

CONTENTS

ANIMAL WELL-BEING AND BEHAVIOR

Study on the morphology and mineralization of the tibia in meat ducks from 1 to 56 d H. Y. Zhang, Q. F. Zeng, S. P. Bai, J. P. Wang, X. M. Ding, Y. Xuan, Z. W. Su, G. S. Fraley, and K. Y. Zhang.....	3355
Rearing system causes changes of behavior, microbiome, and gene expression of chickens Siyu Chen, Hai Xiang, Hui Zhang, Xu Zhu, Dan Wang, Jikun Wang, Tao Yin, Langqing Liu, Minghua Kong, Hua Li, and Xingbo Zhao.....	3365
The effect of alternative feeding strategies for broiler breeder pullets: 1. Welfare and performance during rearing Aitor Arrazola, Elyse Mosco, Tina M. Widowski, Michele T. Guerin, Elijah G. Kiarie, and Stephanie Torrey	3377
Identifying welfare issues in turkey hen and tom flocks applying the transect walk method Joanna Marchewka, Guro Vasdal, and Randi O. Moe.....	3391
Feather HSP70: a novel non-invasive molecular marker for monitoring stress induced by heat exposure in broilers Elizabeth S. Greene, Hossein Rajaei-Sharifabadi, and Sami Dridi.....	3400

GENETICS AND GENOMICS

Dual-purpose production of genetically different chicken crossbreeds in Ethiopia. 2. Egg and meat production of the final-crossbreed females and males Dawud Ibrahim, Gebeyehu Goshu, Wondmeneh Esatu, and Avigdor Cahaner	3405
Low-density lipoprotein receptor-related protein 1 regulates muscle fiber development in cooperation with related genes to affect meat quality Chao Lv, Shuling Niu, Shouqing Yan, Chunyan Bai, Xi Yu, Jian Hou, Wenjing Gao, Jinyu Zhang, Zhihui Zhao, Caini Yang, and Yonghong Zhang.....	3418
Venous blood gas and chemistry components are moderately heritable in commercial white egg-laying hens under acute or chronic heat exposure Kaylee Rowland, Michael E. Persia, Max F. Rothschild, Carl Schmidt, and Susan J. Lamont	3426
Can breeders solve mortality due to feather pecking in laying hens? Esther D. Ellen and Piter Bijma	3431

IMMUNOLOGY, HEALTH, AND DISEASE

Immune modulation, growth performance, and nutrient retention in broiler chickens fed a blend of phytogenic feed additives V. Pirgozliev, S. C. Mansbridge, S. P. Rose, H. S. Lillehoj, and D. Bravo.....	3443
The impact of <i>Bacillus subtilis</i> DSM 32315 on the pathology, performance, and intestinal microbiome of broiler chickens in a necrotic enteritis challenge Rose A. Whelan, Kiran Doranalli, Teemu Rinttilä, Kirsi Vienola, German Jurgens, and Juha Apajalahti	3450
Effect of IBDV infection on the interfollicular epithelium of chicken bursa of Fabricius Ildikó Bódi, Balázs Felföldi, Krisztina Minkó, Zsófia Benyeda, Nándor Nagy, Anna L Kiss, Vilmos Palya, and Imre Oláh.....	3464
Oral antibody to interleukin-10 receptor 2, but not interleukin-10 receptor 1, as an effective <i>Eimeria</i> species immunotherapy in broiler chickens Maria K. Arendt, Laura J. Knoll, and Mark E. Cook.....	3471
Spectral technique for detection of changes in eggshells caused by <i>Mycoplasma synoviae</i> Zofia Lorenc, Sławomir Paško, Olimpia Kursa, Anna Pakuła, and Leszek Salbut.....	3481

METAB

Effect o

and p

Itallo

Ciran

Reduced

of bro

R. Ba

Effect o

Eugen

Evaluati

during

H. Ha

Increased

chicken

Z. Lu

Dietary

of anti

D. Ru

S. Wa

Effects o

in Part

Y. R.

Additivi

in broil

A. Co

and V

Producti

to cond

W. G.

M. M.

Effects o

metabo

Md. R

Pascal

Effect o

and egg

I. M. V

Dietary s

thioredd

X. L. V

Developin

for mod

Hector

Yansoo

Growth p

in Shave

of a sing

M. Nei

Influen

tract tra

in enrich

G. Ege

The prote

diet

Yuepin

and Ya

notypic evolution and epidemiological characteristics of H9N2 influenza virus in Shandong province, China

