BRITISH JOURNAL OF NUTRITION

Volume: 108

Supplement 2

August 2012

An International Journal of Nutritional Science

Supplement

Dietary protein for human health. Supplement Editor: P. J. Moughan



British Journal of Nutrition

An International Journal of Nutritional Science Volume 108, 2012 ISSN: 0007-1145

Aims and Scope

The British Journal of Nutrition is an international, peer-reviewed journal publishing original papers, review articles, short communications and technical notes on human and clinical nutrition, animal nutrition and basic science as applied to nutrition. Correspondence is encouraged in a Nutrition Discussion Forum. The Journal recognizes the multidisciplinary nature of nutritional science and encourages the submission of material from all of the specialities involved in research and clinical practice. The Journal also publishes supplements on topics of particular interest.

The British Journal of Nutrition is published twice monthly by Cambridge University Press on behalf of

The Nutrition Society.

The British Journal of Nutrition is available online to subscribers at journals.cambridge.org/bin Tables of contents and abstracts are available free at the same website.

Editor-in-Chief

PC Calder, School of Medicine, University of Southampton, Southampton, UK

Deputy Editors

F Bellisle, INRA, University of Paris, Bobigny, France

D R Jacobs Jr. School of Public Health. University of Minnesota, Minneapolis, MN, USA

R J Wallace, Gut Health Programme, Rowett Institute of Nutrition and Health, University of Aberdeen, Aberdeen, UK

S J Whiting, College of Pharmacy and Nutrition, University of Saskatchewan, Saskatoon, Sask., Canada

Reviews Editors

D J Millward, Faculty of Health and Medical Sciences, University of Surrey, UK P Aggett, School of Medicine and Health, Lancaster University, Lancaster, UK

Systematic Reviews Editor

M Makrides, Women's and Children's Health Research Institute and University of Adelaide, Adelaide, Australia

Supplements Editor

J Woodside, Nutrition and Metabolism Group, Centre for Public Health, Queen's University, Belfast, UK

Editorial Board

J J B Anderson, Chapel Hill, NC, USA Y Bao, Norwich, UK J H Beattie, Aberdeen, UK G Bell, Stirling, UK M Blaut, Bergholz-Rehbrücke, Germany S Brix Pedersen, Lyngby, Denmark G C Burdge, Southampton, UK A E Buyken, Dortmund, Germany J Buyse, Leuven, Belgium K D Cashman, Cork, Ireland R S Chapkin, College Station, TX, USA M S Choi, Daegu, Korea A Collins, Oslo, Norway S J Duthie, Aberdeen, UK U Ekelund, Cambridge, UK A Esmaillzadeh, Isfahan, Iran B A Fielding, Oxford, UK J L Firkins, Columbus, OH, USA J K Friel, Winnipeg, MB, Canada M Fukushima, Obihiro City, Japan S Garnett, Sydney, Australia B A Griffin, Surrey, UK J C G Halford, Liverpool, UK W Hendriks, Wageningen, The Netherlands E Herrera, Madrid, Spain D J Hoffman, New Brunswick, NJ, USA U Nöthlings, Kiel, Germany E J Johnson, Boston, MA, USA S J Kaushik, Saint Pée-sur-Nivelle, France D S Kelley, Davis, Ca., USA P Palozza, Rome, Italy C W C Kendall, Toronto, Ont., Canada J P Lallès, Rennes, France A Laviano, Rome, Italy C J Petry, Cambridge, UK H J Lightowler, Oxford, UK A M López-Sobaler, Madrid, Spain J A Lovegrove, Reading, UK W D Rees, Aberdeen, UK G Rimbach, Kiel, Germany R D Mattes, West Lafayette, IN, USA C Mayer, Aberdeen, UK S McCann, Buffalo, NY, USA E Ros, Barcelona, Spain J P McClung, Natick, MA, USA S Salminen, Turku, Finland N M McKeown, Boston, MA, USA S McMullen, Nottingham, UK T Sheehy, Cork, Ireland D McMurray, College Station, TX, USA S McNaughton, Burwood, Australia C R Sirtori, Milan, Italy J G Mercer, Aberdeen, UK A M Minihane, Norwich, UK D Tomé, Paris, France T A Mori, Perth, Australia H Mukhtar, Madison, WI, USA F Visioli, Madrid, Spain M Murphy, Reus, Spain

P Nestel, Southampton, UK C M Nyachoti, Winnipeg, MB, Canada M C Ocké, Bilthoven, The Netherlands J H Y Park, Chuncheon, Korea E Perissinotto, Padova, Italy S M Phillips, Hamilton, Ont., Canada S Proctor, Edmonton, Alta., Canada S M Robinson, Southampton, UK M B Schulze, Nuthetal, Germany A J Sinclair, Geelong, Australia K S Swanson, Urbana, IL, USA D Topping, Adelaide, Australia M R Yeomans, Sussex, UK

Publications Staff

C Goodstein (Publications Manager), C Jackson (Deputy Publications Manager), L Weeks, H Zdravics and C T Hughes (Publications Officers) and S Hui and D Owen (Publications Assistants)

The Nutrition Society has as its objective the advancement of the scientific study of nutrition and its applications to the maintenance of human and animal health.

Application of membership is invited from anyone whose work has contributed to the scientific knowledge of nutrition, whether such work has been in the laboratory, the field or the clinic, and whether experimental, clinical, agricultural or statistical in nature. There is also a student membership scheme with reduced subscriptions.

