Principles and Practices of Canine and Feline Clinical Parasitic Diseases

Edited by Tanmoy Rana



Principles and Practices of Canine and Feline Clinical Parasitic Diseases

Principles and Practices of Canine and Feline Clinical Parasitic Diseases

Edited by

Tanmoy Rana Department of Veterinary Clinical Complex West Bengal University of Animal & Fishery Sciences Kolkata, West Bengal, India Copyright © 2024 by John Wiley & Sons, Inc. All rights reserved.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey. Published simultaneously in Canada.

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, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 750-4470, or on the web at www.copyright.com. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at http://www.wiley.com/go/permission.

Trademarks: Wiley and the Wiley logo are trademarks or registered trademarks of John Wiley & Sons, Inc. and/or its affiliates in the United States and other countries and may not be used without written permission. All other trademarks are the property of their respective owners. John Wiley & Sons, Inc. is not associated with any product or vendor mentioned in this book.

Limit of Liability/Disclaimer of Warranty: While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Further, readers should be aware that websites listed in this work may have changed or disappeared between when this work was written and when it is read. Neither the publisher nor authors shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

For general information on our other products and services or for technical support, please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic formats. For more information about Wiley products, visit our web site at www.wiley.com.

Library of Congress Cataloging-in-Publication Data

Names: Rana, Tanmov, editor.

Title: Principles and practices of canine and feline clinical parasitic

diseases / edited by Tanmoy Rana.

Description: Hoboken, New Jersey: Wiley Blackwell, [2024] | Includes

bibliographical references and index.

Identifiers: LCCN 2023030588 (print) | LCCN 2023030589 (ebook) |

ISBN 9781394158249 (hardback) | ISBN 9781394158270 (adobe pdf) |

ISBN 9781394158263 (epub)

Subjects: MESH: Parasitic Diseases, Animal | Dog Diseases | Cat Diseases |

Host-Parasite Interactions | Antiparasitic Agents

Classification: LCC SF810.A3 (print) | LCC SF810.A3 (ebook) | NLM SF

810.A3 | DDC 636.089/696-dc23/eng/20231030

LC record available at https://lccn.loc.gov/2023030588

LC ebook record available at https://lccn.loc.gov/2023030589

Cover Design: Wiley

Cover Image: © Tanmoy Rana

Set in 9.5/12.5pt STIXTwoText by Straive, Pondicherry, India

Contents

| | List of Contributors xxi Preface xxv Acknowledgment xxvii |
|-------|--|
| L | General Introduction to Canine and Feline Parasitic Diseases 1 Sanweer Khatoon |
| l.1 | Introduction 1 |
| 1.2 | Type of Intestinal Parasites 5 |
| 1.3 | Diagnosis, Treatment, and Prevention 6 |
| 1.4 | Control 6 |
| 1.5 | Internal Parasites 6 |
| 1.6 | General Measures for the Prevention of Worm Infections 8 |
| 1.7 | Anti-helminthics and Deworming Guidelines 9 References 9 |
| 2 | Symbiosis and Parasitism in Dogs and Cats 11 |
| 2.1 | Adedayo M. Awoniyi Introduction 11 |
| 2.1 | Examples of Dog and Cat Parasites 14 |
| 2.2.1 | Factors Predisposing Dogs and Cats to Parasitic Infections 15 |
| 2.2.2 | Effect of Parasitism in Dogs and Cats and Possible Spillover Effects on Humans 16 |
| 2.2.3 | Prevention of Parasitic Infections in Dogs and Cats 17 |
| 2.3 | Recommendations and Conclusion 18 References 18 |
| 3 | Risk Factors Associated with Parasitic Diseases in Dogs and Cats 19 Baleshwari Dixit, Rinesh Kumar, Alok K. Dixit, and Alok K. Singh |
| 3.1 | Introduction 19 |
| 3.2 | Intrinsic Factors 21 |
| 3.3 | External Factors 22 |
| 3.3.1 | Management Factors 23 |
| 3.3.2 | Life Style and Social Behavior 26 |
| 3.3.3 | Environmental Factors 27 |
| 3.4 | Control 28 References 29 |
| 1 | Host-Parasite-Microbiome Interactions in Dogs and Cats 31 Furqan Munir, Amna Shakoor, Muhammad Tahir Aleem, and Zia ud Din Sindhu |
| 4.1 | Introduction 31 |
| 1.2 | Microbiome of Parasites 32 |

| vi | Contents | |
|----|----------|---|
| | 4.3 | The Microbiome of Dogs and Cats 32 |
| | 4.4 | Microbiomes and Helminths in the Guts of Dogs and Cats 33 |
| | 4.5 | Microbiota-mediated Protection 33 |
| | 4.5.1 | Internal Environment Resources 34 |
| | 4.5.2 | Immune Response 34 |
| | 4.5.3 | Continuum of Parasitism–Mutualism 34 |
| | 4.6 | Why Do We Need to Study the Microbiota? 36 |
| | 4.7 | Future Perspectives 37 |
| | 4.8 | Conclusion 37 |
| | | Acknowledgments 37 |
| | | References 37 |
| | 5 | Linguatula serrata Worm Infections in Dogs and Cats 41 V. G. Charitha, C. Sreedevi, V. C. Rayulu, and P. M. Kondaiah |
| | 5.1 | Introduction 41 |
| | 5.2 | Taxonomy 41 |
| | 5.3 | Historical Perspective 42 |
| | 5.3.1 | First Period 42 |
| | 5.3.2 | Second Period 42 |
| | 5.3.3 | Third Period 43 |
| | 5.3.4 | Fourth Period 43 |
| | 5.3.5 | Fifth Period 43 |
| | 5.4 | Incidence and Geographical Distribution 43 |
| | 5.4.1 | Definitive Hosts (Dogs/Cats) 43 |
| | 5.4.2 | Humans 43 |
| | 5.4.3 | Intermediate Hosts (Ruminants) 43 |
| | 5.5 | Morphology 43 |
| | 5.5.1 | Adult Worm 45 |
| | 5.5.2 | Egg 45 |
| | 5.5.3 | Nymph 45 |
| | 5.6 | Life Cycle 46 |
| | 5.7 | Pathogensis and Clinical Signs 46 |
| | 5.7.1 | In the Definitive Host 46 |
| | 5.7.2 | In the Intermediate Host 47 |
| | 5.7.3 | In Humans (Zoonotic/Public Health Implications) 47 |
| | 5.7.3.1 | Visceral Linguatulosis 48 |
| | 5.7.3.2 | Nasopharyngeal Linguatulosis 48 |
| | 5.8 | Diagnosis 48 |
| | 5.9 | Treatment and Control 48 |
| | | References 49 |
| | 6 | Annelida Infestations in Dogs and Cats 53 Hanumappa Dhanalakshmi |
| | 6.1 | Leech Structure 53 |
| | 6.2 | Leech Organ Systems 53 |
| | 6.2.1 | Respiratory System 53 |
| | 6.2.2 | Circulatory System 53 |
| | 6.2.3 | Nervous System 53 |
| | 6.2.4 | Excretary System 53 |
| | 6.3 | Reproduction 53 |
| | 6.3.1 | Cocoon Assembly 53 |

