators. This knowledge, in a long run, will help us overcome birth anomalies and improving fertility rates.

© Copyright (2021): Author(s). The licensee is the publisher (B P International).

Simultaneous Estimation of Ofloxacin and Ornidazole from Pharmaceutical Dosage Form by Spectrophotometric Methods

Pralhad Rege^{1*}, Kyle Meyers¹ and Neha Kapadia¹

DOI: 10.9734/bpi/tprd/v4

ABSTRACT

Two simple, sensitive, accurate, precise, rapid and economical methods were developed for the simultaneous estimation of Ofloxacin and Ornidazole from combined tablet dosage form. First method is based simultaneous equations and second method is based on Q-analysis (absorbance ratio method). Ofloxacin and Ornidazole show absorbance maxima at 293nm and 275nm in 0.1N HCl respectively. The linearity was obtained in the concentration ranges of 2-14 µg/ml for Ofloxacin and 5-35 µg/ml for Ornidazole with Regression Coefficient (R^2) greater than 0.999. In the first method concentration and subsequently amount of drug determined by using simultaneous equations and in second method concentration and amount of drugs determined by using ratio of absorbance at iso-absorptive point(which was found to be 284 nm) and at λ_{max} of one of the drug. The results of analysis have been validated statistically and by assay and recovery studies. Therefore the proposed validated method can be successfully applied for routine quality control analysis and simultaneous determination of Ofloxacin and Ornidazole in combined drug formulations.

Keywords: Ofloxacin; Ornidazole; Absorbance ratio; iso-absorptive point; regression coefficient.

ABBREVIATIONS

OF : Ofloxacin
OZ/ ONZ : Ornidazole
SEM : Simultaneous equation method
ARM : Absorbance ratio method

1. INTRODUCTION

In the topical countries like India, the major problems of health arise due to improper lifestyle, unhealthy environmental conditions, unhygienic and substandard food. Infections caused by the microorganisms like, fungi, protozoa, are most common. Drugs with antifungal and antiprotozoal activity have been used in the treatment of the same.

Ofloxacin, $C_{18}H_{20}FN_3O_4$ with molecular weight 361.368 g/mol is used in the treatment of bacterial infections, while Ornidazole, $C_7H_{10}ClN_3O_3$ with molecular weight 219.63 g/mol is used as an antiprotozoal agent. Ofloxacin and Ornidazole in combined dosage form is available in the market, has gained great acceptance in diarrhea, bacterial and protozoal infections. In many cases, drugs with two active ingredients are prescribed to the patients to have an added advantage. Many of these antibacterial drugs are found in combination with antifungal and antiprotozoal drugs which are highly effective against fungal and protozoal infections.

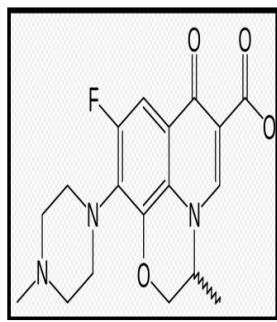
A literature surveys reveals few Chromatographic methods [1] i.e. HPLC HPTLC, Derivative and Extractive spectrophotometric methods for the simultaneous determination of ofloxacin and ornidazole. Very little attention has been paid to the use of electroanalytical method.

¹Department of Chemistry, St. Xavier's College, Maharashtra, India.

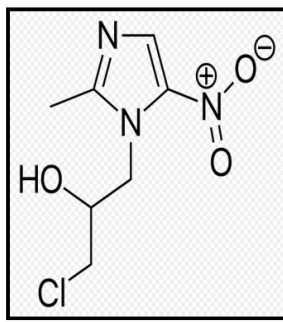
*Corresponding author: E-mail: pralhad1806@gmail.com;

In the present study a successful attempt has been made to estimate both these drugs i.e. Ofloxacin and Ornidazole simultaneously in combined pharmaceutical formulation by two simple spectrophotometric methods. First method is based simultaneous equations and second method is based on Q-analysis (absorbance ratio method). The proposed methods have been validated as per ICH guidelines

