Protein in Neonatal and Infant Nutrition: Recent Updates
Protein in Neonatal and Infant Nutrition: Recent Updates

Editors

Jatinder Bhatia Augusta, GA, USA
Raanan Shamir Tel Aviv, Israel
Yvan Vandenplas Brussels, Belgium
The material contained in this volume was submitted as previously unpublished material, except in the instances in which credit has been given to the source from which some of the illustrative material was derived.

Great care has been taken to maintain the accuracy of the information contained in the volume. However, neither Nestec Ltd. nor S. Karger AG can be held responsible for errors or for any consequences arising from the use of the information contained herein.

© 2016 Nestec Ltd., Vevey (Switzerland) and S. Karger AG, Basel (Switzerland). All rights reserved. This book is protected by copyright. No part of it may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, or recording, or otherwise, without the written permission of the publisher.

Printed on acid-free and non-aging paper (ISO 9706)
ISBN 978-3-318-05482-8
ISSN 1664–2147
e-ISSN 1664–2155

Library of Congress Cataloging-in-Publication Data
Title: Protein in neonatal and infant nutrition : recent updates / editors, Jatinder Bhatia, Raanan Shamir, Yvan Vandenplas.
Subjects: | MESH: Milk Proteins | Infant Nutritional Physiological Phenomena
 | Milk, Human | Infant Formula | Nutritional Requirements | Infant, Newborn | Infant
Classification: LCC RJ216 | NLM QU 55.4 | DDC 613.2/69--dc23 LC record available at http://lccn.loc.gov/2016010974

Basel · Freiburg · Paris · London · New York · Chennai · New Delhi · Bangkok · Beijing · Shanghai · Tokyo · Kuala Lumpur · Singapore · Sydney

Downloaded by: 54.70.40.11 - 11/20/2017 11:05:50 AM
Contents

VII Preface
IX Foreword
XI Contributors

Hydrolyzed Protein in Infant Feeding

1 Proteins, Peptides and Amino Acids: Role in Infant Nutrition
   Nutten, S. (Switzerland)

11 Hydrolyzed Proteins in Allergy
   Salvatore, S. (Italy); Vandenplas, Y. (Belgium)

29 Infant Formula with Partially Hydrolyzed Proteins in Functional Gastrointestinal Disorders
   Vandenplas, Y. (Belgium); Salvatore, S. (Italy)

39 Hydrolyzed Proteins in Preterm Infants
   Senterre, T.; Rigo, J. (Belgium)

51 Hydrolyzed Formula for Every Infant?
   Fleischer, D.M.; Venter, C. (USA); Vandenplas, Y. (Belgium)

Protein in the Feeding of Term Infants

67 The Benefits of Breast Feeding
   Shamir, R. (Israel)

77 Protein Evolution of Human Milk
   Thakkar, S.K.; Giuffrida, F.; Bertschy, E.; De Castro, A.; Destaillats, F. (Switzerland); Lee, L.Y. (Singapore)

87 Metabolic Programming: Effects of Early Nutrition on Growth, Metabolism and Body Composition
   Haschke, F. (Austria); Grathwohl, D. (Switzerland); Haiden, N. (Austria)

97 Human Milk: Bioactive Proteins/Peptides and Functional Properties
   Lönnerdal, B. (USA)
Protein in the Feeding of Preterm Infants

109  Human Milk for Preterm Infants and Fortification
    Bhatia, J. (USA)

121  Protein Needs of Preterm Infants: Why Are They So Difficult to Meet?
    Ziegler, E.E. (USA)

129  Optimizing Early Protein Intake for Long-Term Health of Preterm Infants
    Singhal, A. (UK)

139  Defining Protein Requirements of Preterm Infants by Using Metabolic Studies in Fetuses and Preterm Infants
    van den Akker, C.H.P.; van Goudoever, J.B. (The Netherlands)

151  Amino Acid Intake in Preterm Infants
    Burattini, I.; Bellagamba, M.P.; D’Ascenzo, R.; Biagetti, C.; Carnielli, V.P. (Italy)

161  Concluding Remarks

163  Subject Index

For more information on related publications, please consult the NNI website: www.nestlenutrition-institute.org
Preface

Proteins play a crucial role in the growth and development of children. During the last decade, a deeper understanding has been achieved of the role of proteins in infant feeding as well as short- and long-term consequences of inappropriate protein intake in infancy. The 86th Nestlé Nutrition Institute (NNI) Workshop, which took place in Beijing (China) in May 2015, has focused on the recent updates on the role of protein in neonatal and infant nutrition.