6.4

Life Cycle 54

| 6.5 | Leech Habitats 54 |
|---------|---|
| 6.5.1 | Terrestrial Leeches 54 |
| 6.5.2 | Aquatic Leeches 54 |
| 6.6 | Feeding 55 |
| 6.7 | Morphological Characteristics of Leech Families 55 |
| 6.7.1 | Limnatis nilotica 55 |
| 6.7.2 | Praobdellidae 57 |
| 6.7.2.1 | Dinobdella ferox 57 |
| 6.7.2.2 | Myxobdella fricana 57 |
| 6.7.3 | Haemadipsidae 57 |
| 6.7.3.1 | Phytobdella catenifera 58 |
| 6.7.3.2 | • |
| 6.7.4 | Theromyzon tessulatum 58 |
| 6.8 | Transmission 58 |
| 6.9 | Pathogenesis 58 |
| 6.9.1 | Dogs 58 |
| 6.9.2 | Cats 58 |
| 6.10 | Treatment 58 |
| 6.11 | Control 59 |
| 0.11 | References 59 |
| | References 39 |
| 7 | Insecta Infestations in Dogs and Cats 61 |
| , | Anil Kumar, Tanmoy Rana, Sonam Bhatt, and Ankesh Kumar |
| 7 1 | Introduction 61 |
| 7.1 | |
| 7.2 | Diptera (Flies) 61 |
| 7.2.1 | Nematocerans 62 |
| | Biting Midges 62 |
| | Blackflies 62 |
| | Sandflies 63 |
| 7.2.1.4 | Mosquitoes 63 |
| 7.2.2 | Cyclorrhaphans 63 |
| 7.2.2.1 | House and Stable Flies 63 |
| | Blowflies 63 |
| | |
| 7.2.2.4 | |
| 7.2.3 | Brachycerans (Horseflies) 64 |
| 7.3 | Phthiraptera (Lice) 64 |
| 7.4 | Siphonaptera (Fleas) 65 |
| 7.5 | Hemiptera (Bed Bugs) 67 |
| 7.6 | Ticks and Mites 67 |
| 7.6.1 | Ticks 67 |
| 7.6.2 | Mites 68 |
| | References 71 |
| | |
| 8 | Acanthocephala Worm Infections in Dogs and Cats 73 |
| | Ramesh Putchakayala and Gurram S. Haritha |
| 8.1 | Origin and Classification 73 |
| 8.1.1 | Taxonomical Classification of Acanthocephala Spp. 74 |
| 8.2 | General Description 74 |
| 8.3 | Developmental Stages 75 |
| 8.4 | Acanthocephalans in Small Animals 75 |
| 8.4.1 | Macracanthorhynchus Spp. 76 |

| 8.4.1.2 | Life Cycle of <i>Macracanthorhynchus</i> 76 Clinical Presentation and Diagnosis 76 Treatment and Prevention 76 Oncicola spp. 77 References 78 |
|----------------|---|
| 9 | Tick-borne Diseases in Dogs and Cats 79 |
| | Ugochukwu F. Ogbodo |
| 9.1 | Babesiosis 79 |
| 9.1.1 | Etiology 79 |
| 9.1.2 | |
| 9.1.3 | |
| 9.1.4 | Clinical Signs and Pathology 80 |
| 9.1.4.1 | Canine Babesiosis 80 |
| 9.1.4.2 | Feline Babesiosis 80 |
| 9.1.5 | Diagnosis 80 |
| 9.1.6 | Treatment and Management of Babesiosis 80 |
| | Canine Babesiosis 80 |
| | Feline Babesiosis 81 |
| 9.2 | Cytauxzoonosis 81 |
| 9.2.1 | Etiology 81 |
| 9.2.2 | Epidemiology 81 |
| 9.2.3 | Life Cycle 81 |
| 9.2.4 | Clinical Signs and Pathology 81 |
| 9.2.5 | Diagnosis 81 |
| 9.2.6 | Treatment and Management of Feline Cytauxzoonosis 81 |
| 9.3 | Ehrlichiosis and Anaplasmosis 82 |
| 9.3.1 | Etiology 82 |
| 9.3.2 | Life Cycle 82 Epidemiology 82 |
| 9.3.3 9.3.4 | Clinical Signs and Pathology 83 |
| 9.3.5 | Diagnosis 83 |
| 9.3.6 | Treatment and Management of Canine Ehrlichiosis and Anaplasmosis 84 |
| 9.4 | Hemotropic Mycoplasmosis 84 |
| 9.4.1 | Etiology 84 |
| 9.4.2 | Epidemiology 84 |
| 9.4.3 | Clinical Signs and Pathology 84 |
| 9.4.4 | Diagnosis 84 |
| 9.4.5 | Treatment and Management of Hemotropic Mycoplasmosis 85 |
| 9.5 | Hepatozoonosis 85 |
| 9.5.1 | Etiology 85 |
| 9.5.2 | Life Cycle 85 |
| 9.5.3 | Epidemiology 85 |
| 9.5.4 | Clinical Signs and Pathology 85 |
| 9.5.5 | Diagnosis 86 |
| 9.5.6 | Treatment and Management 87 |
| 9.6 | Lyme Borreliosis 87 |
| 9.6.1 | Etiology 87 |
| 9.6.2 | Epidemiology 87 |
| 9.6.3 | Life Cycle 87 |
| 9.6.4 | Clinical Signs and Pathology 87 |
| 9.6.5 | Diagnosis 88 |