1.1 Structure



Ofloxacin



Ornidazole

2. MATERIALS AND METHODS (EXPERIMENTAL)

2.1 Instruments

Systronics UV – VIS spectrophotometer type 118, single beam spectrophotometer with spectral width of 2.0 nm. Wavelength accuracy is + 1.0 nm and a pair of 10 mm matched quartz cells was used to measure the absorbance. The wavelength ranges from 200 – 1000 nm obtained by a 1200 grooves/mm grating with Czerny – Turner Mount. Fused Silica deuterium lamp and tungsten iodide sources are used to cover the wavelength range. High sensitivity, wide range, reliable silicon photocell is used as the detector. The photometric readings of %T (Percent Transmittance), ABS (Absorbance) and CONC (Concentration) are displayed on an electronic display. Stray light corrections are made using a built-in filter wheel containing four filters. There is a built-in 4-position sample changer provided for 10mm cuvettes. The instrument runs on 230V, 50Hz.

2.2 Materials

Pure standard of Ofloxacin and Ornidazole was obtained from Cipla pharmaceutical Pvt. Ltd. The tablet formulations of the said combination were purchased from a local pharmacy (The label claim contained 200 mg of Ofloxacin and 500 mg of Ornidazole.) All the solutions were prepared in double distilled water. All the reagents use were of AR grade.

2.2.1 Preparation of standard solutions

10 mg of standard Ofloxacin and 25 mg of standard Ornidazole was accurately weighed and dissolved in 0.1N HCl and made up to a volume of 50 ml in standard flask to give stock solution (200 µg/ml of Ofloxacin and 500 µg/ml of Ornidazole respectively). Further all the standard solutions containing the mixture of Ofloxacin and Ornidazole were prepared by using this stock solution.

2.2.2 Preparation of the sample solution

Twenty tablets of the combined drug formulation O2 (Medley Pharma Limited) were weighed and powdered. 51 mg the powdered sample equivalent to (10 mg of OF and 25 mg of OZ) was weighed and transferred to a 50 mL standard flask. To it 25 mL of 0.1N HCl was added to dissolve the sample. The mixture was sonicated for 10mins with intermittent shaking. The sample was cooled to room temperature and diluted to 50 mL with 0.1 N HCl and mixed well. The above solution was filtered through Whatman filter paper no. 41 and Further 1.0 mL of this filtered solution was diluted to 10 mL using 0.1 N HCl. The solution so obtained is supposed to contain 20µg/mL of OF and 50µg/mL of OZ.

Absorbances of these solutions were measured at appropriate wavelengths, i.e. at 293 nm (λ_1) and 275 nm (λ_2).

2.3 Method-1: Simultaneous Equation Method [2,3,4,5,6]

Working standard solutions were scanned in the entire range of 200-400 nm to determine λ_{max} of both the drugs. The λ_{max} of Ofloxacin and Ornidazole were found at 293 nm and 275 nm respectively. A series of solutions were prepared having concentration ranges 1-40 $\mu\text{g/ml}$ by using 0.1N HCl from working standard solutions. Absorbances of resulting solutions were measured at 293 nm and 275 nm and calibration curves plotted at these wavelengths. The linearity was obtained in the concentration ranges of 2-14 $\mu\text{g/ml}$ for Ofloxacin and 5-35 $\mu\text{g/ml}$ for Ornidazole. The absorptivity coefficients of these two drugs were determined by using calibration curve equation. Two simultaneous equations were formed using these absorptivity coefficients values.

$$A_1 = 60.1 C_X + 15.0 C_Y \quad (1)$$

$$A_2 = 35.7 C_X + 23.4 C_Y \quad (2)$$

Where, A_1 and A_2 are the absorbances of sample at 293 nm and 275 nm respectively. C_X and C_Y are the concentration ($\mu\text{g/ml}$) in of Ofloxacin and Ornidazole in sample respectively. From the resulting concentration obtained after solving above equations, then amount of Ofloxacin and Ornidazole present in the given sample was found out.

