POULTRY WORLD'S SCIENCE JOURNAL

Xth European Symposium on Poultry Welfare

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19 - 22 June 2017
Ploufragan - France

Book of Abstracts

Xth European Symposium on Poultry Welfare

Book of Abstracts

Hosted by French Branch
From the World's Poultry Science Association

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WELCOME IN BRITTANY !

Christophe BOSTVIRONNOIS
President of French Branch of WPSA

Dear Colleagues,

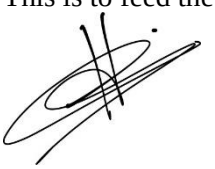
On behalf of the French Branch of WPSA, the Organizing Committee, the Scientific Committee, and the Working Group no.9 "Poultry Welfare and Management" of the European Branch of the WPSA, I would like to extend to all of you a very warm welcome to the X European Symposium on Poultry Welfare in Ploufragan, Brittany, France. I would like this scientific symposium to achieve 3 responsibilities: Support, Benchmark and Simplicity.

Support First. During this meeting, you will have the opportunity to discuss, to share and to debate the latest scientific findings, the researches and the areas of development in the field of poultry welfare. Your role is crucial to support the poultry industry to keep birds welfare at a higher level and in line with the requirement of the consumer demand AND within an acceptable level to maintain the production.

Benchmark then. Of course, competitiveness of the production, costs of production is in the agenda of the poultry production globally. The interesting point is that Welfare topics used to be very European driven in the mid 90' and early 2000'. Now the topic is well spread in the different continents and regions. It makes our responsibility, in Europe, even more important. The world is looking to us and what we are discovering, deciding is considered as a global benchmark by the international community.

Make it Simple. Welfare is far more complicated that to have broilers outdoors on a green grass. It covers topics as production methods, behaviors, health, nutrition, genetics and of course interactions between all of them. It makes the topic complex to handle. This is passionate but at the same time, we have to have in mind that we need to put our decisions, conclusions into reality in an actionable way. To do this, we need to be pragmatic and simple. How can we transfer these very complex topics into something easy to handle and to transform?

Once again, we are very pleased to welcome a very high number of participants coming from many countries and continents. Definitely this is the healthy signal of a growing production, researches and education. Our responsibility is bigger than us. This is to feed the world in a safe, abundant, affordable and sustainable way.



Introduction

Valentina FERRANTE –
Chairwoman of the Working Group n° 9

The WPSA European Federation Working Group 9 (WG9) on Poultry Welfare and Management, together with the WPSA French branch, organised this Xth European Symposium on Poultry Welfare held in Ploufragan, Brittany, France June 19-22th 2017. A memory stick (and a book on request) provide the main record of its proceedings.

Agreement to form WG9 was taken during the WPSA European Poultry Conference in London in 1972. Its inaugural meeting held in Dortmund, Germany during 1973 was attended by 7 members, including me, from 6 countries (Lindgren, N.O. (1973). WPSJ 30 (2): 143-145). Membership and geographical coverage have greatly increased during recent years so that WG9 currently has 33 members from 21 countries.

The first event organised by WG9 was a symposium on bird welfare during the 1976 WPSA European Poultry Conference in Malta. The first European Symposium on Poultry Welfare organised by WG9 was held in Koge, Denmark in 1981. Quadrennial symposia have followed at different venues, the last one was the 9th Symposium in Uppsala, Sweeden.

Apart from scientists, the participants to WG9 Symposia generally come from policy making authorities, funding bodies, the industry and welfare organizations. Hence, these symposia provide excellent opportunities to receive and discuss reports on the latest poultry behaviour, welfare and management research and practice, and for important informal exchanges of information as well as local professional poultry tours.

Past symposia have been characterised by high quality scientific invited and submitted papers and posters.

I am pleased to thank the scientific committee for the excellent program and several members of WG9 for their hard work in rigorous review of the presented abstracts to ensure that this Xth Symposium in Ploufragan was no exception.

The number and standard of contributions was very high once more, making this event truly worthwhile!

TABLE OF CONTENTS

SESSION 1: Broiler breeders welfare and effect of early age experience on welfare

Main lecture

Learning from the experts: innovation within practice-led collaborative networks in the laying hen sector
D.C.J. Main, C.A. Weeks, H.J. Buller, L.K. MacAllister and L. van Dijk 1

Oral

Stereotypic behaviour in broiler breeders affected by alternative feeding strategies
A Arrazola, E. Mosco, T. Widowski, M. Guerin and A.S. Torrey 9

The effect of perch lenght on perching, fertility, and health in broiler breeders
S. G. Gebhardt-Henrich and M. J. Toscano 10

The transgenerational effects of reduced balanced protein diet on the stress susceptibility of broiler breeders
C. Li, J. Lesuisse, S. Schallier, N. Everaert and J. Buyse 11

Maternal behaviour and changes of levels of neuropeptides in the brain of the broody domestic hen
Y. Aleksandrova, J. Stirling, I. C. Dunn and S. L. Meddle 12

Effect of aviary rearing on welfare of hens in large furnished cages
T. M. Widowski, T. M. Casey-Trott, M. Hunniford, L. Cooley and L. C. Caston 14

Access to litter during rearing and environmental enrichment during production reduce fearfulness in adult laying hens
M. Brantsæter, F. M. Tahamtani, J. Nordgreen, E. Sandberg, T. B. Hansen, T. B. Rodenburg, R. Oppermann Moe and A. M. Janczak 15

Posters

Fear related behavioural differences at an early age affect growth and later stress responses of commercial turkeys
A.Güney and S. Özkan 17

Chick quality: from reproductive flock to slaughterhouse
J. Puterflam, M. Guinebretiere, N. Rousset, R. Thomas, H. Bergoug, P. Galliot, V. Michel, R. Souillard and S. Lebouquin 18

C.A.S.H method for improvement in welfare of broilers during brooding period
A. Ghibaudo and J. Marguerie 19

Susceptibility to pre-natal stress in different strains of layers: effects on early body weight and growth rate
M. R. L. V. Peixoto, A. E. M. Newman, N. A. Karrow and T. M. Widowski 20

Qualitative and quantitative behavioural responses in reaction to various odours in new hatched chicks
V. Noiro and J.F. Gabarrou 21

The effect of climate conditions on performance and foot pad lesions in broiler chickens from broiler breeders of two different ages
I. Kempen, K. De Baere, S. Cardinaels, N. Sleeckx and J. Zoons 22

Nesting behaviour of broiler breeders
A.C.M. van den Oever, T.B. Rodenburg, J.E. Bolhuis, L.J.F. van de Ven and B. Kemp 23

SESSION 2: Cognition: another way to investigate welfare?

Main Lecture

Harnessing the best of Europe to understand and solve Keel Bone Damage: An ongoing EU-COST Action
Brinch-Riber, A., Sandilands, V., and M.J. Toscano 27

Oral

Cognitive abilities and adaptation to changes: another way to investigate welfare
V. Guesdon, F. Lormant, B. Peuteman, C. Leterrier and L. Calandreau 35

The speed and success of associative learning in hens depend on genotype and housing system
P. Železnikar and M. Zupan 36

Five shades of grey: cognitive bias in poultry
L. Kostal, M. Horvath, and K. Pichova 37

SESSION 3 (1st part) - Feather pecking origins and prevention

Main Lecture

The GroupHouseNet COST Action: exploiting European synergy to reduce feather pecking in laying hens
T.B. Rodenburg, J. Berk, I. Dimitrov, J. Edgar, J.A.J. van der Eijk, I. Estevez, V. Ferrante, E.N. de Haas, L. Kostal, L. Liaubet, V. Michel, J. Nordgreen, S. Ozkan, D. Piette, K. Pichova, A.B. Riber, E. Sossidou, M. Toscano, A. Valros, M. Zupan and A.M. Janczak 41

Oral

Genetic and phenotypic correlations of explorative behaviour and open-field activity in layer chicks with severe feather pecking as adults
W. Bessei, V. Lutz, J.B. Kjaer, M.Grashorn, and J. Bennewitz 48

Effects of omitting beak-trimming on plumage, skin and keel bone conditions in barn layers
A.B. Riber and L.K. Hinrichsen 49

Selection of beak shape to reduce the damage of feather pecking in layers
D. Cavero, W. Icken, M. Schmutz, and R. Preisinger 50

Effects of litter provision during early rearing and environmental enrichment during the production phase on feather pecking and feather damage in laying hens
F. M. Tahamtani, M. Brantsæter, J. Nordgreen, E. Sandberg, T.B. Hansen, A. Nødtvedt, T.B. Rodenburg, R.O. Moe, and A.M. Janczak 51

The effect of lighted incubation on fear responses in layer chicks at early ages and feather pecking in pullets
M. Dayıoglu and S. Özkan 52

Relationship between light quality, environmental enrichment and injurious pecking in turkeys
J. Berk, E. Stehle and T. Bartels 53

SESSION 3 (2nd part) - Feather pecking origins and prevention

Oral

Effects of divergent selection for natural antibodies on fearfulness and feather damage of laying hens
Hieu Nguyen Ba, Kikianne C. Kroeske, Tom V.L. Berghof, and T. Bas Rodenburg 57

Investigating the effect of feather consumption on artificial feather presentation in ISA Brown hens
K. M. Prescilla, G.M. Cronin, S.Y., Liu, K.M. Hartcher and M. Singh 58

Skin microbiota and its relationship to the feather-pecking status of laying hens: A pilot study
Alannah Mackay, G.M. Cronin, M. Singh, P.J. Groves and D. Phalen 59

Posters

Behavioural and physiological characterisation of laying hen lines divergently selected on feather pecking.
J. A. J. van der Eijk, A. Lammers and T. B. Rodenburg 60

Effect of polyunsaturated fatty acids n-3 provided during embryonic development and starting and growing periods on pecking behaviour of Muscovy ducks
E. Baéza, P. Chartrin, T. Bordeau, M. Lessire, J.M. Thoby, V. Gigaud, M. Blanchet, A. Alinier and C. Leterrier 61

SESSION 4 (1st part) - Free papers

Oral

Broiler health, welfare, antimicrobial consumption and gut microbiota diversity in sheds authorised for increased stocking density
G. Di Martino, A. Garbo, F. Gobbo, M.L. Moronato, M. Boscarato, L. Bano, L. Zandonà, R. Brunetta, A. Stefani, C. Caucci and L. Bonfanti 65

The effect of an integrated approach of predatory mites, local acaricides and plant based supplements on poultry red mites
N.Sleeckx, I. Kempen, and J.Zoons 66

SESSION 4 (2nd part) – Free papers

Oral

Evaluation of custom LED lighting system on performance, health and welfare parameters in commercial broiler flocks
J. E. Martin and M. Mitchell 68

Broiler chicken stocking density affects use of environmental enrichment objects
I.C. de Jong and M. Goërtz 69

The effect of perches and elevated platforms in commercial broiler farms on broiler leg health
E. Kaukonen, M. Norring, and A. Valros 70

Posters

World Veterinary Education in Production Animal Health - W.V.E.P.A.H. poultry programs
P. Cadot 71

SESSION 5 New methods of on farm killing and of slaughter

Oral

Anatomical pathology and behavioural reflex responses induced by nonpenetrating captive bolt devices for on-farm euthanasia of layer chickens
R.M.A.S. Bandara, S. Torrey, L. J. Caston, K. Schwean-Lardner and T. M. Widowski 75

Under pressure: determining optimum air pressure for humane euthanasia of mature broiler breeders with an air-powered non-penetrating captive bolt device
L. Serpa, T.M. Widowski, K. Schwean-Lardner and S. Torrey 77

Assessing physical methods for on-farm euthanasia of compromised turkeys
C. R. Woolcott, S. Torrey, P. V. Turner, K. Schwean-Lardner and T. M. Widowski 78

Design and development of an industrial equipment farm slaughter of animals with controlled atmosphere considering the OIE's Standards
R. Becerra, and V. Garcia 79

Posters

Electrical stunning of poultry: impact of electrical parameters stunning efficiency and meat quality
M. Bourin, E. Baeza, C. Souchet, A. Mika and L. Bignon 80

Improving poultry handling at slaughter – using an OER online teaching material to meet the requirement for operator training and examination
C. Berg, L. Nordensten, M. Lingaas and J. Lindsjö 81

SESSION 6 Welfare at depopulation and during transport

Oral

Implementing a solution for watering and feeding poultry during long-lasting transport.
J. Marguerie and A.Schmitt 85

A new method of stunning poultry: evaluation of physiological and behavioural responses to Low Atmospheric Pressure Stunning (LAPS) in broilers.
J. E. Martin, K.Christensen, Y. Vizzier-Thaxton, M. Mitchell and D. E. F. McKeegan 86

An improved method of depopulating end-of-lay hens from furnished cages
H. A. Elson and C. A. Weeks 88

Relationship between a fitness-for-transport assessment of broilers before transportation and stress physiology
L. Jacobs, E. Delezie, L. Duchateau, K. Goethals, D. Vermeulen, J. Buyse, and F.A.M. Tuyttens 89

Posters

Welfare of end-of-lay hens during catching and transport in the winter period
T. G. C. M. van Niekerk, H. Gunnink and B. F. J. Reuvekamp 91

Necropsy findings in Dead on Arrival broilers from normal- and high-mortality transports
K.E.Kittelsen, R.O.Moe, K. Hoel, O. Nafstad and E.G.Granquist 92

Pre-slaughter thermal stress in broiler chickens and related risk factors
L. Jacobs, E. Delezie, L. Duchateau, K. Goethals, and F.A.M. Tuyttens 93

SESSION 7 - New contributions of PLF for behavioural assessment

Oral

Using tri-axial accelerometers to determine hazardous pathways for laying hens in aviaries
N. Mackie, A. Stratmann, M.J. Toscano and J.F. Tarlton 97

Activity and occupation patterns analysis as broilers' welfare indicator
A. Peña Fernández, E, Tullo, T. Norton, A. Youssef, E. Vranken, M. Guarino, and D. Berckmans 98

Longitudinal observations of individual hens access to an outside area indicates highly consistent patterns of use
S. Vögeli, S. Gebhardt-Henrich, A. Stratmann, B. Völkl, and M. Toscano 99

Monitoring laying hens' range use with hen-mounted light sensors
S. Buijs, C.J. Nicol, F. Booth, G. Richards and J.F. Tarlton 100

Automatic ultra-wideband sensor detection shows selection on feather pecking increases activity in laying hens
Elske N. de Haas, Jerine A.J. van der Eijk, and T. Bas Rodenburg 101

Monitoring individual chickens' positions in a free-range area using Ultra-Wideband technology
L.M. Stadig, B. Ampe, J. Criel, J. Maselyne, T.B. Rodenburg, B. Reubens, and F.A.M. Tuyttens 102

The fractal organisation of ultradian rhythms in poultry behavior
D.A.Guzmán, A.G. Flesia, M.A. Aon, S. Pellegrini, R.H. Marin, and J.M. Kembro 104

SESSION 8 - On field Welfare Monitoring

Oral

An app assessing broiler welfare through animal-based measures
L. Michel, J. Thieffry, G. Midy, D. Pasquier, C. Guillon-Kroon, I. Ajuda and A. Legrand 108

Epidemiological study about feather pecking in laying hens housed in free-range and furnished cage farms in France
J. Coton, M. Guinebretière, V. Guesdon, G. Chiron, C. Mindus, A. Laravoire, G. Dennery, M. Descombes, L. Balaine, M. Descamps, L. Bignon, A. Huneau-Salaün and V. Michel 109

A comparison of on-farm duck welfare assessment methods
M. Makagon, E. Abdelfattah and G. Vezzoli 110

On-farm health and welfare risk factors for pre-slaughter mortality and condemnations in commercial male turkey (*Melagris gallopavo*) flocks.
J. Marchewka, I. Estevez, G. Vezzoli and M. M. Makagon 111

Surveillance of laying hen welfare in multi-tier loose-housing systems with non-debeaked birds
A. Jeremiasson and C. Berg 113

Posters

Validation of the EBENE method's measures for indoor broiler
A. Mika, L. Bignon, V. Bonnaud, C. Mindus, C. Picchiottino, C. Souchet, L. Warin, V. Guesdon and I. Bouvarel 114

Characterisation of activity budgets of turkeys during commercial production: Effects of flock age?
J. E. Martin, M. Farish and M. Mitchell 115

Foot pad dermatitis is infrequent in Finnish broilers
L. Pohjola, P. Perko-Mäkelä and H. Nauholz 116

A shared and practical tool for welfare assessment in poultry and rabbits: EBENE
L. Bignon, A. Mika, C. Mindus, J. Litt, C. Souchet, V. Bonnaud, C. Picchiottino, L. Warin, G. Dennery, C. Brame, V. Guesdon and I. Bouvarel 117

Reflections on Monitoring Five Years of Welfare Outcome Assessment Data for Laying Hens in a UK Farm Assurance Scheme
Elwes, S. & M. Fernyhough 118

The transect method for on-farm broiler assessment: estimating detectability and double counting
N. Ben Sassi, X. Avéros, and I. Estevez 119

Does equipment for automated behavioural monitoring change hen behaviour?
S. Buijs, C.J. Nicol, F. Booth, G. Richards and J.F. Tarlton 120

Validation of the EBENE method's measures for laying hens housed in cages
C. Mindus, L. Bignon, A. Mika, V. Bonnaud, C. Levrault, V. Guesdon and I. Bouvarel 121

SESSION 9 - Poultry production sustainability and consumer perception

Main Lecture

Animal Welfare and Antibiotic Use in Poultry - The Public Perception an How to Respond
T. Blaha 125

Health and Welfare in organic egg production
M. Bestman 130

Oral

Is the dual-purpose chicken an alternative? Consumers' perception in Germany
N. Brümmer, I. Christoph-Schulz and A.-K. Rovers 137

Improve "feedback to the farmer" for animal welfare reasons in poultry slaughterhouses
C. Facon and C. Chimenti 138

Developing higher welfare broiler production in France: a case study from a French cooperative
A. Legrand, I. Ajuda, J. Locqueville and E. Pencalet 139

Network approach to stimulate and support practice-led on-farm innovations in the laying hen sector
Thea van Niekerk, Paula Baker, Monique Mul, Marleen Plomp, J. Stokes, D. Temple, A. Wichman and J. Zak 140

SESSION 10 Posters

Elevated pre-natal corticosterone concentration disrupts bone development in Japanese quail
G.K. Longmoor, B. Brown, K.A. Spencer, C. Farquharson and S.L. Meddle 142

The effect of olive leaves and marigold extract on bone characteristics in broilers
D. Jordan, S. Žgur, J. Leskovec, A. Levart, J. Salobir and V. Rezar 143

Poultry red mite (*Dermanyssus gallinae)* infestation in layers: increasing impact on welfare and effect of a new fluralaner systemic mite treatment on welfare-indicating production parameters
A. Flochlay Sigognault and E. Thomas 144

Prolonged thymol dietary supplementation does not affect liver histomorphology of laying quail
M. E. Fernandez, M. C. Labaque, R. H. Marin, J. M. Kembro and M. L. Ballesteros 145

Biological control of the chicken red mite in layer farms in Europe: state of the art and perspectives
X Morel and T. Groot 147

Testing a dietary acute tryptophan depletion mixture in feather pecking birds
P. Birkl, J. B. Kjaer, W. Szkotnicki, P. Forsythe and A. Harlander-Matauschek 148

Essential oils do they have positive impact on broiler welfare?
R. Becerra and B. Zapata 149

Evaluation of sedative plants to limit nervousness in force-fed duck production
T. Mauvisseau 150

Lameness related to Femoral Head Necrosis in broilers: study of bone micro-architecture and histology and test of feed additives
S. Klein, E. Mansuy, N. Quilléré and S. Lagadec-Pelle 151

Impact of an algae extract on liver function and laying performance of breeding turkeys
F. Bussy, M. Le Goff1 and B. Quero 152

Effects of chronic heat stress on cellular immunity in Japanese quail
E. A. Videla, F.N. Nazar, J.M. Kembro and R.H. Marín 153

Wooden breast myopathy affects gait score in broilers
Marianna Norring, Anna Valros, Jarmo Valaja, Hanna-Kaisa Sihvo, K. Immonen and E. Puolanne 154

Can observation of leg or foot pathology serve as a surrogate measure of leg weakness assessment in meat chickens?
P.J. Groves, R.L. Hopcroft, and W.I. Muir 155

SESSION 11 – Posters

What do hens want: Testing nest surface preference and determining the effect of enclosure on settled nesting behaviour
M. E. Hunniford, G. J. Mason and T. M. Widowski 159

Laying eggs for 80 weeks – effects on feather cover, keel bone condition and production performance
H. Wall, M. Boyner, D. de Koning and R. Tauson 160

Internal roosting location influences use of the outdoor range by free-range hens
I. C. Pettersson, C. A. Weeks, and C. J. Nicol 161

Restraining laying hens for radiographic diagnostics of keel bones
J. Širovnik and M. J. Toscano 162

Effect of litter depths on general and dustbathing behaviour in laying hens
R. A. van Emous, N. W. M. Ogink and H. Gunnink 163

Nighttime preference for roosting height and substrate type among four strains of laying hens in an aviary system
B. A. Ali, D. L. M. Campbell, D. M. Karcher and J.M. Siegford 164

Variation of beak length in two layer strain pullets
P.E. Baker, C.J. Nicol and C.A. Weeks 165

Nest substrate preferences of laying hens in a cage-free system
M. Erasmus 166

Adding value to end of lay hens: improving welfare, sustainability and credibility
C. A. Weeks, H. A. Elson, J. Jozefová, F. Neijenhuis, J. Yngvesson, and E. Voslarova 167

The effect of handling on peripheral temperature in laying hens
K. Pichova, B. Bilcik and L. Kostal 168

Footpad dermatitis does not affect environmental usage in laying hens
A. Elias, C. Martin, B. Tobalske and A. Harlander 170

The effects of nest box floor type and curtain length in enriched cages on hens' choice of laying location and egg quality
S.L.Lambton, F. Daw, F. Monte and C.J. Nicol 171

Effects of keel bone fractures on individual productivity of laying hens
C. Rufener, S. Baur, A. Stratmann, H. Würbel, U. Geissbühler,
and M. Toscano 172

SESSION 12 - Posters

Footpad dermatitis in broiler breeders in Finland
E. Kaukonen, M. Norring, and A. Valros 174

Peat, wood shavings or ground straw – which is the best bedding material for broilers?
E. Kaukonen, M. Norring, and A. Valros 175

The relationship between fear of humans and leg health in Norwegian broiler chicken flocks
G. Vasdal, R.O. Moe, I.C de Jong and E.G. Granquist 176

Commercially reared chicks use ramps to access elevated structures during first week of life, a preliminary study
K. Norman, C. Weeks and C. Nicol 177

Effect of essential oils on broiler chickens welfare during loading
R. Becerra and B. Zapata 178

The impact of ultraviolet wavelengths on broiler chicken welfare indicators
C. James, L.G. Asher, and J. Wiseman 179

A meta-analytical approach to broiler performance and welfare
X. Averós, N. Ben Sassi and I. Estevez 180

The effect of cellulose arbocel on pododermatitis in broiler chickens
M. Lichovníková, A. Musilová and D. Hampel 181

The effect of dark brooders on fearfulness and free-range use of slow-growing broiler chickens
L.M. Stadig, T.B. Rodenburg, B. Ampe, B. Reubens,
and F.A.M. Tuyttens 182

The use of perches and platforms by broiler chickens
M. Norring, E. Kaukonen and A. Valros 183

Advantages and perceived disadvantages of combining free-range chickens with production of short rotation coppice
L.M. Stadig, T.B. Rodenburg, B. Ampe, B. Reubens, B. Duquenne,
J. Aerts and F.A.M. Tuyttens 184

The effects of reduced balanced protein diet on litter moisture, pododermatitis and feather condition of broiler breeders over three generations
C. Li, J. Lesuisse, S. Schallier, N. Everaert and J. Buyse 185

Session 1

Broiler breeders welfare
and
effect of early age experience on welfare

Learning from the experts: innovation within practice-led collaborative networks in the laying hen sector

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Abbreviated Title: Practice-led Innovation

Summary

For many years, the assumption in animal health and welfare policy has been that scientists working in institutions are best placed to provide the technical solutions to our policy challenges. However, there is a growing interest in agricultural innovation generated through practice-led collaborative learning processes, which involve but are not led by scientists.
Using the egg-laying hen sector as a case study, the EU-funded Hennovation project has been testing mechanisms to facilitate practice-led innovation in sustainable animal welfare through development of 'innovation networks'. 19 innovation networks, involving producers and laying-hen processors, have been mobilised in UK, Sweden, Netherlands, Spain and Czech Republic. These are supported by a variety of actors involved in food chain including animal welfare scientists, veterinary surgeons and technical experts. The networks have tackled a range of technical challenges including feather loss, red mites and handling end-of-lay hens. The innovation process has been developed and tested through action research led by a team of trained facilitators.