| 9.6.6 | Treatment and Management 88 |
|--------|---|
| 9.7 | Rocky Mountain Spotted Fever 88 |
| 9.7.1 | Etiology 88 |
| 9.7.2 | Epidemiology 88 |
| 9.7.3 | Clinical Signs and Pathology 89 |
| 9.7.4 | Diagnosis 89 |
| 9.7.5 | Treatment and Management 89 |
| | References 90 |
| | |
| 10 | Doundwarm Infections in Docs and Cate 02 |
| 10 | Roundworm Infections in Dogs and Cats 93 J. Adeppa and V. Gnani Charitha |
| 10.1 | Introduction 93 |
| 10.1 | |
| 10.2.1 | Morphology 93 Adult Worm 93 |
| | |
| 10.2.2 | 22 |
| 10.2.3 | ϵ |
| 10.3 | Life Cycle 95 Tracheal Migration 96 |
| 10.3.1 | e |
| 10.3.2 | Somatic Migration 96 |
| 10.3.3 | Transplacental/Transmammary Routes 96 |
| 10.3.4 | Paratenic Host 96 |
| 10.3.5 | Zoonotic Implications 97 |
| 10.4 | Clinical Findings and Lesions in Small Animals 97 |
| 10.5 | Clinical Findings and Pathogenesis in Humans 97 |
| 10.5.1 | Visceral Larva Migrans 98 |
| 10.5.2 | Occular Larva Migrans/Occular Toxocariosis 98 |
| 10.5.3 | Covert Toxocariois 99 |
| 10.5.4 | |
| 10.6 | Diagnosis 99 |
| 10.7 | Treatment 99 |
| 10.8 | Prevention 99 |
| | References 100 |
| | |
| 11 | Tapeworm Infections in Dogs and Cats 101 |
| | Manoj K. Kalita, Gautam Bordoloi, and Prerona Patowary |
| 11.1 | Introduction 101 |
| 11.2 | Dipylidium Tapeworms 101 |
| 11.2.1 | Life Cycle 102 |
| 11.2.2 | Pathogenesis and Clinical Presentation 102 |
| 11.2.3 | Diagnosis 102 |
| 11.2.4 | Treatment 102 |
| 11.2.5 | Control 102 |
| 11.3 | Taenia Tapeworms of Dogs and Cats 102 |
| 11.3.1 | T. multiceps 104 |
| 11.3.2 | T. pisiformis 104 |
| 11.3.3 | T. taeniaeformis 104 |
| 11.3.4 | T. ovis 104 |
| 11.3.5 | T. serialis 104 |
| 11.3.6 | T. crassiceps 104 |
| 11.3.7 | Clinical Presentation of Taeniosis 104 |
| 11.3.8 | Diagnosis 104 |

| x | Contents | |
|---|----------|---|
| | 11.3.9 | Treatment and Prevention 105 |
| | 11.4 | Echinococcus 105 |
| | 11.4.1 | E. granulosus 105 |
| | | Pathogenesis and Clinical Presentation 105 |
| | | Diagnosis 105 |
| | | Treatment 105 |
| | 11.4.1.4 | Control 105 |
| | 11.4.1.5 | Public Health Considerations 106 |
| | 11.5 | Mesocestoides 106 |
| | 11.5.1 | Pathogenesis and Clinical Presentation 107 |
| | 11.5.2 | |
| | 11.6 | Diphyllobothrium 107 |
| | 11.6.1 | Diphyllobothrium latum 107 |
| | 11.6.1.1 | Pathogenesis and Clinical Presentation 108 |
| | 11.6.1.2 | Diagnosis 108 |
| | 11.6.1.3 | Treatment 108 |
| | 11.6.1.4 | Prevention and Control 108 |
| | 11.6.2 | Spirometra mansonoides 108 |
| | 11.6.2.1 | Pathogenesis and Clinical Presentation 108 |
| | 11.6.2.2 | Diagnosis 108 |
| | 11.6.2.3 | Treatment 109 |
| | | References 109 |
| | 12 | Fluke Infections in Dogs and Cats 111 |
| | | Sanweer Khatoon, Afroz Jahan, Naresh Kumar, and Tikam Goyal |
| | 12.1 | Introduction 111 |
| | 12.2 | Trematodes (Platyhelminthes, Flatworms, Flukes) 111 |
| | 12.2.1 | • |
| | | Life Cycle 112 |
| | 12.2.1.2 | Pathogenesis 112 |
| | 12.2.1.3 | |
| | 12.2.1.4 | |
| | 12.2.2 | 1 7 |
| | 12.2.2.1 | Etiology and Occurrence 112 |
| | 12.2.2.2 | Life Cycle 112 |
| | 12.2.2.3 | Clinical Features 112 |
| | | Diagnosis 112 |
| | | Treatment and Control 112 |
| | 12.2.3 | Intestinal Flukes II. Alaria Spp. Infections 112 |
| | 12.2.3.1 | |
| | 12.2.3.2 | • |
| | 12.2.3.3 | Clinical Features 112 |
| | | Diagnosis 112 |
| | 12.2.3.5 | |
| | 12.2.4 | |
| | 12.2.5 | Heterobilharzia Infection (Blood Fluke) 113 |
| | | Etiology and Occurrence 113 Life Cycle 113 |
| | | Clinical Features 113 |
| | | Diagnosis 113 |
| | 12.2.5.5 | |
| | 12.2.5.3 | Hepatic Flukes 113 |
| | 12.2.7 | Lung Flukes (Paragonimosis) 113 |

12.2.7.1 Etiology and Occurrence 113

| 12.2.7.2 | Life Cycle 113 |
|----------|--|
| 12.2.7.3 | Clinical Features 114 |
| 12.2.7.4 | Diagnosis 114 |
| 12.2.7.5 | Treatment and Control 114 |
| 12.2.7.6 | Public Health Significance 114 |
| 12.2.8 | Order of Distomes 114 |
| 12.2.8.1 | Dicrocoeliidae 114 |
| 12.2.8.2 | Heterophyidae 114 |
| 12.2.8.3 | Troglotrematidae 114 |
| 12.2.8.4 | Echinostomatidae 114 |
| 12.2.8.5 | Diplostomatidae 114 |
| 12.2.8.6 | Eggs 115 |
| 12.2.8.7 | Diagnosis 115 |
| 12.3 | Host Associations and Transmission Between Hosts 115 |
| 12.4 | Pathogenesis 115 |
| 12.5 | Public Health Considerations 115 |
| 12.6 | Conclusion 116 |
| 12.7 | Recommended Treatments and Strategies 116 |
| 12.7 | References 117 |
| | References 117 |
| | |
| 13 | Protozoan Infections in Dogs and Cats 119 |
| | Manoj K. Kalita and Prerona Patowary |
| 13.1 | Babesiosis (Piroplasmosis) 119 |
| 13.1.1 | Epidemiology and Etiology 119 |
| | Canine Babesiosis 119 |
| 13.1.1.2 | |
| 13.1.2 | Life Cycle 119 |
| 13.1.3 | Clinical Features 119 |
| 13.1.4 | Diagnosis 120 |
| 13.1.5 | Treatment and Control 120 |
| 13.1.3 | Hepatozoonosis 120 |
| 13.2.1 | Etiology and Epidemiology 120 |
| 13.2.1 | Life Cycle 121 |
| 13.2.2 | Clinical Features 121 |
| | |
| 13.2.4 | Diagnosis 121 |
| 13.2.5 | Treatment and Control 121 |
| 13.3 | Cytauxzoonosis 121 |
| 13.3.1 | Etiology and Epidemiology 121 |
| 13.3.2 | Life Cycle 121 |
| 13.3.3 | Clinical Features 121 |
| 13.3.4 | Diagnosis 122 |
| 13.3.5 | Treatment and Control 122 |
| 13.4 | Trypanosomiasis 122 |
| 13.4.1 | Etiology and Epidemiology 122 |
| 13.4.2 | Life Cycle 122 |
| 13.4.3 | Clinical Features 122 |
| 13.4.4 | Diagnosis 123 |
| 13.4.5 | Treatment of Trypanosomiasis in Dogs 123 |
| 13.5 | Toxoplasmosis 123 |
| 13.5.1 | Etiology and Epidemiology 123 |
| 13.5.2 | Life Cycle 123 |
| 13.5.3 | Clinical Characteristics 123 |
| 13.5.4 | Diagnosis 124 |

