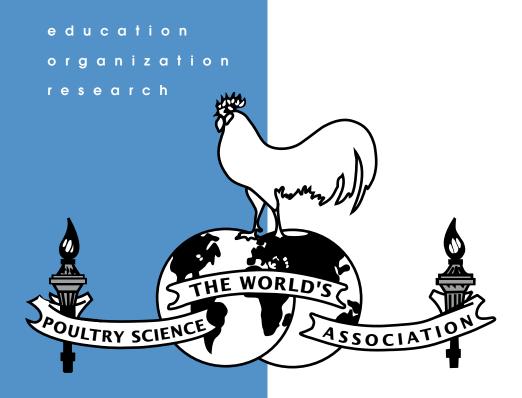
POULTRY SCIENCE JOURNAL



www.wpsa.com

volume 72, March 2016 number 1















GET MORE VALUE FROM YOUR FEED

- Enzymes
- Toxin binders
- Slow release acidifiers
- Immunomodulators
- Flavors
- Raw materials
- Yeast derivates

Quality feed additives for more cost savings and better performance

Achterstenhoek 5 • 2275 Lille • Belgium • Tel: +32 14 88 31 11 • sales@nutrex.be • www.nutrex.be

POULTRY SCIENCE

JOURNAL

Volume 72 March 2016 Number 1

1	Editorial
2	Sponsorship

Reviews

5	Nutritional	requirements	and	feed	management	of	meat	type	ducks
	F Raéza								

- Layer breeding programmes in changing production environments: a historic perspective *F. Leenstra, J. ten Napel, J. Visscher and F. van Sambeek*
- Functions of propolis as a natural feed additive in poultry U.T. Mahmoud, H.W. Cheng and T.J. Applegate
- 49 Infectious bronchitis virus: evolution and vaccination S. Umar, M.A.A. Shah, M.T. Munir, U. Ahsan and K. Kaboudi
- Importance of release location on the mode of action of butyrate derivatives in the avian gastrointestinal tract

 P.C.A. Moquet, L. Onrust, F. van Immerseel, R. Ducatelle, W.H. Hendriks and R.P. Kwakkel
- 81 Chicken genome modelling for the benefit of science M. Stupar, V. Vidović, D. Lukač and N. Puvača
- 93 Worm meal: a potential source of alternative protein in poultry feed S. Khan, S. Naz, A. Sultan, I.A. Alhidary, M.M. Abdelrahman, R.U. Khan, N.A. Khan and S. Ahmad
- 103 Severe feather-pecking in non-cage laying hens and some associated and predisposing factors: a review K.M. Hartcher, S.J. Wilkinson, P.H. Hemsworth and G.M. Cronin
- In-vitro and in-vivo anthelmintic potential of different medicinal plants against Ascaridia galli infection in poultry birds
 A. Raza, F. Muhammad, S. Bashir, B. Aslam, M.I. Anwar and M.U. Naseer
- 125 Low pathogenic avian influenza H9N2: world-wide distribution S. Al-Garib, A. Agha and L. Al-Mesilaty
- 137 Factors affecting ranging behaviour in commercial free-range hens *I.C. Pettersson, R. Freire and C.J. Nicol*
- 151 Flow cytometric analysis of avian natural killer cell activity H.S. Al-Khalifa
- 159 The activity and use of zinc in poultry diets S. Naz, M. Idris, M.A. Khalique, Zia-Ur-Rahman, I.A. Alhidary, M.M. Abdelrahman, R.U. Khan, N. Chand, U. Farooq and S. Ahmad
- Alternative feeding strategies and genetics for providing adequate methionine in organic poultry diets with limited use of synthetic amino acids *H.K. Burley, P.H. Patterson and K.E. Anderson*

Small-scale Family Poultry Production

- Production parameters and profitability of the Egyptian household poultry sector: a survey F.O. Fasina, A.M. Ali, J.M. Yilma, O. Thieme and P. Ankers

 Summaries
- 189 Chinese, French, German, Russian, Spanish World's Poultry Science Association
- 217 Information and Officers
- 222 **Obituary**
- 224 Association News
- 233 Calendar
- 235 Education and Training
- 238 Notes for Contributors