The project has established the key steps necessary for local innovation including mobilizing a network, identifying a problem, generating potential innovative ideas, selecting an idea to focus upon, planning and resource mobilisation, trialing the innovation, implementing/upscaling and finally dissemination/embedding. In addition to these process steps, the project has identified some important conditions necessary for supporting innovation within practice-led networks. These include involving the right people in the network, identifying common goals, focusing on areas that can change, providing sufficient resources, learning by doing, using knowledge from within and outside the network and crucially, expert facilitation.

In focussing on collaborative approaches to innovation, this project contributes to the integration of science and practice leading to solutions designed to deliver lasting change in animal welfare practices.

Keywords: Practice-led, Innovation, Collaborative learning, Innovation networks, Facilitation, Animal welfare, Laying hen

Introduction

There is a growing policy interest in on-farm agricultural innovation generated through practice-led collaborative learning processes. There has been an evolution in the interaction between scientists and farming community. As summarized in Table 1 and described in more detail by Schutt et al. 2014, there has been a move from the Transfer of Technology (TT), towards a farming systems approaches (FS), then Agricultural Knowledge and Information Systems (AKIS) and more recently Agricultural Innovations Systems (AIS). There has been a shift in the direction of knowledge exchange i.e. shifting from top-down towards bottom-up and joint learning amongst scientists and the farming community. Within the UK, previous animal health and welfare initiatives have adopted these approaches. For example a lameness control plan based on HACCP principles aimed to provide farm-specific advice to farmers based on the latest scientific research (Bell et al. 2009). A more consultative approach was adopted in both the AssureWel (Main et al, 2012b) and Healthy Feet Projects (Main et al. 2012a). The latter approach also aimed to utilise social marketing principles to maximise the engagement of the farming community. A participatory bottom-up approach was promoted within the Stable School methodology (Ivemeyer, et al, 2015). This approach is currently being applied on UK farms to address the need to reduce antimicrobial use on dairy farms. More recently the Hennovation project reported here has aimed to encourage networks of farmers, scientists and other stakeholders to develop and test their own innovations. The EU H2020 funded project is a multi-actor approach to innovation that includes a high level of farmer engagement. The interest in practice-led innovation stems from the realisation that, despite large investment, there remains a significant gap between scientific research and the adoption of applied science into farm practice (SCAR, 2013). Practice-led innovation responds to the demand for innovation in practice to solve problems using practical knowledge and creativity at the local farm level.

Table 1.

Overview of the four approaches to agricultural innovation (based on Schut et al., 2014).

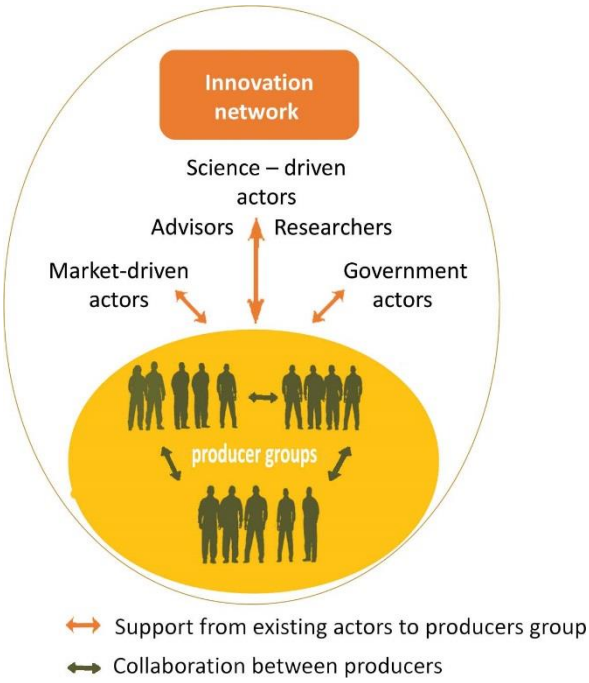
Approach	**Transfer of technology (TT)**	**Farming systems (FS)**	**Agricultural knowledge and information systems (AKIS)**	**Agricultural innovation systems (AIS)**
Originally proposed	1950s–1980s	1980s–1990s	1990s–2000s	2000s–onwards
Key-objectives	Transfer, diffusion and adoption of technology	Contextualise agricultural research and technology	Build local capacities, empower farmers	Enhance systems capacity to generate and respond to change
Flow of innovation	Top-down	Top-down	Bottom-up	Multi-directional
Key intervention approach	Technology dissemination through extension Use mass media to facilitate adoption	Farmer consultation to inform research Surveys to develop farm typologies, modelling of innovation impact	Conduct participatory research Implement joint learning activities	Establish and implement multi-actor innovation platforms
Role of farmers	Adopters of technologies	Adopters of knowledge and technologies	Experimenters Experts	Partners Entrepreneurs

		Source of information		Part of innovation network
Role of research and researchers	Developers of knowledge and technologies	Experts	Capacity builders Facilitators of learning	Actors to enhance innovation capacity in the system Members innovation network
Example of UK animal health & welfare initiatives	Heifer Lameness Control Plans (Bell et al., 2009)	AssureWel, (Main et al., 2012), Healthy Feet Project	Stable Schools (Ivemeyer, et al, 2015)	Hennovation Thematic network (reported here)

Hennovation: Innovation in the laying hen industry

While there is a considerable body of work on how local innovation is generated and facilitated in the field of natural resource management, far less has been done in the area of farm animal welfare. Using the egg-laying hen sector as a case study, the EU-funded Hennovation project is exploring and testing mechanisms to stimulate and facilitate practice-led innovation in sustainable animal welfare through development of 'innovation networks'. In short, the project's mission was to facilitate and promote practice-led innovation, instigate innovation networks, develop the skills of participants and facilitate the interaction and learning of individuals within the network. Innovation networks involving producers and laying-hen processors were mobilized at local, national and European levels. These were supported by a variety of actors such as veterinary surgeons, researchers and industry and moderated by external facilitators, see figure 1.

Figure 1 Schematic overview of the Hennovation innovation networks



As part of the Hennovation project 18 innovation networks were established in the United Kingdom, The Netherlands, Sweden, Czech Republic and Spain. Network size varied from five to eight producers with a variety of support actors e.g. veterinarian, feed company, scientist, and pullet rearer, based on the specific topic addressed by the network. The laying-hen production system varied between groups, e.g. organic, free range and more conventional cage systems. Most networks are formed from larger pre-existing groups connected to a specific egg packing company or veterinary practices. One of the networks included producers of several production systems. The networks explored a variety of topics based on their need and ideas such as: the effect of light on feather peaking, nutrition to prevent feather peaking, management of red mites, hen predation and new ideas for marketing meat from laying hens. Several networks in different countries identified a similar topic to work on which provided opportunities for trans-national collaboration.

Reflection on network mobilization and facilitation by the facilitators after an initial three months implementation, revealed that the use of such intermediates, such as production companies and veterinary surgeons were pivotal in enabling network mobilisation. It was also noticed that there is a great diversity within as well as between countries on what motivates producers to participate in a network. In some countries for example mentioning the upcoming EU ban on beak trimming in laying-hens was a motivational factor whilst in other countries it was too controversial to

mention this. During the initial reflection, discussion also revolved around the challenge of overcoming a culture of receiving rather than collectively creating or producing knowledge. Thus some producers we expecting or were more motivated to learn from "experts".

Facilitating networks

The role of network facilitator in the project was to mobilize the networks, guide the network through the innovation process, promote social learning and encourage engagement with support actors. The facilitators stimulate the co-creation of knowledge (Wielinga and Vrolijk, 2009) which is different from more traditional advisory roles of knowledge dissemination. Practice-led innovation processes evolve as the actors within the network come together to share common problems, experiment with possible solutions and learn. A framework for the facilitation and management of practice-led collaborative innovation processes was developed by ten facilitators from five different countries in Europe (the United Kingdom, The Netherlands, Sweden, The Czech Republic and Spain) during the first workshop for network facilitators in September 2015. A framework was developed to guide the facilitation of the innovation process and to stimulate learning by facilitators on how to manage this process. The challenge in the development of the framework was that on the one hand it needed to provide enough structure to be useful for the facilitator, whilst on the other hand the framework needed to be generic and flexible enough to accommodate the diversity and unpredictability of the process. The framework was built on the experience of the facilitators and they identified six key process steps:

1. Problem identification,
2. Generation of ideas,
3. Action planning and resource mobilization,
4. Practical trialing and development,
5. Implementation and upscaling on-farm and
6. Wider dissemination of the innovation.

During the workshop the facilitators also identified key activities for each step which helped facilitators to guide the group and reflect on the progress in each step of the process. In addition to these process steps, the project has identified some important conditions necessary for supporting innovation within practice-led networks. These include involving the right people in the network, identifying common goals, focusing on areas that can change, providing sufficient resources, learning by doing, using knowledge from within and outside the network and crucially, expert facilitation.

Conclusion

Overall there was a large diversity in capacity and functioning of the innovation networks, both within as between countries. This provides a great opportunity as well as a great challenge for the facilitators learning to manage the innovation process. The framework developed was useful for ensuring facilitators provided the

appropriate support to the innovation process whilst promoting joint learning. In focusing on collaborative approaches to innovation, this project contributes to the integration of science and practice leading to solutions designed to deliver lasting change in animal welfare practices.

Acknowledgements

The paper draws upon research and discussions conducted under the HENNOVATION project, a H2020 EU collaborative research project with 6 academic partners funded under the topic 'Innovative, Sustainable and Inclusive Bioeconomy' ISIB-2-2014/2015: Closing the research and innovation divide: the crucial role of innovation support services and knowledge exchange. Grant agreement no 652638.

The authors wish to thank the many people involved in that project who collaborated in that research and contributed to the material of this paper including the network facilitators, Paula Baker, Monique Mul, Francesca Neijenhuis, Marleen Plomp, Anette Wichman, Jenny Yngvesson, Deborah Temple, Jiří Žák and Jessica Stokes.

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Stereotypic behaviour in broiler breeders affected by alternative feeding strategies

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Abbreviated Title Stereotypic behaviour in broiler breeders

Summary
Since broiler breeders and broilers share the same genetic potential for fast growth, breeders are feed restricted to reduce obesity-related problems. Feed restriction limits weight gain but leads to chronic hunger, frustration and lack of satiety that results in stereotypic behaviour including redirected oral behaviours. The objective of this research was to examine the effect of a rationed alternative diet and non-daily feeding programs for broiler breeders during rearing on stereotypic behaviours. At week 3, 1680 Ross 308 pullets were allocated into 24 pens fed until week 22 with one of four isocaloric treatments: 1) daily control; 2) daily alternative; 3) 4/3 control (4 on-feed days, 3 non-consecutive off-feed days); and 4) graduated control. Graduated treatment was 5/2 from weeks 3-4, 4/3 from weeks 5-11, 5/2 from weeks 12-18, and daily from weeks 19-22. The alternative diet had an inclusion of 40% soybean hulls and 1-5% calcium propionate, increasing with age. Ten birds/pen, 5 on on-feed days and 5 on off-feed days, were focally and continuously observed for 10 minutes at week 7, 14, and 18, starting 30 minutes after feed delivery. Data were analyzed with a glimmix procedure with week as repeated measure. Daily treatments (1&2) performed 0.82±0.07 and 0.67±0.07 more bouts of drinker and feeder pecking, respectively, than non-daily treatments (3&4) ($P<0.05$). The frequency of stereotypic preening was higher for non-daily treatments, 0.50±0.03 bouts, compared to daily treatments, 0.28±0.03 bouts ($P<0.01$), and both non-daily treatments performed 0.71±0.08 more bouts on off-feed days than on on-feed days ($P<0.001$). Overall, non-daily treatments had less bouts of stereotypic behaviour than daily feeding treatments, although non-daily treatments performed more feeding frustration behaviours on off-feed days. This study suggests that welfare of non-daily fed breeders is equivalent or better than daily-fed breeders, although there are still concerns about feeding frustration on off-feed days.

Key words: Broiler breeders, alternative feeding strategies, behaviour, welfare, nutrition.

The effect of perch length on perching, fertility and health in broiler breeders

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Abbreviated Title: Perches and broiler breeders

Summary

The objectives of the current experiment were to test whether broiler breeders use perches and how perches influence health and production. The study was conducted with 2620 Ross 308 breeders in 2 houses with 10 pens per house. Two control pens in each house included nestboxes, raised slats, litter area, two feed troughs, male feeders, and one drinking line. The other 16 pens included perches above the slats of varying lengths (5, 10, 14, or 20 cm). A cross-over design was employed with each pen encountering each perch length for four periods of 4 weeks each. Body weight and production traits were assessed throughout the study's end at 55 weeks of age; health parameters were assessed at 46 weeks of age. Data were analyzed using mixed linear models with pen nested in barn as the subject. Perching depended on age and perch length (length: $F_{3,141}$ = 15.8, P<0.0001, age: $F_{1,141}$ = 25.58, P<0.0001, interaction: $F_{3,141}$ = 5.3, P=0.002). More birds perched at night when 14 cm instead of 10 cm were available (t_{141} = -3.58, P=0.0005) but not less than with 20 cm (t_{141} = -0.06, P=0.95). During a heat wave, mortality was greater in pens without than with perches (χ^2_1 = 17.6, P<0.0001). Lighter hens with perches had less pododermatitis than hens in control pens (perches: $F_{1,18}$ = 4.54, P=0.047, body weight: $F_{1,177}$ = 10,15, P=0.002, interaction: $F_{1,177}$ = 4.83, P=0.03) and better plumage (perches: $F_{2,17}$ = 6.13, P=0.01, body mass: $F_{1,175}$ = 3.88, P=0.05, interaction: $F_{2,175}$ = 5.78, P=0.0037). This study shows that broiler breeders require similar perch lengths as laying hens and perches did not affect production negatively.

Key words: Broiler breeder, perch, aviary, production, health, behaviour.

The transgenerational effects of reduced balanced protein diet on the stress susceptibility of broiler breeders

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Abbreviated Title: Reduced protein diet can change the stress susceptibility of broiler breeders over generations

Summary

Transgenerational effects of maternal stress-induced behavioural alterations on stress reactivity has been reported in rats. It is hypothesized that the psychological stress of broiler breeders induced by their controlled feed intake (*in casu* reduced protein diet) may influence the stress response of their offspring. Two successive generations of breeders were established. There were two treatments for F0 generation: control (C) group fed with standard diet (SD) and reduced balanced diet (RP) group fed with RP diet. The F0-progeny of each treatment was divided into the two diet treatments again, resulting in four treatments for F1 generation: C/C, C/RP, RP/C and RP/RP (breeder feed in F0/F1 generation). To maintain the similar target body weight, the RP diet fed groups received 10% more feed than SD fed groups. An acknowledged test for stress susceptibility is the response of plasma corticosterone (CORT) levels upon an adrenocorticotrophic hormone (ACTH) challenge. At week 42, 16 birds were randomly chosen to obtain blood for each group of F1 generation before and at 30, 45, 90min after a single intravenous ACTH (1IU/Kg of body weight) or saline injection as control. There were no significant differences in the basal CORT levels between the four groups. The C/RP group had significantly lower plasma CORT levels compared to the C/C and RP/RP groups from 0 to 45min; however, the increase in plasma CORT level after ACTH injection from 0 to 30min was significantly higher for the RP/C group compared to that of the RP/RP group and remained elevated for a longer time compared to C/RP and RP/RP groups. Overall, the C/RP group had the lowest stress response whereas the C/C and RP/C groups were the most sensitive groups. The differential response upon ACTH suggest transgenerational effects of RP diet treatment on stress susceptibility thereby welfare condition in broiler breeders.

Key words: Broiler breeder, reduced balanced protein diet, stress, transgenerational effect, ACTH, CORT response.

Maternal behaviour and changes of levels of neuropeptides in the brain of the broody domestic hen

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Abbreviated Title: Broody hen neuropeptides

Summary

The neuropeptides oxytocin and vasopressin regulate mammalian social behaviours including maternal care. The quality of maternal care in domestic birds affects progeny welfare through to adulthood. Understanding maternal behaviour and the underlying neural mechanisms may allow us to develop better welfare strategies for commercially housed birds. In chickens and turkeys, central levels of oxytocin's avian orthologue mesotocin are highest in hens rearing chicks and mesotocin antagonists abolish maternal behaviour (1, 2). Vasopressin's avian orthologue vasotocin has not been studied to date in this context. Mesotocin and vasotocin are synthesized in the brain and act in the social behaviour network including the paraventricular nucleus (PVN) and the bed nucleus of the stria terminalis (BnST). We quantified mesotocin and vasotocin mRNA levels in the brain by in situ hybridisation throughout reproduction in Silkie leghorn cross hens. Brains were collected from layers: birds that had been incubating 10 eggs for 3 (onset), or 14 days (incubation) and birds which had incubated chicks to hatch and had been rearing them for 24 hours (rearing) (n=5-8/group). In the medial PVN, rearing birds had higher mesotocin mRNA than layers ($P<0.05$). There was no significant difference for vasotocin mRNA between groups. In the lateral BnST, mesotocin mRNA levels for onset and incubation were equal but significantly lower than layers and rearing birds ($P<0.05$). Layers had higher levels of vasotocin mRNA in the BnSTl compared to other groups ($P<0.05$). These data suggest that changes in the nonapeptide systems may explain the display of incubation and broodiness. Manipulating these systems to induce or abolish maternal behaviour could improve the welfare of chicks as particular birds could be used to rear the chicks while others are kept from becoming broody. Further experiments examining the role of social interactions could be used to test whether the observed differences are due to the specific social context of incubation and maternal care.

Research supported by the BBSRC, World's Poultry Science Association and British Society for Neuroendocrinology.

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Key words: Mesotocin, vasotocin, maternal care, broodiness, behaviour.

Effect of aviary rearing on the welfare of hens in large furnished cages

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Abbreviated Title: Aviary rearing for large furnished cages

Summary

Rearing pullets in aviaries has beneficial effects on the behaviour and welfare of hens, but little is known about the welfare implications of subsequently housing them in furnished cages. The objectives of this study were to compare the effects of rearing in a complex aviary system versus conventional rearing cages on the welfare of hens housed in furnished cages. Four flock replicates of 540 Lohmann Selected Leghorn-Lite pullets were reared in either conventional cages (CONV) or an aviary rearing system (AVI) and placed into either 30-bird (N= 24) or 60-bird furnished cages (N=24) at 16 weeks of age. AVI hens showed reduced fearfulness (decreased latency to approach a novel object) than CONV ($P<0.05$), but fecal corticosterone metabolite levels measured 1-21 days after placement did not differ ($P=0.80$). AVI body weights were lower at 16 and 30 weeks of age ($P<0.05$), but were higher at 50 and 70 ($P<0.05$). Rearing did not affect hen-day egg production ($P=0.152$) or mortality (AVI: 5.2±0.6%; CONV: 4.0±0.7%, $P=0.227$). At 30, 50 and 70 weeks of age, feather scores did not differ; however, measures of foot health [% birds with injured toes, pododermatitis, and hyperkertosis] were all better ($P<0.035$) and the incidence of keel fractures was lower ($P<0.001$) in AVI compared to CONV hens. Quantitative computed tomography analysis of bones excised from end-of-lay hens indicated that AVI hens had significantly greater cross-sectional area and bone mineral content of structural bone in the radius, humerus and tibia compared to CONV. Aviary-reared birds laid more eggs in the scratch area versus the nest ($P<0.0001$), but their pre-laying behaviour was more settled (less walking, $P=0.003$; longer sitting bouts, $P=0.09$) than cage-reared hens. Overall, these results suggest no detrimental effects and several beneficial effects of rearing in a complex environment on the welfare of hens housed in furnished cages.

Key words: Laying hens, aviary rearing, large furnished cages, welfare.

Access to litter during rearing and environmental enrichment during production reduce fearfulness in adult laying hens

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Abbreviated Title: Litter and enrichment affect fearfulness

Summary

Exaggerated fear-reactions are associated with injuries, smothering, feather pecking and other events that compromise laying hen welfare. The aim of this study was to test the hypothesis that chicks with access to litter during the first five weeks of life would be less fearful as adults compared to birds reared without access to litter. The hypothesis was tested in commercial aviary layer flocks in Norway. Five rearing farmers divided the pullets into two groups within their rearing houses. During the first five weeks of life, paper substrate, on which food and other particles could accumulate, covered the wire mesh floor in the treatment group, whereas the control group was reared on bare wire mesh. At 30 weeks of age, 23 flocks (11 control flocks and 12 paper reared flocks) were visited. A stationary person test and a novel object test were conducted to test fearfulness of the adult hens. Provision of environmental enrichment to adult birds and the interaction between paper treatment x rearing farmer, tended to reduce the latency to approach within 2 m of the stationary person ($P=0.08$). The number of birds approaching the novel object was affected by the interaction between access to substrate during rearing and provision of environmental enrichment as adults ($P=0.05$). For birds without environmental enrichment as adults, access to litter during rearing increased the number of birds that approached the novel object compared with birds reared without paper ($P=0.04$). For birds with access to environmental enrichment during production, the rearing had no effect on the number of birds that approached the novel object ($P=0.99$). These results indicated that both adding paper substrate to chicks from the first day

of life and providing them with environmental enrichment as adults, reduced fearfulness, as assessed by a novel object test, in adult laying hens.

Key words: Fearfulness, rearing, litter, environmental enrichment, laying hen, welfare.

Fear related behavioural differences at an early age affect growth and later stress responses of commercial turkeys

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Abbreviated Title: Fear and stress in commercial turkeys

Summary

The study aimed to investigate growth and later stress responses of male turkeys differing in their responses to humans at 7wk, assessed by a voluntary approach (VA) test under commercial conditions. Male turkeys were grouped according to their responses to observer as approached: low fear (LF) or aversive-high fear (HF) at 8 observation-areas/flock. Two flocks of the same company were used. During the VA test, the first 5 to 3 birds/area that approached the observer were marked as LF (n=64) using coloured leg bands. The same numbers of aversive birds were marked as HF and blood was collected from 7 birds/group/flock to measure H/L ratio and corticosterone hormone. Tonic immobility (TI) was tested on 15 birds/group/flock. Birds from two groups were kept in the same pen within the same house. At 17th wk, 7 birds/group/flock were randomly chosen and blood samples were collected before and after 30 minutes crating in transport cages. Body weights were measured at 7 and 17 weeks. The ANOVA model included behaviour group, flock, and interaction effects for BW and TI data, in addition, age effect for corticosterone and H/L. Statistical significance based on $P \leq 0.05$. Slaughter weights of male turkeys significantly differed between fear groups being higher in LF (16.65±0.22 kg) than HF (14.78±0.22 kg). Significantly lower H/L ratios, but higher lymphocyte percentages were observed in LF group ($P \leq 0.05$), associated with the lower stress response. Tonic immobility responses of turkeys and plasma corticosterone levels did not significantly differ between groups. Although it could not be associated with TI responses in this study, the VA test could be used to define individuals less fearful and less susceptible to stress. Higher slaughter weight together with lower H/L ratios measured in the LF group seemed to be promising to improve our understanding of the relations among behaviour, performance and welfare in commercial turkeys.

Key words: Turkey, fearfulness, voluntary approach test, tonic immobility, H/L, corticosterone.

Chick quality: from reproductive flock to slaughterhouse

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Abbreviated Title: Research projects on chick quality

Summary

The robustness of broiler chickens defines their adaptive potential and their ability to endure various stresses while maintaining high zootechnical performances. This is a crucial parameter to optimize in order to ensure their welfare, to limit their mortality and to reduce the use of antibiotics during the breeding phase. Chick quality depends on various factors:

- Egg quality, also linked to :
  - Reproductive flock (age, sanitary status)
  - Egg storage before incubation (duration, environmental conditions)
- Setting and hatching
- Waiting conditions and duration of chicks at hatchery
- Chicks transport to the farm (duration, conditions)
- Starting phase of rearing: arrival at farm, environmental conditions, etc.
- Rearing

Some of these factors are imponderables because linked to producers constraints. In this context, UMT Sanivol (ITAVI-ANSES collaboration) aims to compensate or control these factors. To achieve this, our objectives are:

- To assess - using experimental facilities - several levers to compensate for unfavorable factors, e.g. improve the environmental storage conditions of eggs to compensate for unfavorable age of reproductive flock,
- To highlight - using epidemiological studies - favourable practices for chick quality (e.g. cleaning and disinfection practices before animals arrive in farms or control some environmental parameters).
- Final objective is to optimize hatching performances and chick robustness, zootechnical performance, animal health and welfare all during the rearing phase, assessed by multi-criteria and an innovative approach (behavior, health, physiology…).

Keywords: Chick quality, epidemiology, experiment, antibiotic use, health.

