ISBN-978-93-94174-63-4

Laboratory Practical Manual for Medical Microbiology and Parasitology

NWADIOHA Samuel Iheanacho
 ODIMAYO Michael Simidele
 ABAYOMI Fadeyi





Second Edition



Excellent Publishers

Second Edition

Laboratory Practical Manual for Medical Microbiology and Parasitology

NWADIOHA Samuel Iheanacho, (MB BCH; MSc; FMCPath; FIIA) Professor of Medical Microbiology & Parasitology, Consultant Clinical Microbiologist & Infectious Disease Physician, Laboratory Consultant @ Maternity & Children Hospital, Hail Kingdom of Saudi Arabia. Formerly, A Staff of Benue State University, Makurdi. Nigeria.

Email: samnwa2000@yahoo.com

ODIMAYO Michael Simidele, (MBBS, PGDE, FMCPath, FIIA)

Professor of Microbial Pathology. Consultant Clinical Microbiologist & Infectious Disease Physician. Department of Microbial Pathology, University of Medical Sciences. Ondo State. Nigeria. Email: <u>simideledimayo@gmail.com</u>

ABAYOMI Fadeyi, (BSc, MBBS, MSc, FMCPath)

Professor of Medical Microbiology & Parasitology. Consultant Clinical Microbiologist & Infectious Disease Physician. College of Health Sciences, University of Ilorin. Ilorin. Nigeria. Email: <u>abayomifadeyi@unilorin.edu.ng</u> Laboratory Practical Manual for Medical Microbiology and Parasitology

Laboratory Practical Manual for Medical Microbiology and Parasitology

Second Edition

Author(s) : NWADIOHA Samuel Iheanacho ODIMAYO Michael Simidele ABAYOMI Fadeyi

- ISBN : 978-93-94174-63-4
- Page(s) : 110
- Published Year : 2024
- Published by: Excellent Publishers
No. 38/48, Second street, Ellappa Nagar
Kanchipuram 631501, Tamilnadu, India.
Cell +91-9842641794
excellentpublishers2013@gmail.com
www.excellentpublishers.com



Disclaimer :

The author is solely responsible for the contents of the book in this volume in any manner, Errors, if any are purely unintentional and readers are requested to communicate such errors to the authors to discrepancies in futures.

Note: No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher.

Copyright © 2024 Excellent Publishers, All Rights Reserved

Laboratory Practical Manual for Medical Microbiology and Parasitology

PREFACE

A complementary text to practical guides in bacteriology, parasitology, virology, and immunology. It addresses some fundamental questions on the subjects. The book proves invaluable to postgraduate students in medical microbiology, medical specialist doctors in medical microbiology, and medical students.

It is a product of practice and teaching of medical microbiology. The purpose is intended for a sound understanding of the subject, as well as preparing the students to the gradual evolution into automation of medical microbiology practice in Africa.

Good luck! As you get married to this book

Authors

Table of Contents

	Contents	Page No.
	Chapter-1 Introduction to Microbiology	1-13
	Iheanacho nwadioha	
1.1	Introduction	1
1.2	Classification of pathogens	2
1.3	Prokaryotes	2
1.4	Bacteria	2
1.4.1	Gram positive bacteria	3
1.4.2	Gram negative bacteria	3
1.5	Waxy cell walls	3
1.6	Bacteria lacking cell walls	3
1.7	Shapes of Bacteria	3
1.8	Resembles Viruses	3
1.9	Viruses	4
1.10	RNA Viruses	
1.10.1	ARBO virus (Arthropod-Borne virus)	4
1.11	ROBO virus (Rodent- Borne virus)	4
1.12	DNA virus	4
1.13	Eukaryotes	5
1.14	Fungi	5
1.14.1	Yeasts e.g. Candida albicans, Cryptococcus neoformans etc.	5
1.14.2	Filamentous fungi or mould; eg. Aspergillus spp, penicillium spp.	5
1.14.3	Dimorphic fungi; eg. Histoplasma spp, Coccidiodes immitis	6
1.15	Fungi are typical eukaryotes with	6
1.16	Parasites	6
1.17	Protozoa	6
1.18	Nemathelminthes (Round Worms)	8
1.19	Intestinal Nematodes	8
1.20	Tissue nematodes	8
1.21	Trematodes (Flukes)	10
1.22	Cestodes	12
1.23	Arthropods	13
1.24	Prions	13
	Chapter-2 Laboratory Safety Odimayo Simidele	14-22
2.1	Bio Safety Issues in the Laboratory	14
2.2	Personal Health and Safety Measures	14

