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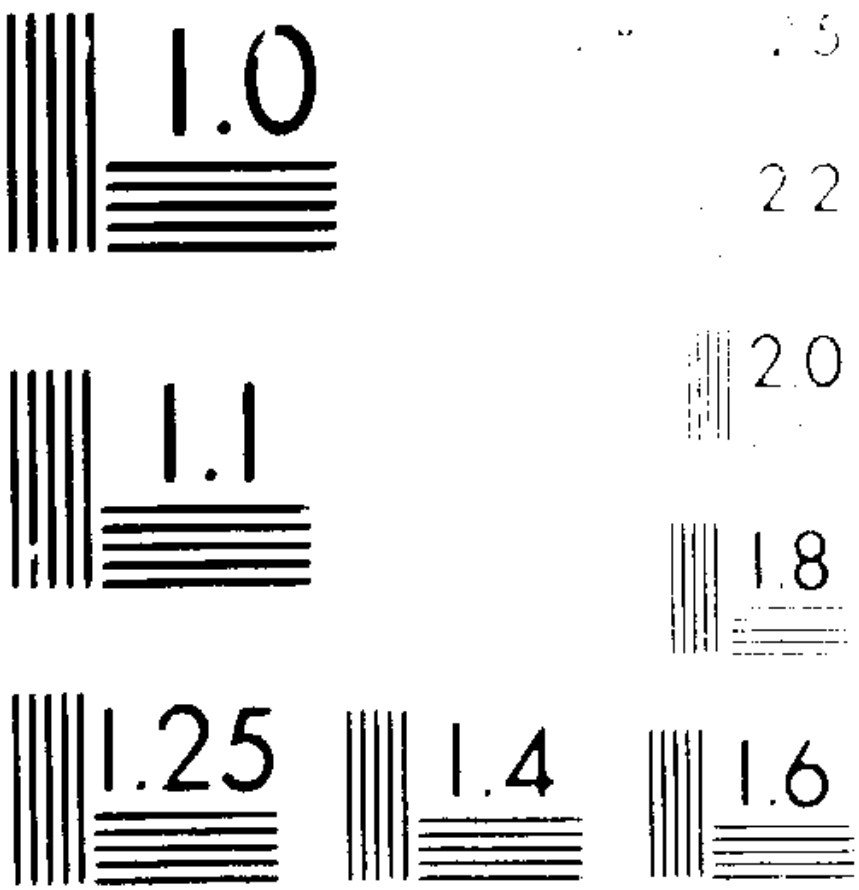
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UNITED NATIONS
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Tanzania. ESTABLISHMENT OF FOOD TESTING AND QUALITY CONTROL LABORATORY

US/URT/79/202

UNITED REPUBLIC OF TANZANIA

Technical Report*

Prepared for the Government of the United Republic of Tanzania by the United Nations Industrial Development Organization

Based on the work of Margaret Dick, expert in food microbiology

* This document has been reproduced without formal editing

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CONTENTS

APPENDICES

1. SUMMARY

Since the bacteriological laboratory was not ready for operation part of the expert's time was spent in the installation and instruction of the use of equipment which has been purchased within the project. Instruction was given in the use of glassware and in the preparation of media and diluents. In the absence of blenders which had not been delivered, improvised methods were established so that testing techniques counts and tests for some specific organisms could be done. Foods tested included tea, coffee and milk. Techniques by which nuts and spices could be tested were demonstrated.

The already established standards and standard methods were cited and discussed in detail with relevant staff. A suggested work programme was prepared as well as a supplementary list of equipment and a suggested list of books for the microbiology laboratory.

2. INTRODUCTION

The project Establishment of Food Testing and Quality Control Laboratory, was formulated following a visit of an expert to several countries in the region. His task was to determine in what country or countries the establishment of such a laboratory would be most desirable and possible. In addition to the food microbiologist an expert in laboratory instrumentation and an expert in food testing were also assigned to the project. Most of the laboratory equipment was provided through the Special Purpose Contribution pledged by the Government of Hungary. The project was accomodated within the Tanzania Bureau of Standards (TBS), offering adequate facilities for this purpose.

The immediate objective of the project was the establishment of testing facilities to serve the existing food processing industry by testing physical, chemical and biological properties and composition of various food products and auxillary materials, and to provide assistance to individual plants in solving their operational and technological problems.

