

Elimination of Pathogenic Organisms from Meat and Poultry

edited by
E.J.M. Smulders



Elsevier

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Proceedings of the International Symposium: Prevention of
Contamination, and Decontamination in the Meat Industry
Zeist, The Netherlands, 2-4 June 1986

edited by

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1987

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AMSTERDAM-NEW YORK-OXFORD

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ISBN 0-444-80893-0

Published by:

Elsevier Science Publishers B.V. (Biomedical Division)
P.O. Box 211
1000 AE Amsterdam
The Netherlands

Sole distributors for the U.S.A. and Canada:

Elsevier Science Publishing Company, Inc.
52 Vanderbilt Avenue
New York, NY 10017
U.S.A.

Library of Congress Cataloging in Publication Data

International Symposium: Prevention of Contamination and
Decontamination in the Meat Industry (1986 : Zeist,
Netherlands)
Elimination of pathogenic organisms from meat and
poultry.

Includes index.

1. Meat--Microbiology--Congresses. 2. Meat--
Contamination--Congresses. I. Smulders, F. J. M.
(Frans J. M.) II. Title.

QR117.L58 1986 664'.9028 87-13662

ISBN 0-444-80893-0

ELIMINATION OF PATHOGENIC ORGANISMS FROM MEAT
AND POULTRY



Preface and Acknowledgements

An International Symposium on contamination and decontamination of red and poultry meat was held at Zeist, The Netherlands, on 2–4 June 1986; it was organised by the Hygiene and Microbiology Section of the Department of the Science of Food of Animal Origin, Faculty of Veterinary Medicine, The University of Utrecht, The Netherlands. The objectives were to monitor the current viewpoints on meat and poultry hygiene and to prepare an updated document to guide public health veterinarians, meat hygienists, food microbiologists, quality assurance officers, legislators, manufacturers and meat trading companies. Although it was recognised that one of the major controls of meat- and poultry-borne diseases lies with the consumer, it was decided that the conference would deal only marginally with consumer behaviour and would focus primarily on those segments of the meat-production chain that, to a large extent, can be controlled by industry. These include procedures on the farm, slaughtering and carcass dressing, meat and poultry processing, and transport. Consequently, those interested in these areas of concern are the target audience for this book.

Since the costs involved in organising such an international event are considerable, the organizers were very pleased to receive financial support from The Commission of the European Communities at Brussels, The Netherlands' Ministry of Agriculture and Fisheries, The Netherlands' Commodity Board for Livestock and Meat, and The Commodity Board for Poultry and Eggs. In addition, The University of Utrecht, celebrating its 350th anniversary, provided for an official reception of the participants.

Besides faculty and staff of The Department of the Science of Food of Animal Origin and the Board of Directors of The Faculty of Veterinary Medicine, many institutions and individuals were involved in organising the conference. The mediation of The Netherlands' National Council for Agricultural Research NRLO was instrumental in securing funds. Financial arrangements were meticulously handled by administrator/treasurer Ing. Rik Timmermans. The Symposium Secretary, Ms. Liesbeth de Waal, in charge of (inter)national correspondence and telephone calls, proved to be a most helpful, eloquent and elegant hostess.

Preparing the final script of the Proceedings is a time-consuming but gratifying task. The fact that most typescripts were submitted before the start of the Symposium facilitated the process immensely, as many of the necessary adaptations could be made 'on the spot'. Few chapters had to be changed or re-arranged through correspondence, and when this was necessary, most contributors were fairly prompt in responding to queries. All manuscripts were word-processed to include a special coding enabling computerized typesetting, and I am very grateful to Mrs. Jenny Scholten-van Denzel for her devoted efforts in this work. In preparing additional graphics Mr. Ko van Eyndthoven and Mr. Peter Koolmees proved reliable as ever. Dr. Terry Roberts

(AFRC Institute of Food Research, Langford, Bristol) generously offered to read the final print-out and 'anglicise' the text where necessary. Since the final editorial work was conducted while I was guest of The University of Wisconsin at Madison, the opportunity was taken to consult Dr. Michael Doyle (Food Research Institute) and Dr. Elmer Marth (Department of Food Science/Food Research Institute) on editorial matters. In addition, the help of the ever patient librarians at the Steenbock Memorial Library, and of my hosts at The Muscle Biology Laboratory, University of Wisconsin at Madison, is gratefully acknowledged. Finally, I thank my dearest companion and colleague Margriet Bos for tolerating me during the preparation of this book.