2.3.1 Analytical method validation [7,8]

2.3.1.1 System suitability

System suitability tests are used to ensure reproducibility of the equipment. The test was carried out by recording absorbance at working concentrations for Ofloxacin (4 $\mu\text{g/ml}$, 8 $\mu\text{g/ml}$, 12 $\mu\text{g/ml}$) and for Ornidazole (10 $\mu\text{g/ml}$, 20 $\mu\text{g/ml}$, and 30 $\mu\text{g/ml}$) with five replicates and the mean was used for the whole calculations.

2.3.1.2 Specificity

The specificity of method was confirmed by recording the spectra of both the standard solution and the drug sample solutions. The spectra obtained from the drugs sample solution were found to be identical to those obtained for standard solution.

The addition of the standard solution to the drug sample solution for recovery analysis did not change the characteristics of spectra confirms specificity.

2.3.1.3 Linearity and range

A good linearity was achieved for Ofloxacin and Ornidazole in the concentration ranges of 2-14 $\mu\text{g/ml}$ for Ofloxacin and 5-35 $\mu\text{g/ml}$ Ornidazole. The calibration curves were constructed with concentration (C) against absorbance of both drugs.

2.3.1.4 Limit of detection and limits of quantitation

The signal-to-noise ratio of 3:1 and 10:1 was used to establish LOD and LOQ, respectively. For LOD and LOQ analysis twenty readings for blank recorded then their standard deviation calculated i.e. for $\text{LOD} = (\text{SD} \times 3 + \text{Mean absorbance of Blank})$ and for $\text{LOQ} = (\text{SD} \times 10 + \text{Mean absorbance of Blank})$.

2.3.1.5 Intra-day and inter-day precision/ ruggedness

The intra-day and inter-day precision was used to study the variability of the method. According to USP, ruggedness is the degree of reproducibility of the results obtained under variety of test conditions. It is expressed as percent RSD. It is also called as reproducibility or intermediate precision. It is the analysis of same sample under variety of normal test condition such as different laboratories, different analysts, different instruments, different lots of reagents, different days etc.

It was checked by recording the absorbance as well as spectra of standard solutions of Ofloxacin and Ornidazole i.e. working concentrations for Ofloxacin (4 µg/ml, 8 µg/ml, 12 µg/ml) and for Ornidazole (10 µg/ml, 20 µg/ml, and 30 µg/ml) with five replicates (both at intra-day (five times within 24 hour) and inter-day (two times each. during 3 days intervals) to check the precision.

2.3.1.6 Assay

The validated spectrophotometric method was used for the simultaneous quantitative determination of OF and OZ from the formulation. Quantification has been done by simultaneous equation method (SEM). Two samples of different brands were used for the determination.

The absorptivity coefficients of these two drugs were determined by using calibration curve equation (1) and (2) mentioned earlier.

$$C_X = \frac{(\lambda_2^{\epsilon_2} \times A \lambda_1) - (\lambda_1^{\epsilon_2} \times A \lambda_2)}{(\lambda_1^{\epsilon_1} \times \lambda_2^{\epsilon_2}) - (\lambda_1^{\epsilon_2} \times \lambda_2^{\epsilon_1})} \quad (3)$$

$$C_Y = \frac{(\lambda_1^{\epsilon_1} \times A \lambda_2) - (\lambda_2^{\epsilon_1} \times A \lambda_1)}{(\lambda_1^{\epsilon_1} \times \lambda_2^{\epsilon_2}) - (\lambda_1^{\epsilon_2} \times \lambda_2^{\epsilon_1})} \quad (4)$$

C_X and C_Y was calculated

Where C_X = is Concentration of Ofloxacin, C_Y = is Concentration of Ornidazole

From their concentration finally, the amount of OF and OZ in the tablet formulation is calculated.