The specific duties of the food microbiologist were to assist in setting up the laboratory, to conduct practical tests and to train counterpart personnel in microbiological determinations, preparation and use of various media and stains, use of equipment and instruments, etc.

During the one month assignment in February/March 1982, the expert carried out her duties basically in line with the job description, however, there were some problems with the electricity supply, electrical fittings, water supply, etc.

3. FINDINGS AND RECOMMENDATIONS

PLAN OF THE LABORATORY

The floor plan and room arrangement of the laboratory was well conceived and the bench surfaces and cupboards were well designed to provide an easily cleaned laboratory, so essential for microbiology.

Perhaps three comments should be made which may be useful for any future planning of this type of laboratory.

Firstly, fume-cupboards are very infrequently used in microbiology and the space used for the two incorporated in this plan could have been utilised as bench space or incubator space, with any fume-cupboard work - which were to be very rare - being done in the chemistry section.

Secondly, the size of the incubators did not appear to be allowed for in the plan. The problem was overcome by double-banking some incubators. The remaining incubators have temporarily been placed in the sterile room and in space designed for a refrigerator which has not yet been installed. When these are removed from the sterile room and when the refrigerator is installed, the only space left for this equipment is in the corridor. This comment is made so that thought can be given to this in any future design.

The third point which should be made is that it is not usual to have shelving above benches used in a food testing microbiological laboratory. These laboratories must be kept free from dust and if shelves exist in such a laboratory and equipment is kept on the shelves, these also must be kept free from dust and sterilized prior to conducting any testing programme. It is far better for equipment to be stored in cupboards, allowing the benches to be easily disinfected.

EQUIPMENT

One piece of equipment, the Colworth Stomacher, a blending machine, although ordered, had not yet been delivered. This is necessary for the preparation of food samples.

In addition, a supplementary list of equipment is attached which it is believed is necessary to have in the laboratory. Amongst this list is :

1. A blender such as an Omnimix (Sorvall) blender. Some of the foods to be tested such as spices are very hard and would puncture the plastic bags used in the Colworth Stomacher, so for these types of foods it is necessary to have a sterisable, preferably, overhead blender.

2. It will be noted that this supplementary list includes a drying and a sterilizing oven. When the laboratory is testing a number of food samples per day, as can be done by a microbiologist plus a laboratory technical assistant, the amount of equipment to be dried and sterilized requires a greater capacity of oven space than supplied by the pieces of equipment which are at present in the laboratory. It may be possible to utilize just one big oven, provided the oven was supplied with a reliable automatic timer which would allow it to function out of working hours.

3. The types of water baths required for food testing work requires that the tubes of media or cultures to be immersed in water at specific temperatures. The two baths supplied are not of this type, but rather radiant heat baths and the test tube holders would not hold normal microbiological tubes.

4. As each different food requires a number of different tests to be performed on it, the media requirement is quite high. The autoclave capacity, one autoclave (the other one supplied has a hole in it and cannot be used) and one pressure cooker, each of which will only take a litre flask, is not enough capacity to cope with media making and disinfection of used equipment. Hence, an autoclave is included in the supplementary list.

5. A glass still or a de-ionizing unit is required. Metal distilled water is not suitable for microbiological work.

6. No facilities were provided for boiling used sterilized equipment with detergent for cleaning purposes. This could be achieved using large pots, which will require hot plates and bench space in the preparation room, close to the sink.

The other equipment listed is basically normal everyday equipment used in a microbiological laboratory. A copy of this supplementary list was supplied on request to Dr. Movitz and Mr. Bavu.

PREPARATION AND TESTING PROCEDURES

The methods for cleaning new and used glassware were explained and put into practice. Details of these procedures are included in the Australian Standard Methods, a copy of which was given to the laboratory.

The equipment and media required for testing foods such as tea, coffee, nuts and spices were prepared and sterilized.

In the absence of blenders, methods of handling tea and coffee were improvised, primarily to demonstrate the techniques used in testing these foods and to give the T.B.S. staff an opportunity of performing the tests. Coffee (instantised) was a simple food to test but tea caused some problems because of the absorbtion of the diluting fluid of the tea itself. More work will have to be done on tea to obtain a suitable dilution technique, but the problem may be overcome with the use of the Stomacher. This problem was discussed with the microbiology staff at T.B.S. with the suggestion that a higher initial dilution should be tried.