C.A.S.H method for improvement in welfare of broilers during brooding period

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Abbreviated title:

Summary

Brooding period remains a key stage of the life of broilers because it represents one third of the total duration of growing, and it lays the foundation for the continuation of the flock. Réseau Cristal, a group of 250 French veterinary clinics and laboratories, set up a comprehensive approach of starting period, suitable for breeders need, to meet regulatory requirements but especially to guarantee animal welfare during the entire phase of brooding. The audit takes into account field data such as hygiene and comfort measures, access to drinking water and food or light stimulation, and laboratory data such as autopsies and bacteriological analyses, in order to evaluate the management of this crucial period and provide corrective measures if necessary. This standardized approach has been called C.A.S.H. for the systemic control of Comfort, Accessibility, Stimulation, and Hygiene. It comes from the study of more than 80 parameters identified in each brooding of 20 farms of the Pays de Loire region; and the questionnaire has been disseminated for a widened use by vets in 2017.

Key words: Brooding period, animal welfare, farming management.

Susceptibility to pre-natal stress in different strains of layers: effects on early body weight and growth rate

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Abbreviated Title: Pre-natal stress in different strains of layers: effects on weight gain

Summary

Maternal stress influences the development of offspring through direct and epigenetic mechanisms. Our aim was to investigate genetic strain differences in offspring susceptibility to parental stress in laying hens. This was tested in both natural mating systems where parents were stressed and by *in-ovo* injection with corticosterone. Four parent flocks (21F:3M/flock) from each of 6 genetic strains - a pure breeder line of White Leghorn (WL), a pure breeder line of Barred Rock (BR), and two white (W1, W2) and two brown (B1, B2) commercial hybrids - were incubated, hatched and reared identically in litter floor pens with perches. Female and male parent stock were equally separated into two groups: Stress, where hens were subjected to a series of daily acute stressors (e.g. physical restraint) for 7 days prior to egg collection, and Control, where hens received routine husbandry. At 26 weeks of age, fertile eggs from both treatments were collected. Additional eggs from Control groups were injected with either 10 ng CORT/mL of egg content, dissolved in vehicle or vehicle alone prior to setting, which resulted in two *in-ovo* offspring groups: CORT and Vehicle. Eggs were incubated and 14 offspring per experimental group were hatched and brooded under identical conditions. Prenatal acute stressors affected hatch weight in 3 strains but not in the same direction: BR Stress was heavier than Control ($P=0.0005$), whereas WL ($P<0.02$) and B1 ($P<0.0001$) were lighter. No differences in body weight were observed by 7 weeks of age. *In-ovo* manipulation decreased hatchability (32.8%) compared to non-manipulated eggs (81%), and decreased hatch weights in A2 ($P<0.02$), B1 ($P<0.001$) and B2 ($P<0.001$). CORT consistently decreased growth rates in BR ($P=0.02$) and B2 ($P<0.02$), resulting in lower body weight at 7 weeks of age. These results suggest strain-specific interactions between prenatal stressors and offspring mass and growth.

Key words: Chicken, maternal effects, prenatal stress, corticosterone.

Qualitative and quantitative behavioural responses in reaction to various odours in new hatched chicks

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Abbreviated Title: Behavioural responses to various odours

Summary

Behavioural reactions of poultry were measured in newly hatched fasting birds according to the method of Porter *et al* (1999). Briefly, chickens were handled on the back under a lamp. They closed their eyes, as if they were asleep (tonic immobility). After 2s with closed eyes they were exposed to an odorous stimulus using a flexible plastic container filled with 0.5 mL liquid, which was pressed 15 times. Control chicks were used to test reactions to air flow. Twenty chicks were used per set of experiment. A set was made of three exposures for each animal comprising a control (soybean oil) and two odorous stimuli presented in a random order. Their reactions to the exposure to each olfactory stimulus were scored from 0 (no response) to 3 (awake and cries). Score 0 was for the lack of behavioural reaction and was interpreted as an absence of perception or indifference to the odour. Score 1 was for small movements of the beak, interpreted as a positive reaction. Score 2 was rapid head movements after more than 5 pressures and was construed as slightly negative. Score 3 was immediate awake with cries, interpreted as highly negative. Score 2.5 was reaction 3 but with more than 5 pressures. Sixty pure molecules, 14 natural extracts and 21 blends were tested on broiler chicks. There were no significant effects of the chemical family (alcohol, ketone, acid, ester…) on the answer note ($P>0.05$). The number of carbons had a significant effect on the reaction ($P<0.05$) with higher scores for molecules with less than 8 carbons. Concerning associations, no synergistic effect was demonstrated, reactions were additive. From these results, a blend of molecules and natural extracts was selected and a reaction-response curve drawn. The reactions of four species (broiler, pheasant, grey partridge and red partridge) were compared for two molecules (anethole and diacetyl). Anethole elicited very small reactions and it was difficult to discriminate the species. However, diacetyl showed greater reactions from ($P<0.05$) red partridges. These results are the basis of the creation of specific formulations with composition and concentration adapted to poultry to elicit attractiveness and well-being. This work permitted to select molecules that could have a behavioural effect, like attracting chicks.

Key words: Behavioural response, odour, chicks.

The effect of climate conditions on performance and foot pad lesions in broiler chickens from broiler breeders of two different ages

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Abbreviated Title: Climate control in broilers

Summary

Optimal brooding management during the first days is important in achieving a good start in broiler chickens. Climate conditions depend, among other things, on the bodyweight of day-old chickens which is related to the age of the broiler breeders. The temperature experienced by chickens is an interaction between the dry bulb temperature and the humidity. In practice, the relative humidity (RH) in poultry houses is often low or not taken into account. The effect of controlling RH combined with 2 different starting temperatures on chickens from young and old broiler breeders was investigated. The experiment was a 2x2x2 factorial design with two replicates (1575 chickens/pen) conducted during 3 production cycles. The factors were: house temperature (starting at 37°C or 34°C), RH (controlled at 60% during the first week or not) and age of the broiler breeder (<30 weeks of >50 weeks). Body weight, feed conversion and the production efficiency factor (PEF) gave the best results at a lower starting temperature (34°C) with a controlled RH in both chickens from younger and older broiler breeders. Performance was lowest in chickens from older broiler breeders starting at a high temperature and in chickens from younger broiler breeders starting at a low temperature, both without controlled RV. Foot pad lesions, hock burn and mortality were lower when chickens from younger broiler breeders started at a lower temperature (no RV control), while no clear conclusion could be made for chickens from older broiler breeders. This study shows an impact of starting temperature and RH control on broiler performance.

Key words: climate control, relative humidity, house temperature

Nesting behaviour of broiler breeders

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Abbreviated Title: Nesting behaviour of broiler breeders

Summary

Broilers have been selected for growth related characteristics, which are negatively correlated to reproductive traits. This genetic background creates challenges in broiler breeders, as the hens do not make optimal use of the nests provided. This project aims to investigate what factors determine nesting behaviour, i.e. where a broiler breeder hen prefers to lay her eggs. Factors such as genetic background, social interactions, physical characteristics of the nest and climate might interfere with the natural nesting behaviour of the hen. Also fundamental trade-offs between different motivations, such as hunger, comfort and safety, might influence nesting behaviour. Behaviour and use of space will be measured in experimental set-ups in order to gain insight in the importance of different system components. This knowledge will be used to optimise housing conditions and develop strategies that stimulate the hen to lay her egg in the nest. The performance of this improved system will be tested in field experiments to investigate the transferability of results from experimental to field conditions.

Key words: Broiler breeders, nesting behaviour, genetics, nest design, housing, climat

Session 2

Cognition : another way to investigate welfare ?

Harnessing the best of Europe to understand and solve Keel Bone Damage: An ongoing EU-COST Action

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Overview

The KeelBoneDamage COST Action seeks to provide the European laying hen industry with the innovations in breeding, nutrition, and management necessary to resolve the problem of keel bone damage (KBD) in order to meet the high standards of welfare and productivity demanded by the European community. The network was established in 2016 following approval of a competitive application process managed by the European Cooperation in Science and Technology (EU-COST) office. Funded for a four year period, the grant does not provide for research expenses *per se*, but to provide a platform for collaboration on a specific topic, i.e., the causes of KBD and solutions to reduce their severity and frequency. The Action brings various participants with a diverse mix of disciplines together to facilitate novel and trans-disciplinary discussions that will lead to definitive and quantifiable outputs. In addition to pursuing these research objectives, the Action also seeks to strengthen European research capacity by connecting relevant scientific communities and providing networking opportunities for young scientists. Activities are performed in concert with industrial partners whom are leaders in the field ensuring that developments are directed into tangible outputs that improve animal welfare and farm productivity.

Explaining the European Cooperation in Science and Technology

The European Cooperation in Science and Technology (EUCOST) serves to support networks, known as Actions, and expand cooperation among researchers and stakeholders across Europe and associated partner nations, typically over a four-year period. Funding applications are evaluated two times per year on set criteria regarding the scientific benefit to the European community and the scientific field. Actions receive funding on an annual basis to support a variety of activities including: training schools, workshops, scientific exchanges of key personnel for brief experiments and/or specific training, and dissemination of activities. Funding is not provided for research *per se* (e.g., salaries, research consumables) but is intended to promote collaboration between participants in the network, support nationally-funded research, and then communicate the resulting information to the

various stakeholders who are likely to benefit. Potential stakeholders are seen as those who will profit from the information directly (e.g. producers) as well as those whom can use the information to make more objective policy decisions (e.g. government regulators, NGOs), as well as other scientists.
Although the EUCOST office has certain regulations which must be followed once funding is approved, the Action is relatively flexible in how it can use the funds to accomplish its objectives over the stated period. Once funded, the Action is overseen by a Management Committee, with representatives from each participating nation and a Chair and vice-Chair, that meets once per year and ensures the objectives are being met and in line with national interests. In addition to the Management Committee, various Working Groups are formed to coordinated the various activities of the Action.
The KeelBoneDamage COST Action currently has 19 European COST-approved members with additional members hailing from Egypt, Canada, and the United States of America, bringing the total number of participants to approximately 75 individuals. Our membership contains scientists from many disciplines (e.g., behaviour, physiology, genetics) as well as industry (e.g., Vencomatic Group, Hendrix Genetics), national trade organizations (e.g., Danish Egg Association, British Egg Industry Council) and NGOs (e.g. Universities Federation for Animal Welfare, Foundation for Food and Agriculture Research). More information regarding membership and activities can be viewed at our dedicated website (www.keelbonedamage.eu). Interested persons are encouraged to join the Action by contacting the Bern-based administrator (lilian.smith@vetsuisse.unibe.ch).

A brief review of keel bone damage

The extremely high frequency and severity of damage to the keel bone in laying hens housed in commercial systems, particularly those in non-cage systems, represents one of the greatest welfare problems facing the industry as suggested by the UK`s Farm Animal Welfare Committee. The issue has also been cited as a major problem by the EFSA-AHAW panel and a North American-based consortium of welfare researchers. The pain believed to be associated with KBD is a primary concern (Nasr et al., 2012) due to gross anatomical disfigurement, though the likely economic losses resulting from poor shell quality and reduced egg production are also a concern with far-ranging effects on the sustainability of production. Despite the high standards of farm animal welfare in Europe and efforts to improve laying hen quality of life, assessments by a variety of research groups place the percentage of birds with damage at an alarmingly high rate. The number of affected birds within commercial flocks can range between 20 to 96% based on reports from various countries (Belgium (Heerkens et al., 2013); Canada (Petrik et al., 2014); The Netherlands (Rodenburg et al., 2008); Switzerland (Kappeli et al., 2011; Stratmann et al., 2015); and the UK (Wilkins et al., 2011; Tarlton et al., 2013; Toscano et al., 2015)), with the variation likely depending on a host of factors (e.g., age, genetic line, nutrition, housing system).

More critically, the levels of KBD appear to be exacerbated by recent EU legislation (Council Directive 1999/74/EC) which banned the use of conventional battery cages from January 2012. Although conceived with the best of intentions and a bold step to improve hen welfare, the unexpected problem of KBD represents a blight on this effort and requires resolution if European community is to remain as the leading force in animal welfare. While furnished cage or non-cage housing systems provide for numerous enhancements of animal welfare including greater ability to perform natural behaviours (Lay et al., 2011) and the presence of perches (Wilkins et al., 2011; Pickel et al., 2011), the increased capacity for movement and collisions appears to be associated with greater levels of damage (Wilkins et al., 2011; Petrik et al., 2015). As a result of this well-intended legislation, the laying hen industry is now faced with the unexpected challenge of greatly increased KBD leading to reduced animal welfare and farm productivity. The problem of KBD thus poses various ethical and commercial components which require immediate action that can only be resolved by bringing various scientific disciplines together in a complementary manner to address this multi-factorial problem.

Working and Support Groups of the Keel Bone Damage Action

Working Group 1 - Improving Assessment of KBD (Ian Dunn & Ari Stratmann)

The first objective of WG1 (**WG1a**) will serve to coordinate efforts in developing a suite of techniques capable of identifying KBD with a level of accuracy, sensitivity, and detail that meets the needs of the study environment and purpose. Within this objective, researchers will share their ongoing efforts in developing methods that can be performed on-farm (e.g., palpation, portable radiography) as well as more technologically advanced means suited for laboratories that can provide greater qualitative detail (e.g., computed tomography, histology).

A secondary objective (**WG1b**) will seek to harmonize the various assessment efforts developed by researchers. Palpation of live birds is by far the most common method used to assess KBD as it is inexpensive, validated, and can be conducted in live birds on-farm. Unfortunately, palpation is unable to provide data for underlying bone properties (e.g., cell structure, mineral content) or even a valid visual image which is essential to objectively assess the nature and severity of damage. In contrast, computed tomography or histology provide detailed information though are expensive, logistically complicated (vs. palpation), and typically require the hen to be culled preventing longitudinal assessments. Taken together, WG1b will serve to link the low- and high-technology methods so that characteristics easily observed in the former (e.g., fracture size, deviations with sharp bends) can now be associated with the more detailed characteristics of the latter (e.g., damaged cell structure, mineralization).

Working Group 2 – Effects of KBD on Welfare and Productivity (Anja Brinch-Riber & Frank Tuyttens)

The increasing awareness worldwide of the high prevalence of KBD suffered by laying hens has naturally led to concerns of how this pathological condition affects animal welfare. In research, different animal-based welfare indicators, e.g. behaviour, physiology, clinical signs, affective states and productivity, may be used to address this question. Research into the effects of KBD on welfare and productivity is growing, but mainly focused on fractures, whereas deviations remain largely unexplored.
Laying hens with keel bone fractures show marked behavioural differences in highly motivated types of behaviour considered to be indicative of reduced mobility and pain in keel fractured birds.
The focus of **WG2** will serve to bridge multiple efforts seeking to identify criteria for objectively evaluating the severity of KBD and at what threshold concern is warranted. Specifically, the WG will consider efforts that seek to determine and quantify the effects of KBD on particular measures of welfare (e.g., sensation of pain, altered mobility) and productivity (e.g. egg production and quality) at the initial time of fracture until the completion of the healing process**.** Objective 2 will serve to clarify the type of damage that should merit the concern of the research community and stakeholders. For instance, small fractures are often seen at the most distal point of the keel and are unlikely to be associated with pain, though without relevant criteria, these decisions are prone to subjective interpretation. **WG2** will also seek to establish visible characteristics associated with the relevant types of damage to allow classification of severity during general assessments, e.g., farm audits.
In addition to assessing effects on direct measures of welfare, **WG2** will also seek to establish effects on productivity. Decreased productivity can be considered one way to determine if an animals` welfare is compromised as it suggests that the relevant coping mechanisms are overwhelmed causing derailment of processes that support long term fitness. Secondly, quantifying economic costs can provide incentive for interventions to reduce KBD, particularly relevant in regions of the world where animal welfare is considered less of a priority giving additional financial justification for intervention and related products.

Working Group 3 – Identifying Sources of KBD and Interventions (Bas Rodenburg & Mirjana Đukić Stojčić)

Objectives of **WG3** focus on coordinating participants to determine causes of KBD in varying systems (**WG3a**) and then developing intervention strategies that can be adopted by the laying hen industry (**WG3b**). Interventions will be broadly classified into three categories - housing/management, genetics, and nutrition - established in preliminary discussions with and highlighted by various scientists within the field. The focus on coordinating these efforts will seek to deliver various options that producers can determine most appropriate given their individual, local, and national priorities.

Towards the ultimate goal of reducing KBD, the coordinating efforts of **WG3b** with industry participants will ensure that the developed innovations are grounded in solid scientific exploration AND attractive to producers to maximize uptake via workshops and summary outputs (e.g., technical leaflets). Moreover, inclusion of industry partners will allow for developments to be applied directly into the stakeholders` commercial activities leading to a strengthened industry, more capable of meeting the high standards of the European community.

Support Group 4 – Research and Training Coordination (Eva Sossidou & Ivan Dimitrov)

The various working groups will inevitably take directions that expand upon and vary from paths outlined in the application (which is encouraged and essential to keeping the COST relevant and helpful to stakeholders). Supporting Group 4 will provide the role of ensuring that those tasks are working toward a complementary set of goals and at-large objectives outlined in the group's charter. For instance, the assessment methods developed by WG1 should be employed by all the activities of the other WGs. The group will also serve to ensure that all participants, particularly the Early Career Investigators, are engaged in appropriate capacity building activities and achieving the stated goals.

Support Group 5 – Dissemination and Exploitation (Lubor Kostal & Ine Kempen)

Given the variety of outputs that will be produced, this WG will ensure that those outputs are received by the stakeholders outlined in the MoU in the most helpful manner. The group will also serve as a *de facto* editorial board to make sure that outputs meet COST policies. In addition to maintaining an up-to-date distribution list, Supporting Group 5 will also seek to expand the stakeholder list beyond those initially proposed, and in coordination with the WGs, will take a lead role in adapting research outputs (manuscripts, abstracts, and presentations) into formats that are more digestible (technical leaflets, instructional videos) for particular groups of stakeholders.

Support Group 6 – Short Term Scientific Mission (STSM) Management (Manja Zupan & Maryse Guinebretiere)

Short Term Scientific Missions will be advertised once per year for the lifetime of the ACTION and will serve as one of the principal tools for the group to meet the stated objectives of advancing research. The Supporting Group will be involved in all aspects of the STSM process including: identifying existing priorities in coordination with the other WGs, advertising the missions, evaluating and deciding on the applicants, receiving the final reports and ensuring their compliance with COST policies.

Support Group 7 – Monitoring Gender, Geographic, and Age Distribution (Marianna Andreopoulou & Tone Beat Hansen)

Support Group 7 will ensure that the activities of the Action are in compliance with the policies of the COST Office in terms of openness and inclusiveness. In addition to monitoring the distribution of people and expenditures across these targeted classifications, the Support Group will also work to identify novel policies to further encourage this distribution.

Support Group 8 - Webmaster (Boris Bilcik & Dragan Žikić)

The webmaster will maintain an active website (www.keelbonedamage.eu) that will serve as a depository and access point for all Action activities and outputs including minutes from meetings, reports from supported scientific exchanges. The website will also maintain a section for participants providing ongoing research activities and expertise of Action participants to be used as a tool to identify potential collaborators. Specific sections will also be maintained to showcase activities of individual researchers.

Support Group 9 – Stakeholder and End-User Advisers (Teun van de Braak & Mia Fernyhough)

Support Group 9 will ensure that the Action is being directed towards benefiting the Stakeholders and End-Users in the most helpful manner and assist the various WGs in developing science that is relevant to stakeholder needs. The group will also work to help expand the contact and dissemination network of the Action as well as forging new contacts with stakeholders to allow for greater participation in the activities of the Action members.

Conclusion

We believe the KeelBoneDamage Action represents an exciting opportunity to harness the collective energies of the scientific community and disseminate results to those that will benefit from the most. While accelerating the pace of discovery, the Action also seeks to ensure a broad representation of gender, geography, and age and promoting the activities and achievements of the next generation of scientists. Anyone from any nation or type of institution is encouraged to join and be involved – please contact our administrator Lilian Smith (Lilian.smith@vetsuisse. unibe.ch) to express your interest and become part of the Action.

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Cognitive abilities and adaptation to changes: another way to investigate welfare

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Abbreviated Title: Cognitive abilities to investigate welfare

Summary

A better understanding of the way a farm animal apprehends its environment can contribute to improve its welfare. We first investigated the relationship between spatial learning abilities and stress in quail in order to better understand whether both are linked when stress is an inherent, genetic trait (comparison between different lines) or when a stress state is induced by a repeated exposure of birds to negative stimulations (presentation of sudden noises, exposure to social stress, to novel environment..). We also highlighted how specific brain plasticity mechanisms may participate in stress related changes in learning abilities. In particular we observed a detrimental effect of stress on markers of neurogenesis into the hippocampus, a brain area critically required in learning and memory.
We then assessed how cognitive abilities could be linked to a behaviour of interest in poultry production. To do such, we focused on the relationship between spatial learning performances and exploratory behaviour in chickens reared in a free range system, since this behaviour can be influenced by the capacity to process spatial information or visual clues to move on a space and to find food. Chickens carried out 2 tasks of spatial learning in an arena with visual cues on the walls. The first task consisted in finding 8 mealworms located in 8 rewarded cups and the second task consisted in finding the 4 rewarded cups among 8 cups (2 trials/day). Interestingly and unexpectedly, chickens with a better spatial learning performances and reference memory were less prone to explore the free range (number of visited cups: Sedentary 7.1±1.8 vs Explorer 5.9±3.1, $P=0.095$ and reference memory index: Strial1 0.73±0.17 vs Strial2 0.81±0.18 and Etrial1: 0.75±0.19 vs Etrial2 0.78±0.20, $P<0.05$), which raises many questions on the way cognitive abilities may drive behaviour in rearing conditions. These results suggest that cognitive abilities may be related to the use of space and then have to be considered to improve the enrichment provided to poultry.

Key words: learning abilities, poultry production, stress, exploration behaviour

The speed and success of associative learning in hens depend on genotype and housing system

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Abbreviated Title: Associative learning in hens

Summary

To investigate associative learning ability in laying hens, 91 hens of three breeds (Slovenian barred hen (Ba, n=30), brown hen (Br, n=30) and silver hen (S, n=31)) were subjected to a task of following a target over two perches (TT) and to a task of discriminating colours of magnet (TC; yellow, red and blue colour). Hens were 7.5 months old and reared either in enriched cages (n=61) or on the floor (n=30). A clicker was used as a predictor signal and successive approximations of the desired behaviour were rewarded with food. In the TT the desired behaviour was to follow a target, a purple ball on a stick, from one perch onto another over a 5 cm gap and peck it at the end of the second perch. In the TC the hen completed the task by affirming the right colour choice (yellow) with pecking only a yellow coloured magnet. A successful hen was one who performed the desired behaviour in 8 training sessions or fewer (3 min per session). 17 hens failed to associate the signal with the reward. The main results from the hens that did associate signal with food were that Ba hens were found to learn more quickly than Br (P=0.03) and S hens (P=0.002) and showed the greatest success rate in the TC (P=0.02 and P=0.03, respectively). Floor hens took less time to complete TT than caged hens (P=0.027). To conclude, hens were found to have different speed and success of associative learning depending on genetic predisposition and housing system.

Key words: Laying hens, operant conditioning, colour discrimination task, training, predictor signal, motivation, cognition.

Five shades of grey: cognitive bias in poultry

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Abbreviated Title: Cognitive bias in poultry

Summary

While connection between emotions and cognition is broadly accepted in humans, the potential of this interaction as a source of information about animal affective states has been uncovered only recently. Cognitive bias in animals is a pattern of deviation in judgment, whereby inferences about situations may be affected by emotional states. Cognitive (judgment) bias test provides a cognitive measure of optimism and/or pessimism by recording behavioural responses to ambiguous stimuli. Since the seminal study of Harding et al. (2004), many papers have been published exploring cognitive bias in various species. Here we describe our experience with operant discrimination training as a basis of cognitive bias testing in Japanese quail and laying hens. We have developed custom operant conditioning chambers for quail and domestic chicken with touch-screen monitor, driven by the Biopsychology Toolbox, a free Matlab Toolbox for the control of behavioural experiments. After the successful discrimination training (two shades of grey; reward – food pellets for quail and mealworms for hens, punishment - white noise) we divided both quail and hens into two housing conditions groups (cages in quail or enriched cages in laying hens vs. deep litter pens) and their decisions under ambiguity have been tested. We expected a higher proportion of responses to ambiguous cues (3 shades of grey intermediate between the positive and negative cue) in quails and laying hens from the enriched environment. Nevertheless, results from several replications of experiments (quails - Exp1 n=6, Exp2 n=11, Exp3 n=9, Exp4 n=19; hens – Exp1Dominant Black n=20, Exp2 Dekalb White n=20) are not conclusive, although trends towards more 'optimistic' responses in birds from enriched environment can be seen. Possible explanations of these results, such as the loss of ambiguity due to repeated testing, will be discussed.