Where,

$$\lambda_1^{\epsilon_1} = 60.1 \times 10^{-3} \text{-(OF at 293 nm)}, \lambda_2^{\epsilon_1} = 35.7 \times 10^{-3} \text{-(OF at 275nm)}$$

$$\lambda_1^{\epsilon_2} = 15.0 \times 10^{-3} \text{-(OZ at 293 nm)}, \lambda_2^{\epsilon_2} = 23.4 \times 10^{-3} \text{-(OZ at 275 nm)}$$

A λ₁ = Absorbance of sample mixture at 293 nm
 A λ₂ = Absorbance of sample mixture at 275 nm

2.3.1.7 Accuracy (recovery)

The recovery was used to evaluate the accuracy of the method. Accuracy of the method was determined using the method of standard addition. A fixed volume of standard Ornidazole solution was mixed with different concentrations of preanalyzed sample solutions and mixtures were analyzed by proposed method. The percent recovery was determined at different levels i.e. from 50% to 150% level.

2.4 Method-2: Absorbance Ratio Method (Q-Analysis) [9,4,5,6]

Absorbance ratio method uses the ratio of absorbance at two selected wavelengths one at iso-absorptive point and other being the λ_{max} of one of the components. From the overlay spectra of two drugs, it is evident that Ofloxacin and Ornidazole show iso-absorptive point at 284 nm and the second which is the λ_{max} of Ofloxacin (293nm). The quantification of both drugs was carried out at the selected wavelengths. i.e. 284nm and 293nm. The absorptivity coefficients of these two drugs were determined by using calibration curve equation at 293 nm and 308 nm.

2.4.1 Linearity and range

A series of solutions having concentration ranges 1-40 µg/ml were prepared by using 0.1N HCl Absorbance of resulting solution was measured at 293 nm and 284 nm. Calibration curves were plotted at these wavelengths. The linearity was obtained in the concentration ranges of 2-14 µg/ml for Ofloxacin and 5-35 µg/ml for Ornidazole.

2.4.2 Assay

The validated spectrophotometric method was used for the quantitative determination of OF and OZ simultaneously from the formulation. Quantification has been done by Absorbance Ratio method (ARM). Two samples of different brands were used for the determination.

The Absorptivity coefficients of these two drugs were determined at 293 nm and 284 nm. The concentration of OF and OZ was found out using following equations

$$C_x = \frac{Q_m - Q_y}{Q_x - Q_y} \times \frac{A}{Ax_1} \quad (5)$$

$$C_y = \frac{Q_m - Q_x}{Q_y - Q_x} \times \frac{A}{Ay_1} \quad (6)$$

Where,

C_x = Concentration of X i.e. Ofloxacin

C_y = Concentration of Y i.e. Ornidazole

Q_m = Ratio of absorbance of mixture at λ_{max} (293nm) and λ_{iso} (284 nm)

Q_x = Ratio of absorptivity of X at λ_{max} (293nm) and λ_{iso} (284 nm)

Q_y = Ratio of absorptivity of Y at λ_{max} (293nm) and λ_{iso} (284 nm)

A = Absorbance of mixture at iso-absorptive point i.e. 284 nm.

Ax_1 = E (1%, 1cm) of X at λ_{iso} (absorptivity of x drug at isoabsorptive point)

Ay_1 = E (1%, 1cm) of Y at λ_{iso} (absorptivity of y drug at isoabsorptive point)

2.4.3 Sensitivity

Sensitivity refers to the smallest quantity that can be accurately measured. It also indicates the capacity of the method to record or measure small variations in concentrations. In the case of Spectrophotometric methods, a parameter known as "Sandell's Sensitivity" is used to evaluate the sensitivity of the method. It is the amount required to give an absorbance of 0.001 units in one square centimeter path.