A sample of milk was also tested. This sample arrived at the laboratory, not in a cold transport box, as would normally be the case, so it could be expected that the counts would be high. The testing procedure was demonstrated and performed by T.B.S. staff. It was useful to use this sample for not only the standard plate count but also for testing for coliforms and E. coli.

At this stage, the water supply to the laboratories ceased and so all testing had to stop. However, it was possible to improvise blending methods (non-mechanical) to use for nuts and spices so that work on these products could continue, pending the delivery of the blenders. Trials have been made using a sterile mortar and pestle, and this technique should be satisfactory to be used temporarily for these products.

In addition, time was spent with the T.B.S. microbiologist, Mrs. Athmedali, discussing the techniques which could be used for testing meat, poultry, butter, ice-cream and other products.

SALMONELLA TESTING

It is not recommended that testing for Salmonella should be done at this stage. Very special precautions must be taken with these organisms. It should not be done in a laboratory into which anyone can walk. It requires special hygienic techniques, including the use of special pipetting techniques - the equipment for which is not yet available. It is suggested that indicator organisms and E. coli tests should be used for gauging the state of the food at this stage. When absence of these organisms is obtained in a food, then perhaps the presence or absence of Salmonella could be checked. But very stringent techniques should be used and safe-guards must be taken in the handling of Salmonella organisms and all other pathogenic organisms.

TESTING FOR BACILLUS ANTHRACIS AND CLOSTRIDIUM BOTULINUM

This is not recommended. Both these organisms require a very high standard biologically clean atmosphere room, and special animal housing, which is not available.

Discussions were also conducted on sampling plans, the organisms to be considered in a particular product using the work of the International Commission for Microbiological Specifications for Foods (I.C.M.S.F.) as the basis of discussion. As I.S.O. and F.A.O. both appear to be adopting methods from the I.C.M.S.F. and the format of the microbiological specifications being adopted by Codex Alimentarius are also based on the sampling plans of the I.C.M.S.F., emphasis was placed on having a working knowledge of the I.C.M.S.F. publications and the adoption of their methods.

RESULTS OF THE TESTS CONDUCTED ON COFFEE, TEA AND MILK

Although these tests were, to a degree, improvised and were basically being used for the demonstration of technique, the results can still be used as a guide to possible problems and an indication of the necessity for further work and perhaps sampling at the factory.

The results are attached as appendix B - and follow up work is suggested in the suggested work programme attached as appendix C.

T.B.S. PRINTED STANDARDS AND METHODS

The author was supplied with a number of T.B.S. standards and standard methods :

T.Z.S.	47 : 1979	Ginger - Whole, in pieces and ground
T.Z.S.	31 : 1979	Chillies and Capsicums - Whole and ground
T.Z.S.	46 : 1979	Tumeric - Whole and ground
T.Z.S.	45 : 1979	Curry Powder
T.Z.S.	34 : (Part 1) 1979	Animal feeds and feeding stuffs - sampling and general methods

These standards did not contain any microbiological specifications except a reference to fungi. For example, in T.Z.S. 46 : 1979, Tumeric, Clause 3.4 the term "Freedom from fungi, insects etc." is used. This means that tumeric should not contain one mould spore. With this type of product, it is doubtful whether it could be produced completely free of mould spores. Such a statement could be questioned legally.

The above point and the following T.B.S. standard methods for microbiological analysis were discussed in detail with Dr. Mosha.

T.Z.S.	117 : 1981	Handling samples for microbiological sampling
T.Z.S.	124 : 1981	Sampling of foods for microbiological examination
T.Z.S.	121 : 1981	Examination for Clostridium botulinum
T.Z.S.	34 : (Part 3)	Animal feeds and feeding style

During these discussions, it was suggested that rather than T.B.S. developing standard methods based on British, Australian and Indian methods, many of which have now been published for some years, that consideration should be given when producing new methods and revising methods to adopting methods from the International Commission on Microbiological Specifications for Foods - Book 1, second edition. These are being adopted by I.S.O. and F.A.O.