- Yue Li, Mengda Liu, Qinjin Sun, Huixia Zhang, Hui Zhang, Shengnan Jiang, Sidang Liu, and Yanyan Huang 3488
 Protective effect of *Salvia miltiorrhiza* polysaccharides on liver injury in chickens
- Chao Han, Yuanyuan Wei, Xiao Wang, Cuijing Ba, and Wanyu Shi 3496
 Effects of vaccination with keyhole limpet hemocyanin or oral administration of *Salmonella enterica* serovar Enteritidis on the growth performance of immunoglobulin knockout chickens
- J. J. Bolek and K. C. Klasing 3504
 Immunosuppressive potential of fowl adenovirus serotype 4
- Jujuan Niu, Qinjin Sun, Yongyong Shi, Yonghe Ding, Zhiqiang Li, Yuanchao Sun, Teihang Li, and Sidang Liu 3514
 Effect of dietary graded resistant potato starch levels on growth performance, plasma cytokines concentration, and intestinal health in meat ducks
- M. Qin, K. Y. Zhang, X. M. Ding, S. P. Bai, J. P. Wang, and Q. F. Zeng 3523
 Fluctuations in luteinizing hormone, follicle stimulating hormone, and progesterone might affect the disappearance of avian leukosis virus subgroup J viremia in chickens with intermittent viremia
- Lanman Dai, Min Feng, Tingting Xie, Yuanfang Li, and Xiquan Zhang 3533
 Cosaponin A protects chickens against pullorum disease via modulation of cholesterol
- Yu Shuai-Cheng, Chu Xiu-Ling, Su Jian-Qing, Wu Zong-Mei, Yu Zhen-Jiang, and Li Lian-Tao 3539
 Combined adjuvant effect of ginseng stem-leaf saponins and selenium on immune responses to a live bivalent vaccine of Newcastle disease virus and infectious bronchitis virus in chickens
- Ma, S. Bi, Y. Wang, X. Chi, and S. Hu 3548

NAGEMENT AND PRODUCTION

Egg quality, fatty acid profile, and sensory attributes of spent laying hens fed expeller press canola meal or a conventional diet

- Strouk Semwogerere, Jeannine Neethling, Voster Muchenje, and Louwrens C. Hoffman 3557
 Effects of cage size on growth performance, blood biochemistry, and antibody response in layer breeder males during rearing stage

Y. Li, W. Liu, R. Y. Ma, Y. Li, Y. Liu, R. R. Qi, and K. Zhan 3571
 Egg hen production and welfare in enriched colony cages at different stocking densities

- L. Weimer, C. I. Robison, R. J. Tempelman, D. R. Jones, and D. M. Karcher 3578
 Non-linear fitting growth curves of the von Bertalanffy-Pütter type

André Kühlein, Norbert Brunner, Werner-Georg Nowak, Katharina Renner-Martin, and Klaus Scheicher 3587
 Long term effect of dietary lipid saturation on eggshell quality and bone characteristics of laying hens

- C. Josling, A. Hugo, M. D. Fair, and F. H. de Witt 3593
 Effect of a probiotic-based cleaning product on the microbiological profile of broiler litters and chicken caeca microbiota

Alessandra De Cesare, Elisabetta Caselli, Alex Lucchi, Claudia Sala, Antonio Parisi, Gerardo Manfreda, and Sante Mazzacane 3602
 Quantitative bone calcium and bone ash from mature laying hens correlates to bone mineral content calculated from quantitative computed tomography scans

- I. Robison and D. M. Karcher 3611
 Effects of in ovo injection of L-ascorbic acid on growth performance, carcass composition, plasma antioxidant capacity, and meat quality in broiler chickens

