FERMENTED MEAT PRODUCTS: HEALTH ASPECTS

Fermented Meat Products Health Aspects

Editor

Nevijo Zdolec

University of Zagreb, Faculty of Veterinary Medicine
Department of Hygiene
Technology and Food Safety
Zagreb, Croatia



CRC Press is an imprint of the Taylor & Francis Group, an **informa** business A SCIENCE PUBLISHERS BOOK

CRC Press Taylor & Francis Group 6000 Broken Sound Parkway NW, Suite 300 Boca Raton, FL 33487-2742

© 2016 by Taylor & Francis Group, LLC CRC Press is an imprint of Taylor & Francis Group, an Informa business

No claim to original U.S. Government works

Printed on acid-free paperVersion Date: 20150611 International Standard Book Number-13:

(Hardback)

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the author and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The authors and publishers have attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

Except as permitted under U.S. Copyright Law, no part of this book may be reprinted, reproduced, transmitted, or utilized in any form by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information storage or retrieval system, without written permission from the publishers.

For permission to photocopy or use material electronically from this work, please access www.copyright.com (http://www.copyright.com/) or contact the Copyright Clearance Center, Inc. (CCC), 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400. CCC is a not-for-profit organization that provides licenses and registration for a variety of users. For organizations that have been granted a photocopy license by the CCC, a separate system of payment has been arranged.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

Library of Congress Cataloging-in-Publication Data

Visit the Taylor & Francis Web site at http://www.taylorandfrancis.com

and the CRC Press Web site at http://www.crcpress.com

Preface

Fermented meat products are traditionally and commercially most the valuable meat products. As a subject of research, they are an inexhaustible source of new knowledge becoming available through development of new technologies. Fermented meat products can be observed from various aspects: technological, chemical, biochemical, microbiological, toxicological, nutritional and alike, always in connection with certain public health topics.

This book focuses exactly on health aspects of fermented meat products, presented by eminent researchers and experts of various profiles – veterinarians, microbiologists, food technologists, molecular biologists, analytical chemists, biotechnologists, and nutritionists. The complexity of production and health aspects of fermented meat products require such multidisciplinary approach providing the reader with a deep insight into potential risks and their control. The book does not aim to criticize meat products but just the opposite – to point out to the complexity of prevention and control of potential hazards/risks in the production which greatly contributes to a higher total value of fermented meat products.

The introductory chapters present the specific types of fermented meat products and the basic principles of contemporary production. Basic technological operations are presented in the context of their impact on the products safety, hurdle technologies as well as risks of the traditional production. Two chapters are dedicated to health aspects of fermented meat products originating from wild game and small ruminants. The following chapters in the book concern microbiology and biotechnology, including microbial ecology, autochthonous starter cultures, biopreservation, probiotics, molecular analytics and microbiological risks in form of pathogenic microorganisms, resistance to antibiotics and microbial spoilage. The next set of chapters is related to

chemical and toxicological topics such as chemical hazards, particularly biogenic amines, the composition of products and their impact on health, particularly fats and fat oxidation in fermented meat products. Finally, there are chapters about self-control in the production, pre-requisite programs, HACCP and official controls. Contents of the majority of chapters are not restricted strictly to fermented meat products but also describe general principles applicable in the context of other foodstuffs, i.e. the entire production chain from field to table. This book is a result of collaborative efforts of a number of distinguished authors with international reputation from renowned institutions and its editing has been a great challenge and pleasure for me. My special thanks go to Dr Ramesh C. Ray who invited me to edit this book under the Book Series "Food Biology". I trust the book will find its way to a wide audience and contribute in the area of science and practice of fermented meat products.

Editor Nevijo Zdolec

Contents

Prefa	ace of contributors	v ix
1.	Fermented meat products — an overview Friedrich-Karl Lücke	1
	Current status of fermented meat production Herbert W. Ockerman and Lopa Basu	15
	Technology of fermented meat products Helga Medić	27
]	Traditional production of fermented meats and related risk Hirokazu Oiki, Hirokazu Kimura and Nevijo Zdolec	49
	Game meat fermented products — food safety aspects Peter Paulsen, Kashif Nauman, Friedrich Bauer, Alessandra Avagnina and Frans J.M. Smulders	58
]	Sheep and goat fermented meat products— health aspects Alfredo Teixeira, Sandra Rodrigues, Teresa Dias and Letícia Estevinho	78
	Hurdle technologies in fermented meat production Josef Kameník	95
	Microbial ecology of fermented sausages and dry-cured meats Bojana Danilović and Dragiša Savić	127
1	Application of molecular methods in fermented meat microbiota: biotechnological and food safety benefits Maria Grazia Bonomo, Caterina Cafaro and Giovanni Salzano	167