Time did not permit discussion with Dr. Mosha of the following standard methods :

T.Z.S.	122 : 1981	Microbiological examination for Salmonella
T.Z.S.	125 : 1981	Method for Staphylococcus aureus
T.Z.S.	119 : 1981	Method for coliform bacteria
T.Z.S.	131 : 1981	Method for plate count
T.Z.S.	131 : 1981	Method for yeast and mould
T.Z.S.	120 : 1981	Milk - microbiological analysis

However, some comments were written on these documents which were left for perusal.

Time did not permit the examination of the following documents :

T.Z.S.	123 : 1981	Method for Clostridium perfringens
T.Z.S.	126 : 1981	Method for Bacillus cereus
T.Z.S.	127 : 1981	Method for Vibrio parahaemolyticus

All of these are based on Australian Standard Methods, some of which are under review at this point in time.

THE SAMPLING ROOM SHEET

Used for attachment to T.B.S. laboratory samples, was viewed and the following amendments suggested :

1. Organoleptic tests should not be done in a microbiology laboratory. These would better be done by the inspector taking the sample and a decision made at that stage whether the sample should or should not be submitted to an expensive microbiological examination.

2. The microbiological tests to which the sample is submitted should be decided only after discussion with the microbiologist. It should be kept in mind that microbiological testing is very expensive and to control this cost, only tests which are significant to a particular product should be conducted.

THE DEVELOPMENT OF MICROBIOLOGICAL STANDARDS OR SPECIFICATIONS

The attainable microbiological criteria for foods is dependent upon a number of factors, including the quality and composition of the raw material, the processing plant and the process itself. These can vary considerably, particularly from country to country. In order to set specifications or standards, it requires considerable data which is based on production which is carried under good hygiene practices. It is therefore recommended that T.B.S. should only start to write microbiological specifications or standards after considerable data has been attained and in many cases, this data should be aligned to the chemistry of the product.

4. ACKNOWLEDGEMENTS

The author would like to acknowledge the assistance given by Dr. Movitz, Mr. Harsanyi and Mr. Loetsco for the speed in which they were able to install and calibrate the equipment so that work could commence.

And to thank Mr. Mwobahe and his staff for their co-operation and assistance given to the author.

APPENDIX A

SUPPLEMENTARY LIST OF EQUIPMENT FOR MICROBIOLOGY LABORATORY

1. Drying Oven - approximate size, internal diameter - 20" x 20" x 26" inches

2. Sterilizing Ovens - as above - See report, page 3, point 2

3. Water baths (with pump and heater)

1 for testing room (45°C)
1 for Coliforms (37°C)
1 for E. coli (44.5°C)

Plus spare heater pump

1. Large autoclave fitted with 2 baskets, one on top of each other. Approximate size 15" internal diameter x 26" internal diameter deep. (Should easily take 1 litre flasks (height) in each basket).

1. Boiler for boiling used equipment approximately 15" x 20" x 8" deep with basket or large preserving pots

1. Large hot plate for above

12. Small baskets for storage of media in refrigerator. 7" diameter (so tubes will not fall)

6. 2 litre erlenmeyer flasks for media making

Standard cultures for routine checking of media (available from Difco)

Spore discs for testing sterility

Standard loops 0.001 ml.

Large spatula's

Beakers - a range of sizes up to 1 litre

Media dispenser eg. Hand Filler "Kigliss" (French) with 10 ml. brevette syringe and 20 ml. Brevette syringe

Similar system if available for 90 - 100 ml. or a 90 ml. dipper with handle (90ml. to brim)

12. Dozen medicine flat bottles or McCartney bottles of approximately 200 ml. capacity

Balance - Top pan - 300g - 0.1g for media and dyes

Glass-still or de-ionizing unit for distilled or de-ionized water

Metal trays for boiling up pipettes

Blender - Omnimix (Sorvall) with stainless steel cups approximately 200 - 300 ml capacity

APPENDIX A

Vortex genie - mixer for test-tubes

Glass sample bottles approximately : 55mm x 42mm diameter (75ml)
105mm x 42mm diameter (150ml)

Special transfer pipettes for pathogenic cultures (Salmonella) - 10ml.
eg. Finn adjustable pipettes fitted with tip ejector and sterilizable.