| xii | Contents | |
|-----|----------|--|
| xii | Contents | |

| 13.5.5 | Treatment and Control 124 |
|-----------|--|
| 13.6 | Leishmanisis 125 |
| 13.6.1 | Etiology and Epidemiology 125 |
| 13.6.2 | Geographic Distribution 125 |
| 13.6.3 | Life Cycle 125 |
| 13.6.4 | Clinical Features 125 |
| 13.6.5 | Diagnosis 125 |
| 13.6.6 | Treatment and Prevention 125 |
| 13.7 | Neosporosis 125 |
| 13.7.1 | Etiology and Epidemiology 125 |
| 13.7.2 | Life Cycle 126 |
| 13.7.3 | Clinical Characteristics 126 |
| 13.7.4 | Diagnosis 126 |
| 13.7.5 | Treatment and Control Management 126 |
| 13.8 | Sarcocystosis 126 |
| 13.8.1 | Etiology and Epidemiology 126 |
| 13.8.2 | Life Cycle 126 |
| 13.8.3 | Clinical Signs and Diagnosis 127 |
| 13.8.4 | Treatment and Control 127 |
| 13.9 | Trichomoniasis 127 |
| 13.9.1 | Etiology 127 |
| 13.9.2 | Life Cycle 127 |
| 13.9.3 | Clinical Features 127 |
| 13.9.4 | Diagnosis 127 |
| 13.9.5 | Treatment 127 |
| 13.10 | Intestinal Protozoa of Dogs and Cats 127 |
| | Giardiasis 127 |
| 13.10.1.1 | Etiology 127 |
| 13.10.1.2 | Life Cycle 128 |
| 13.10.1.3 | Clinical Characteristics 128 |
| 13.10.1.4 | Diagnosis 128 |
| 13.10.1.5 | Treatment and Control 129 |
| 13.11 | Coccidiosis (Isosporiasis) 129 |
| 13.11.1 | Etiology 129 |
| 13.11.2 | Life Cycle 129 |
| 13.11.3 | Clinical Features 129 |
| 13.11.4 | Diagnosis 129 |
| 13.11.5 | Treatment and Control 129 |
| 13.12 | Cryptosporidiosis 129 |
| 13.12.1 | Etiology 129 |
| 13.12.2 | Life Cycle 130 |
| 13.12.3 | Clinical Characteristics 130 |
| 13.12.4 | Diagnosis 130 |
| 13.12.5 | Treatment and Control 130 |
| | References 130 |
| 14 | Immunology and Pathogenic Purview 133 |
| | Krishnan S. Prasanna |
| | Glossary 133 |
| 14.1 | Host–Parasite Associations 133 |
| 14.2 | Immune Machineries in Dogs and Cats 134 |
| 14.2.1 | Parasitic Antigens 135 |

| 14.2.2 | Innate Immunity 135 |
|----------|---|
| 14.2.2.1 | Host Factors 135 |
| 14.2.3 | |
| 14.2.3.1 | • |
| | Cell-mediated Immunity 137 |
| 14.2.4 | Specific Types of Immunity 139 |
| 14.2.4.1 | |
| | Mobilization of Active Immune Response 140 |
| 14.3 | Evasion of Immunity by Parasites 141 |
| 14.3.1 | Immunomodulation in Parasitic Infection 141 |
| 14.3.2 | |
| 14.3.3 | Hypobiosis 142 |
| 14.4 | Immunopathology 142 |
| 14.4.1 | 2 00 |
| 14.4.2 | Immunosuppression 142 |
| 14.5 | Autoimmunity 143 |
| 14.6 | Conclusion 144 |
| 14.0 | References for Further Reading 144 |
| | References for Further Reading 144 |
| 15 | Parasitic Zoonoses and One Health 147 |
| 13 | Hanumappa Dhanalakshmi |
| 15.1 | Zoonoses Caused by Protozoa 147 |
| 15.1.1 | · · · · · · · · · · · · · · · · · · · |
| | Toxoplasmosis 147 |
| | Etiology 147 |
| 15.1.1.2 | |
| | Clinical Signs in Animals 147 |
| | Clinical Signs in Humans 147 |
| 15.1.1.5 | e |
| | Treatment 148 |
| | Control 148 |
| 15.1.2 | |
| | Etiology 148 |
| | Transmission 149 |
| 15.1.2.3 | 6 |
| | Clinical Signs in Humans 149 |
| 15.1.2.5 | Treatment 149 |
| 15.1.2.6 | Control 149 |
| 15.1.2.7 | 8 |
| 15.1.3 | Giardiasis 149 |
| 15.1.3.1 | Etiology 149 |
| 15.1.3.2 | |
| 15.1.3.3 | |
| 15.1.3.4 | <u> </u> |
| 15.1.3.5 | Diagnosis 150 |
| 15.1.3.6 | Treatment 150 |
| 15.1.3.7 | Control 150 |
| 15.1.4 | Cryptosporidiosis 150 |
| 15.1.4.1 | Etiology 150 |
| 15.1.4.2 | Transmission 150 |
| 15.1.4.3 | Clinical Signs in Animals 151 |
| 15.1.4.4 | Clinical Signs in Humans 151 |
| 15.1.4.5 | Diagnosis 151 |