Zhang, K. E. C. Elliott, O. A. Durojaye, S. A. Fatemi, M. W. Schilling, and E. D. Peebles 3617
 A study on the factors affecting egg weight loss, early embryonic mortality, hatchability, and chick mortality with the use of classification tree technique

- Grochowska, A. Kinal, Z. Sobek, I. Siatkowski, and M. Bednarczyk 3626
 Effect of beak tissue sloughing and post-treatment beak shape on the productivity of infrared heat-treated layer pullets and hens

Struthers, H.L. Classen, S. Gomis, and K. Schwean-Lardner 3637
 Effects of post-hatch brooding temperature on performance of starter and growing Pekin ducks

- Xie, P. X. Sun, Y. L. Feng, Y. Jiang, J. Tang, W. Huang, Q. Zhang, and S. S. Hou 3647

METABOLISM AND NUTRITION

- Effect of vitamin E in ovo feeding to broiler embryos on hatchability, chick quality, oxidative state, and performance
Itallo C. S. Araújo, Marcos B. Café, Raiana A. Noleto, Julyana M. S. Martins, Cirano J. Ulhoa, Gabriela C. Guareshi, Matheus M. Reis, and Nadja S. M. Leandro..... 3652
- Reduced protein diet and amino acid concentration alter intestinal barrier function and performance of broiler chickens with or without synthetic glucocorticoid
R. Barekatain, G. Natrass, A. J. Tilbrook, K. Chousalkar, and S. Gilani 3662
- Effect of rate and extent of starch digestion on broiler chicken performance
Eugenia Herwig, Dawn Abbott, Karen V. Schwean-Lardner, and Henry L. Classen..... 3676
- Evaluation of the overall impact of antibiotics growth promoters on broiler health and productivity during the medication and withdrawal period
H. Hamid, L. H. Zhao, G. Y. Ma, W. X. Li, H. Q. Shi, J. Y. Zhang, C. Ji, and Q. G. Ma ... 3685
- Increased fat synthesis and limited apolipoprotein B cause lipid accumulation in the liver of broiler chickens exposed to chronic heat stress
Z. Lu, X. F. He, B. B. Ma, L. Zhang, J. L. Li, Y. Jiang, G. H. Zhou, and F. Gao 3695
- Dietary curcumin enhances intestinal antioxidant capacity in ducklings via altering gene expression of antioxidant and key detoxification enzymes
D. Ruan, Y. W. Zhu, A. M. Fouad, S. J. Yan, W. Chen, Y. N. Zhang, W. G. Xia, S. Wang, S. Q. Jiang, L. Yang, and C. T. Zheng 3705
- Effects of dietary phytosterols on growth performance, antioxidant status, and meat quality in Partridge Shank chickens
Y. R. Zhao, Y. P. Chen, Y. F. Cheng, H. M. Qu, J. Li, C. Wen, and Y. M. Zhou..... 3715
- Additivity of apparent and standardized ileal amino acid digestibility of corn and soybean meal in broiler diets
A. Cowieson, J. O. Sorbara, G. Pappenberger, M. R. Abdollahi, F. F. Roos, and V. Ravindran 3722
- Productivity, reproductive performance, and fat deposition of laying duck breeders in response to concentrations of dietary energy and protein
W. G. Xia, K. F. M. Abouelezz, A. M. Fouad, W. Chen, D. Ruan, S. Wang, M. M. M. Azzam, X. Luo, Q. L. Fan, Y. N. Zhang, and C. T. Zheng 3729
- Effects of wild blueberry (*Vaccinium angustifolium*) pomace feeding on gut microbiota and blood metabolites in free-range pastured broiler chickens
Md. Rashedul Islam, Dion Lepp, David V. Godfrey, Steve Orban, Kelly Ross, Pascal Delaquis, and Moussa S. Diarra 3739
- Effect of wheat distillers dried grains with solubles and exogenous xylanase on laying hen performance and egg quality
I. M. Whiting, S. P. Rose, A. M. Mackenzie, A. M. Amerah, and V. R. Pirgozliev..... 3756
- Dietary selenomethionine increases antioxidant capacity of geese by improving glutathione and thioredoxin systems
X. L. Wan, G. Y. Ju, L. Xu, H. M. Yang, and Z. Y. Wang 3763
- Developing a novel oral vitamin D₃ intake bioassay to re-evaluate the vitamin D₃ requirement for modern broiler chickens
Hector Leyva-Jimenez, Momin Khan, Kimberly Gardner, Raghad A. Abdaljaleel, Yansoon AL-Jumaa, Akhil M. Alsadwi, and Christopher A. Bailey..... 3770
- Growth performance, apparent retention of components, and excreta dry matter content in Shaver White pullets (5 to 16 week of age) in response to dietary supplementation of graded levels of a single strain *Bacillus subtilis* probiotic
M. Neijat, R. B. Shirley, A. Welsher, J. Barton, P. Thiery, and E. Kiarie 3777
- Influence of feed particle size and feed form on productive performance, egg quality, gastrointestinal tract traits, digestive enzymes, intestinal morphology, and nutrient digestibility of laying hens reared in enriched cages
G. Ege, M. Bozkurt, B. Koçer, A. E. Tüzün, M. Uygun, and G. Alkan..... 3787
- The protective effects of modified palygorskite on the broilers fed a purified zearalenone-contaminated diet
Yueping Chen, Yefei Cheng, Chao Wen, Wenbo Wang, Yuru Kang, Aiqin Wang, and Yanmin Zhou 3802