Transport boxes for samples

Containers to hold plastic stomacher bags eg. plastic beakers 600ml.
- litre

Adjustable lamp

First-aid kit

APPENDIX B

ALL TAKEN FROM ONE CAN

INSTANT COFFEE (Aficafe Coffee)

Sample 3 :	Standard Plate Count (32°C)	< 10 orgs/g.
	Malt Agar (25°C)	20 orgs/g. No mould detected
	Coliforms	Not detected/g.
Sample 9 :	Standard Plate Count (32°C)	< 10 orgs/g.
	Malt Agar (25°C)	10 orgs/g.
	Coliforms	Not detected/g.
Sample 5 :	Standard Plate Count (32°C)	< 10 orgs/g.
	Malt Agar (25°C)	< 10 orgs/g.
	Coliforms	Not detected/g.

COMMENTS :

These results are good and can be explained by the fact that the product is subjected to a high heat process in it's preparation.

TEA - SIMBA CHAI

Sample 6 :	Standard Plate Count (32°C)	100,000 orgs/g.
	Malt Agar (25°C)	3,500 moulds/g.
	Coliforms	Not detected/g.
Sample 8 :	Standard Plate Count (32°C)	200,000 orgs/g.
	Malt Agar (25°C)	78,000 moulds/g.
	(Presumptive) E. Coli	Present

MILK (Cartoned pasteurized milk)

Standard Plate Count (32°C)	105×10^4 org/g.
(Presumptive) E. Coli	Approx. 1000/ml.

APPENDIX C

SUGGESTED WORK PROGRAMME FOR THE MICROBIOLOGY LABORATORY OF T.B.S.

When the refrigerator room is working, make up as much of the requisite media and diluent as possible with the number of tubes available and store in the refrigerator room after checking for sterility.

Stock taking of media should be done twice a week and where necessary, additional media should be made.

The media making should be recorded in a special book included the code date of the particular bottle used to make the media. The particular lot of media made on a specific day should be labelled with a date. The oldest media should be used first. When the cultures are available, each bottle of media should be checked with a specific stock organism.

When bottles become available these should be used for media and large quantities of diluent leaving the tubes for diluents and special media required in tubes.

CARE OF THE LABORATORY

The microbiology laboratory requires special care - daily care. The laboratory benches, window sills, any shelving and equipment stores on shelves shall be wiped down with disinfectant each morning and then the floors washed with a disinfectant. Particular care should be taken of the test - assessment rooms and the washing up and preparation area. This daily care applies to all rooms. The cupboards and doors should also be kept scrupulously clean.

Prior to setting up the bench for testing, the bench must again be disinfected.

Before and after examination of cultures and plates, the benches should be disinfected.

Any spillage of cultures must be handled only by the trained microbiologists. As soon as cultures are ready to discard they should be autoclaved at 121.5°C/30 minutes before discarding. The tubes and plates should then be boiled with soap and disinfectant and cleaned with a brush - all glassware must be rinsed a minimum of five times then rinsed with distilled water prior to drying.

TESTING PROGRAMME

At the moment, testing will be restricted to the amount of equipment available. It is important then that all used equipment is recycled as quickly as possible. This means that after testing the used equipment, tubes, pipettes, etc. must be cleaned immediately.

APPENDIX C

It should be possible for both Mrs. Ahmedali and Mr. Mwaya to test approximately four samples of food each per testing day, more when extra glass ware and facilities are available, and possibly at this stage, this could be done on three days of each week.

From the results of the preliminary testing done in the last week on instant coffee, tea and milk, least emphasis should be placed on instant coffee, but importance should be placed on both milk and tea and perhaps raw coffee, particularly on moulds in tea, and the microbiological quality of retail milk.

The high numbers of mould in the tea sample tested this week indicates, if the tea is dry enough, that heavy mould growth may have occured during processing. More tea samples need to be done and in order to get a quick over view of the mould situation, a variety of grades of tea could be tested for mould only. This would allow more results to be obtained with this test, than spreading the equipment over a wide number of tests.

Samples of cartons of milk should be obtained directly from the factory and brought into the laboratory in a transport box to see the microbiological state of the milk at the point of production. If the counts are high and there are coliforms present, then the factory should be visisted, inspected and samples taken aseptically from the pasteurizer and from the filler and these should be examined for counts and coliforms. This will give a guide to where the problem exists at the factory.

With the lack of a blender, methods have to be improvised for testing nuts and spices. Trials have been made using a sterile mortar and pestel and this technique should be satisfactory to be used temporarily for these products.