| l | |
|----------|--------------------------------------|
| 15.1.4.6 | Treatment 151 |
| 15.1.4.7 | Control 151 |
| 15.1.4.8 | Impact of Cryptosporidiosis 151 |
| 15.1.5 | Trypanosomiasis (Chagas Disease) 151 |
| 15.1.5.1 | Etiology 151 |
| 15.1.5.2 | Transmission 152 |
| 15.1.5.3 | Clinical Signs in Animals 152 |
| 15.1.5.4 | |
| 15.1.5.5 | Diagnosis 152 |
| 15.1.5.6 | Treatment 152 |
| 15.1.5.7 | Control 152 |
| 15.2 | Zoonoses Caused by Trematodes 152 |
| 15.2.1 | Treatment 152 |
| 15.2.2 | Diagnosis 152 |
| 15.2.3 | 1 |
| 15.2.3.1 | |
| 15.2.3.2 | |
| 15.2.3.3 | |
| 15.2.3.4 | |
| 15.2.3.5 | 8 |
| 15.2.3.6 | |
| 15.2.3.7 | |
| 15.3 | Zoonoses Caused by Cestodes 153 |
| 15.3.1 | Dipylidiosis 153 |
| 15.3.1.1 | E |
| 15.3.1.2 | E |
| 15.3.1.3 | 2 |
| 15.3.1.4 | |
| 15.3.1.5 | |
| 15.3.2 | |
| 15.3.2.1 | |
| 15.3.2.2 | |
| 15.3.2.3 | e |
| 15.3.2.4 | • |
| 15.3.2.5 | Diagnosis 154 |
| 15.3.2.6 | Treatment 154 |
| 15.3.2.7 | |
| 15.3.3 | Coenurosis 154 |
| 15.3.3.1 | 23 |
| 15.3.3.2 | |
| 15.3.3.3 | ē |
| 15.3.3.4 | E |
| 15.3.3.5 | Diagnosis 155 |
| 15.3.3.6 | Treatment 155 |
| 15.3.3.7 | Control 155 |
| 15.4 | Zoonoses Caused by Nematodes 155 |
| 15.4.1 | Cutaneous Larva Migrans (CLM) 155 |
| 15.4.1.1 | Etiology 155 |
| 15.4.1.2 | |
| 15.4.1.3 | 8 |
| 15.4.1.4 | Diagnosis 155 |

15.4.1.5 Treatment *155*

- 15.4.1.6 Control 155
- 15.4.2 Visceral Larval Migrans 155
- 15.4.2.1 Etiology 155
- 15.4.2.2 Transmission 155
- 15.4.2.3 Clinical Signs in Humans 155
- 15.4.2.4 Diagnosis 156
- 15.4.2.5 Treatment 156
- 15.4.3 Ocular Larva Migrans (OLM) 156
- 15.4.3.1 Diagnosis 156
- 15.4.3.2 Treatment 156
- 15.4.3.3 Control 156
- Neural Larva Migrans 156 15.4.4
- 15.4.4.1 Etiology 156
- 15.4.4.2 Clinical Signs in Humans 156
- 15.4.4.3 Diagnosis 156
- 15.4.4.4 Control Strategies 156
- 15.4.5 Dirofilariasis 156
- 15.4.5.1 Etiology 156
- 15.4.5.2 Transmission 156
- 15.4.5.3 Clinical Signs in Animals 156
- 15.4.5.4 Clinical Signs in Humans 156
- 15.4.5.5 Diagnosis 156
- 15.4.5.6 Treatment 156
- 15.4.5.7 Control 157
- 15.5 Zoonoses Caused by Arthropods 157
- 15.5.1 Scabies 157
- 15.5.1.1 Etiology 157
- 15.5.1.2 Transmission 157
- 15.5.1.3 Clinical Signs in Animals 157
- 15.5.1.4 Clinical Signs in Humans 157
- 15.5.1.5 Diagnosis 157
- 15.5.1.6 Treatment 157
- 15.5.1.7 Control 157
- 15.6 Flea Allergy Dermatitis 157
- 15.6.1 Etiology 157
- 15.6.2 Transmission 157
- 15.6.3 Clinical Sign in Animals 157
- 15.6.4 Clinical Signs in Humans 157
- 15.6.5 Diagnosis 157
- 15.6.6 Treatment 157
- 15.6.7 Control 157
- 15.7 Conclusions 158
- 15.7.1 Education 158
- 15.7.2 Preservation of the Ecosystem 158
- 15.7.3 Disease Surveillance and Monitoring 158
- 15.7.4 Emerging Parasitic Zoonosis 158
- 15.7.5 Ocean Health 159
- 15.7.6 Food and Water Hygiene 159
- 15.7.7 Proper Meat Processing 159
- 15.7.8 Recreation 159
- 15.7.9 Research 159
- 15.7.10 Government 160

References 160

| xvi | Contents | | | | | | |
|-----|---|--|--|--|--|--|--|
| | 16 | Parasitic Fauna Associated with Reproductive Disorders 161 Baleshwari Dixit, Somesh Meshram, Amit K. Jha, and Ravi Khare | | | | | |
| | 16.1 | Introduction 161 | | | | | |
| | 16.2 Toxoplasmosis 162 | | | | | | |
| | 16.3 | Neosporosis 166 | | | | | |
| | 16.4 Leishmaniosis 168 | | | | | | |
| | 16.5 Dirofilariosis 169 | | | | | | |
| | 16.6 | Toxocariasis 170 | | | | | |
| | | References 171 | | | | | |
| | 17 | Diagnostic Perspectives of Parasitic Diseases in Dogs and Cats 173 Manisha Mehra, Gunjan Choudhary, and Jaykumar Desai | | | | | |
| | 17.1 | Parasite Detection in Fecal Materials 173 | | | | | |
| | 17.1.1 | Collection of Fecal Samples 173 | | | | | |
| | 17.1.2 | Storage and Shipment of Fecal Samples 173 | | | | | |
| | 17.1.3 | Fecal Exam Procedures 174 | | | | | |
| | 17.1.4 | Direct Smear Method 174 | | | | | |
| | 17.1.5 | Concentration Methods 174 | | | | | |
| | 17.1.5.1 | Sedimentation Technique 174 | | | | | |
| | 17.1.5.2 | Flotation Technique 174 | | | | | |
| | 17.1.6 | Macroscopic Examination 175 | | | | | |
| | 17.1.7 | Microscopic Examination 175 | | | | | |
| | 17.1.8 | Quantitative Examination of Feces 175 | | | | | |
| | 17.1.8.1 | Egg Counting Methods 175 | | | | | |
| | 17.1.8.2 | Stoll's Dilution Method 175 | | | | | |
| | 17.1.8.3 | McMaster Method 175 | | | | | |
| | 17.1.9 | Protozoan Parasites 176 | | | | | |
| | Isospora spp. 176 | | | | | | |
| | 17.1.9.2 | Toxoplasma gondii and Neospora caninum 176 | | | | | |
| | 17.1.9.3 | Sarcocystis spp. 176 | | | | | |
| | 17.1.9.4 | Cryptosporidium spp. 177 | | | | | |
| | 17.1.9.5 | Giardia intestinalis (G. duodenalis), G. lamblia, G. canis, G. cati, etc. 177 | | | | | |
| | 17.1.10 | Helminth Parasites 178 | | | | | |
| | 17.1.10.1 | Ancylostoma spp. 178 | | | | | |
| | 17.1.10.2 | Toxocara spp. 178 | | | | | |
| | 17.1.10.3 | Trichuris vulpis 178 | | | | | |
| | 17.1.10.4 | Spirocerca lupi 178 | | | | | |
| | 17.1.10.5 | Aelurostrongylus abstrusus 179 | | | | | |
| | 17.1.10.6 | Angiostrongylus vasorum 179 | | | | | |
| | 17.1.10.7 | Dipylidium caninum 179 | | | | | |
| | 17.1.10.8 | Taenia spp. 180 | | | | | |
| | 17.1.10.9 | Echinococcus spp. 180 | | | | | |
| | 17.1.10.10 | Diphyllobothrium latum 180 | | | | | |
| | 17.1.10.11 | Spirometra spp. 181 | | | | | |
| | 17.1.10.12 | Paragonimus kellicotti 181 | | | | | |
| | 17.1.10.13 | Nanophyetus salmincola 181 | | | | | |
| | 17.2 | Parasite Detection in Urinary Systems 182 | | | | | |
| | 17.2.1 | Urine Sedimentation 182 | | | | | |
| | 17.2.2 | Dioctophyme renale 182 | | | | | |
| | 17.2.3 | Pearsonema (Capillaria) plica, P. feliscati 182 | | | | | |
| | 17.3 | Blood Parasites of Dogs and Cats 182 | | | | | |
| | 17.3.1 Immunologic Detection of Blood Parasites 182 | | | | | | |