Key words: Cognitive bias, operant discrimination learning, Japanese quail, laying hen

Session 3

Feather pecking origins and prevention

-

1st part

The GroupHouseNet COST Action: exploiting European synergy to reduce feather pecking in laying hens

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Abbreviated Title: GroupHouseNet – Synergy to reduce feather pecking

Summary

The COST Action GroupHouseNet focuses on the reduction of damaging behaviour in laying hens and pigs, benefiting from the fact that there are many similarities in causation and solutions for feather pecking and tail biting. The research in the network focuses on three main topics, addressed by the three working groups: 1) Genetics and damaging behaviour, 2) Effects of development

on damaging behaviour, and 3) Relationships between health and damaging behaviour. For the work on genetics, we focus on developing new techniques to measure relevant phenotypes (e.g. sensor technology) and investigate methods to link these sensor data to genomic data. Regarding development, the network will review the effects of parental conditions on offspring behaviour. Further, the role of incubation conditions (light, noise, temperature) and early-life environment in the development of damaging behaviour will be explored. On the relationship between health and damaging behaviour, interesting associations are found between immune responses and development of damaging behaviour, that merit further research. Here we will also focus on the complex interplay between the immune system, the HPA-axis, microbiota, gut and brain. Taken together, the network aims to provide new knowledge that can be applied to further develop production systems where laying hens with intact beaks can be optimally managed and damaging behaviour can be controlled.

Key words: feather pecking, genetics, prenatal effects, health, damaging behaviour, sensor technology

Introduction

The GroupHouseNet COST Action aims to exploit synergy between poultry and pig scientists to prevent damaging behaviour in both pigs and chickens (www.grouphousenet.eu). Feather pecking (FP) in laying hens and tail biting in growing pigs are very similar behaviours that share a common causation (Brunberg et al., 2016). In the COST Action GroupHouseNet, 29 European countries and the USA as international partner country currently collaborate on the topic of reducing damaging behaviour. New countries and new individual scientists are very welcome to join this open network. Activities supported by the COST Action include network meetings, workshops, PhD and post doc courses and international exchange visits. COST does not fund actual research projects, but provides opportunities to link ongoing, national projects in an international framework.

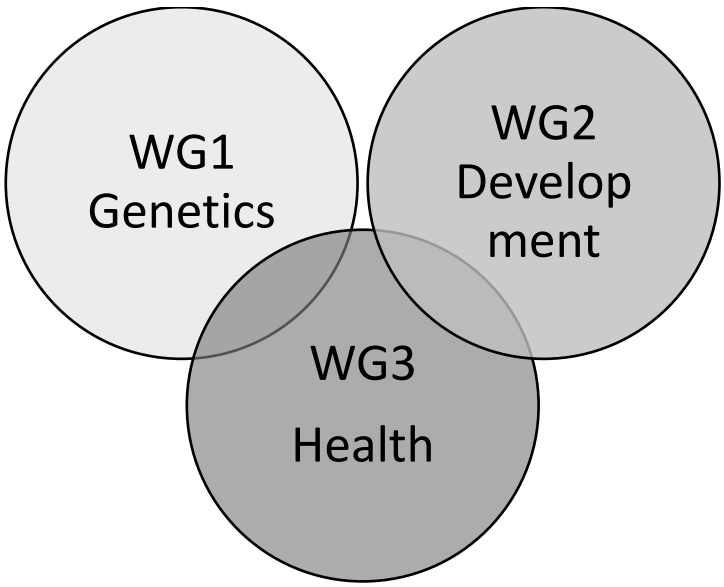

Figure 1. Schematic overview of the three interconnected working groups of GroupHouseNet, aiming to reduce damaging behaviour by investigating 1) the role of genetics and breeding, 2) the role of development and 3) the relationship with health.

GroupHouseNet focuses on three separate topics in its three working groups: 1) Genetics and damaging behaviour, 2) Effects of development on damaging behaviour, and 3) Relationships between health and damaging behaviour (Figure 1). The overall aim of GroupHouseNet is to provide the European livestock industry with innovations in breeding and management for pigs and poultry that are needed for a successful transition to large group housing systems without necessitating painful tail docking and beak trimming. Large group housing is associated with increased risks of damaging behaviours among the animals, such as FP and cannibalism in laying hens in non-cage systems. Recent research suggests the key to reducing the incidence of these behaviours lies in refining and applying methods of genetic selection, and developing husbandry innovations that improve early and later life conditions and that support animal health and resilience.

Breeding for reduced feather pecking

Working Group 1 focuses on genetics of FP and breeding for reduced FP. Activities in this working group are currently focused on the use of smart technology and genomic tools to make the next step in breeding for reduced FP. We hope to do this by learning from recent research projects on novel selection methods to reduce damaging behaviour and mortality in group-housed laying hens (Ellen et al., 2014). Furthermore, the high (HFP) and low (LFP) FP selection lines, originally selected in

Denmark by Kjaer et al. (2001) have been characterised both for behavioural and physiological characteristics (Kjaer, 2009) and for genetic and genomic differences (Bennewitz et al., 2014). However, to be able to make the next step in breeding, an accurate phenotype for giving and receiving FP is needed by commercial breeders. This phenotype could link directly to FP (i.e. automatic recording of FP interactions) or be linked to associated traits such as activity levels or use of space. For this, we will investigate new options for automated phenotyping using smart technology such as ultra-wideband tracking, video tracking or RFID tracking (Rodenburg and Naguib, 2014; Campbell et al., 2016). The first two methods have recently been tested and compared in the PhenoLab project in The Netherlands (de Haas et al., this conference). Furthermore, we will link to research groups active in developing technology for precision livestock farming (PLF) projects, such as KU Leuven in Belgium.

Effects of development on feather pecking

In Working Group 2, the role of the prenatal period on the development of FP is explored. Recent studies indicate that the conditions of the parent stock can affect behaviour of the offspring. This may happen both through hormones transferred from the mother hen to the egg and by epigenetic programming (Janczak et al., 2007; Jensen, 2014; Rodenburg and de Haas, 2016). Recent work in commercial flocks indicates a relationship between performance of the parent stock and FP in the offspring. Parent stock flocks with high levels of feather damage, high fearfulness and high basal corticosterone levels produced offspring that develop severe FP already in the first week of life (de Haas et al., 2014). The effects of age, nutritional status, social environment, housing conditions and potential stressors on behaviour of both parents and offspring will be investigated. A second important topic of this working group is the role of incubation conditions. Commercial chicks are normally hatched in dark and noisy incubators and hatchers. Both light and noise have been found to affect chick behaviour and development (O'Connor et al., 2011). In broilers, Archer and Mench (2014) recently found reduced fear and stress sensitivity in chicks incubated with 12 hours light and 12 hours dark, instead of complete darkness. Preliminary findings indicate that a 16 hours light and 8 hours dark schedule during incubation may also reduce fear in layer chicks (Dayıoglu and Özkan, this conference). As FP has been found to be related to fearfulness (Rodenburg et al., 2004), light during incubation might help to reduce FP. Similarly, reduction of noise levels during incubation may favour early chick development. Novel developments such as in-ovo techniques, early feeding and hatching directly in the rearing house may also hold promise to reduce FP. In addition, the particularities of the early social and physical environment can shape the way animals respond to stimuli and to new environmental conditions that they will encounter later in life. Research on the impact of early life experience may provide new insights into the causation of FP and may be a source of practical strategies for FP control.

Relationship between feather pecking and health

Research in Working Group 3 focuses on the relationship between FP and health. Both in pigs and laying hens, relationships are found between immune challenge and damaging behaviour. It seems that inflammatory immune responses may increase the risk of damaging behaviour developing, possibly through the action of cytokines. To test this hypothesis, relationships between immune activation, the HPA-axis, the gut microbiota and behavioural development will be explored. In laying hens, it was found that challenging young hens with human serum antigen (HuSA) early in life led to much more feather damage later in life compared with hens that received a sham treatment (Parmentier et al., 2009). As this challenge is similar to a routine vaccination, this leads to the question whether the intensive vaccination schedule that we currently subject hens to increases the risk of FP. Also in selection experiments, relationships between FP and immunity have been found: Birds from a HFP line were found to have higher levels of the natural antibody (NAb) IgG (Cheng et al., 2001). Interestingly, divergent selection on NAb levels showed a similar relationship, with the high NAb line showing more feather damage than the low NAb line (Ba et al., this conference). We have only begun to understand the complex relationships between health and damaging behaviour and much work is needed in this area, especially in poultry.

Conclusion

The COST Action GroupHouseNet enables us as European poultry welfare researchers to work together on reducing FP in laying hens. Furthermore, by collaborating with scientists working on tail biting behaviour in pigs, we can also exploit the similarities between these two research fields. On the topic of FP, a lot of basic research has been done focusing on the causes of FP and the motivation to develop FP, for instance om the relationship to foraging behaviour. In tail biting, more research is available on the relationship between damaging behaviour and health. By linking together the two species and utilising the knowledge of scientists from 30 different countries, we expect to come to novel insights that will benefit both species. GroupHouseNet also has the ambition to support the development of welfare-friendly housing systems for non-beak trimmed laying hens and intact pigs that are not subject to significant problems with damaging behaviour.

Acknowledgement

This article is based upon work from COST Action CA 15134 GroupHouseNet, supported by COST (European Cooperation in Science and Technology).

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Genetic and phenotypic correlations of explorative behaviour and open-field activity in layer chicks with severe feather pecking as adults

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Abbreviated title: Feather pecking, exploration and fear

Summary

It is generally assumed that feather pecking in chickens can be interpreted as misdirected foraging and exploratory pecking. Locomotor activity in the open field is inversely related with fear and positively related with exploration. It has been reported, that high open field activity of young chicks may predict feather pecking in adult hens. It was the objective of the present study to elucidate genetic and phenotypic relationships between explorative behaviour in the home pen and open field activity of young chicks with later propensity to perform severe feather pecking as adults. A total of 960 pedigreed birds of a F2 cross of two White Leghorn lines selected for high respectively low severe feather pecking were used. The birds where video recorded from 2 to 3 weeks of age. Each bird was observed for a 20 minute period using the software "Interact" (Mangold International). Sum of duration of locomotor activity and litter pecking was recorded as criterion for exploration. Open-field activity was recorded at eight days of age. Number of steps in a five minute open-field test was used as open-field activity. Severe feather pecking was observed at 27 weeks of age. The birds were housed in deep litter pens in groups of 36 to 42. Heritabilities and genetic and phenotypic correlations were estimated. Structural equation models were applied to estimate the causal relationships between the criteria. Heritabilities of 0.19; 0.20 and 0.00 were estimated for severe feather pecking, open-field activity and explorative behaviour, respectively. The genetic and phenotypic correlations and the estimated Lambda values which explain the causal relationships between the criteria were zero or close to zero. The results are in contrast with the previous assumption that open-field activity is a predictor of feather pecking and that there is a causal relationship between explorative behaviour and feather pecking.

Key Words: Feather pecking, exploration, open field activity, fear, genetics

Effects of omitting beak-trimming on plumage, skin and keel bone conditions in barn layers

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Abbreviated Title: Welfare of beak-intact **barn layers**

Summary

In July 2014, the Danish Egg Association decided to omit beak-trimming in barn layers. The decision was in accordance with a trend towards banning of beak-trimming in Northern Europe. Beak-trimming is used as a method to reduce the damage caused by feather pecking, and the risk of deteriorated plumage and cannibalism is therefore higher in flocks of beak-intact hens. In addition, the discomfort and pain experienced when being pecked may increase fearfulness in flocks with high levels of feather pecking. The aim of this study was to investigate the effects of omitting beak-trimming on plumage, skin and keel bone conditions in barn layers. A study was conducted on 10 commercial farms, each participating with a flock of beak-trimmed hens (T) and a flock of beak-intact hens (NT). Flocks were visited at 32 and 62 weeks of age where the plumage, skin and keel bone conditions of 100 birds were assessed. Data were analysed using regression models in R. Poor plumage condition was non-existent at age 32 weeks, but at age 62 weeks NT had a higher prevalence than T (72.4%±12.27% vs 6.7%±3.88%; X^2=403.9, *df*=1, *P*<0.001). The prevalence of body wounds increased with age (4.2±1.66 vs 1.1±0.48; X^2=51.5, *df*=1, *P*<0.001) and was higher in NT than T (3.7±1.47 vs 1.2±0.54; X^2=34.7, *df*=1, *P*<0.001). In addition, the prevalence of keel bone fractures did not differ between the two treatments at age 32 weeks, but at age 62 weeks NT had a higher prevalence (age 32: 3.8±0.90 vs 3.2±0.79; age 62: 17.6±3.05 vs 9.0±1.81; X^2=5.1, *df*=1, *P*=0.02). Thus, not only had beak-intact flocks a higher prevalence of poor plumage and skin conditions, but also an increased prevalence of keel bone fractures. A higher arousal level in flocks experiencing high levels of painful feather pecking may lead to more high-risk situations of bone fracturing.

Key words: Beak treatment, feather pecking, laying hen, on-farm study, welfare

Selection of beak shape to reduce the damage of feather pecking in layers

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Abbreviated Title: Selecting beak shape in layers

Summary

Feather pecking and mortality due to cannibalism in layers are of economic and welfare concern. Information from relatives in group cages has been used since decades to select for better social behaviour. Selection for low mortality and good feather cover helps to reduce feather pecking and cannibalism, but cannot eliminate it completely. Since several years beak shape measurements is been used to select for a blunt beak. Hereby, the selection criterion is to reduce the protrusion of the upper over the lower part of the beak. This will be a biological tool to attenuate the damage in flocks with intact beaks in case the hens start pecking.
Information of three generations of four brown and four white egg pure lines housed in single cages were available. In total, 66,957 observations were analysed in this study. The difference between the upper and lower beak was found to be higher in the brown lines (3.2 mm) as compared to the whites (2.6 mm). It shows a moderate heritability, with h^2 ranging between 0.10 and 0.25, as well as a substantial individual variation within the lines (CV ~ 20%). The phenotypic correlation of beak shape at 23 and 48 weeks of age ranged between +0.30 and +0.42, indicating an acceptable repeatability.
In group cages, birds with blunt beaks tended to have better feather score (genetic correlation (rg) between -0.30 to +0.05) and lower mortality (rg from -0.08 to +0.19). The correlations are low, but confirm our working hypothesis that birds with above-average upper beaks are more likely to generate feather damage and mortality in their group.
Individual selection for blunt beaks may be an additional tool to reduce the negative impact of feather pecking and cannibalism, while family selection for intact feather cover and liveability continues and management practices are optimized.

Key words: Layers, breeding, feather pecking, beak shape

Effects of litter provision during early rearing and environmental enrichment during the production phase on feather pecking and feather damage in laying hens

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Abbreviated Title: Litter provision and feather pecking

Summary

Feather pecking is a multi-factorial behavioural disorder and a serious welfare issue in the poultry industry. Several studies report early life experience with litter to be a major determinant in the development of feather pecking. The current study aimed to test the large-scale on-farm efficiency of rearing birds on chick paper to ensure litter access on feather pecking and plumage damage during the production stage. Five laying hen-rearing farmers from across Norway participated in the study. These farmers were asked to create divisions within their hen rearing houses and to separate their chicks into two groups: one reared with access to paper substrate from the first day of age, the other a control group without access to paper substrate during rearing. At 16 weeks of age the flocks, separated in the two treatment groups, were sent to aviary production farms for the duration of the laying period. All flocks were visited during at the production farms at 30 weeks of age and observed for pecking behaviour and feather damage. Birds in the control group had a higher likelihood of having feather damage compared to the birds from the treatment group (odds ratio=3.28; $p<0.04$). In addition, flocks provided with environmental enrichment at the production farms had a reduced incidence of feather pecking, irrespective of the treatment ($p<0.006$). These results indicate that husbandry procedures during both rearing and production stages have the potential to alleviate feather pecking and increase laying hen welfare.

Key words: Feather pecking, laying hen, litter, welfare

The effect of lighted incubation on fear responses in layer chicks at early ages and feather pecking in pullets

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Abbreviated title: Fear and feather pecking in layers affected by lighted incubation

Summary

Light exposure during incubation had significant impact on behaviour and welfare in chickens. This study investigated whether lighted (16L:8D) incubation (LI) using green (520 nm) and white LED as compared with the dark (control) incubation affected the responses of layer chicks to T-maze and isolation tests at early ages and feather pecking in pullets. Treatments were repeated in two batches. Chicks were reared on litter at floor (6 pens/treatment; 24 chicks/pen). At post-hatch d 2, T maze performance and behaviour such as defecation and pecking (54 chicks/treatment) were measured. On d 24, fear was assessed by recording number of vocalisations (18 chicks/treatment) during isolation test in a bucket. Feather pecking as gentle and severe, and aggressive pecking were recorded (4 pens/treatment) in two days (3 sessions of 10 min) on 16th week and were averaged across all birds in a pen (pecking/bird). ANOVA model included lighting treatment, batch, and interaction effects (plus session and pen for pecking behaviour). Chi-square was used for binomial data. In T-maze test, both LI chicks defecated less and pecked at mirror more often than control chicks ($P \leq 0.05$) which might indicate low fear. However, latencies to exit the maze didn't vary with the treatment indicating no difference in sociality among treatments. Control chicks had the highest vocalisation number in isolation test which may represent high fear as compared with the LI. Gentle, severe, and aggressive pecking frequencies differed with treatment ($P \leq 0.05$). Green-LI significantly reduced severe and aggressive pecking as compared to White-LI and control. Control and green-LI had similar values for gentle pecking. However, white-LI chicks had significantly higher gentle pecking than green-LI and control. From the preliminary results, it could be concluded that LI and wavelength might have an influence on early fear responses and feather pecking behaviour in layer chickens. The underlying mechanism is currently being investigated by analyzing additional physiological and behavioural data from the rearing and laying periods.

Relationship between light quality, environmental enrichment and injurious pecking in turkeys

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Abbreviated Title: Injurious pecking in turkeys

Summary

Injurious pecking reduces turkey welfare and leads to economic losses. A lack of preoccupation is considered as one of the causes of this undesirable behaviour. Beak trimming and a reduction of light intensity are common management practices to decrease pecking. In Germany, beak trimming is expected to be banned in the future. Keeping non-debeaked turkeys may cause more injurious pecking. Knowledge regarding the effects of light quality on turkey behavior is limited. Therefore, the influence of light quality and barn enrichment on the prevalence of injurious pecking in non-debeaked turkeys was evaluated. In two trials, 600 male day-old B.U.T. 6-turkeys each were allocated to six pens (each 36 m², 2.8 toms/m²), and kept for 20 weeks. The pens were illuminated by two tubular fluorescent lamps (58 W) of different colour temperatures (either 3000 K or 6500 K). Each pen consisted of two parts, differing in their luminance intensity (20 lx vs. 100 lx). Both parts were enriched with wheat grain feeders and were connected with a passage which was equipped with two antennas for recording the frequency of changes between compartments. Therefore, the birds were equipped with two leg transponders. Video recordings were used to evaluate turkey behaviour including the use of enrichment. Effects of light spectrum and luminance intensity on the use of the feeders were tested using GLM. The prevalence of injurious pecking in response to the use of feeders and light quality was evaluated by a generalised linear mixed Poisson model. In both trials, injurious pecking occurred more frequently in pens illuminated with warm white light (3000 K, $p<0.0001$). Injurious pecking decreased with increasing use of wheat grain feeders ($p<0.0001$). The study indicates that light quality and using whole grain feeding as enrichment seems to have an important influence on the prevalence of injurious pecking in turkeys.

Key words: beak trimming, enrichment, turkeys, animal welfare, pecking

Session 3

Feather pecking origins and prevention

-

2nd part

Effects of divergent selection for natural antibodies on fearfulness and feather damage of laying hens

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Abbreviated Title: Feather pecking and immunity

Summary

The laying hen industry aims to improve general disease resistance of laying hens. Genetic selection for increased natural antibody (NAb) levels is a promising strategy, because Nab levels are related to survival and are heritable in chickens. However, selection for increased NAb levels may increase feather pecking (FP), possibly through increased stress reactivity and reduced serotonergic activity. Therefore, the aim of this study was to determine the effects of divergent selection for NAb levels on feather damage, stress reactivity, and whole-blood serotonin levels. In total 389 White Leghorn hens in the high and low NAb lines were studied. From each line, 75 hens were chosen to measure feather damage and to test with a bucket test, open field (OF) test, social novel object (NO) test, tonic immobility (TI) test, and manual restraint (MR) test. Total levels of NAb binding Keyhole Limpet Hemocyanin (KLH), plasma corticosterone and whole-blood serotonin concentrations were also measured. High NAb hens showed significantly higher total levels of NAb binding KLH and had more feather damage than low NAb hens. In the bucket test, high NAb hens started to vocalise significantly later than low NAb hens. Furthermore, the number of high NAb hens that approached the NO in the home pen was significantly lower than in low NAb hens. There was no significant difference between the two lines in OF, TI and MR tests. Levels of plasma corticosterone and whole-blood serotonin were not significantly different between the two NAb lines. These results suggest that selection for high NAb levels results in more feather pecking and feather damage. In the behavioural tests, the high NAb birds seemed more fearful, indicated by longer freezing in the bucket and longer latency to approach the NO, but these differences were not supported by differences in stress physiology.

Key words: natural antibodies, feather pecking, fearfulness, behavioural tests, serotonergic system

Investigating the effect of feather consumption on artificial feather presentation in ISA Brown hens

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Abbreviated Title: Feather appetite and digestibility

Summary

There is evidence to suggest a link between nutritional factors and severe feather-pecking. However, information is scant on feather appetite and feather digestibility. The aims of this experiment were to investigate the above in ISA Brown birds, and to determine the effect of feather consumption on feather pecking. Sixty 56-week-old ISA Brown hens were individually housed in wire cages (width 25cm, height 40-50cm, depth 55 cm) and randomly allocated to one of three dietary treatments: commercial diet (Control), commercial diet and pelleted feed containing 15% ground feathers (Ground), and commercial diet and 20 whole feathers (Whole), presented in two separate feeders to allow for choice feeding. Each bird was presented with 10 semi-plume feathers mounted on an artificial substrate and bird behaviour was observed over 14 days, where the latency to peck was recorded. Feed intake was higher ($p<0.01$) in the Ground treatment (125.9g/d) when compared to Control (111.8g/d) and Whole (114.7g/d) treatments and average ground feather appetite was ~5.5% (range 0.2-10.6% of total intake). Whole feather consumption was low when presented in feeders. Although overall protein digestibility was unaffected by treatment, increased feed intake and protein consumption allowed Ground treatment birds to digest more protein (26.7g, $p<0.001$) than Control and Whole treatments over 48 hours (18.3g and 17.3g respectively). Ileal amino acid digestibility was unaffected by ground feather inclusion, but Ground treatment birds digested more cysteine ($p<0.01$) and methionine ($p<0.001$) content than Control and Whole treatments. Latency to peck at artificially mounted feathers was higher for Ground treatment birds ($p<0.001$) suggesting decreased feather pecking motivation. ISA Brown birds may be capable of digesting ground feathers, and increased digestion of cysteine and methionine may be related to feather pecking motivation (latency to peck). This has implications for feather pecking behaviour which will be investigated in further studies.

Key words: Feather eating, feather digestibility, feather pecking, ISA Brown

Skin microbiota and its relationship to the feather-pecked status of laying hens: A pilot study

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Abbreviated Title: Feather-pecking, laying hens

Summary

Severe feather-pecking (SFP) represents a significant challenge for the poultry industry worldwide, as it negatively impacts farm animal welfare and production efficiency. Despite extensive research into this injurious behaviour, the underlying motivations behind SFP are not fully understood, as its cause is complex, multi-factorial and influenced by a range of environmental stimuli. Previous research has proposed that the onset of a feather-pecking event may be associated with a hen's inability to satisfactorily dust-bathe. In addition, it has been suggested that preen oil and stale lipids on the plumage serve as possible attractants for feather-pecking. Therefore, we hypothesised that microbial changes on the feathers and skin integument would lead to SFP when ISA Brown hens housed in a floor pen system were given limited access to a dust-bathing substrate. Specifically, our aim was to limit dust-bathing behaviour and investigate the bacteriological relationship between feather-pecked and non-feather-pecked birds upon initiation of a feather-pecking outbreak. Descriptive data analysis indicated feather-pecked birds had double the amount of bacteria on the rump, uropygial gland and vent compared to non-feather-pecked birds, while the opposite was true for the breast. A possible explanation is that the breast remains the most thoroughly oiled region during preening and has frequent contact with the litter material (e.g. when squatting on the floor) compared to other regions of the body. The current trial was a preliminary investigation and future studies aim to develop a reliable model to initiate SFP, which could be applied to determine whether SFP is linked to dust-bathing deprivation, increased stress or both. Upon elucidation of this phenomenon, interventions could be applied as a tool to mitigate the problem on a commercial scale.
The authors would like to acknowledge the support of the Poultry Research Foundation and the Australian Veterinary Association Limited.