SALMONELLA TESTING

It is not recommended that testing for Salmonella should be done at this stage. Very special precautions must be taken with these organisms. Such work should not be done in a laboratory into which anyone can walk. It requires special hygienic techniques, including the use of special pipetting techniques, the equipment for which is not yet available.

It is suggested that indicator organisms and E. coli tests should be used for gauging the state of food at this stage. When the absence of these organisms is achieved in the food, then perhaps the presence or absence of Salmonella could be checked. But very stringent techniques should be used and safeguards must be taken in the handling of Salmonella organisms.

TESTING FOR BACILLUS ANTHRACIS AND CLOSTRIDIUM BOTULINUM

This is not recommended. Both these organisms require a very high standard biologically clean atmosphere room and special animal housing which is not available at T.B.S.

APPENDIX C

RECORD BOOKS, RESULTS AND REPORTING

It is important that records be kept of samples arriving at the laboratory, the dates of arrival and testing, any incubation which has to be done and the date it is to be tested after incubation and so on.

There should be a day recording book on all results of tests. And there should be records of the results recorded under specific products for easy reference.

These records should be under the control of the microbiologist who should issue reports on the samples as required.

APPENDIX D

SUGGESTED BOOK LIST FOR MICROBIOLOGY LABORATORY OF THE T.B.S.

Micro-organisms in Foods 1. 2nd Edition. International Commission on Microbiological Specifications for Foods (I.C.M.S.F.) (1978)
(University of Toronto Press)

Micro-organisms in Foods 2. (I.C.M.S.F.) (1974)
(University of Toronto Press)

Microbial Ecology of Foods 1. (I.C.M.S.F.) (1980)
Microbial Ecology of Foods 2. (I.C.M.S.F.) (1980)

Food-borne Inspections and Intoxications
H. Riemann and F.L. Bryan. 2nd Edition (1979)
(Academic Press)

Food poisoning and Food Hygiene
B.C. Hobbs and R.J. Gilbert. 4th Edition (1978)

Hospital Hygiene (2nd Edition)
Author : I.M. Maurer
(Edward Arnold)

Standard Methods for the Examination of Dairy Products (14th Edition)
Editor : E.H. Marth
Published By : American Public Health Association (A.P.H.A.)
1015 Eighteenth St., Washington D.C., 20036

Standard Methods for the Examination of Water and Waste Water (14th Edition)
Published By : A.P.H.A., 1015 Eighteenth St., Washington D.C., 20036

Water Activity and Food (1978)
J.A. Troller and J.H.B. Christian
(Academic Press)

The Genus Penicillium and it's Telemorphic States
Eupenicillium and Talaromyces (1979)
J.I. Pitt
(Academic Press)

Identification Methods for Microbiologists (2nd Edition) (1979)
Edited By : F.A. Skinner and D.W. Lovelock
(Academic Press)

Isolation of Anaerobes (1971)
Editor : D.A Shapton and R.G. Board
(Academic Press)

APPENDIX D

Microbial Growth and Survival in Extremes of Environment (1980)
Editor : G.W. Gould and J.E.L. Corry
(Academic Press)

Laboratory Manual for Food Canners and Processors
Volume 1. - Microbiology and Processing
Compiled by Natural Canners Association Research Laboratories
(A.V.I. Publishing Co. Inc. - Westport, Conneticut)

Canned Foods - Thermal Processing and Microbiology
A.C. Hersom and E.D. Hulland
7th Edition
(Churchill Livingstone)

Smith's Introduction to Industrial Mycology (7th Edition) (1981)
A.H. Onions, D. Allsop and H.O.W. Eggins
(Edward Arnold)

Identification of Enterobacteriaceae
P.R. Edwards and W.H. Ewing (3rd Edition) (1972)
(Burgess Publishing Co.)

Official Microbiological Methods of the American Spice Trade Association (1976)
(American Spice Trade Association Inc. - Englewood Cliffs, New Jersey)

Laboratory Methods in Food and Dairy Microbiology
W.F. Harrigan and M.E. McCance (1976)
(Academic Press)

Biology of Micro-organisms
T.D. Bock (1970)
(Prentice Hall)

The Genus Aspergillus
K.B. Raper and D.I. Fennel (1965)
(Baltimore, Williams and Wilkins)