| 17.3.2 | Microscopic Evenination of Plead Smear 192 | | | | | |
|-----------|---|--|--|--|--|--|
| | Microscopic Examination of Blood Smear 183 Giemsa Stain 183 | | | | | |
| 17.3.2.1 | | | | | | |
| 17.3.3 | Microscopic Examination of Blood for Nematode Parasites 183 | | | | | |
| 17.3.4 | Tests for Canine Heartworm Microfilariae in Blood Samples 183 | | | | | |
| 17.3.4.1 | Direct Smear 184 | | | | | |
| 17.3.4.2 | Hematocrit Test 184 | | | | | |
| 17.3.4.3 | Modified Knott's Test 184 | | | | | |
| 17.3.4.4 | Filter Test 184 | | | | | |
| 17.3.5 | Hepatozoon spp. 184 | | | | | |
| 17.3.5.1 | Laboratory Diagnosis 184 | | | | | |
| 17.3.5.2 | Signs and Symptoms 185 | | | | | |
| 17.3.6 | Babesia canis and B. gibsoni 185 | | | | | |
| 17.3.6.1 | Laboratory Diagnosis 185 | | | | | |
| 17.3.6.2 | Signs and Symptoms 185 | | | | | |
| 17.3.7 | Cytauxzoon felis 185 | | | | | |
| 17.3.7.1 | Laboratory Diagnosis 185 | | | | | |
| 17.3.7.2 | Signs and Symptoms 185 | | | | | |
| 17.3.8 | Leishmania spp. 185 | | | | | |
| 17.3.8.1 | Laboratory Diagnosis 185 | | | | | |
| 17.3.8.2 | Signs and Symptoms 186 | | | | | |
| 17.3.9 | Trypanosoma cruzi 186 | | | | | |
| 17.3.9.1 | Laboratory Diagnosis 186 | | | | | |
| 17.3.9.2 | Signs and Symptoms 186 | | | | | |
| 17.3.10 | D. immitis 186 | | | | | |
| 17.3.10.1 | Laboratory Diagnosis 186 | | | | | |
| 17.3.10.1 | Signs and Symptoms 186 | | | | | |
| 17.5.10.2 | References 187 | | | | | |
| | References 107 | | | | | |
| 18 | Anti-helminthic Resistance: A Barrier to Controlling Parasites in Dogs and Cats 189 | | | | | |
| 10 | Fathy A. Osman | | | | | |
| | Introduction 189 | | | | | |
| 10 1 | | | | | | |
| 18.1 | | | | | | |
| 18.2 | Principles of Anti-helminthic Resistance (AR) Development 190 | | | | | |
| 18.3 | Factors Contributing to the Development of Anti-helminthic | | | | | |
| | Resistance 190 | | | | | |
| 18.3.1 | Frequency of Treatment 190 | | | | | |
| 18.3.2 | Targeting and Timing of Mass Treatment 191 | | | | | |
| 18.3.3 | Anti-helminthic Dose Rates 191 | | | | | |
| 18.3.4 | Genetics 191 | | | | | |
| 18.3.5 | Refugia 192 | | | | | |
| 18.3.5.1 | Implementing Refugia 193 | | | | | |
| 18.3.5.2 | Two Strategies to Preserve Refugia 193 | | | | | |
| 18.3.5.3 | Estimation of Population Sizes for Canine Parasites 193 | | | | | |
| 18.4 | Evidence of Anti-helminthic Resistance 194 | | | | | |
| 18.5 | Mechanisms of Resistance 194 | | | | | |
| 18.5.1 | Anti-helminthic Resistance Arises in a Limited Number of Ways 194 | | | | | |
| 18.5.2 | Role of the Parasite to Becoming Resistant 194 | | | | | |
| 18.5.3 | Anti-helminthic Resistance Results from a Variety of Mechanisms 195 | | | | | |
| 18.6 | Monitoring Anti-helminthic Resistance (AR) 195 | | | | | |
| 18.6.1 | Determining Evaluated Anti-helminthic Resistance 196 | | | | | |
| 18.6.2 | In Vivo Examination 196 | | | | | |
| 18.6.2.1 | Fecal Egg Count Reduction Rest 196 | | | | | |
| 18.6.2.2 | Egg Reappearance Period (ERP) Test 196 | | | | | |
| | | | | | | |