Dr L.A. Waldron LWT Animal Nutrition Ltd PO Box 119, Feilding 4740 New Zealand

Phone: +64 6328 9026. Mobile +64 21743374 Fax: +64 6328 9027

E-mail: lucy@animalnutrition.co.nz

Assistant Editor

Mrs D.M. Kleverwal World's Poultry Science Association Dr S. Cherepanov, Russia PO Box 31, 7360 AA Beekbergen Prof D.K. Flock, Germany The Netherlands

Phone: +31 570 541948 Fax: +31 207 508941 E-mail: wpsa@xs4all.nl

Associate Editors

Prof J.A. Castelló, Spain Dr D. Grastilleur, France Prof N. Yang, China

International Editorial Board

Prof W. Bessei, Germany Prof I.J. H Duncan, Canada Prof D.J. Farrell, Australia Prof R.M. Gous, South Africa Dr. E.F. Guèye, Mali Prof P. Horn, Hungary Dr P. Hunton, Canada

Dr M. Lilburn, USA Dr R.W.A.W. Mulder, Netherlands Prof G.D. Rosen, UK Dr D. Narahari, India Prof. Y. Nys, France Prof Jun-ichi Okumura, Japan Prof H. Pingel, Germany Dr R.A.E. Pym, Australia

Prof J.R. Roberts, Australia Prof P.J. Sharp, UK Prof P.B. Siegel, USA Dr M. Tixier-Boichard, France Prof S. Yahav, Israel

The World's Poultry Science Journal is published in March, June, September and December by the World's Poultry Science Association. The Secretary of the Association is Dr Roel W.A.W. Mulder, PO Box 31, 7360 AA Beekbergen, The Netherlands (phone: +31 6 51519584, fax: +31 207 508 941, e-mail: roel.mulder@wpsa.com, website: www.wpsa.com).

Disclaimer: The Editors of the World's Poultry Science Journal take all reasonable steps to ensure the accuracy of material published. However, all statements, conclusions and opinions expressed in it are those of the authors and contributors; the Editors, Associate Editors, Members of the Editorial Board and the Publishers accept no responsibility or liability for them.

2016 subscriptions rates: £243/\$438 for organisational online & print; £181/\$334 for organisational online only; £117/\$213 for individuals online & print.

Subscription enquiries and orders: Orders, which must be accompanied by payment, may be sent to a bookseller, subscription agent or to the Publisher: Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge, CB2 2RU, UK; or in the USA, Canada and Mexico: Cambridge University Press, Journals Fulfilment Department, 100 Brook Hill Drive, West Nyack, New York 10994-2133. EU subscribers (outside the UK) who are not registered for VAT should add VAT at their country rate. VAT registered subscribers should provide their VAT registration number. Japanese prices for institutions are available from: Kinokuniya Company Ltd, PO Box 55, Chitose, Tokyo 156, Japan.

Periodicals postage pending at New York, NY, and at additional mailing offices. Postmaster: send address changes in USA, Canada and Mexico to: World's Poultry Science Journal, Cambridge University Press, 100 Brook Hill Drive, West Nyack, New York 10994-2133. Claims for missing issues should be made immediately on receipt of the subsequent issue.

Back issues: Dr Roel Mulder, PO Box 31, 7360 AA Beekbergen, The Netherlands.

Advertising enquiries: Dr Roel Mulder, PO Box 31, 7360 AA Beekbergen, The Netherlands (phone: +31 6 51519584, fax: +31 207 508 941, e-mail: roel.mulder@wpsa.com).

Copyright: All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, optical, mechanical, photocopying, recording or otherwise without the written permission of the copyright holder. © World's Poultry Science Association.

Reprints and Photocopying: Readers who require multiple copies of papers published in this journal may either purchase reprints (minimum order 100) or obtain permission to copy from the Editor. However, permission is granted for the making of single copies of articles for internal or personal use. In North America, this permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center Inc. (CCC) to make single copies of any article herein for the flat fee of \$3 per article. Payment should be sent directly to CCC, 2 Congress Street, Salem, MA 01970, USA. The item-free Code for this publication indicates that authorization is to make single copies only for internal or personal use. Serial-free Code: ISSN 0043-9339, \$3. In the UK, the Copyright Licensing Agency (CLA), 90 Tottenham Court Road, London W1P 9HE is mandated to grant permission to make single copies.