3. RESULTS AND DISCUSSION

1. The proposed methods were found to be simple, accurate, sensitive, precise and economical.
2. Both the methods have been validated as per as ICH guidelines. For system suitability, the mean % RSD was found to be less than 1. for both OF and OZ, Regression analysis (Linearity and Range) for both the drugs was > 0.999 indicates the precision of the validated method. Lower value of LOD and LOQ confirm the sensitivity of the specified method.
3. Lower values of Sandell's Sensitivity and higher values for Molar Absorptivity signifies the effectiveness of the methods for routine use.
4. Repeatability and also inter and intra-day precision was studied where % RSD was found to be less than 1) for both drugs (Table 1).
5. Accuracy was determined for the given methods by calculating the percent recovery at different levels i.e. from 80% to 120% level. The percentage recovery at three different was found to be from 98.00% to 102.00% for both the drugs (Table 3).
6. Quantification of drugs from the formulation was done by assay analysis Assay studies were carried out at three different levels i.e. 80%, 100%, 120% level. The percentage assay at three different levels for OF and OZ was found to be from 98.00% to 102.00% (Table 2).

Table 1. Method validation parameters

Parameters	Method 1 (SEM)		Method 2 (ARM)	
	Ofloxacin	Ornidazole	Ofloxacin	Ornidazole
System suitability (n=5) %RSD	0.69%	0.46%	0.24%	0.51%
Linearity range ($\mu\text{g mL}^{-1}$)	2 to 14 $\mu\text{g/ml}$	5 to 35 $\mu\text{g/ml}$	2 to 14 $\mu\text{g/ml}$	5 to 35 $\mu\text{g/ml}$
Correlation coefficient (R^2)	0.9998	0.9999	0.9998	0.9998
LOD ($\mu\text{g mL}^{-1}$)	0.3 $\mu\text{g/ml}$	0.8 $\mu\text{g/ml}$	0.3 $\mu\text{g/ml}$	0.8 $\mu\text{g/ml}$
LOQ ($\mu\text{g mL}^{-1}$)	1 $\mu\text{g/ml}$	2.5 $\mu\text{g/ml}$	1 $\mu\text{g/ml}$	2.5 $\mu\text{g/ml}$
Intraday precision (n=5) %RSD	0.75%	0.65%	0.35%	0.71%
Interday precision (n=5) %RSD	0.60%	0.45%	0.29%	0.54%
Assay	98% to 102%	98% to 102%	98% to 102%	98% to 102%
Recovery	98% to 102%	98% to 102%	98% to 102%	98% to 102%
Sandell's sensitivity ($\mu\text{g/cm}^2$)	0.01034	0.02858	0.01184	0.02969
Molar Absorptivity (mole/lit/cm)	21718.22	5139.23	18502.041	4128.95

Sample Used:

Brand Name	O2 (Medley Pharma Limited)
Batch No.	E00701
A.P.I.	Ornidazole- 500 mg Ofloxacin – 200 mg
Excipients	q.s.
Colours	Sunset yellow FCF, & titanium dioxide IP

Table 2. Result of assay studies

	Method 1 (SEM)		Method 2 (ARM)	
	Ofloxacin	Ornidazole	Ofloxacin	Ornidazole
Labeled claim (mg)	200 mg	500 mg	200 mg	500 mg
Drug found in mg	198.8 mg	499.1 mg	201.2 mg	504.0 mg
% Assay	99.7%	99.85%	100.3%	100.6%
SD	0.366	0.498	0.524	0.467
% RSD (n=5)	0.311	0.472	0.515	0.461

Table 3. Results of recovery studies

Method Name	Level of % Recovery	% Recovery Found		Standard Deviation (SD)		Relative Standard Deviation % (RSD)(N=5)	
		OF	OZ	OF	OZ	OF	OZ
SEM	0	100.6%	100.2%	0.037	0.032	0.57	0.73
	50 %	99.8%	99.4%	0.041	0.04	0.35	0.51
	100 %	101.01%	101%	0.051	0.045	0.39	0.50
	150%	100.2%	99.7%	0.01	0.07	0.69	0.79
ARM	0	99.6%	100.0%	0.02	0.056	0.33	0.62
	50 %	99.5%	99.9%	0.025	0.015	0.53	0.22
	100 %	100.3%	100.5%	0.032	0.05	0.52	0.55
	150%	101.7%	100.7%	0.033	0.076	0.44	0.69