Amorphous cellulose feed supplement alters the broiler caecal microbiome Celine De Maesschalck, Venessa Eeckhaut, Luc Maertens, Loek De Lange, Leon Marchal, Georges Daube, Jeroen Dewulf, Freddy Haesebrouck, Richard Ducatelle, Bernard Taminau, and Filip Van Immerseel.....	3811
Feeding broiler chicks diets containing keto- and hydroxy-acids: performance and carcass weight A. Adrizal, P. H. Patterson, C. R. Angel, and A. Markant	3818
Effects of zinc oxide nanoparticles on growth performance and concentrations of malondialdehyde, zinc in tissues, and corticosterone in broiler chickens under heat stress conditions Suriya Kumari Ramiah, Elmutaz Atta Awad, Saminathan Mookiah, and Zulkifli Idrus	3828
Effects of <i>Bacillus subtilis</i> and coccidial vaccination on cecal microbial diversity and composition of <i>Eimeria</i> -challenged male broilers Xi Wang, Yuhua Z. Farnell, Aaron S. Kiess, E. David Peebles, Kelley G. S. Wamsley, and Wei Zhai	3839
Peppermint and its respective active component in diets of broiler chickens: growth performance, viability, economics, meat physicochemical properties, and carcass characteristics Ahmed A. A. Abdel-Wareth, Saskia Kehraus, and Karl-Heinz Südekum.....	3850
Effects of cottonseed oil and ferrous sulfate on the performance and expression of antioxidant enzymes in broilers R. S. Araujo, A. C. Oliveira, F. C. B. Sousa, L. R. B. Dourado, S. E. F. Guimarães, W. Silva, D. Biagiotti, G. F. V. Bayão, and K. R. S. Sousa.....	3860
Effect of a high dose of exogenous phytase and supplementary myo-inositol on mineral solubility of broiler digesta and diets subjected to in vitro digestion assay D. Farhadi, A. Karimi, A. A. Sadeghi, J. Rostamzadeh, and M. R. Bedford	3870
Influence of graded concentrations of phytase in high-phytate diets on growth performance, apparent ileal amino acid digestibility, and phytate concentration in broilers from hatch to 28 D post-hatch C. L. Walk and O. A. Olukosi.....	3884
Growth performance, zinc tissue content, and intestinal health in meat ducks fed different specific surface area of micronized zinc oxide X. P. Wu, Y. F. Zhu, K. Y. Zhang, X. M. Ding, S. P. Bai, J. P. Wang, H. W. Peng, and Q. F. Zeng	3894
Effects of lysophospholipid on growth performance, carcass yield, intestinal development, and bone quality in broilers C. Chen, B. Jung, and W. K. Kim.....	3902
Response of broiler chickens to xylanase and butyrate supplementation G. González-Ortiz, T. T. dos Santos, K. Vienola, S. Vartiainen, J. Apajalahti, and M. R. Bedford.....	3914
Effects of residual superdoses of phytase on growth performance, tibia mineralization, and relative organ weight in ducks fed phosphorus-deficient diets L. Fan, Z. Z. He, X. Ao, W. L. Sun, X. Xiao, F. K. Zeng, Y. C. Wang, and J. He.....	3926
Influence of beak trimming and inclusion of sodium butyrate in the diet on growth performance and digestive tract traits of brown-egg pullets differing in initial body weight J. García, H. A. Mandalawi, G. Fondevila, and G. G. Mateos	3937
Amino acid pattern in the liver and blood of fattening turkeys suffering from hepatic lipidosis L. Middendorf, D. Radko, K. Düngelhoef, E. Sieverding, H. Windhaus, D. Mischok, and C. Visscher	3950
Effect of a low protein diet on chicken ceca microbiome and productive performances Alessandra De Cesare, Ítalo Faria do Valle, Claudia Sala, Federico Sirri, Annalisa Astolfi, Gastone Castellani, and Gerardo Manfreda.....	3963
Screening of single or combined administration of 9 probiotics to reduce ammonia emissions from laying hens Jiandui Mi, Xi Chen, and Xindi Liao.....	3977
Glycerol inoculation in eggs of young broiler breeders at different embryonic periods G. C. Dal Pont, E. C. Goes, R. A. Araujo, S. G. Oliveira, C. Rocha, and A. Maiorka	3989
Predicting nutrient digestibility and energy value for broilers S. Cerrate, R. Ekmay, J. A. England, and C. Coon.....	3994
Cassava (<i>Manihot esculenta</i>) root chips inclusion in the diets of broiler chickens: effects on growth performance, ileal histomorphology, and cecal volatile fatty acid production Sudhir Yadav, Birendra Mishra, and Rajesh Jha.....	4008

