

## CONTENTS

### ANIMAL WELL-BEING AND BEHAVIOR

- Limestone particle size fed to pullets influences subsequent bone integrity of hens  
P. E. Eusebio-Balcazar, S. Purdum, K. Hanford, and M. M. Beck ..... 1471
- Why did severe feather pecking and cannibalism outbreaks occur? An unintended case study while investigating the effects of forage and stress on pullets during rearing  
G. M. Cronin, R. L. Hopcroft, P. J. Groves, E. J. S. Hall, D. N. Phalen, and P. H. Hemsworth ..... 1484
- Effects of stocking density and string provision on welfare-related measures in commercial broiler chickens in windowed houses  
C. L. Bailie, C. Ijichi, and N. E. O'Connell ..... 1503

### GENETICS AND GENOMICS

- Relationships among mortality, performance, and disorder traits in broiler chickens: a genetic and genomic approach  
X. Zhang, S. Tsuruta, S. Andonov, D. A. L. Lourenco, R. L. Sapp, C. Wang, and I. Misztal ..... 1511

### IMMUNOLOGY, HEALTH, AND DISEASE

- Isolation, characterization, and antibiotic sensitivity assessment of *Gallibacterium anatis* biovar *haemolytica*, from diseased Egyptian chicken flocks during the years 2013 and 2015  
Ahmed R. Elbestawy, Hany F. Ellakany, Hatem S. Abd El-Hamid, Ahmed A. Bekheet, Nahla E. Mataried, Sherif M. Nasr, and Nadim M. Amarin ..... 1519
- Expression of angiogenic factors and plexiform lesions in the lungs of broiler and layer chickens: A comparison  
X. Tan, F.-J. Shao, G.-J. Fan, and Y.-T. Ying ..... 1526
- Culture and characterization of chicken small intestinal crypts  
J. Li, J. Li, Jr., S. Y. Zhang, R. X. Li, X. Lin, Y. L. Mi, and C. Q. Zhang ..... 1536
- Evaluation of a coccidia vaccine using spray and gel applications  
Grace A. Albanese, Laura R. Tensa, Emily J. Aston, Deborah A. Hilt, and Brian J. Jordan ..... 1544
- Forsythia suspensa* extract attenuates breast muscle oxidative injury induced by transport stress in broilers  
L. Pan, X. K. Ma, P. F. Zhao, Q. H. Shang, S. F. Long, Y. Wu, and X. S. Piao ..... 1554
- Involvement of cholinesterases in oxidative stress induced by chlorpyrifos in the brain of Japanese quail  
D. Ćupić Miladinović, S. Borožan, and S. Ivanović ..... 1564

### Non-Invited Review

- Gut barrier function: Effects of (antibiotic) growth promoters on key barrier components and associations with growth performance  
Leon J. Broom ..... 1572

### MANAGEMENT AND PRODUCTION

- Meat quality traits in the Greater rhea (*Rhea americana*) as influenced by muscle, sex and age  
L. Bernad, P. D. Casado, N. L. Murillo, A. B. Picallo, C. A. Garriz, and N. O. Maceira ..... 1579