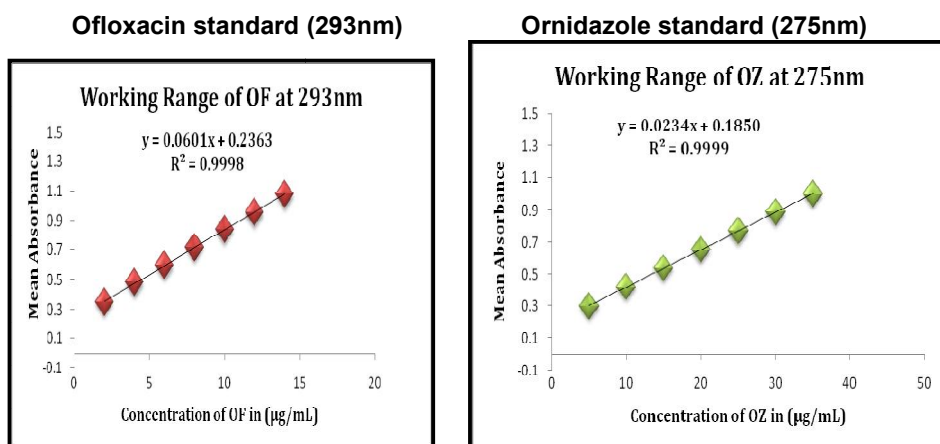


Fig. 1. Linearity graph for :- (SEM)

Iso-absorptive point

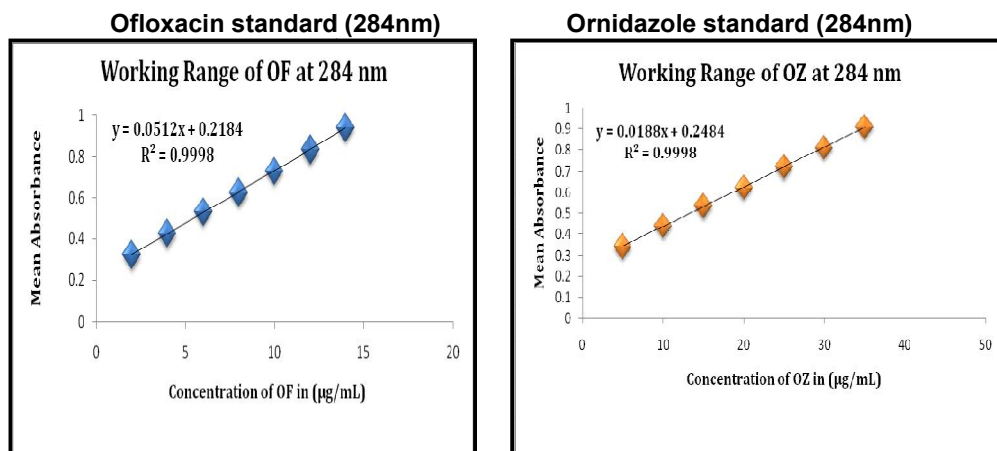


Fig. 2. Linearity graph for: - (ARM)