Frans J.M. Smulders
Madison, 18th May 1987

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Biographies of authors

Zuhair A.M. Al-Chalaby graduated in Veterinary Medicine from the University of Baghdad. He obtained an M.Sc. degree in Meat Science from the University of Bristol in 1980. The subject of his Ph.D. thesis was the epidemiology of *Salmonella* infections in broiler chickens. Dr. Al-Chalaby is currently lecturer in Veterinary Public Health at the College of Veterinary Medicine, Baghdad University.

Anthony C. Baird-Parker studied Microbiology at the University of Birmingham and received his Ph.D. in 1979 for his work on the taxonomy of oral microorganisms. He joined Unilever Research in 1959 and since 1969 has been Head of Microbiology at the Unilever Research Laboratory, Colworth House. He has published more than 70 papers on various aspects of food microbiology, particularly on the classification of staphylococci and micrococci and food-borne disease-causing microorganisms. He is a member of various international and national committees including the International Commission on Microbiological Specifications for Food (ICMSF) and has worked extensively with the WHO and the Codex Alimentarius Food Hygiene Committee. His current interests are preventive quality assurance and predictive microbiology.

Peter S. Elias studied Chemistry and Medicine at London University. He received his B.Sc. (Hons) in Chemistry in 1945, his M.B., B.S. in 1952 and his M.D. in 1958. After spending some 11 years in clinical medicine he joined the United Kingdom Department of Health and Social Security (DHSS) in 1964. He left the DHSS as Principal Medical Officer, Toxicology, to become Director of the FAO/IAEA/WHO International Food Irradiation Project at Karlsruhe, Federal Republic of Germany. The Project was wound up in 1982 having successfully completed its objectives. In 1983 he was nominated Honorary Professor of Food Toxicology at the University of Stuttgart/Hohenheim where he continues teaching food toxicology. Professor Elias has also worked extensively as a member of many international expert committees, particularly JECFA, the EEC Scientific Committee for Food, the EEC Scientific Committee for Animal Nutrition, the EEC Scientific Veterinary Committee and the Council of Europe. He is still associated with the Federal Research Centre for Nutrition at Karlsruhe, where he continues research into the mutagenicity of food additives and ingredients.

Constantin Genigeorgis was born and reared in Greece. He studied Veterinary Medicine at the Aristotle University in Thessaloniki where he received the D.V.M. degree. After emigration to the United States of America he continued his studies at the University of California at Davis where he received a M.Sc. and a Ph.D. degree in comparative pathology. Thereafter he joined the Research and later Teaching Staff of that University.

ty. Currently he is Professor of Food Safety in the Department of Epidemiology and Preventive Medicine of the School of Veterinary Medicine, University of California at Davis. Professor Genigeorgis has published numerous contributions to scientific journals and textbooks. He is a member of several international societies, a Fellow of the Royal Society of Health (United Kingdom), and a consultant for the Panamerican Health Organization. In 1982, Professor Genigeorgis was recognised as 'Outstanding Teacher of Food Hygiene' by the Veterinary Colleges of North America.

Geert E. Gerats studied Food Science at the H.A.S. College in 's-Hertogenbosch where he received a B.Sc. degree in Food Technology. In 1973 he joined the Department of the Science of Food of Animal Origin, Faculty of Veterinary Medicine, at the University of Utrecht as a research assistant. He primarily worked in the field of meat microbiology and the sociology of hygiene behaviour. In 1980 Dr. Gerats obtained a M.Sc. degree in Sociology at the University of Utrecht. Currently Dr. Gerats is Head of the Netherlands Meat Industries' Quality and Hygiene Assurance Assistance Programme.

Colin O. Gill studied biochemistry at the University of Leicester and, in 1973, received the Ph.D. degree from the University of Hull for work on the physiology of yeasts utilising *n*-alkanes. Since 1973 he has been employed at the Meat Industry Research Institute of New Zealand, currently holding the position of Head of the Microbiology Section. His research activities have been largely concerned with elucidation of the processes of microbial spoilage in chilled and frozen meat, and definition of the microbiological status of both normal and bruised deep tissues. His current interests are concerned with the identification of packaging systems that give improved spoilage control in chilled meats, and the use of temperature function integration techniques for assuring the hygienic efficiency of food-processing procedures.