Wet feed and cold water as heat stress modulators in growing Muscovy ducklings M. F. A. Farghly, M. E. Abd El-Hack, M. Alagawany, I. M. Saadeldin, and A. A. Swelum.....	1588
"Cracking" into the debate about laying hen housing C. Bir, N. M. Thompson, W. E. Tyner, J. Hu, and N. J. O. Widmar.....	1595
Mineral content of eggs differs with hen strain, age, and rearing environment Laura E. Heflin, Ramon Malheiros, Kenneth E. Anderson, LuAnn K. Johnson, and Susan K. Raatz.....	1605
<b>METABOLISM AND NUTRITION</b>	
Effects of feeding reduced crude protein diets on growth performance, nitrogen excretion, and plasma uric acid concentration of broiler chicks during the starter period R. Kriseldi, P. B. Tillman, Z. Jiang, and W. A. Dozier, III.....	1614
Phytase supplementation in diets rich in fiber from rapeseed enhances phosphorus and calcium digestibility but not retention in broiler chickens M. Bournazel, M. Lessire, S. Klein, N. Même, C. Peyronnet, A. Quinsac, M. J. Duclos, and A. Narcy .....	1627
Effects of supplementation with $\alpha$ -tocopherol, ascorbic acid, selenium, or their combination in linseed oil-enriched diets on the oxidative status in broilers J. Leskovec, A. Levart, A. Nemec Svete, L. Perić, M. Đukić Stojčić, D. Žikić, J. Salobir, and V. Rezar.....	1641
Multigenerational effects of a reduced balanced protein diet during the rearing and laying period of broiler breeders. 1. Performance of the F1 breeder generation J. Lesuisse, C. Li, S. Schallier, W. L. S. Clímaco, A. Bautil, N. Everaert, and J. Buyse.....	1651
Multigenerational effects of a reduced balanced protein diet during the rearing and laying period of broiler breeders. 2. Zootechnical performance of the F1 broiler offspring J. Lesuisse, S. Schallier, C. Li, A. Bautil, B. Li, J. Leblois, J. Buyse, and N. Everaert .....	1666
<b>Research Note</b>	
Regression method-derived energy value of dried egg albumen for broiler chickens S. Hancock, F. Zhang, and O. Adeola.....	1677
<b>MICROBIOLOGY AND FOOD SAFETY</b>	
Application of calcium oxide (CaO, heated scallop-shell powder) for the reduction of <i>Listeria</i> <i>monocytogenes</i> biofilms on eggshell surfaces S. Y. Park, S.-J. Jung, I. Kang, and S.-D. Ha.....	1681
Evaluation of different <i>Campylobacter jejuni</i> isolates to colonize the intestinal tract of commercial turkey pouls and selective media for enumeration M. J. Sylte, M. H. Inbody, T. A. Johnson, T. Loof, and J. E. Line.....	1689
Co-infection of fowl adenovirus with different immunosuppressive viruses in a chicken flock Fanfeng Meng, Guiwei Dong, Yubiao Zhang, Sibao Tian, Zhizhong Cui, Shuang Chang, and Peng Zhao.....	1699
Viability of <i>Campylobacter spp.</i> in frozen and chilled broiler carcasses according to real-time PCR with propidium monoazide pretreatment Andréa G. S. A. Castro, Elaine M. S. Dorneles, Ethiene L. S. Santos, Telma M. Alves, Guilherme R. Silva, Tadeu C. Figueiredo, Débora C. S. Assis, Andrey P. Lage, and Silvana V. Cançado.....	1706
<b>MOLECULAR AND CELLULAR BIOLOGY</b>	
The effect of <i>Eimeria maxima</i> infection on the expression of amino acid and sugar transporters aminopeptidase, as well as the di- and tri-peptide transporter PepT1, is not solely due to decreased feed intake Katarzyna B. Miska and Raymond H. Fetterer.....	1712