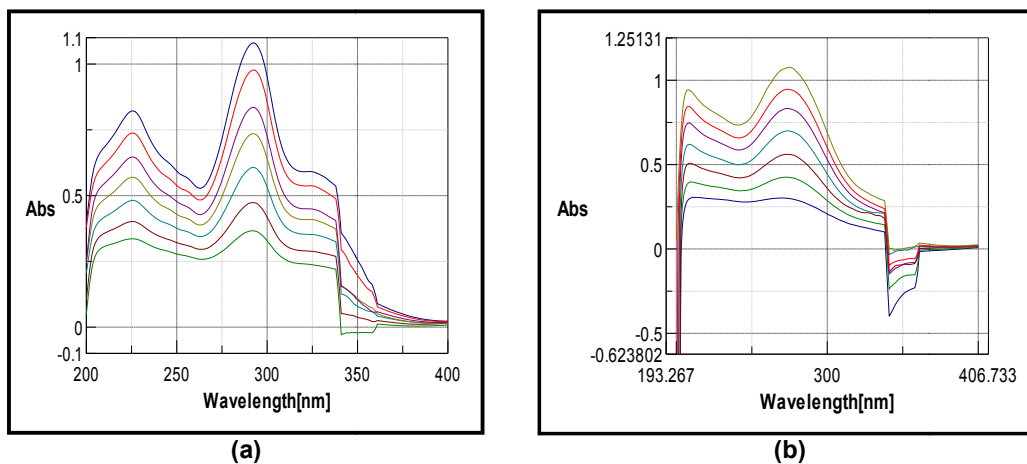


Fig. 3. Overlay spectra of the working range for (a) OF (293 nm) and (b) OZ (275 nm), for a set of Linear working range

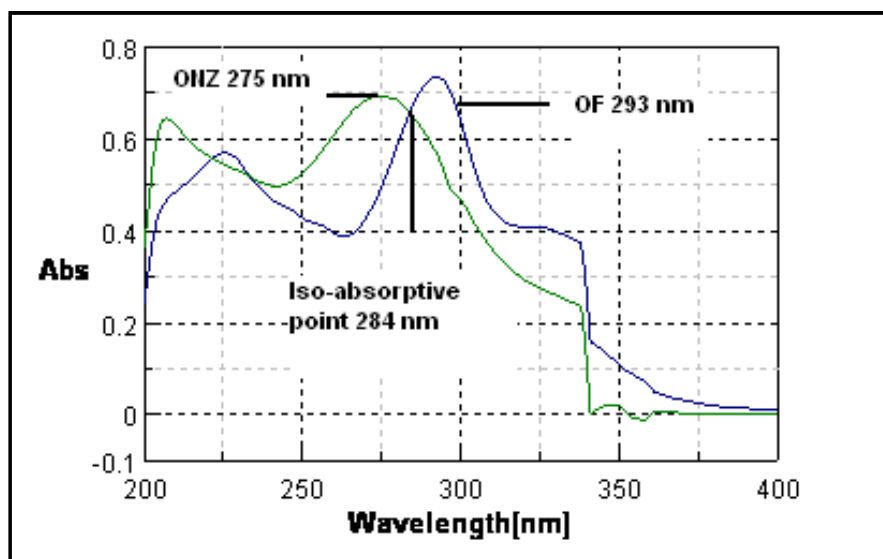


Fig. 4. Overlain spectra of Ofloxacin (293nm), Ornidazole (275nm) and Iso-absorptive point (284nm)

4. CONCLUSION

All above mentioned factors lead to the conclusion that, both the methods described in this paper for simultaneous estimation of Ofloxacin and Ornidazole are found to be simple, accurate, precise, accurate, economical, and rapid, therefore presented methods can be recommended for routine quality control analysis of Ofloxacin and Ornidazole in their combined dosage form.

ACKNOWLEDGEMENT

We thank Cipla Pharmaceutical Pvt. Ltd (Vikroli) and our Department of Chemistry, St. Xavier's College, Mumbai for providing us all the Necessary instrumentation facilities and their technical assistance.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Raj-SV, Kapadia-SU, Argekar-AP. Simultaneous determination of metronidazole and norfloxacin from pharmaceutical preparations by RP-HPLC. *Indian-Drugs*. Oct 1997;34(10): 585-589.
2. Gupta-R, Singhai-AK, Agrawal-RK. Derivative UV spectrophotometric determination of norfloxacin and tinidazole combination in tablets. *Indian-Drugs*. Jul. 2000;37(7):348-349.
3. ICH Q2B, Validation of Analytical Procedure: Methodology, In. *Proc. Int. Con. Harmonization*, Geneva; 1996.
4. Chaudhary Ankit B*, Patel Rakesh K, Chaudhary Sunita A. Estimation of Valsartan and Nebivolol in pharmaceutical dosage forms by absorption ratio method *International journal of Research in Pharmaceutical Science*. 2010;1(2):108-112.
5. Patel SA, Patel NM, Patel MM. Simultaneous spectrophotometric estimation of ciprofloxacin and ornidazole in tablets. *Indian J. Pharm. Sci*. 2006;68(5):665-667.