The first session was dedicated to the role of hydrolyzed protein in infant feeding. The presentations were designed in a way to cover the characteristics of hydrolysates and the rationale of using the appropriate hydrolysate for healthy infants as well as infants with special dietary requirements. It was stressed that partially hydrolyzed infant formulas can significantly reduce the risk of atopic dermatitis in at-risk infants. However, clinical evidence is required for specific hydrolysates as not all hydrolysates are produced in the same way. There is some evidence showing positive benefits of using hydrolyzed protein formulas in infants with functional gastrointestinal disorders and in preterm infants regarding tolerability and digestibility. These benefits should be considered in the clinical context. More research and clinical evidence is required to recommend partially hydrolyzed protein formulas as routine use in such conditions.

The second session of the workshop covered the role of proteins in the feeding of term infants with a special focus on the properties and benefits of human milk. We have discussed in detail the evolution of proteins in human milk, and the importance of using proper methods and technologies in this type of research were emphasized. Breast milk is the ideal nutrition for infants. In non-breastfed babies, there is evidence that infant formula with a lower protein content can reduce weight gain without affecting height in infancy and early childhood. The high quality of the proteins in infant formulas makes it possible to reduce the amounts of protein bringing it closer to the human milk content. This ensures essential amino acid supply sufficient for appropriate growth and development. Functions of human milk bioactive peptides and immunological prop-
erties were also discussed. It was concluded that current and new research can bring important information on how proteins can be used in the future in feeding of infants who are not breastfed.

The third session on protein in feeding of preterm infants brought our interest to the arena of human milk fortification and personalized nutrition. It is absolutely clear that human milk is the first option in feeding preterm infants. However, the level of protein and some other nutrients is not sufficient to ensure adequate growth of preterm infants. Adequate growth is beneficial to cognitive development which should be considered as a priority over other health outcomes in this population. Currently, with available human milk fortifiers, adequate growth and accretion similar to that observed in utero is difficult to achieve in preterm infants. In that context, it has been shown that growth of the preterm infant and the fetus is different. The difference could be explained by the different metabolic rate of amino acids. The last topic was on parenteral nutrition, where recent studies have shown that there is no positive correlation between growth and the level of protein provided. Rationale of adding other sources of energy apart from protein should be considered and proven scientifically and clinically.

We would like to thank the distinguished Faculty and all participants for the interesting program and wonderful and stimulating discussions.

On behalf of all participants, we congratulate the Nestle Nutrition Institute on this fantastic workshop, which gave all participants a unique opportunity for learning and discussion.

Jatinder Bhatia
Raanan Shamir
Yvan Vandenplas
Foreword

There are many global changes today that influence the health of future generations; many arise from economic challenges and changes in social and cultural norms. The most prevalent topic of discussion is that of noncommunicable diseases, including obesity, diabetes and cardiovascular diseases.

Over the last few years, our Nestlé Nutrition Institute (NNI) workshops have focused on many of the major issues of child nutrition, but in our most recent workshop, we decided to take a slightly different approach and discuss the role of nutrition in its nontraditional sense, i.e. beyond its role as a supplier of energy and nutrients.

The workshop looked at recent updates in ‘Protein in neonatal and infant nutrition’ and took place in Beijing, China, a country with a number of identified areas where science and nutrition, academia and the private sector can work together to help solve public health concerns, on May 24–27, 2015.

Protein was selected as the central theme of the 86th workshop program due to its vital role in growth and development and its ability to ‘program’ healthy growth by influencing gene methylation for positive long-term health outcomes. The understanding of such a mechanism is critical to support and improve the health of the next generation in the short and long term.

We have chosen an incredible international faculty led by three chairpersons, Prof. Yvan Vandenplas (Belgium), Prof. Raanan Shamir (Israel) and Prof. Jatinnder Bhatia (USA), who put the scientific program together.

The first session with Yvan Vandenplas (Head of the Department of Pediatrics, Universitair Ziekenhuis Brussel) was about the role of hydrolyzed proteins in infant feeding and the evidence-based benefits of its use in nonbreastfed infants at risk of allergy and infants with functional gastrointestinal disorders.

The second session, chaired by Prof. Raanan Shamir (Institute of Gastroenterology, Nutrition and Liver Diseases, Schneider Children’s Medical Center, Israel, and Professor of Pediatrics, Sackler Faculty of Medicine), focused on human milk and its potential alternatives in the feeding of healthy term infants. It
was clearly stated that there is no comparable alternative to human milk. In a situation where breastfeeding is no longer possible, the protein quality and quantity in the infant formula should be the decision-making factor in the choice of the right food for that infant.