A glycomics approach to discover novel renal biomarkers in birds by administration of cisplatin and diclofenac to chickens C. Ishii, Y. Ikenaka, O. Ichii, S. M. M. Nakayama, S.-I. Nishimura, T. Ohashi, M. Tanaka, H. Mizukawa, and M. Ishizuka .....	1722
Structural change of ovalbumin-related protein X by alkali treatment Takashi Akazawa, Masahiro Ogawa, Shigeru Hayakawa, Misato Hirata, and Takahiro Niwa.....	1730
<b>PHYSIOLOGY AND REPRODUCTION</b>	
Testicular histomorphometrics including Sertoli cell quantitation for evaluating hatchability and fertility issues in commercial breeder-broiler roosters Floyd D. Wilson, Deirdre I. Johnson, Danny L. Magee, and Frederic J. Hoerr .....	1738
CYP17 gene plays a key role in goose genital growth by influencing the testosterone level at puberty W. Sun, X. Gan, J. Hu, L. Li, and J. Wang .....	1748
<b>Research Note</b>	
Comparison of two methods for determination of intestinal villus to crypt ratios and documentation of early age-associated ratio changes in broiler chickens F. D. Wilson, T. S. Cummings, T. M. Barbosa, C. J. Williams, P. D. Gerard, and E. D. Peebles .....	1757
<b>PROCESSING AND PRODUCTS</b>	
Descriptive texture analyses of broiler breast fillets with the wooden breast condition stored at 4°C and -20°C G. Sanchez Brambila, B. C. Bowker, D. Chatterjee, and H. Zhuang .....	1762
Consumers' acceptability of indigenous cockerel Kingsley K. Duah, Edward K. Essuman, Osca S. Olympio, Worlah Akwetey, Vida Gyimah, and Jeremiah O. Yeboah .....	1768
Dietary oregano ( <i>Origanum vulgare</i> L.) aqueous extract improves oxidative stability and consumer acceptance of meat enriched with CLA and n-3 PUFA in broilers C. Forte, R. Branciari, D. Pacetti, D. Miraglia, D. Ranucci, G. Acuti, M. Balzano, N. G. Frega, and M. Trabalza-Marinucci.....	1774
Effects of quantitative nutrient allocation on myopathies of the <i>Pectoralis major</i> muscles in broiler chickens at 32, 43, and 50 days of age K. J. Meloche, B. I. Fancher, D. A. Emmerson, S. F. Bilgili, and W. A. Dozier, III .....	1786
Effects of reduced dietary energy and amino acid density on <i>Pectoralis major</i> myopathies in broiler chickens at 36 and 49 days of age K. J. Meloche, B. I. Fancher, D. A. Emmerson, S. F. Bilgili, and W. A. Dozier, III .....	1794
Phosphofructokinase and mitochondria partially explain the high ultimate pH of broiler pectoralis major muscle Sulaiman K. Matarneh, Con-Ning Yen, Jennifer M. Elgin, Mariane Beline, Saulo da Luz e Silva, Jordan C. Wicks, Eric M. England, Rami A. Dalloul, Michael E. Persia, Islam I. Omara, Hao Shi, and David E. Gerrard.....	1808
Variability and interaction of some egg physical and eggshell quality attributes during the entire laying hen cycle F. Sirri, M. Zampiga, A. Berardinelli, and A. Meluzzi.....	1818
Protein hydrolysate from turkey meat and optimization of its antioxidant potential by response surface methodology Daoying Wang and Fereidoon Shahidi.....	1824
Broiler responses to increasing selenium supplementation using Zn-L-selenomethionine with special attention to breast myopathies H. S. Cemin, S. L. Vieira, C. Stefanello, L. Kindlein, T. Z. Ferreira, and A. K. Fireman.....	1832

Effect of pre-slaughter shackling and wing flapping on plasma parameters, postmortem metabolism, AMPK, and meat quality of broilers J. C. Huang, J. Yang, M. Huang, Z. S. Zhu, X. B. Sun, B. H. Zhang, X. L. Xu, W. G. Meng, K. J. Chen, and B. C. Xu.....	1841
--	------

#### Research Notes

Consumer acceptance of eggs from Hy-Line Brown layers fed soybean or soybean-free diets using cage or free-range rearing systems M. N. Al-Ajeeli, R. K. Miller, H. Leyva, M. M. Hashim, R. A. Abdaljaleel, Y. Jameel, and C. A. Bailey.....	1848
Identification and characterization of the proteins in broth of stewed traditional Chinese yellow-feathered chickens Jun Qi, Hu-hu Wang, Wen-wen Zhang, Shao-lin Deng, Guang-hong Zhou, and Xing-lian Xu.....	1852