Frederick H. Grau, while employed as a Technical Assistant at the Meat Research Laboratory of the Commonwealth Scientific and Industrial Research Organization (CSIRO) of Australia, obtained a Science Degree at the University of Queensland. In 1961, he received a Ph.D. degree from the Bacteriology Department, University of Wisconsin at Madison. Since 1961 he has been employed at CSIRO Meat Research Laboratory, Brisbane, Australia, initially as Leader of the Microbiology Section and, since 1982, as Leader of the Microbiology and Food Technology Section. Dr. Grau's work at the Meat Research Laboratory has been concerned with the microbiology of beef and sheep meats, particularly in the areas of boneless meat production, *Salmonella* contamination, hot boning, vacuum-packaged meat and, more recently, *Campylobacter*.

Walther H. Heeschen studied Veterinary Medicine at the University of Hannover (Tierärztliche Hochschule). In 1958 he received the Ph.D. degree in Veterinary Science at the University of Hannover. After training in meat and food inspection and in veterinary practice he joined the Institute for Hygiene of the Federal Dairy Research

Centre in Kiel in 1961. In 1972 he was appointed Professor at the Federal Dairy Research Centre and nominated as Lecturer (Privatdozent) of Food Hygiene at the Free University in Berlin. In 1982 he was appointed Professor of Milk Hygiene in Berlin. Professor Heeschén has worked extensively in different fields of milk hygiene: occurrence of saprophytic and pathogenic microorganisms in milk and milk products, chemical residues and contaminants in milk and milk products, diagnostic methods for mastitis research and animal diseases with importance for milk hygiene. He is a member of several scientific organisations and acting as adviser and consultant for international bodies, such as WHO, FAO, and EEC. Professor Heeschén is chairman of the groups of experts E12 (pesticides), E47 (antibiotics) and A4 (residues and contaminants in milk and milk products) of the International Dairy Federation and member of other experts' groups in the same organisation.

Mike H. Hinton graduated in Veterinary Medicine in 1966. After working in veterinary practice and as a veterinary officer in the Ministry of Agriculture's Veterinary Investigation Service he joined the staff of the University of Bristol's Veterinary School in 1973 as a lecturer in clinical pathology. He was promoted to Senior Lecturer in Veterinary Public Health in 1977. His principal research interests include the epidemiology of *Salmonella* and *Campylobacter* infections in farm animals and the ecology of drug resistance among enteric bacteria.

William R. Hudson is a Fellow of the Institute of Medical Laboratory Sciences. His early career was as a technician in the Pathology Laboratory of a general hospital, then as the senior bacteriology technician at a large children's hospital. He joined the Agricultural Research Council in 1968 to work in the Microbiology Section of the Meat Research Institute. From 1975 to 1984 he was the officer-in-charge of an institute laboratory attached to a commercial abattoir. He is currently employed as a senior scientific officer in the Hygiene Section of the Microbiology Division of the Institute of Food Research, Bristol Laboratory. His work encompasses all aspects of carcass hygiene and decontamination.

Clive S. Impey joined the Low Temperature Research Station, Cambridge, in 1959 and initially was engaged in work on red-meat hygiene. Later, with Dr. Ella Barnes, he expanded his interest to the processing, storage and spoilage of poultry meat and to the analyses of avian gut microflora. In 1966, the poultry work was transferred to the newly formed Food Research Institute at Norwich where Mr. Impey continued to develop his expertise in the isolation, characterisation and preservation of gut microorganisms. Together with Dr. Mead, he ultimately became responsible for the work on *Salmonella* exclusion and continued in this role at the Institute of Food Research at Langford.

Anthony W. Kotula is a Supervisory Research Food Technologist and Research Leader of the Meat Science Research Laboratory of the Agricultural Research Service, United

States Department of Agriculture (USDA). He received a B.Sc. in Chemistry from the University of Massachusetts in 1951 and a M.Sc. in Food Science from the same university in 1954. He joined the USDA in 1954 and for 13 years carried out research on poultry quality. During 1961–1964, he attended the University of Maryland on a part-time basis and obtained a Ph.D. in Food Science in 1965. He has authored or co-authored over 115 scientific and popular articles. His research results and those of his laboratory have been used as the basis for changes in USDA inspection regulations, USDA standards for grades and FDA decisions on GRAS affirmation petitions. Dr. Kotula is a member of The American Meat Science Association, The Institute of Food Technologists, The American Society of Animal Science, The Poultry Science Association and The World Poultry Science Association (Life Member).