| xviii | Contents | | |
|-------|----------|--|-----|
| · | 18.6.3 | In Vitro Examination 196 | |
| | 18.6.3.1 | Egg Hatch Assays (EHAs) 196 | |
| | | Larval Development Test (LDT) 197 | |
| | | Larval Motility Test (LMT) 197 | |
| | | | |
| | 18.6.4 | Key Differences in Anthelmintic Resistance (AR) Development Between Pets and Grazing Animals | 197 |
| | 18.6.5 | Management Strategies to Delay the Development of Anti-helminthic Resistance 197 | |
| | 18.6.5.1 | Correct Use of Anti-helminthic Drugs 198 | |
| | 18.6.5.2 | Refugia 198 | |
| | 18.6.5.3 | Use of Multi-active Anti-helminthic Products 198 | |
| | 18.6.5.4 | Other Options 199 | |
| | 18.7 | Prevention of Anti-helminthic Resistance (AR) Development in Dogs and Cats 199 | |
| | 18.8 | Conclusion and Recommendations 200 | |
| | | Glossary 200 | |
| | | References 201 | |
| | 19 | Molecular Biology of Parasites in Dogs and Cats 205 | |
| | | Sanweer Khatoon, Afroz Jahan, Tikam Goyal, and Srinivas | |
| | 19.1 | Introduction 205 | |
| | | References 211 | |
| | 20 | Parasitic Vaccines in Dogs and Cats 213 | |
| | | Furqan Munir, Amna Shakoor, Muhammad Tahir Aleem, and Zia ud Din Sindhu | |
| | 20.1 | Introduction 213 | |
| | 20.2 | Importance of Vaccination in Companion Animals 214 | |
| | 20.3 | The Manipulation of Immune Responses for the Development of Vaccines 214 | |
| | 20.4 | Advancement in the Development of Anti-parasitic Vaccines 216 | |
| | 20.4.1 | Anti-protozoal Vaccines 216 | |
| | 20.4.2 | Anti-helminthic Vaccines 217 | |
| | 20.4.3 | Anti-ectoparasitic Vaccines 217 | |
| | 20.5 | Novel Drug Delivery Systems for the Delivery of Vaccines 217 | |
| | 20.6 | Future Perspectives 218 | |
| | 20.7 | Conclusion 219 | |
| | | Acknowledgments 219 | |
| | | References 220 | |
| | 21 | Biological Control of Parasites 223 | |
| | | Amita Dubey, Rupesh Verma, Amita Tiwari, and Apeksha Khare | |
| | 21.1 | Introduction 223 | |
| | 21.2 | Traditional Control 224 | |
| | 21.3 | History of Biological Control 224 | |
| | 21.4 | Advantages of Biological Control 224 | |
| | 21.5 | Disadvantages of Biological Control 224 | |
| | 21.6 | Biological Control Agents 224 | |
| | 21.6.1 | Predators 225 | |
| | 21.6.2 | Parasitoids 225 | |
| | 21.6.3 | Pathogens 225 | |

Use of Biological Agents to Control Ticks and Mites 227

Applying Biological Control 227

Summary 227

References 228

21.7

21.8

21.9

| 22 | I nerapeutic Measures and Control Strategies 229 |
|--------------|--|
| | Muhammad Tahir Aleem, Fakiha Kalim, Azka Kalim, and Furqan Munir |
| | Glossary 229 |
| 22.1 | Introduction 229 |
| 22.2 | Risk Analysis for Designing Appropriate Control Strategies 230 |
| 22.3 | Deworming 230 |
| 22.3.1 | Ancillary Therapy for Dogs 231 |
| 22.3.2 | Ancillary Therapy for Cats 231 |
| 22.4 | Use of Anti-parasitic Drugs 231 |
| 22.5 | Use of Nanotechnology 231 |
| 22.6 | Ecological Control 236 |
| 22.7 | Management Practices 236 |
| 22.8 | Role of Veterinarian 238 |
| 22.9 | Future Perspectives 238 |
| 22.10 | Conclusion 239 |
| | Acknowledgment 239 |
| | References 239 |
| 23 | Future Advanced Research Directions against Parasitic Diseases in Dogs and Cats Abrar Ul Haq, Idrees M. Allaie, Shahana R. Tramboo, and Tanmoy Rana |
| 23.1 | Introduction 243 |
| 23.1 | |
| 23.2 | Major Endoparasitic and Ectoparasitic Diseases of Dogs and Cats 243 Advances in the Diagnosis of Parasitic Diseases in Dogs and Cats 244 |
| | Advanced Therapies for Parasitoses in Dogs and Cats 245 |
| 23.4 | Veterinary Parasitic Vaccines 246 |
| 23.5 23.6 | Challenges and Future Directions Against Parasitic Diseases of Dogs and Cats 247 |
| 23.0 23.7 | Conclusion 248 |
| 23.7 | |
| | References 249 |
| | Index 252 |
| | Index 253 |

List of Contributors

Abrar Ul Hag

Department of Veterinary Medicine Guru Angad Dev Veterinary and Animal Sciences University Ludhiana, Punjab, India

Adedayo M. Awoniyi

Institute of Collective Health Federal University of Bahia Salvador, Brazil

Afroz Jahan

Department of Veterinary Pharmacology & Toxicology COVS, Rampura Phul GADVASU, India

Alok K. Dixit

Department of Veterinary Parasitology College of Veterinary Science and Animal Husbandry Rewa, Nanaji Deshmukh Veterinary Science University Jabalpur, Madhya Pradesh, India

Alok K. Singh

Department of Veterinary Parasitology College of Veterinary Science and Animal Husbandry Rewa, Nanaji Deshmukh Veterinary Science University Jabalpur, Madhya Pradesh, India

Amit K. Jha

Department of Animal Genetics and Breeding College of Veterinary Science & Animal Husbandry Rewa, Nanaji Deshmukh Veterinary Science University Jabalpur, Madhya Pradesh, India

Amita Dubey

College of Veterinary Science and AH NDVSU, Jabalpur Madhya Pradesh, India

Amita Tiwari

College of Veterinary Science and AH NDVSU, Jabalpur Madhya Pradesh, India

Amna Shakoor

Department of Anatomy Faculty of Veterinary Science University of Agriculture, Faisalabad Punjab, Pakistan

Anil Kumar

Department of Veterinary Clinical Complex Bihar Veterinary College Bihar Animal Sciences University (BASU) Patna, Bihar, India

Ankesh Kumar

Department of Veterinary Clinical Complex Bihar Veterinary College Bihar Animal Sciences University (BASU) Patna, Bihar, India

Apeksha Khare

College of Veterinary Science and AH NDVSU, Jabalpur Madhya Pradesh, India

Azka Kalim

Faculty of Medical Sciences Government College University Faisalabad, Punjab, Pakistan

Baleshwari Dixit

Department of Veterinary Public Health and Epidemiology College of Veterinary Science and Animal Husbandry Rewa, Nanaji Deshmukh Veterinary Science University Jabalpur, Madhya Pradesh, India

C. Sreedevi

Department of Veterinary Parasitology NTR College of Veterinary Science Sri Venkateswara Veterinary University Gannavarm, Andhra Pradesh, India

Fakiha Kalim

Department of Parasitology Faculty of Veterinary Science University of Agriculture, Faisalabad Punjab, Pakistan

Fathy A. Osman

Agriculture Research Center Animal Health Research Institute Cairo, Egypt

Furgan Munir

Department of Parasitology Faculty of Veterinary Science University of Agriculture, Faisalabad Punjab, Pakistan