10.	Foodborne pathogens of fermented meat products Spiros Paramithiotis and Eleftherios H. Drosinos	196
11.	Protective cultures and bacteriocins in fermented meats Maria João Fraqueza, Luis Patarata and Andrea Lauková	228
12.	Autochthonous starter cultures Jadranka Frece and Ksenija Markov	270
13.	Probiotics in fermented meat products Rodrigo J. Nova, George Botsaris and Fabiola Cerda-Leal	294
14.	Antimicrobial resistance of lactic acid bacteria in fermented meat products Nevijo Zdolec, Slavica Vesković-Moračanin, Ivana Filipović and Vesna Dobranić	319
15.	Microbial spoilage of fermented meat products Spiros Paramithiotis and Eleftherios H. Drosinos	343
16.	Chemical and sensorial properties of fermented meat products Tanja Bogdanović, Jelka Pleadin, Nada Vahčić and Sandra Petričević	359
17.	Fermented meats composition— Health and nutrition aspects Peter Popelka	389
18.	Chemical hazards in fermented meats Jelka Pleadin and Tanja Bogdanović	417
19.	Biogenic amines in fermented meat products José M. Lorenzo, Daniel Franco and Javier Carballo	450
20.	Fat content of dry-cured sausages and its effect on chemical, physical, textural and sensory properties José M. Lorenzo, Daniel Franco and Javier Carballo	474
21.	Lipid oxidation of fermented meat products Slavomír Marcinčák	488
22.	HACCP in fermented meat production Igor Tomašević and Ilija Djekić	512
23.	Official controls of raw meat fermented sausage production Milorad Radakovic and Slim Dinsdale	535
Inde	ex	553

List of the contributors

Avagnina, Alessandra

Institute of Meat Hygiene, Meat Technology and Food Sciences University of Veterinary Medicine Vienna Veterinaerplatz 1, A 1210 Vienna, Austria Tel. +431250773301

Fax +431250773390 Email: anarvik@infinito.it

Basu, Lopa

University of Kentucky 38 Charles E Barnhart Bldg Lexington, KY 40546, USA

Tel: 6148432749 Email: lopa.basu@uky.edu

Bauer, Friedrich

Institute of Meat Hygiene Meat Technology and Food Sciences University of Veterinary Medicine Vienna Veterinaerplatz 1, A 1210 Vienna, Austria

Tel: +431250773302 Fax +431250773390

Email: friedrich.bauer@vetmeduni.ac.at

Bogdanović, Tanja

Croatian Veterinary Institute Regional Department Split Laboratory for Analytical Chemistry and Residues, Poljička cesta 33

21000 Split, Croatia Tel: +38521789705

Email: t.bogdanovic.vzs@veinst.hr

Bonomo, Maria Grazia

Dipartimento di Scienze Università degli Studi della Basilicata Viale dell'Ateneo Lucano 10 85100 Potenza, Italy

Tel: +390971205690

Email: mariagrazia.bonomo@unibas.it

Botsaris, George

Department of Agricultural Sciences Biotechnology and Food Science Cyprus University of Technology

Limassol, Cyprus Tel: +35725002582

Email: george.botsaris@cut.ac.cy

Cafaro, Caterina

Dipartimento di Scienze Università degli Studi della Basilicata Viale dell'Ateneo Lucano 10 85100 Potenza, Italy Tel: +390971205690

Email: caterina.cafaro@unibas.it

Carballo, Javier

Área de Tecnología de los Alimentos Facultad de Ciencias de Ourense Universidad de Vigo 32004 Ourense, Spain Tel: +34988387052

Fax: +34988387052 Fax: +34988387001 Email: carbatec@uvigo.es

Cerda-Leal, Fabiola

Departamento de Ingeniería en Alimentos

Universidad del Bío-Bío Campus Chillán, Avenida Andrés Bello S/N, Chillán, Chile Tel: + 56422463249 Email: fcerda@ubiobio.cl

Danilović, Bojana

Faculty of Technology Bulevar Oslobodjenja 124 16000 Leskovac

Serbia

Tel: +38116247203

Email: danilovic@tf.ni.ac.rs

Dias, Teresa

School of Agriculture of Polytechnique Institute of Bragança (ESA-IPB)

Apartado 172, Bragança

Portugal

Tel: +351273303298 Email: tdias@ipb.pt

Dinsdale, Slim

FoodSafetyExperts Limited

Maltyard, Brooke Road, Shotesham

Norwich NR15 1XL UK Tel: +441508550007 Cell: +447768662188 Fax: +448704601150

Email: dinsdale@foodsafetyexperts.co.uk

Djekić, Ilija

Food Safety and Quality Management Department, University of Belgrade – Faculty of Agriculture, Nemanjina 6 11080 Belgrade

Republic of Serbia Tel: +381112615315/427 Cell: +38165 5127848 Email: idjekic@agrif.bg.ac.rs

Dobranić, Vesna

University of Zagreb

Faculty of Veterinary Medicine Department of Hygiene Technology and Food Safety Heinzelova 55, 10000 Zagreb

Croatia

Tel: +38512390191 Email: vdobranic@vef.hr

Drosinos, Eleftherios H.