Key words: Feather-pecking, dust-bathing, microbiology, laying hen

Behavioural and physiological characterisation of laying hen lines divergently selected on feather pecking.

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Abbreviated Title: Characterisation of laying hen lines divergently selected on feather pecking

Summary

Feather pecking, i.e. hens pecking and pulling at feathers or tissue of conspecifics, is a serious welfare and economic issue in the egg production industry. Beak trimming is currently used to limit plumage damage and mortality from feather pecking. However, with the expected ban on beak trimming in many EU countries, it is crucial to find alternative solutions to control this damaging behaviour. In order to better understand the development of feather pecking, we characterised laying hen lines divergently selected on feather pecking with regard to their behavioural and physiological development. We used genetic lines selected for high (HFP) and low (LFP) feather pecking and an unselected control line (CON). Lines were housed separately in groups of 19 birds per pen, with 8 pens per line. Group size was reduced by 2-3 birds at 0, 5 and 10 weeks of age. HFP birds showed more severe feather pecking behaviour in their home pen, were less fearful and showed a more pro-active coping style compared to CON and LFP birds in several behavioural tests at both young and adult ages. In addition, lines also differed with regard to immunological and neuroendocrine related parameters. HFP birds had lower natural IgM titres compared to CON and LFP birds. While LFP birds had lower natural IgG titres compared to CON and HFP birds. In addition, HFP birds had lower peripheral serotonin levels compared to CON and LFP birds. In conclusion, our results suggest that selection for or against feather pecking affects not only behavioural but also physiological characteristics. These results can help to better understand the development of feather pecking behaviour, and possibly to identify behavioural and/or physiological characteristics as potential indicators of feather pecking.

Key words: Laying hens**,** feather pecking, fearfulness, coping style, stress, immune system.

Effect of polyunsaturated fatty acids n-3 provided during embryonic development and starting and growing periods on pecking behaviour of Muscovy ducks

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Abbreviated Title: Pecking behaviour of Muscovy ducks

Summary

In rearing, ducks can express unwanted behaviours such as nervousness and feather pecking. Numerous studies realised with humans and murine models showed a positive effect of long chain polyunsaturated fatty acids n-3 (LC PUFA n-3) on the brain development and functioning. The aim of this trial was to test the possibility of decreasing the pecking behaviour of Muscovy ducks in rearing by providing LC PUFA n-3 during embryonic development and the starting and growing periods of ducklings. The enrichment of eggs and thus embryos in LC PUFA n-3 was realised by feeding female ducks with a diet containing docosahexaenoic (DHA) and linolenic acids (microalgae and linseed oil). A control group of female ducks was fed with a diet enriched in n-6 FA (soya oil). Offspring from both groups were fed starting and growth diets enriched with DHA and linolenic acid or only linoleic acid, resulting in four treatment groups with 48 ducklings in each. Infrared beak trimming of ducklings was performed just after hatching in order to limit feather pecking during the rearing period. Several behavioural tests were realised at one week of age to analyse the adaptation capacity of ducklings. The growth performance, time budget, social interactions, feather growth and pecking behaviour, were regularly recorded during the rearing period of ducklings. Ducklings issued from female ducks fed a diet enriched with n-3 FA had higher body weight at D0, D28 and D56, lower feed conversion ratio for the growing period, lower hyperactivity and lower reactivity to stress than ducklings issued from female ducks fed a diet enriched with n-6 FA. The enrichment with LC PUFA n-3 of diet distributed to female ducks reduced the frequency and the gravity of feather pecking of offspring. Diets enriched with LC PUFA n-3 and distributed during the starting and growing periods had

positive effects on bone mineralisation of ducklings and FA composition of thigh muscles measured at 84 days of age.

Key words: duck, pecking behaviour, n-3 fatty acids

Session 4

Free papers

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1st part

Broiler health, welfare, antimicrobial consumption and gut microbiota diversity in sheds authorised for increased stocking density

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Abbreviated Title: Broiler health and welfare in sheds at increased stocking density

Summary

According to Council Directive 2007/43/EC, farmers can increase broiler stocking density to 39kg/m^2, provided that specific environmental requirements are met. Such compliance can be guaranteed by commercial precision-farming equipment, which enables automated and continuous monitoring of the microclimate. Indeed, previous studies found the quality of the environment, rather than stocking density, to be connected to broiler health. This study evaluated the impact of a next-generation broiler shed combined with increased stocking density (A) on broilers' health, welfare, antimicrobial use and on the taxonomic richness of gut microbiota (as a potential expression of gut health). Two old-generation sheds (B-C) were recruited within the same farm as control groups. 63,900 mixed-gender chicks from a single hatchery were allotted and reared under the same management (litter, diet, vaccinations). Actual density was 32kg/m^2 in A *vs*. 22kg/m^2 in B-C. Animal welfare was assessed by applying the Welfare Quality® protocol (WQ) to each shed. Environmental parameters (light, noise, ammonia, CO_2, air speed) were measured in different parts of each shed. After slaughter, intestinal contents were collected from 25 randomly selected males per shed. Bacterial DNA was processed by 16S rDNA-PCR using adapted primers for DGGE method. The amplification was evidenced by a DGGE electrophoretic cell with specific adaptation of denaturing parameters. Results did not show significant differences in terms of WQ outcomes (all sheds resulted "*Enhanced*") and number of antimicrobial treatments (n.1 per shed). However, birds from A had higher carcass weight and lower mortality (1.7% *vs*. 2.6-3.0%) compared to B and C. Moreover, a higher microbiota diversity in the distal gut was detected by DGGE electrophoretic pattern. These preliminary results, that need to be confirmed by further repetitions, may indicate different microbial populations as an innovative additional tool to evaluate health and welfare in broilers, while WQ outcomes may lack sensitivity. RC IZSVe 16/14.

Key words: broiler, precision-farming, welfare, health, microbiota

The effect of an integrated approach of predatory mites, local acaricides and plant based supplements on poultry red mites

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Abbreviated Title: Integrated PRM treatment

Summary

The poultry red mite (PRM), *Dermanyssus gallinae,* is an important cause of welfare and health problems in laying hens, yet the control remains a challenge. A combination of treatments in an integrated pest management approach shows promising results. In this study the effect of a combination of predatory mites, locally applied acaricides and a plant-based supplement was investigated. In addition to the efficacy of the treatment, the financial cost and workload of the farmer was also evaluated.
A total of 31,000 hens were housed in 12 climate- and light-independent compartments equipped with enriched cages, type 1 or type 2. In each housing type, four combination treatments were tested: 1) predatory mites + amitraz, 2) predatory mites + amitraz + plant supplement, 3) predatory mites + milbemectin, 4) predatory mites + milbemectin + plant supplement. Two types of predatory mites were used: *Androlaelaps casalis,* which was released in cultivating bottles attached to the housing system and *Cheyletus eruditus*, which was spread by hand throughout the housing system. The acaricides were applied locally through different types of traps, while the plant-based supplement was added to the drinking water of the hens. Both a visual score (Mite Monitoring System) and a counting of PRM in cardboard traps were performed to maintain an overview of the (changes) in population. In addition, the predatory mite population was monitored weekly.
Preliminary results show effects of all combinations with the highest reduction of PRM for the triple treatment in the enriched cages. Visual scores in both cage types indicate a decrease in PRM score, however the effect is not persistent. Statistically analysed results will be presented at the conference.
In conclusion, the combination treatment shows promising results but further evaluation is needed.
Key words: poultry red mite, predatory mites, local acaricides, plant supplement

Session 4

Free papers

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2nd part

Evaluation of custom LED lighting system on performance, health and welfare parameters in commercial broiler flocks.

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Abbreviated Title: Lighting effects on commercial broiler flocks

Summary

In 2015 over 59 billion broiler chickens were produced globally for human consumption and with an increasing human population and demand for animal protein sources, the volume of poultry production will continue to increase. As the industry expands and farm sizes increase Agritech research and development must provide management systems and platforms to support efficient and sustainable large scale intensive production. New management systems must include sophisticated environmental control protocols (e.g. optimal lighting regimes). A comparison of two lighting systems (traditional fluorescent bulbs (T) v. custom LED (L)), both with a standardised average lighting intensity of 20 lux across the house and identical light/dark periods, was undertaken across eight broiler houses (four per lighting treatment) over three consecutive crops. Flock size, breeder flock age and breeder source was standardised across the two lighting treatments for each crop. Production, environmental and lighting performance measures were recorded daily. Weekly individual bird health and welfare assessments (e.g. weight, foot pad (FPD) score) were conducted (20 birds/house/week); and $1m^2$ health transects (6 transects/house/week) observed (for e.g. proportion of sick or injured birds). Results showed no difference in key production measures average total weight gain and FCR between lighting treatments. There were differences in key welfare/health measures: total mortalities (L=5.29±0.31%; T=6.00±0.41%, P=0.034) and FPD scores at 6wks (L=2.3±0.1; T=2.8±0.1, P=0.044), with L flocks outperforming T across the three crops. The L system outperformed the traditional system in bulb failure rate (L=0 bulbs; T=97 bulbs, P=0.002). There are some statistically demonstrable differences in bird production, health and welfare parameters studied or in the characteristics of the physical environment associated with lighting regime or type. The operational costs of the custom LED system, as well as some improvements to bird welfare and health, demonstrated in this trial appear to exhibit advantages over the traditional fluorescent lighting system.

Key words: lighting, broiler, behaviour, production, animal welfare.

Broiler chicken stocking density affects use of environmental enrichment objects

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Abbreviated Title: Broiler enrichment

Summary

Enrichment may promote species-specific behaviour and stimulate activity in broilers. We found that platforms and wood shavings bales were well used by commercially housed broilers. However, the extent to which these are used may depend on the stocking density; this has been tested in the current experiment. Broilers (Ross 308) were housed on two commercial farms of which one house/farm was divided into equal sections (±5300-8700 broilers/section). Two of these sections per house, during two production cycles, were used for the present experiment (4 replicates/treatment). Broilers in a section were stocked at 25 kg/m^2 (L) or 35 kg/m^2 (H) and each section was equipped with raised platforms (available for approximatively 5% of the broilers) and wood shavings bales (1 per 1000 broilers). Behaviour and use of the enrichment objects was determined by scan sampling at 10 and 21 days of age and before depopulation. Observations were performed in 6 predefined areas of 2 m^2 per time block including an enrichment object and the surrounding litter area. Age and time effects were present but are not presented here. Significantly more broilers were found on the platforms in L as compared to H (2.9 vs 1.7 broilers, SED=0.2, P<0.0001). Foraging, dustbathing, comfort behaviour and object pecking were observed more frequently near the bales than the platforms, and significantly more L than H broilers were foraging (1.23% (L) vs. 0.8% (H), SED =0.098), dustbathing (1.87% (L) vs. 1.42% (H), SED =0.09), showing comfort behaviour (2.36% (L) vs 1.88% (H), SED=0.09) and object pecking (0.38% (L) vs 0.19% (H), SED=0.04), P<0.01 at least; whereas more H than L broilers were resting (81.4% (H) vs. 79.0% (L), SED=0.50) and standing 5.98% (H) vs. 5.11% (L), SED=0.2), P<0.01 at least. In conclusion, reducing the stocking density better enables the broilers to perform species specific behaviours stimulated by the enrichment objects.

Key words: broilers, environmental enrichment, behaviour, stocking density

The effect of perches and elevated platforms in commercial broiler farms on broiler leg health

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Abbreviated Title: Broiler leg health and elevated perching structures

Summary

Modern fast-growing broilers spend most of their time resting and this inactivity has been suggested to impair gait and increase the incidence of leg disorders. Tibial dyschondroplasia (TD) is one of the most common leg pathologies in broilers. Elevated perching structures bring complexity to broilers' environments and might motivate more varied locomotion. This study examined the impact of perches and elevated platforms on walking ability and the occurrence of TD in fast-growing broilers.

The investigation was conducted on four commercial broiler farms throughout 4-5 (perches) or 6 (platforms) consecutive batches. On each farm two houses were included. One house offered elevated (30 cm) plastic slats covering 10% of the floor area or wooden perches (height 10 and 30 cm) 15 cm/ bird calculated for 10% of the birds, the other house being a control. Farmers recorded the use of platforms twice a week using a 5-point scale. Walking ability was evaluated with the Welfare Quality® Assessment protocol for gait scoring poultry. The severity of TD was assessed at the slaughterhouse in 200 birds per batch using a 0-3 scale. As the use of perches was very low, the houses with perches were excluded when analysing walking ability and TD. Effects of age and platform on gait were analysed using general linear univariate models. TD data were analysed with nonparametric tests.

Overall 30% of the tested birds had gait score ≥3. Younger scoring age resulted in lower mean gait score and a lower percentage of birds scoring 3 and 4-5 (both $P<0.05$). The platforms were used frequently but only single birds were observed to utilise perches. Leg health appeared better in birds with access to platforms: mean gait score, the percentage of birds with gait score 3, and TD percentage and severity were lower in birds with platform access (both $P<0.05$). Offering additional possibilities for locomotion seems to improve the leg health of broilers.

Key words: Broiler, perching, leg health, tibial dyschondroplasia

World Veterinary Education in Production Animal Health - W.V.E.P.A.H. - poultry programs

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Abbreviated Title: WVEPAH: Poultry programs

Summary

WVEPAH is the second branch of the "European Association for Veterinary Specialization" (EAVS), a non-for-profit organization registered in Luxembourg since 1989. In 1992 it created the "European School for Advanced Veterinary Studies" (ESAVS, www.esavs.org) to support the concept of veterinary specialization by offering high quality continuing education on companion animals. Each year ESAVS organizes trainings in 25 locations in Europe, plus 6 in China, for more than 1000 participants from more 50 countries. EAVS is officially affiliated with the Sciences Department at the University of Luxembourg, offering European Certificate and Master programs in the field of small animal veterinary medicine. WVEPAH was created in 2010 with the support of the OIE. WVEPAH is dedicated to the training of production animal health specialists, including their competence to enforce the "OIE recommendations". The WVEPAH program includes the teaching of an OIE regulation module. Participants who pass the respective examination will obtain the "Certificate in Animal Health: Poultry production" validated by the OIE. With regards to collaboration with the industry, the WVEPAH has partnerships with the pharmaceutical and poultry industries who support our training programs by sponsoring teachers or students. This partnership also ensures the participation of excellent experts from industry to help teaching various aspects of the program. Collaboration with post-graduate training organizations includes all veterinary faculties hosting the 7 current courses. The WPSA, the WVPA and many associations, support the WVEPA Education programs.

Session 5

New methods of on farm killing and of slaughter

Anatomical pathology and behavioural reflex responses induced by nonpenetrating captive bolt devices for on-farm euthanasia of layer chickens

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Abbreviated Title: Nonpenetrating captive bolt devices for euthanasia of layer chickens

Summary

This study evaluated three types of non-penetrating captive bolt devices (Zephyr-E, Zephyr- EXL and TED) for loss of consciousness, cessation of heart beat and severity of brain damage in four different age groups of layer chickens (11, 20, 30-35, and 60-70 weeks). Zephyr-E (120 psi) and Zephyr-EXL (98-100 psi) were powered by compressed air while TED was powered by a gas canister. None of the three devices has been scientifically assessed on layer chickens. Comparison among the devices and age groups were computed statistically with GLM in SAS. Insensibility was observed immediately after device application as measured by pupil, nictitating membrane and pedal reflexes in all birds. With the Zephyr-E, 12.3% failures were recorded (five 60-week old roosters and two 30-week old hens) and no failures were recorded for the other devices. Cessation of heart rate took longest (P=0.009) with TED (201±5 s), followed by Zephyr-EXL (192±5 s), and the shortest in Zephyr-E (176±5 s). Similarly, mean end time of convulsions (P=0.0315) and cloacal contractions (P=0.01) were longest in TED and shortest in Zephyr-E. Older birds experienced the shortest time (P<0.0001) to cessation of heart beat, onset of tonic convulsions, conclusion of convulsions and cessation of cloacal contraction. External bleeding was observed with all three devices (TED: 82.8%, Zephyr-EXL: 85.9%, Zephyr-E: 79.8%). The highest level of subcutaneous hemorrhages (P<0.0001) occurred with TED in comparison to the other two devices. There was no effect of device on the skull damage (P=0.1334). The least brain damage as measured by subdural hemorrhages was caused by Zephyr-E (P<0.0001). Results demonstrated that all three devices induced immediate insensibility leading to death in all age groups of layer chickens. Due to the failure rates, however, TED and

Zephyr-EXL appears to be more efficient than the Zephyr-E for on-farm killing of layer chickens.

Key words: Euthanasia, nonpenetrating captive bolts, layer chickens

Under pressure: determining optimum air pressure for humane euthanasia of mature broiler breeders with an air-powered non-penetrating captive bolt device

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Non-penetrating captive bolt devices have been commercially developed for on-farm euthanasia of poultry species. While a prototype device powered by compressed air was scientifically validated for use on turkeys and piglets, no data existed on the use of commercially available devices for broiler breeders. Our objective was to assess the efficacy of the Zephyr-EXL (Bock Industries), powered at different air pressures, for inducing rapid loss of consciousness and death in mature broiler breeder roosters. We hypothesized that higher air pressures would have higher success rates, but would result in greater external and internal damage. Seventy-five mature broiler breeder roosters (>45 wk of age; 4.7 ± 0.4kg) were killed with the Zephyr-EXL, with 15 roosters killed at each of 80, 90, 100, 110 and 120 psi. We assessed presence or absence of palpebral and nictitating eye reflex immediately after device application to evaluate efficacy, and scored the external damage to the skull on a 3 point scale (from no visible blood to extensive blood from site and orifices). On a subsample of birds (5 per pressure), macroscopic dissections were performed to assess damage to brain, brain stem and spinal cord. Data were analyzed with a Kruskal Wallis analysis. All but one rooster was rendered unconscious immediately after device application (one failure at 90 psi). Overall, there was no effect of treatment on external damage (P=0.091), but roosters killed at 120 psi (score=1.27±0.15) had higher damage scores than all others combined (0.71±0.09; P=0.0086). There were no other differences among pressures in subcutaneous hemorrhages, subdural dorsal hemorrhages, subdural ventral hemorrhages or internal skull damage. Our results suggest that pressures between 80-120 psi are equally effective at humanely killing broiler breeder roosters, although 120 psi resulted in more blood loss, potentially deeming this pressure too high for biosecurity and aesthetic reasons.

Assessing physical methods for on-farm euthanasia of compromised turkeys

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Abbreviated Title: Assessing methods of euthanasia

On-farm euthanasia is an important welfare issue in the poultry industry and is particularly difficult to perform in turkeys. The objective of this study was to determine the effectiveness of two commercially-available non-penetrating captive bolt devices (Bock Industries, USA) for on-farm euthanasia. The Zephyr-EXL is hose-connected to an air compressor, whereas the TED is cordless and powered by a propane fuel cell and battery. Both devices were used by 10 stock people to euthanise turkeys from six commercial farms. The Zephyr-EXL and TED were tested at three ages: 4 weeks (n=41, n=51), 10 weeks (n=39, n=40), and 15-20 weeks (n=42, n=40). After application, brain stem reflexes were monitored every 15s to assess insensibility. Convulsions and heart beat were recorded to determine estimated time of brain death and cardiac arrest. Brain hemorrhages and skull fractures were scored to evaluate traumatic brain injury. Effects of device, age and sex were evaluated. Zephyr-EXL and TED caused immediate, irreversible insensibility in 97.5% and 89.3% of birds, respectively (P=0.0108). Reasons for device failure included incorrect placement, and incorrect adapter selection (TED). For birds rendered insensible, there was no effect of device on any other measures (P>0.05). Tonic convulsions ended later in males (195 ± 6.72 s) than females (171 ± 6.22 s, P=0.0041). Cardiac arrest also occurred later in males (232 ± 6.29 s) than females (208 ± 5.96 s, P=0.0086). Cardiac arrest occurred faster at 4 weeks (197 ± 8.31 s) compared to 10 weeks (222 ± 6.37 s; P=0.0214) or 15-20 weeks (244 ± 6.99 s; P<0.0001). Macroscopic scoring indicated moderate to severe subcutaneous hemorrhage in 71% of birds and severe skull fracture in 97%. Although both devices were effective in the majority of cases, the Zephyr-EXL was more reliable and consistent in causing immediate insensibility and traumatic brain injury leading to death.

Key words: animal welfare, euthanasia, poultry, turkey, captive bolt

Design and development of an industrial equipment farm slaughter of animals with controlled atmosphere considering the OIE's Standards

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Abbreviated Title: Equipment farm slaughter OIE's Standards

Summary

This project is to design and develop equipment for slaughtering farm animals weighing less than 10 kilograms, which is easily transportable and use, economically viable and allows the humane slaughter of animals in compliance with the OIE recommendations. One of the main problems concerning emergency slaughter is having the right equipment to properly implement the OIE animal welfare recommendations. There are countries and situations where, although the intention is good, the poorly-designed available equipment and incorrect use of equipment cause even greater suffering. Furthermore, graphic media images of the farm slaughter process using poor equipment and methods results in heavy criticism by the public. These factors and the variability in conditions between farms to deliver good animal welfare outcomes make enforcement of animal welfare laws very challenging. For this reason, a need arose to develop portable well-designed industrial equipment. This has been designed with the necessary expertise and scientific and technical input to be able to monitor the whole animal management process from handling and moving animals through yards to the point of humane slaughter and confirmation of death. Another important issue is the requirement for the staff to have the necessary skills, experience, attitude and training to use the specially designed equipment to achieve good animal welfare. Therefore, equipment should be of efficient and simple design so that people can be easily trained to use it properly. The prototype created was designed by veterinarians with extensive experience in animal welfare, considering the industry's needs. Specifically, it can be used for farm slaughter of poultry. If used properly, it will guarantee the necessary animal welfare standards for humane slaughter. It will address ethical concerns by the public, is cost effective, safe for operators and supports biosecurity, environmental and aesthetic requirements.

Key words: controlled atmosphere, emergency slaughter, poultry, chicken

Electrical stunning of poultry: impact of electrical parameters stunning efficiency and meat quality

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Abbreviated Title: Electrical stunning of poultry

Summary

Stunning of animals in slaughterhouses is the first essential step before bleeding, inducing a state of insensibility in the stunned animal which lasts until it is dead. To regulate this practice, the European Union introduced regulation 1099/2009 on the protection of animals at the time of killing. The stunning method should ensure immediate loss of consciousness from bleeding to death of animals, to spare them unnecessary physical hardship, stress and fear. In France, electronarcosis using an electric water bath is the method generally used to stun broilers. Commission Regulation requires a minimum current distributed to each animal depending of frequency applied: 100 mA at a frequency of less than 200 Hz, 150 mA at a frequency of from 200 to 400 Hz, and 250 mA at a frequency of from 400 to 1500 Hz. However, applying such parameters can induce carcasses defects. The objective of our study was to compare effect of regulatory parameters (100 mA / 50 Hz; 150 mA / 400 Hz; 200 mA/1000 Hz) and non-regulatory parameters (60 mA / 400 Hz; 100 mA / 400 Hz; 100 mA/600 Hz) on stunning efficiency and product quality. According to our results, Chickens stunned at 100 mA/50 Hz where the ones who show no conscious signs after stunning and during bleeding but some carcass defects as red head and red wings. Chickens stunned at 150 mA/400 Hz, and 200 mA/1000 Hz were the ones who showed no conscious signs after stunning and during bleeding: on the other hand, chickens stunned at 60 mA/400 Hz showed conscious signs as corneo-palpebral reflex and respiration after stunning and wings agitation during bleeding, while they have less carcass defects compared to the group 100 mA/50 Hz).

Key words: Animal protection, Electrical stunning, Poultry, Meat Quality.

Improving poultry handling at slaughter – using an OER online teaching material to meet the requirement for operator training and examination

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Abbreviated Title: poultry welfare slaughter training

Summary

Since 2013, the EU Council Regulation on the protection of animals at the time of killing (1099/2009) requires all slaughterhouse staff handling live animals, from lairage to exsanguination, to hold a certificate of competence. This can be limited to certain species and stunning methods. Initially, most member states applied transitional simplified procedures for experienced staff (Art 29.2) but since the end of 2015 slaughterhouse staff have to take courses and pass an exam to receive the certificate. To facilitate the development of such training course packages, the Swedish Board of Agriculture (SBA), funded the Swedish University of Agricultural Sciences to create an on-line Open Educational Resource (OER) with training material for slaughterhouse staff, including poultry abattoir workers. The material, known by its acronym DISA, is available at disa.slu.se in Swedish and partially also in English.
Since 2013, the SBA has issued a total of 1445 Certificates of Competence, of which 1198 were issued by way of the simplified procedure. In total, 297 certificates relate to poultry, whereof 233 by simplified procedure and 64 after passing the exam. There are 4 nationally approved course providers for poultry slaughter. The main course provider and only approved examiner, Meny, has since 2013 provided relevant training to 391 persons, including the poultry slaughter sector, based on the DISA material and examined 280 persons (80 for poultry). The overall success rate for the exam has been more than 70%. Based on this, we hypothesize that the knowledge about animal welfare among slaughterhouse staff has been improved in line with the content of the OER. The abattoirs have stated that continuous access to online teaching material is useful also after the training phase, whenever questions arise regarding legislation or best practices. The OER also is used by official control staff, and veterinary and animal welfare students.

