

---

# Immunodiagnostic Technologies from Laboratory to Point-Of-Care Testing

---

Pankaj Suman • Pranjal Chandra  
Editors

# Immunodiagnostic Technologies from Laboratory to Point-Of-Care Testing

 Springer

### *Editors*

Pankaj Suman  
Animal Biotechnology Laboratory  
National Institute of Animal  
Biotechnology (NIAB) Hyderabad  
Hyderabad, Telangana, India

Pranjal Chandra  
School of Biochemical Engineering, Indian  
Institute of Technology  
Laboratory of Bio-Physio Sensors  
and Nano-bioengineering  
Varanasi, Uttar Pradesh, India

ISBN 978-981-15-5822-1      ISBN 978-981-15-5823-8 (eBook)  
<https://doi.org/10.1007/978-981-15-5823-8>

© Springer Nature Singapore Pte Ltd. 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 Singapore Pte Ltd.  
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

---

# Contents

|  |            |
|--|------------|
| <b>Biosensors for Clinical Samples: Consideration and Approaches . . . . .</b>   | <b>1</b>   |
| Mihaela Tertis, Oana Hosu, Anca Florea, and Cecilia Cristea  |            |
| <b>Immunodiagnosis by Electrochemical Multiplexing<br/>in Clinical Samples . . . . .</b>                                     | <b>33</b>  |
| S. Campuzano, P. Yáñez-Sedeño, and José M. Pingarrón   |            |
| <b>Principle and Applications of Immunodiagnostics Using Radioisotope<br/>as Tracers . . . . .</b>                           | <b>61</b>  |
| Shishu Kant Suman, Rohit Sharma, and Chandan Kumar   |            |
| <b>Redox Cycling Technologies for Point-of-Care Immunodiagnostics<br/>in Various Matrices . . . . .</b>                      | <b>75</b>  |
| Gorachand Dutta, Despina Moschou, and Riddhipratim Mandal  |            |
| <b>Next-Generation Immunosensing Technologies Based<br/>on Nano-Bio-Engineered Paper Matrices . . . . .</b>                  | <b>93</b>  |
| Kuldeep Mahato, Budhhadev Purohit, Ashutosh Kumar,<br>Ananya Srivastava, and Pranjal Chandra                                 |            |
| <b>Alternative Analyte-Binding Compounds for Immunosensor-Like<br/>Point-of-Care Application . . . . .</b>                   | <b>111</b> |
| Ankita Kushwaha, Yuzuru Takamura, and Manish Biyani  |            |
| <b>Bead-Based SELEX for Aptamers Selection and Their Application<br/>in Detection of Diverse Antigens . . . . .</b>          | <b>125</b> |
| Devika N. Nagar, T. Yathirajaro, Pankaj Kumar, Pooja Kushwaha,<br>and Pankaj Suman   |            |
| <b>Changing Trends in Immunosensing Technologies and Their<br/>Commercial Aspects in Animal Health and Welfare . . . . .</b> | <b>141</b> |
| Sherin Kaul, Rajni Singh, Sharanya Kamaraju, and Pankaj Suman  |            |
| <b>Methods for Enhancing Aptamer Affinity for Antigen Detection<br/>and Its Characterization . . . . .</b>                   | <b>163</b> |
| Komal Birader, L. Sai Keerthana, T. Yathirajaro, Jeannie Alice Barla,<br>and Pankaj Suman                                    |            |

---

|   |            |
|---|------------|
| <b>Application of Biosensors to Enhance Reproductive Efficiency and Production of Livestock and Poultry by Diverse Antigen Analysis . . .</b> | <b>185</b> |
| Pankaj Kumar, Shalini Chakraborty, Devika Nagar, Komal Birader, and Pankaj Suman  |            |
| <b>Clinical Implications of Cortisol and Bioanalytical Methods for Their Determination in Various Biological Matrices . . . . .</b>           | <b>195</b> |
| Ajay Kumar Sahi, Neelima Varshney, Rakesh Kumar Sidu, Suruchi Poddar, Pallawi, Kameshwarnath Singh, and Sanjeev Kumar Mahto                   |            |
| <b>Receptors in Immunodiagnostics: Antibodies, Antibody Fragments, Single Domain Antibodies and Aptamers . . . . .</b>                        | <b>223</b> |
| Nachiket Shembekar  |            |

---

## About the Authors

**Pankaj Suman** is a Scientist and Principal Investigator at the National Institute of Animal Biotechnology, Hyderabad, India. He did his Bachelors in Veterinary Medicine from Maharashtra Animal & Fishery Sciences University, Nagpur, India and obtained his MS degree from the Indian Institute of Technology Roorkee, Roorkee, India. He did his Ph.D. at the National Institute of Immunology, New Delhi. He also worked as visiting scholar at Friedrich-Schiller University, Jena, Germany (2007–2010). His research experience spans through varying discipline of science pertaining to immunology, reproductive biology, veterinary, and clinical medicine. In the past, he has made a significant contribution in understanding the molecular mechanisms behind the immunological basis of pregnancy, vaccine delivery, and diagnostics. His current research is focused on the development of biosensing devices for the detection of small molecules (toxins, metabolites, etc.) through designing small antibodies and aptamers as a tool for detection. Till now, he has published over 25 research articles in various reputed journals. He is a recipient of several prestigious fellowships and awards from agencies like Council of Scientific & Industrial Research, India, Department of Science and Technology, India, and United States Department of Agriculture, USA. He is also a recipient of the prestigious G. P. Talwar Young Scientist award for outstanding contribution in reproductive health. He has attended several national and international conferences and delivered invited talks.

**Pranjal Chandra** is currently employed as an Assistant Professor at the School of Biochemical Engineering, Indian Institute of Technology (BHU), Varanasi, India. He earned his Ph.D. from Pusan National University, South Korea and did his postdoctoral training at Technion-Israel Institute of Technology, Israel. His research focus is highly interdisciplinary, spanning a wide range in biotechnology, nanobiosensors, material engineering, nanomedicine, etc. He has designed several commercially viable biosensing prototypes that can be operated for onsite analysis for biomedical diagnostics, environmental monitoring, and other point-of-care testing applications. He has published six books on various aspects of biosensors/medical diagnostics from IET London, Springer Nature, and CRC Press, USA. He has also published over 85 journal articles in topmost journals in his research area including Biosensors and Bioelectronics, Analytical Chemistry, Biomaterials,

Chemical Communications, Electroanalysis, etc. His work has been greatly highlighted in over 300 topmost news agencies globally including Rajya Sabha TV; DD Science; Science Trends, USA; Nature India; Vigyan Prasar; Global Medical Discovery, Canada; APBN Singapore; Business Wire, Dublin; etc. He is a recipient of many prestigious awards and fellowships such as DST Ramanujan Fellowship (Government of India); Early Career Research Award (DST, Government of India); Brain Korea-21 and National Research Foundation Fellowship, South Korea; Technion Postdoctoral Fellowship, Israel; NMS Young Scientist Award, Biotech Research Society India Young Scientist Award, Young Engineers Award 2018, RSC Highly Cited Corresponding Author Award (general chemistry); ACS/Elsevier Outstanding Reviewer Awards, etc. He is a reviewer of over 50 international journals and expert project reviewer of various national/international funding agencies. He is Associate Editor of *Sensors International* and an editorial board member of *Materials Science for Energy Technologies* by KeAi and Elsevier; *World Journal of Methodology*, USA; *Frontiers in Biosciences*, USA; and *Reports in Physical Sciences*, Singapore.