6. Sohan S. Chitlange*, Soni Ranjana, Sagar B. Wankhede, et al. Spectrophotometric Methods for Simultaneous Estimation of Nimesulide and Drotaverine. International Journal of ChemTech Research, April-June. 2009;1(2):135-138.
7. Raj-SV, Kapadia-SU, Argekar-AP. Simultaneous determination of metronidazole and norfloxacin from pharmaceutical preparations by RP-HPLC. Indian-Drugs. Oct. 1997;34(10): 585-589.
8. ICH, Q2A, Validation of Analytical Procedure: Methodology, In. Proc. Int. Con. Harmonization, Geneva; 1994.
9. Pralhad Rege*, Kyle Meyers, Neha Kapadia. "Simultaneous Determination of Norfloxacin and Metronidazole from combined tablet dosage formulation by spectrophotometry" The Pharma Innovation Journal. 2019;8(6):975-979.

Biography of author(s)



Dr. Pralhad Rege

Department of Chemistry, St. Xavier's College, Maharashtra, India.

He is working in capacity of Assistant Professor in the Department of Chemistry, St. Xavier's College Mumbai. He completed his Ph.D. in Analytical Chemistry. He also hold PGDHRM from Symbiosis, Pune and PG Diploma in Clinico-Regulatory and Patents from Ruia College. His total teaching experience is 13 years and research experience is 12 years. He is a Mumbai University recognized guide for M.Sc by research and Ph.D. Currently two students for M.Sc by research and three students for PhD are working under his supervision. His area of research interest is Analytical chemistry, Pharmaceutical chemistry, synthetic chemistry and Herbal science. He has published 21 research papers in various national and international, actively participated in more than 70 conferences / workshops/ Seminars/ online FDP's. Till date he has Presented 15 research papers in the form of Oral / poster presentations. He has been part of various Departmental and College level committees. He is an Advisory and Editorial member of various National and International journals. He has received Minor Research Grant from University of Mumbai for the Academic year 2016-17. He has Worked as Reviewer for the book titled "Concise Graduate Chemistry –II (ISBN: 978-81-942249-1-4) published by University of Mumbai. He has Written a book (As one of the Authors) titled "Concise Graduate Chemistry –III (ISBN: 978-81-942249-5-2) currently in Press and will be published by University of Mumbai. He is also a visiting faculty in Ruia, K.J.Somaiya, Mithibai, Guru Nanak, Vivekanand and Konkan Gyanpeeth, Karjat College. He has invited as a Recourse Person in Chemistry in the International Junior Science Olympiad-Cum-Selection Camp (OCC) at K.J.Somayia College. He worked as a Presiding Officer in various Assembly Parliamentary and Legislative Assembly Elections. His prime objective is to make a significant contribution in the field of Education and Research.



Mr. Kyle Meyers

Department of Chemistry, St. Xavier's College, Maharashtra, India.

He is an aspiring researcher with experience in education and chemistry. He is also a detail-oriented bench researcher with a substantial background in various fields of chemistry some of which include Nanoparticles and analytical instrumentation. He has been a Research Scholar with Dr. Pralhad Rege since his student life and he has shared many research and educational endeavors with him.



Ms. Neha Kapadia

Department of Chemistry, St. Xavier's College, Maharashtra, India.

She is an aspiring researcher with experience and a highly refined skill set, including strategic planning, confidentiality, organization, and teamwork. She also worked as a research assistant for a year in the field of Nano-sciences and Spectroscopy. She has been known and awarded for my optimistic nature which helps her maintain a positive vibe in her work ethics. Social help has always been a part of her nature.

© Copyright (2020): Author(s). The licensee is the publisher (Book Publisher International).

DISCLAIMER

This chapter is an extended version of the article published by the same author(s) in the following journal.
Analytical Chemistry: An Indian Journal, 10(9): 570-575, 2011.