Influence of the particle size and form of feed on growth performance, digestive tract traits and nutrient digestibility of white egg-laying pullets from 1 to 112 D of age M. Bozkurt, B. Koçer, G. Ege, A. E. Tüzün, H. H. Biyik, and E. Poyrazoğlu	4016
Nutritional modulation of the antioxidant capacities in poultry: the case of vitamin E Peter F. Surai, Ivan I. Kochish, Michael N. Romanov, and Darren K. Griffin	4030
An update on the cecectomy technique in roosters anesthetized with isoflurane used in subsequent amino acid digestibility experiments C. F. M. Mansano, B. I. Macente, P. do E. S. Silva, R. W. da Rocha, A. Escobar, N. K. Sakomura, K. U. Khan, J. B. K. Fernandes, and E. P. da Silva.....	4042
Non-cellulosic polysaccharide content in feed ingredients and ileal and total tract non-cellulosic polysaccharide digestibility in 21- and 42-day-old broilers fed diets with and without added composite enzymes P. Maharjan, M. Mayorga, K. Hilton, J. Weil, A. Beitia, J. Caldas, J. England, and C. Coon.....	4048
The use of inulin and wheat bran only during the starter period or during the entire rearing life of broilers: effects on growth performance, small intestinal maturation, and cecal microbial colonization until slaughter age Bing Li, Martine Schroyen, Julie Leblois, Yves Beckers, Jérôme Bindelle, and Nadia Everaert.....	4058
High dietary zinc and glutamine do not improve the performance or reduce excreta moisture of broiler chickens fed diets with and without magnesium supplementation R. Barekatain and M. Toghyani.....	4066