Laboratory of Food Quality Control and Hygiene, Department of Food Science and

Human Nutrition

Agricultural University of Athens Iera Odos 75, GR-11855 Athens

Tel: +302105294713 Fax: +302105294683 Email: ehd@aua.gr Estevinho, Letícia

School of Agriculture of Polytechnique Institute of Bragança (ESA-IPB)

Apartado 172, Bragança

Mountain Research Centre (CIMO)

Portugal

Tel: + 351273303221 Fax + 351273325405 Email: leticia@ipb.pt

Filipović, Ivana

University of Zagreb

Faculty of Veterinary Medicine Department of Hygiene Technology and Food Safety Heinzelova 55, 10000 Zagreb, Croatia

Tel: +38512390192 Email: ivanaf@vef.hr

Franco, Daniel

Centro Tecnológico de la Carne de Galicia

Rua Galicia no. 4

Parque Tecnológico de Galicia

San Cibrao das Viñas

32900 Ourense

Spain

Tel: +34988548277

Email: danielfranco@ceteca.net

Fraqueza, Maria João

CIISA, Faculty of Veterinary Medicine University of Lisbon Avenida da Universidade Técnica

Avenida da Universidade Tecnica Pólo Universitário do Alto da Ajuda 1300-477 Lisbon

Portugal

Tel: +351213652884

Email: mjoa of raqueza@fmv.ulisboa.pt

Frece, Jadranka

Laboratory for General Microbiology and Food Microbiology, Faculty of Food Technology and Biotechnology University of Zagreb, Pierottijeva 6,10000 Zagreb,

Croatia

Tel: +38514605284 Fax. + 38514836424 Email: jfrece@pbf.hr

Kameník, Josef Department of Meat Hygiene and

Technology, Faculty of Veterinary Hygiene and Ecology, University of Veterinary and

Pharmaceutical Sciences Brno Palackého tř. 1/3, CZ-61242 Brno

Czech Republic, Tel: + 420 604 220851 Email: kamenikj@vfu.cz

Kimura, Hirokazu

Department of Life Science Shokei University, 2-6-78 Kuhonji Chuo-ku, Kumamoto 862-8678

Japan

Tel: +81-96-362-2011(452) FAX: +81-96-363-2975

Email:kimura@shokei-gakuen.ac.jp

Lauková, Andrea

Institute of Animal Physiology Slovak Academy of Sciences Laboratory of Animal Microbiology, Šoltésovej 4-6, 040 01 Košice

Slovakia

Tel: + 421557922964 Email: laukova@saske.sk

Lorenzo, José M.

Centro Tecnológico de la Carne de Galicia Rua Galicia no. 4, Parque Tecnológico de Galicia, San Cibrao das Viñas

32900 Ourense, Spain Tel: +34988548277

Email: jmlorenzo@ceteca.net

Lücke, Friedrich-Karl

Fulda University of Applied Sciences P. O. Box 2254, 36012 Fulda

Germany

Tel: +49 661 9640 376 Fax +49 661 9640 399

Email: Friedrich-karl.luecke@he.hs-fulda.de

Marcinčák, Slavomír

University of Veterinary Medicine and Pharmacy in Košice, Department of Food Hygiene and Technology

Komenského 73, 041 81 Košice, Slovakia

Tel: +421915984756

Email: slavomir.marcincak@uvlf.sk

Markov, Ksenija

Laboratory for General Microbiology and

Food Microbiology

Faculty of Food Technology and Biotechnology University of Zagreb Pierottijeva 6, 10000 Zagreb

Croatia

Tel: +38514605284 Email: kmarko@pbf.hr

Medić, Helga

University of Zagreb, Faculty of Food Technology and Biotechnology 10000 Zagreb, Pierottijeva 6 Croatia

Tel: + 38514605126 Fax:+385 1 4605 072 Email: hmedic@pbf.hr

Nauman, Kashif

Department of Meat Technology University of Veterinary and Animal

Sciences, Lahore

Pakistan

Tel: +431250773301

Email: drkashif@uvas.edu.pk

Nova, Rodrigo J.