Particulars of The Nutrition Society and application forms for membership are available from The Nutrition Society, 10 Cambridge Court, 210 Shepherds Bush Road, London W6 7NJ, UK. Tel: +44 (0)20 7602 0228, Fax: +44 (0)20 7602 1756, Email: office@nutsoc.org.uk

The Nutrition Society Home Page is at http://www.nutritionsociety.org

© Nutrition Society 2012

British Journal of Nutrition Volume 108 Supplement 2 August 2012

Dietary Protein for Human Health

The papers included in this Special Supplement were presented at the 2011 International Symposium Dietary Protein for Human Health, organised by the Riddet Institute, Palmerston North, New Zealand; Health Canada, Ottawa; FAO, Rome, Italy.

Guest Editor

Paul J. Moughan Riddet Institute, Massey University, New Zealand

Contents

Preface Dietary protein for human health. P. J. Moughan S1 - S2Section One: Protein and amino acid requirements, amino acid scoring patterns and the assessment of dietary protein and amino acid adequacy in developing countries. Identifying recommended dietary allowances for protein and amino acids: a critique of the 2007 WHO/FAO/UNU report. D Joe Millward S3-S21 Recent advances in determining protein and amino acid requirements in humans. R. Elango, R. O. Ball & P. B. Pencharz S22-S30 Amino acid scoring patterns for protein quality assessment. D. Joe Millward S31-S43 Amino acid requirements in children and the elderly population. R. R. Pillai & A. V. Kurpad S44-S49 Protein intakes in India. S. Swaminathan, M. Vaz & A. V. Kurpad S50-S58 Available lysine and digestible amino acid contents of proteinaceous foods of India. S. M. Rutherfurd, K. Bains & P. J. Moughan S59-S68 Dietary protein quality and malnutrition in Africa. H. C. Schönfeldt & N. Gibson Hall S69-S76 Assessment of protein adequacy in developing countries: quality matters. S. Ghosh, D. Suri & R. Uauy S77-S87 Section Two: Specific metabolic roles of amino acids, and the paradigm of optimal, as opposed to minimal dietary protein and amino acid requirements for performance, long-term health and optimal organ function. The role of dietary protein in optimizing muscle mass, function and health outcomes in older individuals. R. R. Wolfe S88-S93 New perspectives in the control of body protein metabolism.

M. A. McNurlan S94-S104 Dietary protein - its role in satiety, energetics, weight loss and health. M. S. Westerterp-Plantenga, S. G. Lemmens & K. R. Westerterp S105-S112 The metabolism of "surplus" amino acids. D. A. Bender S113-S121 Effects of a high protein diet on body weight and comorbidities associated with obesity. P. Clifton S122-S129 The role of high-protein diets in body weight management and health. L. Te Morenga & J. Mann S130-S138 Role of specific dietary amino acids in clinical conditions. R. Jonker, M. P. K. J. Engelen & N. E. P. Deutz S139-S148 Food proteins as a source of bioactive peptides with diverse functions. K. J. Rutherfurd-Markwick S149-S157 Dietary protein requirements and adaptive advantages in athletes. S. M. Phillips S158-S167

Section Three: Dietary protein quality assessment: Amino acid analysis, determination of amino acid digestibility and availability for humans and implications to the Protein Digestibility Corrected Amino Acid Score (PDCAAS).

Background on international activities on protein quality assessment of foods.	
G. Sarwar Gilani	S168-S182
Protein quality evaluation twenty years after the introduction of the protein digestibility	
corrected amino acid score method.	
J. Boye, R. Wijesinha-Bettoni & B. Burlingame	S183-S211
The regulation of protein content and quality in national and international food standards.	
J. L. Lewis	S212-S221
Criteria and markers for protein quality assessment – a review.	
D. Tome	S222-S229

Standardised methods for amino acid analysis of food.	
D. E. Otter	S230-S237
Determination of protein and amino acid digestibility in foods including implications	
of gut microbial amino acid synthesis.	
M. Fuller	S238-S246
Ileal and faecal protein digestibility measurement in humans and other	
non-ruminants – a comparative species view.	
W. H. Hendriks, J. van Baal & G. Bosch	S247-S257
Gut luminal endogenous protein: Implications for the determination of ileal amino acid	
digestibility in humans.	
P. J. Moughan & S. M. Rutherfurd	S258-S263
Evidence for validity of ileal digestibility coefficients in monogastrics.	
D. Columbus & C. F. M. de Lange	S264-S272
Animal models for determining amino acid digestibility in humans – a review.	
A. Deglaire & P. J. Moughan	S273-S281
In vitro determination of dietary protein and amino acid digestibility for humans.	
C. A. Butts, J. A. Monro & P. J. Moughan	S282-S287
Aspects of physical and chemical alterations to proteins during food processing – some	
implications for nutrition.	
J. A. Gerrard, M. Lasse, J. Cottam, J. P. Healy, S. E. Fayle, I. Rasiah, P. K. Brown,	
S. Md. BinYasir, K. H. Sutton & N. G. Larsen	S288-S297
Available versus digestible dietary amino acids.	
S. M. Rutherfurd & P. J. Moughan	S298-S305
Available versus digestible amino acids – new stable isotope methods.	
R. Elango, C. Levesque, R. O. Ball & P. B. Pencharz	S306-S314
Impact of Antinutritional Factors in Food Proteins on the Digestibility of Protein and	
the Bioavailability of Amino Acids and on Protein Quality.	
G. Sarwar Gilani, C. Wu Xiao & K. A. Cockell	S315-S332
Advantages and limitations of the protein digestibility-corrected amino acid score (PDCAAS)	
as a method for evaluating protein quality in human diets.	
G. Schaafsma	S333-S336