Key words: Broiler, certificate, competence, examination, layer, poultry, slaughter, staff

Session 6

Welfare at depopulation and during transport

Implementing a solution for watering and feeding poultry during long-lasting transport.

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Abbreviated Title: Solutions for transport

Summary

European Welfare regulations ask for feeding and watering of poultry that are transported for more than 12 hours. Sometimes dedicated slaughter-houses for spent hens are located far from laying farms and journeys last more than 12 hours. There is obviously no technical solution to comply with this welfare requirement. A solution may be providing a consumable nutritive gel in transport crates during long journeys to reduce hunger/thirst. Trial 1: two groups of spent hens (n=10 birds/group) were kept in transport crates, one with and one without water. No differences could be shown between the two groups on hematocrits. Uric acid blood levels were not a good indicator of dehydration because of high variation in levels (10 to >60 units) during first hours of water deprivation and remained high at 70 units for 7 hours after re-watering. Trial 2: six groups of spent hens (n=7 birds/group) were also kept in transport crates for 16h, 24h, or 48h (n=2 groups per duration) with or without gel to analyse water consumption after deprivation.. Whatever the duration of water deprivation, water consumption after re-watering was always higher in groups which were provided with gel (+20%, +30% and +50%) compared to those without (give figures, and P value), seeming to demonstrate that the biological functions and behaviors of these hens had been preserved. Trial 3: commercial spent hens were transported for 26h and given gel (n=750) or not (n=2658); mortality (4.1% vs 1.5%) and condemnations rates (3.3% vs 3.4%) demonstrated no positive impact on birds. Total dead on arrival seems not correlated with the usage of gel (nor with the duration of transport). Gel is now distributed on a large number of transport of spent hens and data are collected to complete the analysis of impact of gel distribution.

Key words: Transport, gel, spent hens, welfare

A new method of stunning poultry: evaluation of physiological and behavioural responses to Low Atmospheric Pressure Stunning (LAPS) in broilers.

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Abbreviated Title: Low Atmospheric Pressure Stunning (LAPS) in poultry

Summary

Low Atmospheric Pressure Stunning (LAPS) renders birds unconscious by progressive hypobaric hypoxia (gradual decompression over 280s). We examined behavioural, electroencephalogram (EEG) and electrocardiogram (ECG) responses to LAPS in broilers, and interpreted their welfare impact. Trial 1: characterised the responses of broilers exposed to LAPS in 30 triplets at two temperature settings (TS3 (13-18ºC); TS4 (5-12ºC)). Trial 2: examined the influence of illumination and sham treatment in a 2x2 factorial design (20 pairs per treatment), at TS4 only. In each triplet/pair, one bird was instrumented for recording of EEG and ECG, and the behaviour of all birds was recorded. Birds consistently exhibited ataxia, loss of posture, convulsions and became motionless during LAPS. TS affected behavioural changes including latency to loss of posture (TS4=62.3±1.1s; TS3=57.5±1.2s ($P<0.001$)) but did not affect latencies to EEG characteristics that indicate unconsciousness. In the sham treatments, illumination increased activity levels and dark induced sleep. In both trials during LAPS, EEG spectral analysis revealed progressive decreases in median frequency and increases in total power (PTOT), followed by decreases in PTOT before the onset of an isoelectric state (brain death). There were increases in PTOT at 50-60s, reflecting slow-wave dominance, indicating unconsciousness. ECG showed latency to pronounced bradycardia in LAPS was affected by TS (TS3=52.5±4.5s; TS4=46.7±2.2s ($P= 0.021$)). In Trial 2, bradycardia was absent in sham and was not affected by illumination (dark=42.5±1.9s; light=49.3±4.8s ($P=0.078$). Collectively, these results suggest that

responses to LAPS are consistent and similar to those observed with controlled atmosphere stunning.

Key words: hypobaric hypoxia, low atmospheric pressure stunning, behaviour, EEG, ECG, animal welfare.

An improved method of depopulating end-of-lay hens from furnished cages

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Abbreviated title: Depopulating hens from furnished cages

Depopulation of end of lay (EOL) hens involves ***catchers*** to remove them from cages, ***carriers*** who receive and carry several by their legs (inverted) from the house to ***loaders*** to place them in drawers of transport modules. This is arduous, stressful to both hens and workers and often results in injuries. Scientific evidence indicates that inversion is stressful so an improved method that reduces handling and avoids inversion was investigated.
When furnished cages came into use, aisle width increased to at least 90 cm. This could allow wheeled trolleys with drawers to be used for depopulation so that catchers could load EOL hens directly into the transport drawers for removal from the house, where they could be readily transferred into aligned transport modules. This method was proposed at a Hennovation workshop in 2015 to reduce labour, decrease damage to the hens and improve their welfare. A subsequent UK industry survey revealed interest in innovative and practical approaches that would improve hen welfare. A network comprising a major egg producer, an equipment manufacturer, a poultry processor and the authors, under the auspices of Hennovation (EU Horizon 2020 project: www.hennovation.eu), has been investigating the feasibility and benefits of improved handling systems.
A prototype trolley was produced and tested on a farm during 2016. Following modifications this proved acceptable and 12 such trolleys were then obtained to enable a full-scale comparison of current and new methods to be made later in 2016. Analysed results of this study, including labour requirements, stress levels and damage to EOL hens using the original and improved methods will be provided when the full paper is presented. There is also potential for mechanisation of catching and loading with this improved method of depopulation which, with further refinement, may also be suitable for use in other housing systems.

Keywords: depopulation; EOL hens; injury; stress; welfare

Relationship between a fitness-for-transport assessment of broilers before transportation and stress physiology

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Abbreviated Title: Broilers' fitness for transport

Summary

EU legislation stipulates that unfit broilers may not be transported, but guidelines on how to assess fitness-for-transport are not provided. Moreover, the effect of transport conditions (e.g. crate stocking density; SD) may depend on the broilers' fitness. We aimed to evaluate a fitness-assessment method and test physiological stress responses to the pre-slaughter phase with different SDs. Ross chickens (41d; n=1,939) were transported for 45min at 'high' (160cm^2/kg), 'medium' (190cm^2/kg) or 'low' (220cm^2/kg) SD, and were subjected to a commercially-representative pre-slaughter phase duration of ≈16h. Prior to loading, lameness, illness, hock burns, footpad dermatitis, lesions, physical defects, cleanliness and cachexia were scored on a sample of chickens, for categorisation as fit (n=49) or unfit (n=25). Blood was collected before and after the pre-slaughter phase for determination of plasma levels of corticosterone (CORT), lactate, glucose and thiobarbituric-acid-reactive substances (TBARS). Scores for lameness, footpad dermatitis, lesions, illness, defects, and cachexia were, or tended to be, correlated with ≥1 physiological stress indicators. Unfit chickens tended to show or showed lower pre-transport glucose (P=0.077) and lactate levels (P=0.001) than fit chickens, suggesting that the assessment distinguishes between chickens with metabolic differences. Post-lairage, unfit chickens had higher TBARS (P=0.036) and lower lactate levels (P=0.025) compared to fit chickens. Plasma CORT levels of unfit chickens were higher than those of fit chickens at high (P=0.040) and low (P=0.016) SD. Furthermore, plasma CORT levels of unfit chickens increased more at low SD (P=0.010). Generally, high SD resulted in higher glucose levels post-lairage (P=0.002). The association between fitness-for-transport indicators and stress physiology, and the

different stress responses depending on fitness, showed that our method potentially identifies chickens that will experience additional stress during the pre-slaughter phase, due to their poor physical condition. Transport at high and low SD proved a stressor for all and even more so for unfit chickens.

Key words: fit for transport; broiler chicken; animal-based measure; stress physiology

Welfare of end-of-lay hens during catching and transport in the winter period

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Abbreviated Title: Catching transport end-of-lay hens

Summary

To get more insight into the effects on welfare of laying hens from the moment of catching to the moment they are slaughtered, 24 flocks have been monitored during winter time. Per flock the management with regards to catching of the flock was recorded, as well as the transport times, DOAs and rejections. Blood samples from 30 hens (from 3 crates) per transport were analysed before the start of transport and directly prior to slaughter. Data loggers were attached on the inside of 3 crates to continuously record the temperature. On average, the transport duration of the laying hens was 10 hours. The actual road transport lasted on average 2 hours. The rest of the time, the trucks stood in the lairage of the slaughter house (on average 8 hours). During transport from the layer farm to the slaughter house in winter time, hens were on average 2/3 of the time within the thermal neutral zone (10-25°C). In general the percentage rejections was low (0.13% total damaged birds -this includes broken bones-, 0.28% DOAs). The time spent in the lairage had no clear effect on damaged birds or DOAs. A longer travel time seemed to result in more DOAs. In the slaughter house, more damaged birds were found if: 1. flocks were withdrawn from food for a longer period of time; 2. a professional catching crew did 100% of the catching (in comparison to the use of own people); 3. birds were carried by hand to the crates (in comparison to the use of lorries); flocks were herded to one compartment prior to depopulation (to reduce the walking distances for the catching crew). The blood parameters of the hens before and after transport gave indications of minor dehydration of the birds.

Key words: End-of-lay hens, catching, transport, management, welfare.

Necropsy findings in Dead on Arrival broilers from normal- and high-mortality transports

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Abbreviated title: Necropsy findings in DOA broilers

Summary

Transport of broilers from the farms to the abattoirs is the one of the largest commercial translocation of live animal groups. It is estimated that approximately 60 billion broilers are slaughtered worldwide each year. Transport mortality rate; i.e. dead on arrival (DOA), is the key animal based measure currently used to assess the animal welfare in transit. In 2015, the mean DOA number in Norway was 0.10 %. In the same period, approximately 5 % of the transports were classified as high-mortality transports (i.e. DOA above 0.3%). In order to gain more knowledge of these transports, DOA broilers form normal- and high-mortality transports were subjected to post-mortem examination. The data sources were necropsy findings in 535 DOA broilers, production and slaughter data, along with transport distance and duration for the 61 studied flocks. The most frequent pathological finding was lung congestion (75.5 %). This post-mortem finding was significantly more common in broilers from high mortality transports (89.3%) than in broilers from normal-mortality transports (58%). The following production variables had a significantly higher prevalence in the high-mortality flocks: foot pad lesion score, carcass rejection numbers, transport distance and transport duration.
The results indicate that high mortality during transport to the abattoir may be linked to several steps in the broiler production chain. To target such transports a holistic view is needed. Aspects to consider are health during the production period, transport environment and transport distance.

Keywords: DOA, broiler, transport, post-mortem finding, animal welfare

Pre-slaughter thermal stress in broiler chickens and related risk factors

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Abbreviated Title: Pre-slaughter thermal stress in broilers

Summary

During the pre-slaughter phase broiler chickens may experience thermal stress. We aimed to assess the impact of thermal conditions on, and identify potential risk factors for, thermal stress. Per transported flock (n=50), 1-3 temperature-humidity loggers were placed in-crate. Additionally, data were collected on weather conditions, truck curtain configuration (open/half-open/closed), stocking density, transport and lairage duration, ventilation and wetting during lairage. Transport microclimate was documented with a temperature-humidity-index (THI; 0.85*dry-bulb-temperature + 0.15*wet-bulb-temperature). Thermoregulatory indicators were assessed before transportation and after lairage: body temperature, body weight, panting and huddling prevalence. The abattoir provided mortality% and rejection% data. Transports were categorised in four groups (hot n=18, medium n=13, neutral n=13, cold n=6) based on mean THI, maximum THI, and the duration of THI>20°C. Both before transportation (P=0.028) and after lairage (P=0.009), body temperature (mean±SE) was or tended to be higher under hot and medium compared to neutral and cold conditions (Before: hot 41.34±0.06°C, medium 41.29±0.07°C, neutral 41.15±0.07°C, cold 41.00±0.10°C; After: hot 40.64±0.07°C, medium 40.51±0.09°C, neutral 40.34±0.08°C, cold 40.21±0.12°C). Panting prevalence was higher under hot conditions compared to medium, neutral or cold conditions before transportation (hot 3.80±1.11%, medium 0.20±0.14%, neutral 0.03±0.02%, cold 0.0±0.0%; P<0.001) and higher than under neutral conditions after lairage (hot 2.85±0.99%, neutral 0.19±0.10%; P=0.007). Group (hot, medium, neutral, cold) mortality%, rejection%, huddling prevalence and body weight did not differ. Outside temperature (hot 16.5±1.1°C, medium 10.9±1.2°C, neutral 8.3±1.2°C, cold 5.0±1.8°C), wind speed (hot 3.0±0.3m/s, medium 3.2±0.4m/s, neutral 4.1±0.4m/s, cold 5.2±0.5m/s), and truck configuration (open: hot 77.8%, medium 46.2%, neutral 30.8%, cold 0%) differed between thermal groups (P≤0.003), indicating those as potential risk factors for thermal stress. Panting occurred under hot conditions, but body temperature remained within normal range. This may indicate that thermoregulatory behaviours helped the birds to cope with the studied hot conditions. Open curtain configuration seemed to alleviate heat stress.

Key words: microclimate, transport, broiler chicken, heat stress, thermoregulatio

Session 7

New contributions of PLF for behavioural assessment

Using tri-axial accelerometers to determine hazardous pathways for laying hens in aviaries

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Abbreviated Title: Hazardous pathways for hens

Summary

Complex housing systems, such as aviaries, can result in falls and collisions, contributing to the high number of keel bone fractures in laying hens. Our study examined the acceleration vectors (AVs) associated with bird movements in an aviary system and produced quantifiable data to indicate hazardous navigation pathways within the system. The aim of the study was to identify pathways with the highest AVs to define features of housing design associated with hazard, and to allow focused modifications to reduce falls, collisions and levels of keel bone fractures.
Tri-axial accelerometers were fitted to laying hens housed in eight semi-commercial pens across two flocks, with seven or eight focal birds per pen. Sensors were placed on the keel and back, producing an output when a pre-set threshold was reached (~15*g*). Accelerometer output was matched to video recordings, linking behaviour, location, and path of the hen. Bird movements were classified as either controlled or uncontrolled.
Movements between a medium perch and the nest box (n=76) resulted in 32% of movements with an AV >50*g* and 74% falls. Movements between a lower perch to the nest box (n=47) resulted in 23% of movements >50*g* and 47% falls. Of movements between the upper tier and a medium perch (n=144), 23% were >50*g* and 52% were falls. In comparison, movements between the litter and the lower tier (n=319), 15% were >50*g* and 11% were falls. Movements between the top perch and the litter (n=88) resulted in 13% of all movements >50*g* and 9% falls.
Our data demonstrate that accelerometers can define hazardous navigation pathways in aviaries, providing an evidence base directing focused improvement to system designs. Initial results suggest that navigation around the nest box and the top tier to the lower levels should be altered to make transitioning less hazardous for the hens.

Key words: laying hen, movement, accelerometer, falls, hazardous, keel bone fracture

Activity and occupation patterns analysis as broilers' welfare indicator

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Abbreviated Title: Activity and occupation broilers´ welfare

Summary

Monitoring activity and floor occupation patterns of broiler chickens enables people to detect management problems in the house using Precision Livestock Farming technologies. Such problems include blocking of feeder or water lines, power failures or climate control malfunctions. The aim of this work is to illustrate how tracking deviations from normal patterns makes it possible to establish a link with the welfare status of the flock as well.
In this study, the Fancom eYeNamic® system, comprising four top-view cameras, was installed in one commercial broiler farm in The Netherlands. This system visualised the floor area and continuously recorded time-lapsed images during the light periods for 8 complete growing cycles, which produced activity and occupation indices captured each minute. This provided the capacity to raise alerts when deviations between the gathered data and the predicted levels were higher than 20%. It has been proven that monitoring occupation is possible to detect management problems with 95% accuracy. When these deviations were expressed as the percentage of time birds spent in an alert situation along the growing cycle, a statistically-relevant correlation ($p<0.05$) with the welfare quality assessment scores was found.
Thus, monitoring these deviations in the activity and occupation time-series allowed staff to reduce possible welfare problems, such as foot pad lesions or hock burns, at the end of the cycle. Moreover, linking these alerts of technical problems during the production cycle to welfare quality assessment scores shows which factors are likely to impact broiler's welfare and health status.

Key words: broilers, welfare, behaviour, precision livestock farming

Longitudinal observations of individual hens access to an outside area indicates highly consistent patterns of use

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Abbreviated Title: Ranging patterns in hens

Summary

Provision of an area outside the house provides benefits and detriments to the hen and producer, though those effects have largely been limited to flock-level observations. Limited information suggests that sub-populations do exist and associate with behavioural phenotypes. The current work sought to expand our knowledge of how individual hens use the outside area of a commercial system over an extended period. Four side-by-side pens were observed, each containing 355 Brown Nick laying hens and three connected outside areas: winter-garden, yard covered in stone, and a grass-covered pasture area. Each area was outfitted with radio frequency identification antennae that allowed tracking of animals within the three outside areas and, by default, within the house. At population (18 wks of age), 110 hens from each pen were selected in a stratified manner and given a transponder, which, when in proximity to the antennae, registered that animal's presence. Each focal animal's location within the key areas could then be generated and analysed. Our analysis revealed *large individual differences in temporal* patterns for use of the outdoor areas. While some individuals entered the range area shortly after the pop holes were opened, some delayed entering the range area by hours, and others rarely exited. These patterns were surprisingly consistent over time. Interestingly, birds entering the range earlier showed much less intra-individual variation than the late birds. The timing of entering the range area was correlated with several other measures describing the spatio-temporal activity patterns of the birds (durations spent in the different areas, order of appearing in the areas, leaving times, number of visits), allowing us to identify consistent individual phenotypes. Multivariate analysis suggests that most of the observed variation in spatio-temporal patterns can be explained by two major axes and that most individuals can be assigned to one of two major clusters.

Key words: range use, outside, RFID

Monitoring laying hens' range use with hen-mounted light sensors

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Abbreviated Title: Light-based range use monitoring

Summary

Studying the ranging behaviour of individual hens is very difficult without the use of an accurate automated monitoring system. To assess the accuracy of a novel light-based monitoring system we compared outputs to direct observations of hen location. Fourteen hens from a commercial flock (British Blacktails, 45 weeks old, total flock size 2000) were equipped with a device that measured and stored light levels each minute. Attempting to equip hens that varied in their range use, 7 hens were caught on the range and 7 inside the house. Data were collected 2-7 days after equipping. Hen location (in/out) was determined by comparing the hen's sensor to four ambient light sensors placed in the brightest areas of the shed. When the reading of a hen-mounted sensor exceeded that of all inside ambient sensors, the hen was considered to be outside. To avoid collecting data when inside and outside light levels were too similar, two additional ambient light sensors were placed outside, and data were discarded when min(out) <1.1*max(in). This resulted in daily data collection starting between 07.11 and 07.45 and ending between 16.20 and 16.35, corresponding with sunrise and sunset for that time of year (November). In addition, 0-30 minutes of data per day when the sun shone through the popholes (around 08.00 or 14.30) had to be discarded. The accuracy of the system was then evaluated by direct observation of the equipped hens (206 min in total). Monitoring and observations were in agreement 92% of the time. The monitoring system indicated that hens originally caught outside spent a much greater percentage of the monitored time on the range than those caught inside (median (Q1-Q3): 42% (40-51) vs. 6% (3-17), P<0.001, Wilcoxon rank-sum test). We conclude that the system shows great promise as a tool to monitor range use.

Key words: Laying hen, outdoor, range use, automated monitoring, sensor

Automatic ultra-wideband sensor detection shows selection on feather pecking increases activity in laying hens

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Abbreviated Title: Selection on feather pecking increases **a**ctivity in laying hens

Summary

Feather pecking in laying hens has been associated with increment of home-pen activity and postulated as a model for hyperactivity disorder. Here, we assessed if hens divergently selected on feather pecking (high feather pecking: HFP; low feather pecking: LFP) and a control line (CON) differed in activity in a novel arena. We used the automatic ultra-wideband sensor technique of Ubisense® to detect location of an individual hen inside a test-room of 760 cm x 820 cm. The room was equipped with four sensors, one in each corner of the arena. Hens were habituated to a backpack in their home pen, and placed inside the test-room after adding an active sending tag to the backpack (dimensions tag: 4 cm *(l)* x 4 cm *(w)* x 1.4 cm *(h)*, weight: 19 g including 3V lithium battery). For five minutes we sampled the location of each hen twice every second. Data was analysed by means of the Tracklab software developed by Noldus (Wageningen, The Netherlands). After correction for outliers, we assessed line differences with a mixed model with a fixed effect of line and a random effect of pen. Hens selected for high feather pecking walked almost the double distance compared to control and low feather pecking hens, as indicated by total distance moved (HFP: 1016.7 ± 148cm, LFP: 651.9 ± 121.9cm, CON: 523.6 ± 91.0cm; $F(2,121) = 4.42$, $P = 0.01$). Our data supports the hypothesis of a hyperactivity disorder model of feather pecking. This automated activity method could be used to detect hens with a propensity for feather pecking. Further research will focus on activity differences between the different phenotypes: pecker, victim, pecker+victim and neutral, to consolidate our findings.

Key words: Laying hens, feather pecking, ultra-wideband tracking, activity, sensor technology

Monitoring individual chickens' positions in a free-range area using Ultra-Wideband technology

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Abbreviated Title: Tracking individual chickens

Summary

In behavioural research, chickens' free-range use is mainly monitored using visual observations. These have several disadvantages, therefore our aim was to develop a system that automatically registers free-range chickens' positions. For this purpose an Ultra-Wideband (UWB) system was designed to meet the demands specific for this study, regarding accuracy, signal strength, battery lifetime, size and weight. This system uses active tags, sending out signals to anchors at fixed positions; when three or more anchors receive the tag's signal, its position can be calculated. The system consisted of seven anchors placed on a 100 x100 m field, of which 50% contained dense vegetation (short rotation coppice with willow). Lifetime of the latest version of the tags was estimated to be 60 days (update rate: 1/min). The tags' dimensions were 75x49x17 mm and they weighed 36 grams. They were placed in a plastic casing, which was fitted in a backpack that can be attached to the chicken. Analysis of accuracy and signal reception measurements are currently ongoing, but preliminary results indicate an accuracy of ~70 cm, which increased towards the centre, and decreased towards the edges, of the field. Signal reception also decreased towards the edges of the field, and was negatively influenced by the presence of vegetation. Whether wearing a backpack with tag affected the chickens' behaviour is currently being studied. When comparing 30 birds equipped with tags to those without tags from week 5-10, welfare indicators (foot pad dermatitis (0 vs. 7%), hock dermatitis (both 7%), abnormal gait (83 vs. 80%), cleanliness (both 0%)) and weight increase (0.78 vs 0.72kg) (respectively)were not negatively affected by the tags ($P>0.1$). In conclusion, although signal strength was diminished in dense vegetation,

this may be solved with extra anchors, and this system appears suitable for monitoring individual chickens' positions in flocks with free-range access.

Key words: broiler chicken, outdoor, automatic positioning system, accuracy, welfare

The fractal organisation of ultradian rhythms in poultry behavior

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Abbreviated Title: Fractal organisation of ultradian rhythms

Summary

The temporal organisation of biochemical and physiological processes involved in animal behavior, such as hormonal secretion, sleep, and locomotion, has evolved periodicities that match the external world (i.e. circadian day/night cycles, or circannual seasonal cycles), and endogenous spontaneous patterns that can be complex and non-periodic. A large body of evidence indicates that some behavioral processes (e.g. locomotor activity, swimming patterns, social behavior) exhibit robust scale-invariant fractal patterns and long-range temporal correlations. By definition, fractals are composed of parts that at different magnification scales resemble the whole, i.e. they are self-similar. This self-similarity trait, when applied to time series, renders fractal temporal fluctuations across multiple time scales. Hence, animal behavior displays both periodic rhythms and fractal dynamics yet the relationship between these two dynamic regimens remains unexplored. Herein we studied locomotor time series of visually-isolated Japanese quails sampled every 0.5s during 6.5 days (>1 million data points). These high-resolution, week-long, time series allow simultaneous evaluation of ultradian rhythms as well as fractal organisation. Irrespective of visual isolation, all animals exhibited synchronised ultradian rhythms. Wavelet analysis of time series showed that all birds exhibit the same circadian and ultradian behavioral rhythms (12, 8, 6, 4.8, 4h and lower). In addition, all birds presented a similar overall fractal dynamics (for time scales between 30s to >4.4h). This is the first demonstration that avian behavior presents fractal organisation that predominates at shorter time scales and coexists with synchronised ultradian rhythms. This chronobiological pattern is advantageous for

keeping the organism's endogenous rhythms in phase with internal and environmental periodicities, notably the feeding, light-dark and sleep-wake cycles. Moreover, the novel approach, based on wavelet analysis, presented herein for detecting ultradian rhythms as well as assesing rhythm syncronization between animals are useful tools for assesing potential effects of stressors on animal physiology/behavior.