School of Veterinary Medicine and Science

Sutton Bonington Campus University of Nottingham LE12 5RD, United Kingdom

Tel: 00441159516391

Email: rodrigo.nova@nottingham.ac.uk

Ockerman, Herbert W.

The Ohio State University Plumb Hall 230A, 2027 Coffey Rd Columbus, OH 43210, USA

Tel: 6142924317

Email: ockerman.2@osu.edu

Oiki, Hirokazu

Department of Biochemistry and Applied Chemistry, Kurume National College of Technology, 1-1-1 Komorino, Kurume

Fukuoka 830-8555, Japan Tel: +81942359407 Fax: +81942359400

Email:oiki@kurume-nct.ac.jp

Paramithiotis, Spiros

Laboratory of Food Quality Control and Hygiene, Department of Food Science and

Human Nutrition

Agricultural University of Athens Iera Odos 75, GR-11855 Athens, Greece

Tel: +302105294705 Fax: +302105294683 Email: sdp@aua.gr

Patarata, Luis

Veterinary and Animal Research Centre (CECAV),

(CECAV)

Universidade de Trás-os-Montes e Alto Douro, 5001-801 Vila Real, Portugal

Tel: +351259350539 Email: lpatarat@utad.pt

Paulsen, Peter

Institute of Meat Hygiene

Meat Technology and Food Sciences University of Veterinary Medicine Vienna Veterinaerplatz 1, A 1210 Vienna, Austria

Tel: +431250773318 Fax +431250773390

Email: peter.paulsen@vetmeduni.ac.at

Petričević, Sandra

Croatian Veterinary Institute Regional Department Split Laboratory for Analytical Chemistry and Residues

Poljička cesta 33, 21000 Split, Croatia

Tel: + 38521789705

Email: petricevic.vzs@veinst.hr

Pleadin, Jelka

Croatian Veterinary Institute Laboratory for Analytical Chemistry Savska cesta 143, 10000 Zagreb

Croatia

Tel: + 38516123626 Email: pleadin@veinst.hr

Popelka, Peter

Department of Food Hygiene and Technology, University of Veterinary Medicine and Pharmacy in Košice Komenského 73, 041 81 Košice

Slovakia

Email: peter.popelka@uvlf.sk

Radakovic, Milorad

University of Cambridge

Department of Veterinary Medicine

Madingley Road,

Cambridge CB3 0ES, UK Tel: +44 1223 765048

Cell: +44 7917 228664

Email: mr412@cam.ac.uk

Rodrigues, Sandra

School of Agriculture of Polytechnique Institute of Bragança (ESA-IPB) Apartado 172, Bragança, Portugal

Tel: + 351273303221 Email: srodrigues@ipb.pt

Salzano, Giovanni

Dipartimento di Scienze

Università degli Studi della Basilicata

Viale dell'Ateneo Lucano 10

85100 Potenza, Italy Tel: + 390971205690

Email: giovanni.salzano@unibas.it

Savić, Dragiša

Faculty of Technology, Bulevar Oslobodjenja 124,16000 Leskovac Serbia

Tel: +38116247203 Email: savic@tf.ni.ac.rs

Smulders, Frans J.M.

Institute of Meat Hygiene

Meat Technology and Food Sciences University of Veterinary Medicine Vienna

Veterinaerplatz 1, A 1210 Vienna

Tel. +431250773301 Fax +431250773390

Email: frans.smulders@vetmeduni.ac.at

Teixeira, Alfredo

School of Agriculture of Polytechnique Institute of Bragança (ESA-IPB) Apartado 172, Bragança, Portugal

Tel: + 351273303206 Email: teixeira@ipb.pt

Tomašević, Igor

Animal Source Food Technology Department

University of Belgrade Faculty of Agriculture Nemanjina 6, 11080 Belgrade

Republic of Serbia Tel: + 381112615315/272 Cell: + 381604299998 Email: tbigor@agrif.bg.ac.rs

Vahčić, Nada

Faculty of Food Technology and Biotechnology, University of Zagreb Pierottijeva 6, 10000 Zagreb

Tel: + 38514605 277 Email: nvahcic@pbf.hr

Vesković-Moračanin, Slavica

Institute of Meat Hygiene and Technology Kaćanskog 13, 11000 Belgrade, Serbia

Tel: +381112650655

Email:slavica@inmesbgd.com

Zdolec, Nevijo

University of Zagreb, Faculty of Veterinary Medicine, Department of Hygiene Technology and Food Safety Heinzelova 55, 10000 Zagreb, Croatia Tel: + 385 12 390 199

Email: nzdolec@vef.hr