2.3	Practice of personal hygiene	15
2.4	The Following are Important in Making the Workplace Safe	15
2.5	Risk Groups	17
2.6	Specimens	19
2.7	Spills	20
2.8	Hazardous Chemicals	20
2.9	No Storage in Alphabetical Order	21
2.10	Vapours	21
2.11	Explosives	21
2.12	Chemicals spills	21
2.13	Chemical spills	21
2.14	Fire	22
2.15	Causes	22
2.16	Electricity	22
2.17	Noise	22
	Chapter-3	23-32
	Specimens in Medical Microbiology	
2.1	Ineanacho Nwaaiona & Faaeyi Abayomi	00
3.1	Introduction	23
3.2	Transport	23
2.4	Storage	23
3.5	Storage Some Common Laboratory Specimens	24
3.6	Urino	24
37	Collection	24
3.8	Transport and storage	24
39	Stool Collection	24
3.10	Sputum	25
3.11	Transport and storage	25
3.12	Cerebrospinal Fluid (CSF)	25
3.13	Transport and storage	25
3.14	Swab	25
3.15	Throat Swab	25
3.16	Transport and storage	25
3.17	Aspirates	25
3.18	Transport and storage	26
3.19	Skin Scrapings	26
3.20	Transport	26
3.21	Nail Clippings	26
3.22	Transport	26
3.23	Skin Snip	26

3.24	Blood Culture	26
3.25	Sample Rejection Criteria	27
3.26	Procedure	27
3.27	Examples of Sample Rejection Criteria	27
3.27.1	Unlabelled or mislabeled samples	27
3.27.2	Duplicate samples	27
3.27.3	Leaky containers	27
3.27.4	Contaminated samples	28
3.27.5	Inappropriate sample sources	28
3.27.6	Delayed transport time and sample processing	28
3.27.7	In General, the following conditions will lead to rejection of a	28
	specimen by the UTH Laboratory	
3.27.8	Actions for When Samples are Rejected	29
3.28	Instrumentation	30
	Chapter-4	33-38
	Microscopes and Microscopy	
11	Uaimayo Simiaele	
4.1	Introduction	33
4.2	Microscopes	33
4.5	Types of Microscopes	33
4.4	Microscopy	34
4.5	Mars Darfarm Microscope	35
4.0	Why Perform Microscopic Examination	36
4./	Cimple Lene	36
4.0	Simple Lens	36
4.9	Compound Microscope	30 27
4.10	Care when using the incroscope	37
4.11	Wat Propagation	37
4.12	Hanging Drop	37
4.13	Proparation	38
4.15	Preparation of Smears for Staining	38
4.15	Fiving Smears	38
1.10	Chanter-5	39-41
	Stains and Staining Techniques in Microbiology	57 11
	Iheanacho Nwadioha & Fadeyi Abayomi	
5.1	Introduction	39
5.2	Staining	39
5.3	Types of Stains	39
5.4	Common stains used in Bacteriology	39
5.5	Negative Staining	39

5.6	Simple Positive Staining	40
5.7	Common stains used in Bacteriology	40
5.8	Gram staining	40
5.9	Interpretation	40
5.10	Ziehl Neelsen staining	40
5.11	Interpretation	40
5.12	Spore staining	41
5.13	Interpretation	41
5.14	Capsule staining	41
5.15	Interpretation	41
5.16	Further Notes	41
Chapter-6 Media in Microbiology Iheanacho Nwadioha & Odimayo Simidele		42-45
6.1	Introduction	42
6.2	Aim of Culture	42
6.3	Types of Culture Media	42
6.4	Composition of Media	42
6.5	Classification based on Consistency	43
6.6	Examples of Media Used in Microbiology	43
6.6.1	Selenite F and Tetrathionate Enrichment Broths	43
6.6.2	Deoxycholate Citrate Agar (DCA)	43
6.6.3	Eosin Methylene Blue (EMB) Agar	44
6.6.4	MacConkey (MAC) agar	44
6.6.5	Xylose Lysine Deoxycholate (XLD) agar	44
6.6.6	Salmonella Shigella (SS) agar	44
6.6.7	Kligler Iron Agar ("KIA")	44
6.6.8	Triple Sugar Iron agar ("TSI)	44
6.6.9	Anaerobic Media	44
6.6.10	Virology/Cell cultures media	45
6.6.11	Parasitology	45
6.6.12	Mycology	45
	Chapter-7 Culture Techniques Odimayo Simidele	46-47
7.1	Aerobic culture	46
7.2	Inoculating Artificial Agar Solid Agar in Petri Dishes	46
7.3	Aim	46
7.4	Procedure	46
7.5	Inoculation of Slopes & Butts	46
7.6	Procedure	46