Key words: Locomotion, quail, long-range correlations, wavelets, detrended fluctuation analysis

Session 8

On field Welfare Monitoring

An app assessing broiler welfare through animal-based measures

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Abbreviated Title: Broiler welfare assessment

Summary

TIBENA (Terrena animal-based welfare measures for a New Agriculture) for broilers is an innovative tool aimed at assessing chicken welfare on-farm through 37 animal-based welfare indicators. This welfare assessment tool, based on the 5 Freedoms, helps identify good practices and generates key recommendations in order to support farmers' animal welfare improvement process. The results are used to discuss various aspects of flock welfare and management with the farmer: water and nutrition, comfort, health, stress level and animal behavior.
Construction of the tool began with an exhaustive consultation process: bibliography (mainly Welfare Quality), interviews with scientists and professionals. Then, the trial app was assessed on the field using 30 farms, and with an expert committee, until the tool was considered reliable and robust enough to be used commercially. Reproducibility was tested, in order to select measures that were as objective as possible. Technical feasibility was tested by different operators, and scientific validity was followed until the end with bibliography and experts.
The animal-based measures are collected through individual and global observations of broilers (about one hour). The app automatically generates a score for each welfare indicator, which is then aggregated per Freedom. The results aim to give an objective picture of the flock's overall welfare state. Thanks to the clear and illustrated instructions, and the convenience of a smartphone app, anyone can use the tool and obtain a valid result. The app contains recommendations to drive welfare improvement, with the primary goal being to encourage and help farmers making progress.
Since October 2016, the app is used by 10 agricultural advisors. 23 will use it by the end of 2017. The longer-term goal is to make the app available to the whole industry, starting with Terrena's members, which represent 22 million broilers per year. Today, TIBENA also exists for pigs, rabbits and dairy cattle.

Key words: TIBENA, assessment, welfare, broiler, app

Epidemiological study about feather pecking in laying hens housed in free-range and furnished cage farms in France

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Summary

Beak trimming is currently used in France to avoid negative consequences of severe feather pecking. However, this practice is disputed regarding animal welfare and already forbidden in some European countries. This study aimed to: i) evaluate the prevalence of feather pecking in French laying hens farms, ii) describe how farmers manage with this behavioural disorder and iii) get a better understanding of its related factors. An epidemiological study was conducted between May 2015 and June 2016 in layer farms of four French regions representative of French egg production. All flocks included were trimmed beak brown layers. A total of 79 furnished cages and 80 free-range flocks were visited. Data collected included plumage condition, skin damage and beak condition as well as farm and hen house characteristics, bird performance and management (through a questionnaire filled in with the farmer). Results showed poor plumage score (i.e. score >2) in 24 flocks out of 79 in furnished cages (scale: 0= perfect plumage to 6= very poor plumage) but was not associated with high mortality (mean= 3.4%). Regarding free-range systems, 19 flocks out of 80 had poor plumage score (plumage score >2). Seven of these flocks also had high mortality which reached 16.3% (mean= 4.9%). In these farms, feather pecking was confirmed by farmers. The prevalence of severe feather pecking associated with high mortality in free-range system is estimated at 8.3% (confidence interval= 95%; [0.02-0.14]). The ongoing data analysis aims to identify factors related to poor plumage condition and high mortality (in free range system only) with statistical tools as Chi-squared, Wilcoxon, Kruskal-Wallis and Spearman tests.

Key words: laying hens, welfare, plumage, feather pecking

A comparison of on-farm duck welfare assessment methods

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Abbreviated Title: On-farm assessment of duck welfare

Summary

Although duck welfare evaluations have been used in on-farm research, flock audits and health checks, little is known about the impacts that the assessment method may have on the results. We compared the outcomes of welfare assessments conducted on commercial Pekin duck farms using two methods: catch-and-inspect (CAI) and transect walks (TW). Two flocks (approx. 5850-6300 ducks/flock) of 30-day-old ducks were evaluated on each of three farms, which were managed using identical husbandry protocols. Each flock was evaluated independently by two observers using both methods (in random order) on the same day. During CAI, 30 ducks were corralled and evaluated in each of five randomly-selected barn locations (150 ducks/flock). During TW, the observers walked predetermined paths, delineated by drinkers and feeders, along the length of the house. The observers, during CAI as well as TW, evaluated the proportion of ducks with dirty feathers (DF), damaged feathers (FQ), blood on feathers (BF), stained or infected eyes (EYE), plugged nostrils (NOS), and those that appeared sick (S). Foot pads were scored during CAI, and gait (GS0=no visible problems to GS2=reluctant to walk) was scored during TW. The data were analysed using ProcMIXED in SAS (v9.4). Higher proportions of ducks were determined to have DF, FQ, BF, NOS (all p=0.001) and EYE (p=0.003) using CAI than TW. The incidence of foot pad lesions was positively correlated with the incidence of GS2 (Pearson correlation, r=0.98). Whereas CAI is most often used for evaluating duck welfare during research and audits, TW resembles the daily welfare checks performed by farm personnel. Since the CAI method yielded consistently higher estimates of welfare issues, differences in how flock welfare is perceived by researchers, auditors and farm personnel may be partially explained by the method used to evaluate the flock. Further work is needed to determine the accuracy of each method.

Key words: Pekin ducks, welfare assessment

On-farm health and welfare risk factors for pre-slaughter mortality and condemnations in commercial male turkey (*Melagris gallopavo*) flocks.

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Abbreviated Title: Welfare of commercial male turkeys

Summary

To decrease housing- and feeding-related economic losses, while improving bird welfare, it is necessary to identify and remove unhealthy individuals that will not reach end of production, while preventing them from unnecessary suffering. The aim of this study was to identify on-farm health and welfare problems of commercial male turkeys at 16 weeks of age, for pre-slaughter mortality and condemnations at the slaughter plant. Ten hybrid turkey flocks (1 flock/barn/farm) raised under similar management protocols were evaluated using transect walks method. Each barn was subdivided longitudinally into four predetermined transects. An observer walked the transects in random order at the 16th week of production and recorded the total number of birds per transect that were: immobile (I), lame (L), with visible head- (H), vent- (V) or back- (B) wounds, small (SM), featherless (F), dirty (D), sick (S), terminal (T), or dead (DE). Mortality rates and slaughter plant parameters: livability (%), condemned (total, whole and parts), dead-on-arrival (DOA%), average weight gain (grams), age (days), gain/day for each flock were obtained. We calculated Pearson correlation in SAS software (v 9.3). Proportion of I and L birds, identified at 16th week of life was highly and positively correlated with percentage of total- (r=0.78 and r=0.97) partial- (r=0.63 and r=0.78) and whole birds' (r=0.79 and r=0.93) condemnation at the slaughter plant. Proportion of L birds was positively correlated (r=0.65) with DOA%. Proportion of S birds was positively correlated with partial condemnations (r=0.75), while SM birds' proportion with rejections of the whole carcasses at the slaughter plant (r=0.63). If farmers, based on a welfare assessment, could better identify birds to be excluded from the flock at the 16th week,

listed above losses at the slaughter plant could be avoided, while costs reduced, increasing profitability of the production and ultimately welfare of the birds.

Key words: turkey, transect walks, welfare, mortality, condemnations, indicators

Surveillance of laying hen welfare in multi-tier loose-housing systems with non-debeaked birds

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Abbreviated Title: Laying hen welfare loose-housing

Summary

Conventional cages were banned in Sweden in 1988, and there has been a ban on de-beaking for even longer. Today 15% of Swedish layers are kept in enriched cages, 9% in indoor single-tier and 57% in indoor multi-tier systems, whereas 19% have outdoor access (organic or free range). During the transition period from conventional cages to alternative systems, the Swedish Egg Association, together with representatives from the Swedish Board of Agriculture and the Swedish University of Agricultural Sciences, developed a layer welfare programme in order to monitor and ensure that the welfare of the layers was not negatively affected. This programme is still running and consists of on-farm visits every fourth year with data collection and grading of 25 control points (housing, biosecurity, welfare and management) on a scale from 4 (best) – 0 (worst). The result decides the stocking density in the multi-tier systems. In this pre-study we have therefore analysed the results for key welfare indicators regarding the condition of the birds, for all commercial Swedish laying hen farms with the multi-tier system during one control cycle, which is four years (2012-2015). Selected control points were mortality, body condition, plumage, foot health and pecking injuries. The total number of flocks seen was 189, of which 94% were white hybrids, with a flock size ranging from 1,300 to 57,500 layers. Average monthly mortality, between 40-57 weeks of age, was 0.32% in 2012, 0.31 % in 2013, 0.25% in 2014 and 0.27% in 2015. Injurious pecking was only observed in one of the 189 flocks. Plumage condition was top scored in 75% of the flocks at 40-57 weeks of age. In 14% of the flocks, plumage condition was score 3. Good management and low infection pressure is a likely reason.

Key words: Layers, welfare, loose-housing, non-debeaked, beak trimming, plumage, mortality

Validation of the EBENE method's measures for indoor broiler

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Abbreviated Title: Welfare assessment in broilers

Summary

Further to a request from the poultry industry and in a progress objective, a shared and practical method of commercial poultry and rabbit welfare assessment was developed: EBENE method. This assessment method was crafted to be implemented by producers once per flock a week before slaughter, thus its application should be easy to implement fast (one hour per assessment) and efficient. Seven broiler farms were visited in order to validate the relevance of the indicators and the practicability and repeatability of the method. Two assessors realized the protocol together on the same population sample and did the assessment a second time the following day. First, behavioral indicators measures were conducted on two areas of the building (about 100 animals / area) and then sanitary indicators measures were realized on three transects, covering 1/3 of the total number of animals (considered as homogeneously distributed in the building). Results of intra assessor repeatability showed that conclusions on a farm status were relevant (significance threshold of 0.05) for 16 indicators on 17, except for indicator "head injuries" rarely observed in our sample. Inter assessor repeatability showed that 15 indicators on 17 were relevant except for indicators "head injuries" and "stretching". The practicality of the method is confirmed with a lower total duration (26min +/- 5min for behavioral data and 24min à +/- 6min for sanitary data) than required in the specifications. Correlations between indicators or modifications of observation techniques will potentially allow simplification of the protocol in order to finalize the method. Once the protocol is stabilized and validated, work efforts will continue on result's aggregation to allow representation and use of the EBENE method as a tool for progress for professionals. Furthermore, creation of an ergonomic tool will facilitate deployment of the method on a large scale on the field.

Key words: Welfare assessment, indicators, broiler.

Characterisation of activity budgets of turkeys during commercial production: Effects of flock age?

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Abbreviated Title: Activity budgets in commercial turkeys

Summary

Modern meat poultry exhibit high growth rates and production efficiencies. Previous studies have described some growth related myopathy associated with these desirable production traits. There is limited published data on the daily behaviour and activity budgets of commercial turkeys, as well as any associated aetiology of the idiopathic myopathies. Therefore this pilot study was established to generate a detailed behavioural ethogram for turkey behaviours and an understanding of turkey behavioural activities during production, providing a baseline for future trials. All turkey behavioural activity was digitally video recorded continuously between 4-11 weeks of age in two commercial houses (4 CCTV cameras per house). Scan samples were taken to tally the activity/behaviour of each bird in view at four time points per day (07:00, 11:00, 15:00 and 19:00), with two sample days taken per week between 4-11 weeks. House was confounded by strain (House 3=T9; and House 4=Hybrid Grademaker), with the starting flock size of 7650 female birds per house. A behavioural ethogram was established using pilot video footage, which contained 20 behaviours (e.g. sitting, sleeping, perching, standing, eating, drinking, preening, and walking). Behavioural data was averaged to generate activity budgets per week and behaviours were analysed at individual behaviour level as well as at aggregated levels (e.g. active and inactive) using GLMMs (Genstat - 15th Edition). Production and environmental measures were recorded daily. The percentage of active behaviours did not change with bird age (P=0.596), nor strain (P=0.081). However, bird age had an effect on locomotor behaviours (P=0.048), with a decrease in locomotor behaviours, as bird age increased. Bird age was shown to have an effect on comfort behaviours (P=0.050), with a higher proportion of older birds displaying comfort behaviours compared to younger. Quantitatively there appears to be changes in turkey behaviour with age, with birds showing a trend to be less active as they get older. The pilot study provides valuable information through the development of an ethogram and an insight into the changes of turkey behaviour during production.

Key words: Turkey, behaviour, activity budget, animal welfare.

Foot pad dermatitis is infrequent in Finnish broilers

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Abbreviated title: Foot pad dermatitis in Finnish broilers

Summary

Foot pad dermatitis is a common condition reducing the welfare of broiler chickens. It is characterized by lesions on the foot pads. There are many factors influencing foot pad health, such as bedding material and quality, housing conditions and gut health. In Finland approximately 65 000 000 broilers (3500 flocks) are slaughtered every year. Much attention has been paid to the factors affecting broiler welfare. The most commonly used bedding material is peat. Air conditioning in the challenging climate has been focused on. Gut health of broilers is good with no signs of necrotic enteritis. Foot pad lesions as a broiler welfare indicator are evaluated at slaughter by the meat inspection veterinarians by assessing one foot pad of at least a hundred birds of each slaughter batch. According to the severity of the lesions, based on the depth of the damage, points are awarded in three classes 0, 1 and 2. Class 0 corresponds to a healthy foot pad, class 1 to mild superficial inflammatory changes and class 2 to deep inflammation. A foot pad score is calculated on the basis of these points. The foot pad health of a flock is considered to be good, if the score is less than 40. A score of more than 80 refers to obvious problems in the flock's welfare and is a subject for notification to the Regional State Administrative Agency. The producer must take immediate steps in order to improve the rearing conditions. National data (> 95% of the production) of the foot pad lesion scores is collected by Animal Health ETT in Finland. For almost all the flocks in the years 2012-2016 the score was less than 40 (94,5-98,4 %), and even < 20 was achieved by 79.2-92.4% of all slaughtered broiler flocks in Finland in these years. Conclusion: Good housing conditions, peat as bedding material, whole grain feeding (low protein, high digestability) and excellent gut health of the broilers with no need for any vaccination or antibiotic treatment for the seven last years give a solid basis for good foot pad condition and welfare of the Finnish broilers.

Key words: Foot pad dermatitis, welfare, broiler.

A shared and practical tool for welfare assessment in poultry and rabbits: EBENE

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Abbreviated Title: Welfare assessment in poultry

Summary

Recent European (regulation) and international (OIE) welfare texts increasingly focus on results assessed with animal based measures and stakeholder empowerment (animal welfare training, good practices guidelines, etc.). To help poultry and rabbit sectors with this aim in view, a practical and shared method for assessing welfare is under development: EBENE method. The first step was to agree on a methodological framework with a pilot group of professionals. The second step was to propose indicators and methods of measurement specific to each sector within five working groups: meat sector (broilers, turkeys, ducks, guinea fowl, and quails), laying hens, ducks for foie gras, and rabbits. The third stage aimed to take into account the views of other stakeholders. From the beginning of the process, NGOs (CIWF, Welfarm) and scientists in the field (INRA, ANSES, ISA Lille, Oniris) were consulted on methods for broiler / turkey and laying hens in cages. Meetings between poultry and rabbit industry and other civil society stakeholders (NGOs, scientists, competent authorities, distribution) allowed the different stakeholders to share the EBENE method, as a tool for welfare and technical progress. Finally, the current method integrates all the components of welfare and is based on the principles and criteria grid established in the Welfare Quality® Project. Farmers, technicians and / or veterinarians could use it. Currently, first proposals for measures are available in broilers and turkeys, rabbits and laying hens in cages. These measures are being validated and adapted to alternative farms and other species. Thus, they will evolve during 2017 following scientific validation, confrontation with their users and exchanges with the various stakeholders. These steps are still needed in order to aggregate and present the results.

Key words: Poultry, rabbits, welfare assessment, indicators, shared tool.

Reflections on Monitoring Five Years of Welfare Outcome Assessment Data for Laying Hens in a UK Farm Assurance Scheme

Elwes, S. & M. Fernyhough

Abbreviated Title: Monitoring Welfare Outcomes Data for Laying Hens

RSPCA Assured is a private farm assurance scheme that introduced welfare outcome assessments into its farm audits for its laying hen members in 2011. The welfare outcome assessment protocols were developed as part of AssureWel™; to ensure consistent application and data quality, the protocol contained a small number of measures which had objective scoring systems. Exclusion of some measures and some compromises in scoring sensitivity were necessary to ensure protocols were practical for use within farm assurance scheme assessments. This approach allows monitoring of key welfare outcomes in order to support welfare policy objectives, standards developments and improvement strategies. Data were collected on seven animal based measures for laying hens across five years (averaging 735 assessments per. year). Measures included assessment of (1) feather loss using a 3 point scale on two body regions: 'Head and Neck' and 'Back and Vent'. Feather cover, considered to be an important indicator of welfare performance improved by 13% and 8% in 'Head & Neck' and 'Back & Vent' respectively between 2011 and 2016. Other measures included (2) dirtiness of birds, (3) antagonistic behaviours, (4) beak trimming status, (5) flock demeanour, (6) birds requiring further care and (7) mortality levels (previous flock, current flock at the time of assessment and current flock to 40 weeks of age). A range of information relating to breed, housing and rear were also recorded and explored in analysis. RSPCA Assured Assessors were trained to carry out assessments using a standardised method and to feedback results to farmers in a manner that encourages the uptake of advice and to make welfare improvements on farm. Scheme level changes in the seven measures were monitored and used to drive improvement at both a farm and scheme level and monitor the effectiveness of improvement and intervention strategies.

The transect method for on-farm broiler assessment: estimating detectability and double counting

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Abbreviated Title: Transect method validation

Summary

The transect method consists on a set of walks in paths delineated by feeder and drinker lines, along which the incidence of validated welfare indicators are collected for on-farm meat poultry welfare assessment. However, it is still unknown how assessments could potentially be biased due to double counting birds or the reliability of the method to detect individuals with a particular welfare problem. To address these two issues a study was conducted in 9 commercial flocks. In each, 80 birds taken randomly in eight locations were individually marked. Starting the following day, the location of marked birds was collected for two consecutive days by two observers (Obs) performing two scans (all transects in the house)/day and house. Detection rate (DR), bird repetition rate per transect (RRT) and scan (RRS) were calculated. Obs, day, number of transects/house (6 or 8) and scan time effects were estimated with GLM ANOVAs. RRT and RRS were similar for both Obs ($P>0.05$), but some differences were obtained for DR (68.58±0.99 and 63.23±1.28%, mean±SE for Obs. 1 and 2, $P<0.001$). RRS and RRT were higher for a.m. as compared to p.m. assessments (RT: 2.84±1.19 and 0.0±0.0 %, RS: 25.48±0.84 and 22.58±1.28%; for a.m. and p.m. assessment; $P<0.05$). RRS was higher for houses with a lower number of transects as compared to 8 per house (27.55±0.81 and 20.52±1.02%, for 6 and 8 transects/house; $P<0.001$). Day of observation had no effect ($P>0.05$). These results indicate similar RRT and RRS across obs. but DR did vary in around 5%. RRT remained quite low, and for both RRT and RRS lower detection during p.m. probably coincided with a lower bird activity. RRS was relatively high, thus assessing the entire house may not contribute to higher certainty in the estimation of the welfare status of broiler flocks.

Key words: welfare, assessment, double counting, detection rate.

Does equipment for automated behavioural monitoring change hen behaviour?

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Abbreviated Title: Does monitoring affect behaviour?

Summary

Automated monitoring of behaviour can provide a wealth of information, but often requires attaching equipment to focal animals which can alter behaviour, invalidating the data collected. Specifically, laying hens often respond aggressively to flock members with even minor alterations in appearance, causing equipped hens to flee, fight or hide. We evaluated the effect of 50g 'backpacks' on hen behaviour using direct observations. These 'backpacks' contained two monitoring devices (a light sensor and an accelerometer) and a location device. The equipment was wrapped in brown tape and fitted to the hen's back using elastic loops around the wing base. Fourteen hens (British Blacktails, 45 weeks old) were equipped. These hens were housed on a commercial free-range farm in a flock of 2000 hens. Behaviour of equipped and non-equipped hens was observed 2, 3 and 7 days after equipping (5 min/bird/day, alternating between equipped and non-equipped hens) and compared using Wilcoxon rank-sum tests. None of the equipped hens were ever observed to flee or fight. Although equipment tended to increase the frequency of pecks received on day 2 and 3 (P=0.08 and 0.05, respectively) by comparison with non-equipped birds, median values were 0 for both groups and differences in interquartile range were small (0-0 vs. 0-0.3 and 0-0 vs. 0-0.6 pecks/minute, respectively). Equipped hens generally showed no reaction to these pecks (which included all types of pecks except severe feather pecks). Equipped and non-equipped hens were not found to differ significantly in the proportion of time spent eating/drinking, foraging, perching, preening, sitting, standing, walking or in the nest box, or in their frequency of body-shaking and pecking other hens (all P-values >0.05 for each day). Although further evaluation in other flocks is required, this system seems to have only a very minor impact on behaviour, confirming its suitability for collecting automated behavioural data.

Key words: Laying hen, behaviour, automated monitoring, aggression

Validation of the EBENE method's measures for laying hens housed in cages

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Abbreviated Title: Welfare assessment of caged laying hens

Further to a request from the poultry industry and in a progress objective, a shared and practical method of commercial poultry and rabbit welfare assessment was developed: EBENE method. This assessment method was crafted to be implemented by producers, thus its application should be easy to implement, efficient and fast (one hour per assessment). Nine laying hen cage farms were visited when hens were between 25 and 30 weeks of age (5 farms) or beyond 55 weeks of age (4 farms), in order to validate the relevance of the indicators and the practicability and repeatability of the method. Two assessors carried out the protocol a first time together on the same population sample and did the assessment a second time the following day. Observations were conducted on 12 cages per flock. Firstly, behavioural indicators measured on a cage scale followed by sanitary indicators measured on an individual scale (five to eight animals per cage). Results of intra assessor repeatability showed that conclusions on a farm status were relevant (significance threshold of 0.05) for 15 indicators of 19 except for indicators injury, dead, huddled, prostrated and inter assessor repeatability showed that 15 indicators of 19 were relevant except for indicators rarely observed in our sample such as dead, aggression, huddled and prostrated. Data variability and significant differences ($p<0.05$) between farms related to 13 indicators showed the measure's sensitivity. Measure's total duration (54min +/- 10min for behavioural data and 26min à +/- 8min for sanitary data) was still longer than required in the specifications. Correlations between indicators (e.g. aggression and severe feather pecking) or modifications of observation techniques will potentially allow simplification and shortening of the EBENE indicator's measures. Once the protocol is stabilised and validated, work efforts will continue on aggregation of results, to allow representation and use of the EBENE method as a tool for progress for professionals. Furthermore, creation of an ergonomic tool will facilitate method deployment on a large scale in the field.

Session 9

Poultry production sustainability and consumer perception

Animal Welfare and Antibiotic Use in Poultry

The Public Perception an How to Respond

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The current state of animal welfare in the European poultry production

It is an ethical achievement in our developed societies that molecular biology and modern ethology makes animals more "human" and humans more "animal", which leads to the following moral obligation: Humans have a high responsibility for the welfare and wellbeing of the sentient animals they own or care for. Animals are no longer only things in the legal meaning of "property", which can be treated as the owners want to, but also feeling creatures that have an intrinsic value and that have the right that their needs and interests are met by those that are responsible for the animals.

There is indeed a high degree of consensus that animals should be kept in a decent way and that their needs have to be met. However, due to the fact that urban people lose more and more contact to the reality of animal husbandry in agriculture and that they measure their understanding of animal welfare from their relationship with their beloved pet animals, the opinions about the quality of the lives of food producing animals are controversial and often quite emotionally disputed in the public discourse. Therefore it is important that animal production professionals, veterinarians and ethologists carry the evidence-based knowledge about the different needs of the different farm animal species and about the actual living conditions of food animals into the public discussions. Those that are responsible for guaranteeing a good animal welfare status of food animals and those that are responsible for controlling the verification of the compliance of animal owners and keepers are well advised to stick to the definition of animal welfare given by the **Terrestrial Health Code (2014) of the World Animal Health Organisation (O.I.E):**

"Animal welfare means how an animal is coping with the conditions in which it lives. An animal is in a good state of welfare if it is healthy, comfortable, well-nourished, safe, able to express innate behaviour, and if it is not suffering from unpleasant states such as pain, fear, and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management and nutrition, humane handling and humane slaughter or killing. Animal welfare refers to the state of the animal; the treatment that an animal receives is covered by other terms such as animal care, animal husbandry, and humane treatment".