Cecile A. Lahellec studied Veterinary Medicine at the Veterinary School of Maisons-Alfort, France. She received the D.V.M. degree in 1964. Subsequently she studied microbiology at the Science Faculty of Caen where she graduated in 1969. Thereafter she followed advanced courses in microbiology at the Pasteur Institutes in Lille and Paris. As a senior scholar Dr. Lahellec collaborated with Dr. Ella M. Barnes at the Food Research Institute at Norwich, United Kingdom in 1966 and 1970, and with Dr. Daniel Y.C. Fung at Kansas State University in 1980. Currently she is Associate Director of the Poultry Experiment Station at Ploufragan, where she is mainly concerned with food hygiene. Major research interests include poultry-borne microorganisms and shelf life, and the detection, isolation and identification of pathogens in the food chain. Dr. Lahellec is Head of the Food Microbiology Group of the French Society of Microbiology. She is a member of the Poultry Meat Quality Group of the European Federation of the World's Poultry Science Association.

Alan H. Linton graduated in Science at the University of Bristol in 1945. After 1 year as a biochemist in industry and 3 years in public health bacteriology, he was appointed Lecturer in Veterinary Microbiology in 1949. Since then, he has taught microbiology to the veterinary students in Bristol and specialist teaching on pathogenicity and epidemiology to Honours microbiology science students. He was promoted to Senior Lecturer (1963), Reader (1977) and is currently Professor of Bacteriology and Head of the Department of Microbiology, University of Bristol. Professor Linton jointly edited the standard textbook *Micro-organisms—Form, Function and Environment* first published in 1971 (2nd Edn. 1979), and later wrote the book, *Microbes, Man and Animals*, published in 1983. His early research was mainly centred on studies into the dynamics of microbial assays for which he obtained the degrees of M.Sc. (1949) and Ph.D. (1954). More recently, with Dr. Hinton, he has been involved in studies on the epidemiology of salmonellosis in animals and the ecology of *Escherichia coli* and antibiotic resistance in animals. During this time he was awarded an Membership of the Royal College of Pathology (1970) for his published work, was elected to become a Fellow (F.R.C. Pathol. 1975) and received a D.Sc. (1978). He has been a member of the Veterinary

Products Committee (United Kingdom) since April, 1981.

Jan G. van Logtestijn studied Veterinary Medicine at the University of Utrecht. In 1956 he received the D.V.M. degree at that university. After having worked in veterinary practice he joined the staff of the Department of the Science of Food of Animal Origin in 1958. In 1965 he received a Ph.D. degree in Meat Science. In 1970 Dr. van Logtestijn was appointed Associate Professor, and in 1973 nominated full Professor of Hygiene of Foods of Animal Origin at the Faculty of Veterinary Medicine in Utrecht. Since 1972 he is Chairman of that Department. Professor van Logtestijn is a member of the Scientific Veterinary Committee of the European Economic Communities.

Thomas A. McMeekin graduated with the degree of B.Agr. from the Queens University of Belfast in 1968 and obtained the degree of Ph.D. in 1971 for a thesis dealing with the biology of a group of Gram-negative yellow-pigmented organisms. After a short spell as lecturer at Loughry College of Agriculture and Food Technology, he took up an appointment in the University of Tasmania, where he is now a Reader in Agricultural Microbiology. His research interests are wide, but he has published numerous papers dealing with poultry microbiology in general and with the attachment of microorganisms to poultry skin in particular.

Geoffrey C. Mead graduated from Queen Mary College, London University. His first appointment was with the Metropolitan Water Board from where he obtained a Ph.D. degree in 1965 for work on streptococci as indicators of faecal pollution in water supplies. For the following two years he was concerned with microbiological monitoring of water and food at the Laboratory of the Government Chemist before joining the Agricultural and Food Research Council, Food Research Institute at Norwich. Since the early 1970s Dr. Mead has been increasingly involved in studies on the microbiology of poultry, including the influence of processing on carcass contamination, factors affecting the shelf-life and spoilage of chilled products and more recently on carriage of *Salmonella* by the live bird. In the early parts of 1985, the poultry work at FRI was transferred, together with associated staff, to the Meat Research Institute at Langford, near Bristol—now known as the Institute of Food Research, Bristol Laboratory—where Dr. Mead is currently Head of the Hygiene Section.

David A.A. Mossel studied Medicine at the University of Leiden. In 1948 he received the Ph.D. degree in Food Science at the University of Utrecht. After advanced training in microbial ecology of foods at Cambridge (United Kingdom) and in medical microbiology at the Pasteur Institutes in Paris and Lille (France) he was appointed Head of the Section of Microbiology of the Central Institute for Nutrition and Food Research TNO at Utrecht, later at Zeist. In 1969 he was nominated Professor of Medical Microbiology of Foods and Drinking Water at the Catholic University of Leuven (Belgium) and in 1973 Professor of Food Microbiology at the Department of

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John T. Patterson graduated from the Queens University of Belfast with the degree of B.Agr. in 1958. He received the degree of Ph.D. in 1964 from this university and has held various research posts in a joint appointment with the university and the Department of Agriculture, Northern Ireland. In 1983 he moved from research to become Head of the Milk/Food Technology Inspectorate of the Department and at present is on secondment to the Industrial Development Board, in which he is Technical Adviser to the Food Division.