7.7	Inoculation of Liquid Media	47
7.8	Anaerobic culture	47
	Chapter-8 Introduction to Anaerobiosis Iheanacho Nwadioha	48-49
8.1	Introduction	48
8.2	Why they are Anaerobes	48
8.3	Media for Isolating Anaerobes	48
8.4	Achieve Anaerobic Culture Condition Using	49
8.5	Components of Anaerobic Chamber	49
	Chapter-9 Cutural Identification of Bacteria Odimayo Simidele	50-53
9.1	Introduction	50
9.2	Haemolysis	50
9.2.1	α-Haemolysis	50
9.2.2	Beta-Haemolysis	50
9.2.3	Gamma-Haemolysis	50
9.2.4	a' Hemolysis	51
9.3	Swarming	51
9.4	Lactose Fermentation	51
9.5	Pigment Production	51
9.6	Colonial Morphology	51
9.6.1	Size of Colonies	51
9.6.2	Margin	51
9.6.3	Elevation	51
9.6.4	Density/Optical Properties	52
9.6.5	Colour	52
9.6.6	Consistency/Texture (Determined by Touching Colony with Sterile Wire Loop)	52
9.6.7	Pigments	52
9.6.8	Odour	52
9.7	Growth In Liquid Media	52
9.8	Growth in Cell Cultures	53
	Chapter-10 Biochemical Tests for Identification of Bacteria Isolates	54-57
10.1	Indication	54
10.2	Catalase test	54
10.3	Slide coagulase test	54