The third session with Prof. Jatinder Bhatia (Professor and Chief of the Division of Neonatology, Department of Pediatrics, Augusta University) was dedicated to preterm infants, their nutrition needs and physiological capacities to ingest adequate amounts of protein for appropriate growth and development. There is still a lot of research work to be done in this area, but it is very clear that proteins in the feeding of this category of infants play a critical role in both the short- and long-term health outcome of these infants.

We would like to thank all participants for their contributions to the formal and informal discussions during the workshop. We believe that such an event helps to create additional professional relations in areas of common interest in order to shape the future together.

It is time that we move from focusing purely on science and observations to finding practical solutions. Events, such as this workshop, help to pave the way for future action.

Finally, we would like to congratulate all those involved in the organization of this workshop – both at global and at regional level – and give special thanks to Dr. Lawrence Li and his team for their wonderful hospitality and professionalism.

Dr. Natalia Wagemans
Head
Nestlé Nutrition Institute
Vevey, Switzerland
Contributors

Chairpersons & Speakers

Prof. Jatinder Bhatia
Division of Neonatology
Department of Pediatrics
Medical College of Georgia
Augusta University
1120 15th Street, BIW 6033
Augusta, GA 30912-3740
USA
E-Mail jatindeb@gru.edu

Prof. Virgilio P. Carnielli
Department of Medical Sciences
Polytechnic University of Marche
Piazza Roma 22
IT–60121 Ancona
Italy
E-Mail v.carnielli@gmail.com

Assoc. Prof. Dr. David M. Fleischer
Section of Allergy
Department of Pediatrics
Children’s Hospital Colorado
13123 East 16th Avenue, B518
Aurora, CO 80045
USA
E-Mail david.fleischer@childrenscolorado.org

Prof. Ferdinand Haschke
Department of Pediatrics
Landeskrankenhaus Salzburg/
Universitätsklinikum der PMU
Müllner Hauptstrasse 48
AT–5020 Salzburg
Austria
E-Mail fhaschk@gmail.com

Dr. Le Ye Lee
Department of Neonatology
Yong Loo Lin School of Medicine
National University of Singapore
NUHS Tower Block Level 12
1E Kent Ridge Road
Singapore 119228
Singapore
E-Mail le_ye_lee@nuhs.edu.sg

Dr. Bo Lönnerdal
Department of Nutrition
University of California
3109 Meyer Hall
1 Shields Avenue
Davis, CA 95616
USA
E-Mail blonnerdal@ucdavis.edu

Dr. Sophie Nutten
Nutrition and Health Research
Department
Nestlé Research Centre
Route du Jorat 57
CH–1000 Lausanne 26
Switzerland
E-Mail Sophie.Nutten@rdls.nestle.com

Dr. Silvia Salvatore
Pediatric Department, Ospedale F. del Ponte
Via F. Del Ponte 19
IT–21100 Varese
Italy
E-Mail silvia.salvatore@uninsubria.it
Contributors

Dr. Thibault Senterre
Department of Neonatology
Centre Hospitalier Régional de la Citadelle
CHU de Liège, University of Liège
Boulevard du 12ème de Ligne 1
BE–4000 Liège
Belgium
E-Mail thibault.senterre@chu.ulg.ac.be

Prof. Raanan Shamir
Institute for Gastroenterology, Nutrition and Liver Diseases
Schneider Children’s Medical Center
14 Kaplan Street
Petach-Tikva 49202
Israel
E-Mail shamirraanan@gmail.com

Prof. Atul Singhal
The Childhood Nutrition Research Centre
Institute of Child Health
University College of London
30 Guilford Street
London WC1N 1EH
UK
E-Mail a.singhal@ucl.ac.uk

Dr. Sagar K. Thakkar
Nestlé Research Centre, Nestec Ltd.
Route du Jorat 57
CH–1000 Lausanne 26
Switzerland
E-Mail Sagar.Thakkar@rdls.nestle.com

Dr. Chris van den Akker
AMC – Emma Children’s Hospital
Department of Pediatrics – Neonatology
Room H3-214
Meibergdreef 9
NL–1105 AZ Amsterdam
The Netherlands
E-Mail c.h.vandenakker@amc.nl

Prof. Dr. Yvan Vandenplas
Universitair Ziekenhuis Brussel
Department of Pediatrics
Vrije Universiteit Brussel
Laarbeeklaan 101
BE–1090 Brussels
Belgium
E-Mail yvan.vandenplas@uzbrussel.be