Terence A. Roberts received a B.Sc. degree in Pharmacy in 1957. In 1961 he obtained his Ph.D. for research on the radiation resistance of bacterial spores. In 1963 he joined the Low Temperature Research Station, Cambridge to research the microbiological safety of food irradiation. Dr. Roberts received a M.A. degree in 1967 (Cantab.). In 1967/1968 he joined the new Meat Research Institute, Bristol, where, in 1969, he was appointed Head of the Microbiology Section. From 1976 to 1984 he was Head of the Food Quality Division and in 1984 he was appointed Head of the newly formed Microbiology Division after the transfer of poultry microbiology from the Food Research Institute, Norwich. Current research interests include the microbiological safety of foods, resistance of bacterial spores to heat, radiation and food preservatives, and their recovery after food preservation treatments. Dr. Roberts is author of numerous scientific papers and (co-)editor of several books on microbiology. He is a member of the International Commission on Microbiological Specifications for Foods (ICMSF).

Niels Skovgaard studied veterinary medicine at the Royal Veterinary and Agricultural University of Copenhagen. After a few years in general practice and meat inspection, he followed advanced courses in bacteriology, pathology, hygiene, and forensic medicine, whereafter he joined the Veterinary Services as Chief of the Meat Inspection Laboratory at the afore-mentioned university. Also, he was employed as external lecturer at the same university. In 1973 he was nominated Professor of Food Microbiology and Hygiene. Professor Skovgaard served as secretary and course leader at several FAO/WHO courses on 'Abattoir management and operation'. Currently he is Secretary-General of the International Committee on Food Microbiology and Hygiene, Danish delegate in the World Association of Veterinary Food Hygienists, and member of the Danish Food Council and the Danish Ministry of Fisheries' Quality Council. He participates in WHO 'Expert Panels', 'Round Table Conferences', and

'Consultations', concerning food hygiene, zoonoses, and irradiation of foods, and in Working Groups of the Commission of the European Communities on the same subjects. Professor Skovgaard is a member of the EEC's Scientific Veterinary Committee and of related Working Groups. He is an author of several textbooks and numerous scientific papers on food microbiology and hygiene.

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Paul Teufel studied Veterinary Medicine at the Ludwig Maximillians University of Munich. In 1968 he received the D.V.M. degree at the same university. After 7 years of research work and lecturing in veterinary microbiology at the Free University of Berlin, he joined the Robert-von-Ostertag Institute of the Federal Health Office at Berlin (West). In 1981 Dr. Teufel was appointed Head of the Unit for Special Food Hygiene of the Food Hygiene Division. Main fields of work are hygiene and microbiology of food of animal origin.

Connor J. Thomas has worked extensively on the microbiology of poultry processing, and in particular on the attachment of microorganisms to the skin. He obtained the Ph.D. degree in the University of Tasmania in 1979, continuing in the university as a Research Fellow from 1979–1981. Recent appointments have been held in the Massey University, New Zealand from 1981–1985 and the University of Adelaide, South Australia from 1986.

Contents

Preface and Acknowledgements *v*

List of participants *vii*

Biographies *xi*

Opening address

A. Ploeg 1

Sanitary control in the meat production line: an introduction

Jan G. van Logtestijn 5

SESSION I

Prevention of microbial contamination of red meat in the ante mortem phase:
epidemiological aspects

Alan H. Linton and Mike H. Hinton 9

Contamination of red meat carcasses by gut contents at slaughter *9*

Factors affecting the composition of the gut flora at the time of slaughter *12*

Factors influencing the type and numbers of microorganisms ingested by meat animals *12*

Animal-associated factors influencing the composition of the gut flora *17*

Age and diet *17*

Oral antibiotics *18*

Concurrent fascioliasis *19*

Excretion *19*

Stress *19*

Antibiotics *19*

Conclusions *20*

References *21*

Discussion with the authors *23*

Field and experimental investigations into the epidemiology of *Salmonella* infections in
broiler chickens

Mike H. Hinton, Zuhair A.M. Al-Chalaby and Alan H. Linton 27

Introduction *27*

Infection under commercial conditions *28*