Conors	Chapter-11 I Considerations in Identification of Common Bactaria Isolatas	58-60
11 1	Introduction	58
11.2	Follow the Identification guide below	58
11.2	Characterisation of oxidase-negative isolates	59
11.0	Chanter-12	61-64
	Antibiotic Susceptibility Testing	01 01
12.1	Objectives	61
12.2	Techniques	61
12.3	Dilution	61
12.3.1	Broth dilution method	61
12.4	Diffusion	62
12.4.1	Kirby Bauer method	62
12.5	Kirby Bauer Method of Antibiotic Susceptibility Testing	62
12.6	Stokes Method	62
12.7	Precautions in Kirby Bauer Method	63
12.8	Antimicrobial Gradient Method	63
12.9	Other Antimicrobial Susceptibility Testing Methods	63
12.10	Automated Instrument Systems	63
12.11	Genotypic method	64
12.12	Synergy tests	64
	Chapter-13	65-68
	Immunadia anasis in Madiaal Mianahiala ay	05 00
131	Immunodiagnosis in Medical Microbiology	65
13.1 13.2	Immunodiagnosis in Medical Microbiology Introduction Antigen Detection Methods	65 65
13.1 13.2 13.3	Immunodiagnosis in Medical Microbiology Introduction Antigen Detection Methods Enzyme immunoassay for Henatitis B	65 65 65
13.1 13.2 13.3 13.4	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latex	65 65 66 66
13.1 13.2 13.3 13.4	Immunodiagnosis in Medical Microbiology Introduction Antigen Detection Methods Enzyme immunoassay for Hepatitis B Direct antigen for Cryptococcal meningitis using latex agglutination	65 65 66 66
13.1 13.2 13.3 13.4 13.5	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latex agglutinationAntibody Detection Methods	65 65 66 66 66
13.1 13.2 13.3 13.4 13.5 13.6	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latexagglutinationAntibody Detection MethodsApplication	65 65 66 66 66 66 67
13.1 13.2 13.3 13.4 13.5 13.6 13.7	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latex agglutinationAntibody Detection MethodsApplicationPrecipitation assays	65 65 66 66 66 66 67 67
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latexagglutinationAntibody Detection MethodsApplicationPrecipitation assaysNeutralization tests	65 65 66 66 66 66 67 67 67
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latex agglutinationAntibody Detection MethodsApplicationPrecipitation assaysNeutralization testsMicroscope –Assisted- Labeled- Reagent Technology	65 65 66 66 66 66 67 67 67 67
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latexagglutinationAntibody Detection MethodsApplicationPrecipitation assaysNeutralization testsMicroscope -Assisted- Labeled- Reagent TechnologyTreponema pallidum Haemagglutination Test	65 65 66 66 66 67 67 67 67 67 67 68
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10 13.11	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latex agglutinationAntibody Detection MethodsApplicationPrecipitation assaysNeutralization testsMicroscope –Assisted- Labeled- Reagent TechnologyTreponema pallidum Haemagglutination TestFebrile Agglutinin Test for Salmonella	65 65 66 66 66 67 67 67 67 67 67 67 68 68 68
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10 13.11 13.12	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latex agglutinationAntibody Detection MethodsApplicationPrecipitation assaysNeutralization testsMicroscope -Assisted- Labeled- Reagent TechnologyTreponema pallidum Haemagglutination TestFebrile Agglutinin Test for SalmonellaTest of Cell Mediated Immunity	65 65 66 66 66 67 67 67 67 67 67 68 68 68 68
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10 13.11 13.12	Immunodiagnosis in Medical Microbiology Introduction Antigen Detection Methods Enzyme immunoassay for Hepatitis B Direct antigen for Cryptococcal meningitis using latex agglutination Antibody Detection Methods Application Precipitation assays Neutralization tests Microscope -Assisted- Labeled- Reagent Technology <i>Treponema pallidum</i> Haemagglutination Test Febrile Agglutinin Test for Salmonella Test of Cell Mediated Immunity Chapter-14	 65 65 66 66 66 67 67 67 67 67 68 68 68 68 69-94
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10 13.11 13.12	Immunodiagnosis in Medical Microbiology Introduction Antigen Detection Methods Enzyme immunoassay for Hepatitis B Direct antigen for Cryptococcal meningitis using latex agglutination Antibody Detection Methods Application Precipitation assays Neutralization tests Microscope -Assisted- Labeled- Reagent Technology <i>Treponema pallidum</i> Haemagglutination Test Febrile Agglutinin Test for Salmonella Test of Cell Mediated Immunity Chapter-14 Laboratory Techniques in Parasitology	65 65 66 66 66 67 67 67 67 67 67 67 68 68 68 68 68 68 68 68
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10 13.11 13.12 14.1	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latexagglutinationAntibody Detection MethodsApplicationPrecipitation assaysNeutralization testsMicroscope -Assisted- Labeled- Reagent TechnologyTreponema pallidum Haemagglutination TestFebrile Agglutinin Test for SalmonellaTest of Cell Mediated ImmunityChapter-14Laboratory Techniques in ParasitologySpecimen Collection and Preservation	65 65 65 66 66 67 67 67 67 67 67 67 67 67 67 67 67 67 67 68 68 68 69
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10 13.11 13.12 14.1 14.2	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latexagglutinationAntibody Detection MethodsApplicationPrecipitation assaysNeutralization testsMicroscope -Assisted- Labeled- Reagent Technology <i>Treponema pallidum</i> Haemagglutination TestFebrile Agglutinin Test for SalmonellaTest of Cell Mediated ImmunityChapter-14Laboratory Techniques in ParasitologySpecimen Collection and PreservationBlood Specimen	 65 60 65 65 66 66 67 67 67 67 67 68 68 68 68 69 69 69
13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10 13.11 13.12 14.1 14.2 14.2.1	Immunodiagnosis in Medical MicrobiologyIntroductionAntigen Detection MethodsEnzyme immunoassay for Hepatitis BDirect antigen for Cryptococcal meningitis using latexagglutinationAntibody Detection MethodsApplicationPrecipitation assaysNeutralization testsMicroscope -Assisted- Labeled- Reagent TechnologyTreponema pallidum Haemagglutination TestFebrile Agglutinin Test for SalmonellaTest of Cell Mediated ImmunityChapter-14Laboratory Techniques in ParasitologySpecimen Collection and PreservationBlood SpecimenTiming	65 65 65 66 66 67 67 67 67 67 67 67 67 67 67 67 67 67 67 67 69 69 69 69 69 69 69 69 69 69

14.2.3	Capillary blood obtained by finger prick	69
14.2.4	Venous blood obtained by venipuncture	70
14.3	Stool Specimen	70
14.4	Serum/Plasma Specimens	71
14.4.1	Specimen Requirements	71
14.4.2	Serum for all tests	72
14.5	Other Specimens	72
14.6	Tissue Specimens	72
14.7	Stool Parasitology	72
14.8	Stool Specimen processing	72
14.9	Macroscopic examination	72
14.10	Specimen Collection	73
14.11	Appearance	73
14.12	Microscopic Examination	73
14.13	Possible Pathogens	73
14.14	Stool Concentration Techniques	73
14.15	Flotation Technique	73
14.16	Sedimentation Technique	74
14.17	Specific staining reactions	75
14.18	Urine	76
14.19	Sample Collection	76
14.20	Microscopic Examination	77
14.21	Report the Appearance of Urine	77
14.22	Blood	77
14.23	Sample Collection	77
14.24	Wet Blood Preparation	77
14.25	Making Films	77
14.25.1	Fresh film preparation and examination	77
14.25.2	Thick Film	78
14.25.3	Thin Blood Film	78
14.26	Staining	79
14.26.1	Leishmans (<i>Thin films</i>)	79
14.26.2	Giemsa	79
14.26.2.1	Thin films	79
14.26.2.2		79
14.26.3		79
14.26.3.1		/9
14.26.3.2		80
14.27	Blood Specimen	80
14.28	Preparing Blood films	80
14.28.1	I hick films	80