Prof. Ekhard E. Ziegler
Department of Pediatrics
809 Wylde Green Rd.
Iowa City, IA 52246
USA
E-Mail ekhard-ziegler@uiowa.edu

Participants

Peter Fryer/Australia
Rebecca Hill/Australia
Gemma McLeod/Australia
John Sinn/Australia
Mohammed Sarwar Ferdaus/Bangladesh
Kazi Naushad Un Nabi/Bangladesh
Ary Lopes Cardoso/Brazil
Maria Elizabeth Lopes Moreira/Brazil
Suying Chang/China
Shuang Chao/China
Junshi Chen/China
Pingyang Chen/China
Qian Chen/China
Tongxin Chen/China
Yiaohua Dai/China
Gangqiang Ding/China
Ling Fan/China
Qi Feng/China
Xiaohui Gong/China
Junhuai Han/China
Zhen Juan He/China
Xinlin Hou/China
Junsheng Huo/China
Shan Jian/China
Jingxiong Jiang/China
Yi Jiang/China
Jianqiang Lai/China
Hui Li/China
Li Li/China
Zhenghong Li/China
Guanghui Liu/China
Jie Mi/China
Rong Mi/China
Tian Qian/China
Jie Shao/China
Xiaoyang Sheng/China
Xiuying Tian/China
Xiaomei Tong/China
Chen Wang/China
Danhua Wang/China
Yuying Wang/China
Zhixu Wang/China
Bin Wu/China
Contributors

Li Xiang/China
Haiping Xu/China
Xiaoguang Yang/China
Zhenyu Yang/China
Baomin Yin/China
Shian Yin/China
Wei Zhang/China
Ai Zhao/China
Dongmei Zhao/China
Ri ge tu Zhao/China
Yingdong Zheng/China
Danni Zhong/China
Jianxing Zhu/China
Zonghan Zhu/China
Siqi Zhuang/China
Yuet Yee Chee/Hong Kong
Bryan Leung/Hong Kong
Vivian Tsang/Hong Kong
Siu-chun Mabel Wong/Hong Kong
Jasjit Singh Bhasin/India
Tapabrata Chatterjee/India
Soumitra Dutta/India
Pankaj Garg/India
Vivek Garg/India
Kishore Kumar Rajagopal/India
Shashidhar Rao/India
Umesh Vidyadhar Vaidya/India
Rahul Jagdishlal Verma/India
Alaql Fahad Abdulrahman/Saudi Arabia
Silaiman Alsaad/Kuwait
Pei Fan Chai/Malaysia
Dagoberto Delgado/Mexico
Otilia Perichart/Mexico
Salvador Villalpando/Mexico
Huma Fahim/Pakistan
Elizabeth Gallardo/Philippines
Gracia Paliza/Philippines
Mercedes Puya Sagarbarria/Philippines

Maria Josephine Sunga/Philippines
Elena Lukushkina/Russian Federation
Sergey Ukrainsev/Russian Federation
Marion Aw/Singapore
Rachel Yip Choy Har/Singapore
Kenny Ee/Singapore
Poh Choo Khoo/Singapore
Lin Min, Lena Kong/Singapore
Fung Chi, Angelin Lin/Singapore
Whati Lindiwe/Singapore
Winston Ng/Singapore
Victor Samuel Rajadurai/Singapore
Nancy Tan/Singapore
Vanessa Tan/Singapore
Janice Wong/Singapore
Fabian Yap/Singapore
Yeng Yoong Yip/Singapore
Peter Erdmann/Switzerland
Sanjeev Ganguly/Switzerland
Anette Järvi/Switzerland
Evelyn Spivey-Krobath/Switzerland
Simona Stan/Switzerland
Shih-Ming Chu/Taiwan/China
Beng-Huat Lau/Taiwan/China
Eva Peng/Taiwan/China
Po-Nien Tsao/Taiwan/China
Mei-Li Wang/Taiwan/China
Meng-Che Wu/Taiwan/China
San-Nan Yang/Taiwan/China
Chun-Yan Yeung/Taiwan/China
Pantipa Chatchatee/Thailand
Nalinee Chongviriyaphan/Thailand
Narumon Densupsoontorn/Thailand
Narissara Suratannon/Thailand
Turgay Coskun/Turkey
Karin Harput/Turkey
Hatice Serap Sivri/Turkey
Rasit Vural Yagci/Turkey