MICROBIOLOGY AND FOOD SAFETY

Carvacrol antimicrobial wash treatments reduce <i>Campylobacter jejuni</i> and aerobic bacteria on broiler chicken skin S. Shrestha, B. R. Wagle, A. Upadhyay, K. Arsi, D. J. Donoghue, and A. M. Donoghue	4073
Association of host genetics with intestinal microbiota relevant to body weight in a chicken F2 resource population J. Ji, C. L. Luo, X. Zou, X. H. Lv, Y. B. Xu, D. M. Shu, and H. Qu	4084
McBR is involved in biofilm formation and H ₂ O ₂ stress response in avian pathogenic <i>Escherichia coli</i> X40 Lumin Yu, Wenchang Li, Kezong Qi, Siyu Wang, Xiaolin Chen, Jingtian Ni, Ruining Deng, Fei Shang, and Ting Xue	4094
<i>Salmonella</i> recovery from chicken bone marrow and cecal counts differ by pathogen challenge method Amie M. Jones-Ibarra, Christine Z. Alvarado, Denise H. Caldwell, J. Allen Byrd, and T. Matthew Taylor	4104

MOLECULAR AND CELLULAR BIOLOGY

Expression of digestive enzyme and intestinal transporter genes during chronic heat stress in the thermally manipulated broiler chicken Mohammad Borhan Al-Zghoul, Aseel Ra'ed Said Alliftawi, Khaled Musa Mohammad Saleh, and Ziad Waheed Jaradat.....	4113
Broiler chicken myofiber morphometrics and myogenic stem cell population heterogeneity O. J. Tejeda, A. J. Calderon, J. A. Arana, K. J. Meloche, and J. D. Starkey	4123

PHYSIOLOGY AND REPRODUCTION

Evaluation of molt induction using cassava meal varying the length of feeding period in older (90 week) laying hens M. Chanaksorn, C. Boonkaewwan, A. Kayan, and N. Gongruttananun.....	4131
Assessment of the body development kinetic of broiler breeders by non-invasive imaging tools Jérémie Grandhaye, François Lecompte, Christophe Staub, Eric Venturi, Ingrid Plotton, Estelle Cailleau-Audouin, Patrice Ganier, Christelle Ramé, Sylvain Brière, Joelle Dupont, and Pascal Froment.....	4140
The different effects of viral and bacterial mimics maternal stimuli on ethology of hens and reproduction of their offspring Lei Liu, Di Wang, Siyuan Mi, Zhongyi Duan, Shuang Yang, Jiuzhou Song, Guiyun Xu, Ning Yang, and Ying Yu	4153

Sucrose increases the quality and fertilizing ability of cryopreserved chicken sperms in contrast to raffinose	
Pachara Thananurak, Napapach Chuaychu-noo, Aurore Thélie, Yupin Phasuk, Thevin Vongpralub, and Elisabeth Blesbois	4161
The capability of L-carnitine-mediated antioxidant on cock during aging: evidence for the improved semen quality and enhanced testicular expressions of GnRH1, GnRHR, and melatonin receptors MT 1/2	
Abdelmotaleb A. Elokil, Ali A. Bhuiyan, Hua-Zhen Liu, Mona N. Hussein, Hafiz I. Ahmed, Syed A. Azmal, Liubin Yang, and Shijun Li	4172
Differences in semen quality, testicular histomorphology, fertility, reproductive hormone levels, and expression of candidate genes according to sperm motility in Beijing-You chickens	
Yanyan Sun, Fuguang Xue, Yunlei Li, Li Fu, Hao Bai, Hui Ma, Songshan Xu, and Jilan Chen.....	4182

PROCESSING AND PRODUCTS

Improvement of chilling efficiency and meat tenderness of broiler carcasses using subzero saline solutions	
M. M. Metheny, H. C. Lee, S. Viliani, D. C. Bennett, S. Hurley, and I. Kang.....	4190
Effects of rice protein coatings combined or not with propolis on shelf life of eggs	
P. G. S. Pires, P. D. S. Pires, K. M. Cardinal, A. F. R. Leuven, L. Kindlein, and I. Andretta.....	4196
Use of blade tenderization to improve wooden breast meat texture	
G. Tasoniero, B. Bowker, A. Stelzleni, H. Zhuang, M. Rigdon, and H. Thippareddi	4204
Effects of preslaughter shackling on postmortem glycolysis, meat quality, changes of water distribution, and protein structures of broiler breast meat	
X. B. Sun, J. C. Huang, T. T. Li, Y. Ang, X. L. Xu, and M. Huang.....	4212

ASSOCIATION NOTES

Positions Available.....	4221
--------------------------	------