14.28.2	Thin films	81
14.29	Staining of Blood films with Giemsa	81
14.29.1	Thin films	81
14.29.2	Thick film	82
14.30	Special Procedures for Detecting Microfilariae	82
14.31	Blood microfilariae	82
14.31.1	Centrifugation (Knott's technique)	82
14.31.2	Filtration	82
14.32	Microscopic Examination	83
14.33	Assessment of Malaria Parasite density	86
14.33.1	Thick Blood Film	86
14.33.1.1	Double counter technique	86
14.33.1.2	Earle and Perez method	86
14.33.2	Thin Blood Film	87
14.33.2.1	Percentage of parasitaemia	87
14.34	Skin Snip	87
14.35	Other Clinical Specimens	87
14.36	Isolation of Leishmania Organisms	87
14.37	Sputum Specimens	87
14.38	Induced Sputum and Bronchoalveolar Lavage (Bal) For <i>Pneumocystis jirovecii</i>	88
14.39	Aspirates	88
14.40	Other Specimens	89
14.41	Vaginal Swabs for Detection and Susceptibility of Trichomonas	89
14.42	Cellulose Tape or Swube Tube Procedure for Demonstration of Pinworm Eggs	89
14.43	Urine Specimens	89
14.44	Biochemical Diagnosis	90
14.45	Advantages of isoenzyme diagnosis	90
14.46	Disadvantages of isoenzyme diagnosis	90
14.47	Immunodiagnosis	90
14.47.1	Antibody Based Methods	90
14.47.2	Antigen based tests	91
14.48	DNA Based Tests	91
14.49	Culture	92
14.50	Malaria Culture	92
14.51	Leishmanial culture	93
14.52	Trypanosomiasis culture	93
14.53	Entamoeba histolytica	93
14.54	Strongyloides stercoralis/ hookworms	93

14.55	Animal Innoculation	94
	Chapter-15	95-96
	Laboratory Techniques in Mycology	
1 - 1	Ineanacho Nwaaiona	
15.1	Specimens	95
15.2	Direct Microscopic Examination	95
15.3	Wet Preparation	95
15.4	Unstained Wet Mount	95
15.5	KOH Preparation	95
15.6	Staining: Calcoflour White – KOH Stain	95
15.7	Gram Stain	96
15.8	Indian Ink	96
15.9	Germ Tube Test	96
15.10	Culture	96
15.11	Lactophenol Cotton Blue Mount	96
15.12	Other Identification Techniques	96
15.13	Antifungal Susceptibility Testing	96
	Chapter-16	97-105
	Laboratory Techniques in Medical Virology Odimayo Simidele	
16.1	Specimen Collection, Transport and Storage	97
16.1.1	Specimen collection	97
16.1.2	Timing of Collection	98
16.1.3	Transport Conditions	99
16.1.4	Processing of Specimens	100
16.2	Specimen Processing	100
16.3	Virus Detection Methods	100
16.4	Cytology and Histology	100
16.5	Electron Microscopy (EM)	100
16.6	Immunodiagnosis (Antigen-antibody detection)	101
16.6.1	Neutralization Test	101
16.6.2	Haemagglutination	102
16.6.3	Complement Fixation	102
16.6.4	Precipitation Test	102
16.6.5	Immunofluorescent antibody tests	102
16.6.6	Gel diffusion	102
16.6.7	Radial haemolysis	102
16.6.8	ELISA	102
16.6.9	Complement fixation Test	103
16.6.10	Haemagglutination	103
16.7	Molecular Biology Techniques	103

Laboratory Practical Manual for Medical Microbiology and Parasitology

16.7.1	Probing	103
16.7.2	Polymerase Chain Reaction (PCR)	103
16.7.3	Electropherotyping	103
16.8	Viral Culture	103
16.9	Anti Viral Susceptibility Testing	104
16.10	Phenotypic assays	104
16.11	Genotypic assay	104
16.12	Further Reading	105

Second Edition

Laboratory Practical Manual for Medical Microbiology and Parasitology

NWADIOHA Samuel Iheanacho
ODIMAYO Michael Simidele
ABAYOMI Fadeyi





Excellent Publishers Kancheepuram, Tamilnadu, India