Gautam Bordoloi

Department of Veterinary Parasitology Lakhimpur College of Veterinary Science Assam Agricultural University, Joyhing North Lakhimpur, India

Gurram S. Haritha

Department of Veterinary Clinical Complex CVSc, SVVU, Garividi Andhra Pradesh, India

Hanumappa Dhanalakshmi

Department of Veterinary Parasitology KVAFSU, Veterinary College Bengaluru, India

Idrees M. Allaie

Department of Veterinary Parasitology Faculty of Veterinary Sciences and Animal Husbandry Shuhama, SKUAST, Kashmir, India

J. Adeppa

Department of Veterinary Parasitology Veterinary College, Karnataka Veterinary Animal and Fisheries Sciences University Bidar, Karnataka, India

Krishnan S. Prasanna

Department of Veterinary Pathology College of Veterinary and Animal Sciences Kerala Veterinary and Animal Sciences University Wayanad, Kerala, India

Manisha Mehra, Gunjan Choudhary, Jaykumar Desai

Department of Veterinary Pathology CVAS, RAJUVAS Bikaner, India

Manoj K. Kalita

Department of ARGO Lakhimpur College of Veterinary Science Assam Agricultural University, Joyhing North Lakhimpur, India

Muhammad Tahir Aleem

Department of Parasitology Faculty of Veterinary Science University of Agriculture, Faisalabad Punjab, Pakistan

Naresh Kumar

Department of Veterinary Parasitology CVAS, Navania, Udaipur, India

P. M. Kondaiah

Department of Veterinary Parasitology College of Veterinary Science Sri Venkateswara Veterinary University Tirupati, Andhra Pradesh, India

Prerona Patowary

Department of Veterinary Clinical Medicine, Ethics and Jurisprudence College of Veterinary Science Assam Agricultural University, Khanapara Guwahati, Assam, India

Ramesh Putchakayala

Department of Veterinary Clinical Complex CVSc, SVVU, Garividi Andhra Pradesh, India

Ravi Khare

Department of Veterinary Parasitology College of Veterinary Science and Animal Husbandry Rewa, Nanaji Deshmukh Veterinary Science University Jabalpur, Madhya Pradesh, India

Rinesh Kumar

Department of Veterinary Parasitology College of Veterinary Science and Animal Husbandry Rewa, Nanaji Deshmukh Veterinary Science University Jabalpur, Madhya Pradesh, India

Rupesh Verma

College of Veterinary Science and AH NDVSU, Jabalpur, Madhya Pradesh, India

Sanweer Khatoon

Department of Veterinary Parasitology CVAS, Navania, Udaipur, India

Shahana R. Tramboo

Department of Veterinary Parasitology Faculty of Veterinary Sciences & Animal Husbandry Shuhama, SKUAST, Kashmir, India

Somesh Meshram

Department of Livestock Product Technology College of Veterinary Science & Animal Husbandry Rewa, Nanaji Deshmukh Veterinary Science University Jabalpur, Madhya Pradesh, India

Sonam Bhatt

Department of Veterinary Medicine Bihar Veterinary College BASU, Patna, Bihar, India

Tanmoy Rana

Department of Veterinary Clinical Complex West Bengal University of Animal & Fishery Sciences Kolkata, West Bengal, India

Tikam Goyal

Department of Veterinary Extension CVAS, Navania, Udaipur, India

Ugochukwu F. Ogbodo

Veterinarian University of Ilorin Veterinary Teaching Hospital Ilorin, Kwara State, Nigeria

V. C. Rayulu

Controller of Examinations, YSR Bhavan Sri Venkateswara Veterinary University Tirupati, Andhra Pradesh, India

V. Gnani Charitha

Department of Veterinary Parasitology College of Veterinary Science Sri Venkateswara Veterinary University Proddatur, Andhra Pradesh, India

Zia ud Din Sindhu

Department of Parasitology Faculty of Veterinary Science University of Agriculture, Faisalabad Punjab, Pakistan

Preface

Dogs and cats are the most wonderful companion animals on the planet. Dogs and cats are generally acquainted with parasites due to the ingestion of raw meat and inhabiting unhealthy environments. The primary objective of this book is to provide necessary information for veterinary students, veterinary practitioners, academicians, researchers, and veterinary technologists about the parasitic diseases of dogs and cats. In my opinion, this book will be helpful to readers that greatly enjoy the amazing field of parasites in canine and feline species. It is routine to provide endo- and ectoparasite management in dogs and cats. The treatment and control of parasitic diseases are the most useful preventive measures on the basis of various diagnostic evaluations like the observation of parasite eggs, antigenic tests, host seroconversion, and molecular detection of the parasites. Proper preventive strategies and control measures should be considered to protect against any risk of death. Molecular diagnostic evaluation detects parasites as well as the interpretation of reports in the veterinary diagnostic laboratory. Various parasitic diseases are evaluated in a systematic fashion according to the principal system affected. The book is well designed, organized, and presented for quick reference. It, therefore, is very helpful for public health veterinarians, students, and laboratory technicians to acquire knowledge about the parasitic diseases of dogs and cats. The book is intended for students to gradually realize the importance of parasites and parasitic diseases that affect canine and feline

welfare. The book is also beneficial for the veterinary parasitologists who are directly involved in the diagnosis, treatment, and control of parasitic diseases of dogs and cats. Parasitic diseases of dogs and cats are elaborately described on the basis of identifying particular parasites with significant epidemiological importance. Drugs for parasitic diseases are marked by their chemical form, rather than proprietary. The book is sequentially arranged to magnify the importance of veterinary parasitology, epidemiology, immunity, anthelmintics, ectoparasiticides, and laboratory diagnosis. I am indebted to the authors of various sources and books on veterinary parasitology whose work we have consistently consulted. It is the responsibility of all veterinary practitioners to be knowledgeable of the laws that govern drugs in their field of practice. Neither the publisher nor the authors undertake any responsibility for any damage and/or injury to persons or property following the application of the information and material(s) contained in this book. The application of any trade names or commercial products used in this book is purely for the purpose of information and does not indicate any finalization and/or recommendation by the publisher or authors. Finally, I hope that the book will be a valuable asset for students and practitioners as well as a very useful resource for academicians.

> Tanmoy Rana Kolkata, India

Acknowledgment

I would like to convey our sincere gratitude to all those who contributed the chapters in this book. I would like to express my gratitude to Dr. Rituparna Bose, Acquisition Editor, Jennifer Seward, Editorial Project Manager; and other members of Wiley Blackwell who have actively or indirectly helped me edit this book.

Finally, I would like to acknowledge my family members for cheering me on during the writing and editing of this book.

> Tanmoy Rana Kolkata, India