The European Commission issued binding regulations on the welfare standards in animal husbandry: in 1998: the quite basic and general rules about animal welfare in

food animals by the Council **Directive 98/58/EC concerning the protection of animals kept for farming purposes** (Anonymous, 1998). The framework and guidance for harmonised minimal standards for animal welfare in all Member States has become the Communication from the Commission to the EU Parliament, the Council and the EU Economic and Social Committee on the European Union Strategy for the Protection and Welfare of Animals 2012-2015.
The European Commission has been pro-active by having funded the FP6 Welfare Quality® Project (FOOD-CT-2004-506508), which highlights the "Five Freedoms" that describe the current European understanding of good animal welfare:

- Freedom from hunger and thirst, by ready access to fresh water and a diet to maintain full health and vigour.
- Freedom from discomfort, by providing an appropriate environment including shelter and a
  comfortable resting area.
- Freedom from pain, injury, and disease, by prevention or rapid diagnosis and treatment.
- Freedom to express normal behaviour, by providing sufficient space, proper facilities and company of the animal's own kind.
- Freedom from fear and distress, by ensuring conditions and treatment that avoid mental suffering.

The European Commission has, especially for improving the quality of animal welfare of laying hens and chickens for meat production, issued the following legislation:
:

- Council Directive 1999/74/EC of 19 July 1999 laying down minimum standards for the protection of laying hens
- Opinion of the Scientific Panel on Animal Health and Welfare (AHAW) on a request from the Commission related to the welfare aspects of various systems of keeping laying hens. European Food Safety Authority (EFSA), 7 March 2005
- COUNCIL DIRECTIVE 2007/43/EC of 28 June 2007 laying down minimum rules for the protection of chickens kept for meat production
- REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the impact of genetic selection on the welfare of chickens kept for meat production, 7.4.2016

However, despite these clear legal guidelines and demands, there are major concerns regarding poultry production in Europe:

- the still in several EU Member States permitted use of cages for laying hens,
- the routine beak trimming in laying hens to prevent feather pecking,
- the increasingly criticised killing of male one-day pullets in egg producing production chains,

since the male chickens of genetic laying hen lines cannot be marketed as broilers

economically,

- the high frequency of pododermatitis in many poultry operations, and
- the lack of access to outdoor areas and so-called "wintergardens",
- the quite high variability in the health status of poultry flocks, even within the same husbandry systems, pointing to varying skills in the care for the animals and determining to a high degree the **amount of antimicrobial substances per animal used in broiler and turkey flocks**.

Reducing antimicrobial substances (resistance) and its impact on animal welfare

Bacterial resistance is not a new phenomenon, but is ancient. Antibiotic resistance in bacteria against naturally occurring antibiotic substances is a natural phenomenon that predates the modern selective pressure of clinical antibiotic use. However, the antibiotic resistance of bacteria against the "man-made" antibiotics that are used to fight bacterial disease in humans and animals poses an increasing threat to human and animal medicine, health and welfare. Antibiotic resistance can lead to failure of treatment for severe and fatal diseases that are currently curable, and prevent surgical interventions that modern medicine currently allows in both humans and animals.

Since the early 1990's, the European medical and veterinary community has tried to curb bacterial resistance by promoting the rules of "prudent use of antibiotics" both in humans and in animals. The need for reducing the amount of antibiotics used has been emphasized by the emergence of Vancomycin resistant Enterococci (VRE) in livestock in the end of the last century, the occurrence of the livestock-associated MRSA in food animals (laMRSA) in 2006 and, somewhat later, the growing knowledge of extended spectrum ß-lactamase producing Enterobacteriacea (ESBL) in food animals and in food of animal origin. This has led to a mixed demand by society, with the need to reduce antibiotic usage on one hand, and on the other hand, concerns that this could lead to animal welfare challenges. Antibiotics are vital and will remain vital to treat bacterial infections in humans, whilst animals deserve treatment too. Reduction of antibiotic usage should not be achieved by reducing the amount and the length of necessary antibiotic treatment when there is a properly diagnosed bacterial infection of animals.

Although there are in the animal production and veterinary community still perceived concerns about a deterioration of the animals' wellbeing, if the amount of antimicrobial substances is reduced, there is no real conflict between the prudent use of antibiotics and good animal welfare. On the contrary, prudent use of antibiotics embraces the need to improve the husbandry of animals in terms of enhanced biosecurity, hygiene and animal care, thus reducing the frequency of bacterial infections requiring antibiotic treatment. In addition, introducing positive welfare steps will reduce stress and therefore the susceptibility to infection.
Methods to reduce the amount and the frequency of using antibiotics in poultry flocks:

a) Completely refraining from using antibiotics for production enhancement. High production levels and rapid growth can be achieved without the use of any antibiotics. However, this requires good management, good housing, appropriate nutrition for preventing enteric diseases and a high level of external and internal biosecurity on farms, thus ensuring that the infection pressure is kept to a minimum level. Introducing welfare enhancing measures will reduce stress and therefore the susceptibility to infection.

b) Refrain from routinely using antibiotics as prophylaxis and as "metaphylaxis" Move away from the use of antibiotics against expected bacterial infections at certain fixed points in time of the life of the animals. Instead treat the flocks as early as possible after having diagnosed a bacterial infection.

c) Improve the animal health status by all known and proven measures in order to prevent the occurrence and spread of bacterial animal diseases. This includes regular veterinary health visits where the veterinarians, together with their clients, draw up an effective health and welfare plan. Such a plan should include relevant biosecurity, vaccination, good housing, good management, appropriate nutrition, welfare enhancing measures (such as optimized climate and stocking density, dry and soft litter, pecking materials) and welfare relevant genetic breeding goals (such as disease resistance, robustness and moderate growth rates).

Overall: the prevention of disease is essential for all animals, including poultry. The degree of reduction of antibiotics that is possible without animal welfare consequences will differ from region to region: for example, depending on factors such as the regional flock density, the disease status in the region, climate conditions, vaccination programs and the organisation of the poultry production sector in question (e.g. a strict production pyramid from high health grand-parent flocks down to production flocks with an optimized biosecurity or small-scale flocks without any organizational structure).

To achieve these goals, monitoring and benchmarking systems should include health and welfare parameters (mortality, pododermatitis, condemned carcasses etc.) as well as monitoring antibiotic consumption and resistance.

Examples of successful antibiotic reduction efforts can be found in Europe, where the antibiotic use in animals has been significantly reduced without negatively affecting the welfare of the animals and without impairing the efficiency of production of food of animal origin (e.g. in Denmark, The Netherlands, Belgium and Germany).

This shows that a positive association can often be seen between reduced antibiotic use and animal welfare. Animals which are well cared for and appropriately housed will be less prone to infections and will need less antibiotics. In other words, effective improvements in animal health and welfare will successfully curb bacterial resistance in animals.

Health and welfare in organic egg production

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Summary

Organic agriculture in Europe developed in the last decade to a professional and economically profitable way of agriculture. According to the author, organic egg production has the potential to reach the highest levels of animal welfare, compared to other professional poultry husbandry systems. Thanks to the free range area, lower animal density, prohibition of beak trimming and additional environmental enrichment inside and outside. However, there are some weaknesses with respect to animal health and emissions to the environment. Moreover, when looking at the organic principles, there is some discrepancy between the principles and the implementation in practice, especially on the animal feed side and nutrient loads in the free range area. Organic egg production as it is implemented now in Europe, has a larger ecological footprint than conventional intensive egg production. What we learned from organic egg (and free range) production helps us to improve animal welfare in all egg production systems and develop new systems which combine the good things from both worlds.

Keywords: organic, free range, welfare, health, sustainability

Introduction

Overall in Europe, 3.8 % of all commercially farmed laying hens are kept on organic farms. In some northwestern European countries this percentage is higher: in Denmark for example 22 % of the hens are organic (Marktinfo Eier und Geflügel 3/9/2015). A reason for this is the consumer expectation that organic production is more welfare friendly compared to cage, barn or free range systems. The organic regulations aim for a higher level of animal welfare by giving the hens more space, access to outdoor areas and access to roughage. The European regulation (EC No 834/2007) prescribes a maximum group size of 3,000 hens per compartment, 6 hens per m² indoors, a free range area of 4 m² per hen, 18 cm perch per hen and one third of indoor floor surface covered with litter. It also prohibits beak trimming. Moreover, the hens should be fed organically grown feed, e.g. no synthetic amino acids are allowed. In some countries additional regulations exist (Bestman et al, 2017), for example concerning the rearing of organic hens (The Netherlands) or a free range area of 10 m² per hen (United Kingdom).

Welfare aspects

Despite these presumed welfare enhancing requirements in the organic regulations, welfare and health problems have been reported in flocks of organic laying hens. The main welfare issues are feather pecking and high mortality (Bestman and Wagenaar 2003; Hegelund et al 2006; van de Weerd et al 2009; Leenstra et al 2012; Bestman and Wagenaar 2014; Bestman et al, 2017). Feather pecking is an indicator for reduced welfare (Rodenburg et al. 2013). The topic of mortality will be addressed in the 'health' paragraph. Epidemiological studies on feather pecking on organic farms showed that conditions during the rearing period and use of the free range area are significant factors in its prevention. A higher density during the first 4 weeks of life and the absence of daylight during 7 to 17 weeks of life seemed to be risk factors for feather pecking. Moreover, Bestman et al (2009) showed that if flocks did not have feather damage during the rearing period, in 71 % of the cases they did not do so either during the laying period. In flocks that did have feather damage during the rearing period, 90 % of these flocks also had feather damage during the laying period. These findings show the importance of rearing conditions. Factors in adult organic hens found to reduce feather damage, are a higher % of hens from a flock using the free range area, a younger age at arrival on the laying farm and an increasing number of cockerels in the flock (Bestman and Wagenaar, 2003). A higher number of hens seen outside being related to significantly less feather damage, is seen in nearly all studies that look at the relation between feather pecking and use of the free range area (for example Green et al, 2000). The number of chickens from a flock that goes outside, depends on the degree of cover by trees or artificial structures in the range area (Bestman and Wagenaar 2003; Zeltner and Hirt 2003), but also smaller flocksize, younger age at arrival on the laying farm and an increasing number of roosters (Bestman and Wagenaar, 2003). Moreover, Bright et al. (2016) found less feather pecking damage in chickens that had more trees in their free range area. Thus a free range area with cover contributes to the welfare of the chickens using it. Moreover, Bestman et al (submitted to Agroforestry Systems) indicate that woody cover in free range areas may discourage avian influenza risk birds from using it.

Health aspects

An important health issue in organic egg production is mortality being higher compared to barn egg production. Borell and Sørensen (2004) cited Danish results finding an average mortality rate of 17%. In the Netherlands, mortality in organic egg production reduced from 11.9 in 2008/2009 to 7.9%. In the same period mortality in free range hens, barn hens and cage hens reduced to respectively 9.7, 9.0 and 8.8 % (Leenstra et al 2014). Bestman (2016) reported that mortality caused by predation is 4 % in organic and free range hens. Other reasons for higher mortality are the incidental occurrence of diseases that cause high mortality (> 40 %), such as

Erisypelothrix or *Pasteurella*. During the last decade health care on organic farms has further professionalized by working more hygienic, preventive vaccinations and veterinary assistance that broadened to management aspects instead of only curative measures. Another health issue is endoparasites. It has been shown that hens with access to an outdoor range area often have higher faecal worm egg counts than hens without access to range (see review by van de Weerd et al 2009). However, recent studies also show that outside access may be part of the solution as well. Thapa et al (2015) found less *Acaridia galli* worm burden in case of outside access earlier on the day.

Environmental aspects

Van Asselt et al (2015) assessed several dimensions of sustainability of enriched cage, barn, free-range and organic egg production systems in the Netherlands. They concluded that for the Dutch situation, enriched cages scored highest on the environmental aspects, whereas free range egg production scored highest on 'social' issues (food safety, animal welfare and human welfare). From an economic point of view, both enriched cage and organic egg production scored highest. A negative environmental aspect of organic egg production, is the accumulation of phosphor and nitrogen from manure in the free range area. Especially phosphor reaches high values (Dekker et al, 2012). Niekerk and Leenstra (2014) calculated that with 250 hens per hectare free range area, there is a balance between manure input and manure uptake by the vegetation. European regulation (EC No 834/2007) allows a maximum of 2500 hens per hectare, ten times more, which is generally applied in practice. Another negative environmental issue, is the ecological footprint caused by the feed ingredients, which mainly consists of concentrates with protein ingredients grown in for example China. Dekker et al (2011) calculated alternative scenarios for reducing the ecological impact of organic feed. However, van Krimpen et al (2016) stated that in practice it is very difficult to compose a 100 % organic feed.

Organic principles

The current European regulation is described in the introduction paragraph. Since this regulation has come into practice, the organic movement has been discussing its principles and Arbenz et al (2017) published a new vision: organic 3.0. The new vision aims (amongst others) at minimized environmental pollution, high animal welfare and efficiency in resource utilization. El-Hage Scialabba et al (2014) calculated that, in order to feed the human world population in 2050, livestock needs to be fed according to a strategy differing radically from the current practices in order to conserve environmental resources. Poultry should be fed with agricultural residues and food waste and not with concentrates anymore. Concentrates consist of ingredients that could be eaten by humans too. Current organic poultry mainly eats

concentrates. Although El-Hage Scialabba et al (2014) are more specific than Arbenz et al (2017), there is a huge discrepancy between strategies proposed in both publications for feeding and keeping poultry on the one hand and the current commercial practice of organic egg production on the other hand. Not only the feed needs to change, but also its environmental impact by the manure emission in the free range area. A current (but rare) practice that resembles most the proposed strategy, is small-scale poultry keeping in mobile houses on mixed farms. However, a mobile house may reduce manure impact, but its residents still eat mainly concentrates.

Current state of knowledge of welfare of laying hens

Weeks and Nicol (2006) reviewed the behavioural needs, priorities and preferences of laying hens for increased space, perching, nesting, foraging and dustbathing behaviour. It would go too far to call a free range area a behavioural need, but as mentioned in the welfare paragraph, using a free range area is related to less feather pecking damage and therefore may be regarded as significantly contributing to the welfare of laying hens. Which aspect or aspects are responsible for that relation (more space, daylight, fresh air, diverse incentives for foraging, dustbathing and exploring), is not clear. Marino (2017) concludes in her review that chickens are just as cognitively, emotionally and socially complex as most other birds and mammals in many areas. She refers to studies on personality, sociality self-awareness, cognitive bias, social learning and self-control in chickens. Animal welfare is the quality of life as perceived by the animal and besides so-called physiological needs (for food, water, etc.) they also need to exercise certain natural behaviours (scratching, dust-bathing (Bracke and Hopster, 2006). Perhaps in the future, when we got to know chickens even more better, more needs can be specified, resulting in demands for housing and management that go further than what is practiced now.

Conclusions and perspectives

Organic egg production has the potential to reach the highest levels of animal welfare, compared to other egg production systems. However, feather pecking, high mortality and endoparasites are obstructing this from becoming real. Despite of the organic principles, the environmental impact of organic egg production is worse compared to some intensive systems. However, what we have learned from welfare aspects in organic egg production, especially the importance of a free range area, and new insights on animal cognition, demands us thinking on how to improve existing egg production systems and develop future systems with respect to animal welfare and health, not only in potential, but also in practice. These may have covered free range areas and combine the best from both worlds. However, progress on environmental issues may not lead to a decline in animal welfare.

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Is the dual-purpose chicken an alternative? Consumers' perception in Germany

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Abbreviated Title: Consumers' perception of dual-purpose chickens

Summary

The usage of dual-purpose breeds is one of the discussed alternatives to prevent cockerel chicks of laying hens from being killed for economic reasons. Many consumers refuse to accept the killing of day-old chicks due to ethical concerns. Therefore, the aim of this study is to analyse whether consumers would accept products from dual-purpose chicken breeds. The meat of dual-purpose chickens has a different appearance and is more expensive than those from hybrid chickens. Regarding this, it is of great interest to investigate consumers' perception in Germany. To get an insight into the consumers' view on dual-purpose chickens, we initially conducted six focus groups with German citizens (n = 6-8 participants per group) focussing on chicken meat preferences and attitudes towards a dual-purpose chicken. The results show that most of the participants were aware of the killing of day-old chicks. However, the dual-purpose chicken was scarcely known. After giving the participants information about the dual-purpose chicken, they were generally in favour of it. Some participants raised concerns regarding the economic efficiency and the higher product prices. For others, ethical values predominated. To learn more about the taste of the dual-purpose chicken meat, we carried out paper-and-pencil surveys (n = 306-361 participants per survey) in university canteens in Hanover, where two different meals with dual-purpose cockerels were offered. Results show that the meat was well perceived by more than 80 % of the participants. However, further research is needed to find out if consumers would pay a surcharge for the meat. Therefore, an online-survey including the assessment of consumers' willingness to pay for dual-purpose chickens will be conducted soon.

Key words: Dual-purpose chicken, consumer, perception, cockerel meat

Improve “feedback to the farmer” for animal welfare reasons in poultry slaughterhouses

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Summary

Processing of poultry is a particularly interesting operation to observe indicators of animal welfare. Pododermatiits is well known and evaluated link to the quality of the litter in farms. Causes of carcass condemnation indicate quantitatively the rate of condemnations and qualitatively the causes. However causes of carcass condemnations focus only on food safety: cachexia, congestive carcass or arthritis are classified in Category 2 and small chickens or those with a hematoma are classified in Category 3. These 2 categories classify the food unfit for human consumption. Moreover, causes of carcass condemnations are not always notified precisely in poultry slaughterhouses in the European Union.
Some details concerning the condemnation cause could easily be notified in order to help poultry production to enhance welfare. A major condemnation cause such as cachexia does not describe the pathological reason. Our study, documented by pictures and data, showed different causes of cachexia in broilers and meat turkeys.
In meat turkeys, in a study of 59 flocks, 75% of condemnations were classified as cachexia. To explain cachexia, 22 flocks of 59 showed arthritis, 34 flocks of 59 showed non infectious lameness etiology (tendon rupture, “cowboys” and rotated tibias) and 3 of 59 flocks showed no lesions.
In broilers, we described the main condemnation cause as cachexia. Cachexia is mainly associated to small carcasses whereas the etiology is different. We discuss the importance of a rigorous determination of carcass sorting.
The research of farm pathological causes in addition to food safety should allow an action plan for welfare in the farm.

Key words : slaughterhouses, condemnations

Developing higher welfare broiler production in France: a case study from a French cooperative

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Abbreviated Title: Developing higher welfare chicken production

Summary

Higher welfare broiler production indoors, although little developed in France, has been shown to have clear welfare benefits for the birds, and to be economically viable for the farmers too. Compassion in World Farming (CIWF) awards leading food companies addressing key welfare issues in broiler production, with its Good Chicken Awards (GCA). In these systems, chickens are typically slower growing (≤50g/d), have more space to move around (stocking density ≤ 30kg/m^2) and benefit from environmental enrichment such as perches, pecking substrates and natural light. As part of its "La Nouvelle Agriculture ®" initiative, the cooperative Terrena is pioneering higher welfare indoor chicken production in France, and has recently received a GCA from CIWF for its work to improve chicken welfare. The Nouvelle Agriculture® breeders are reducing stocking density by 20% in their flocks and the cooperative already reports several advantages associated with this new production system, such as an important reduction in antibiotic use (50% lower than in conventional systems), as well as lower mortality rates. Production costs are higher but farmers are able to maintain a stable income, thanks to a better return on the final product (+0.06 €/kg of live weight). They also find the system more pleasant to work in (less human stress, more comfort, and improved working conditions).

Key words: Broilers, welfare, stocking density, antibiotics, higher welfare indoors.

Network approach to stimulate and support practice-led on-farm innovations in the laying hen sector

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Abbreviated Title: Practice led innovations through networks

Summary

The Hennovation project aims at improving knowledge exchange between science and practice. Knowledge exchange between farmers is usually limited, but could be beneficial to them if it took place on a wider scale. Innovations made by farmers will most likely be very practical and useful to other farmers. One of the main project goals was to establish on-farm innovations, initiated and led by farmers The laying hens sector was chosen to study this. Farmers that were positive to this idea were asked to form groups (called networks) and work on innovations aiming at the problem of injurious pecking in egg-laying flocks. This problem has many possible approaches and each network was free to choose its own innovative approach. In 5 countries (Czech Republic, Spain, Sweden, The Netherlands and the UK) in total 16 innovation networks were established, mainly consisting of laying hen farmers and some industry personnel. Although they worked on different ideas, and used various approaches, there were some mutual themes. In 4 countries there was a network aiming at reducing red mites, in 3 countries networks focused on knowledge exchange. The topics nutrition, free range and litter were addressed in 2 countries.
The network groups needed more time than expected to find a topic to work on. The progress made in the development of the innovation depended not only on the complexity of the subject, but also on the energy (of some persons) in the groups.
At the time of writing this abstract the project is still running and final results are not yet obtained. Available results will be presented at Xth EPWS. This research was funded by the EU H2020 programme ISIB-2-2014/2015: grants agreement no. 652638.

Key words: Innovations, laying hens, networks

Session 10

Posters

Elevated pre-natal corticosterone concentration disrupts bone development in Japanese quail

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Abbreviated Title: Pre-natal corticosterone disrupts bone development.

Summary

Galliformes are precocial with well-developed bones before hatch. Adverse early life experiences can have detrimental effects on growth and development, and in commercial settings overcrowding of breeding poultry is both commonplace and stressful. Stressed hens deposit higher levels of the stress hormone corticosterone in the yolk of their eggs, and this increases corticosterone levels in hatched chicks (Hayward & Wingfield, 2004). The effect of elevated pre-natal corticosterone on the skeletal system is unknown for birds but in mammals, adverse conditions before birth can have detrimental effects on bone length (Dancause *et al*, 2012), and exposure to corticosterone after hatch can affect bone growth and reduce bone density in chickens (Luo, *et al* 2013). To investigate the effects of pre-natal corticosterone on bone development, we injected a physiologically relevant dose of the hormone into Japanese quail eggs at embryonic day 8 (8.5 ng, dissolved in peanut oil; n=31) and collected tibiotarsus at day 16. Control eggs were injected with peanut oil alone (n=35). Animal care and use protocols were carried out under the UK Home Office licence guidelines [Animal Scientific Procedures Act (1986)]. Our data shows that pre-natal elevation of corticosterone significantly reduces bone weight and bone strength (i.e. maximum force taken before bending, $P<0.05$). Although studies in mammals have found sex differences in effects of stress on bone (Dancause *et al*, 2012), we did not observe sex differences for any bone properties measured. Further studies to investigate the effects of elevating corticosterone before hatch on bone later in life are ongoing, as well as analyses of density and histology in the embryonic samples. Our findings have implications for the welfare of birds housed in commercial barn systems where there is a problem of bone fragility due to the increased risk of collision and breakage of bones.
Research supported by the BBSRC and World's Poultry Science Association.

Key words: Corticosterone, pre-natal, Japanese quail, bone, embryo.

The effect of olive leaves and marigold extract on bone characteristics in broilers

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Abbreviated Title: Olive leaves and marigold in broilers

Summary

Olive leaves (*Olea europaea*) and marigold (*Calendula officinalis Linn.*) are known for their antimicrobial, antioxidant, anti-inflammatory and other properties that can beneficially influence animal health and productivity. Their use as a feed supplement is therefore interesting also in farm animal nutrition. However, plant bioactive substances may exert also negative effects on the digestion of some nutrients, especially micro minerals. This may cause disorders in bone mineralisation which may consequently lead to leg problems. The aim of this study was to investigate the effect of olive leaves and marigold petal extract on growth and bone characteristics of 72 Ross 308 male broilers housed in a deep litter system. Chicks were randomly assigned to one of six dietary treatments designed as a 3 x 2 factorial design: three supplement treatments (not supplemented, olive leaves or marigold petal extract) and two different oils (walnut or linseed oil). For the first 21 days, birds were fed *ad libitum* starter diets and from 21 to slaughter at 38 days finisher diets. Body weight was recorded weekly. Bone characteristics (weight, length, maximum breaking force and bend, dry defatted weight/fresh weight, ash weight/dry defatted weight) were determined for *Tibia, Femur* (only the first 4 parameters) and *Humerus.* Type of plant extract significantly influenced only daily gain during the starter period (P=0.02) and *Tibia* ratio between ash weight and dry defatted weight (P=0.01). Both parameters were higher in broilers supplemented with marigold extract. Type of oil significantly influenced only maximum *Tibia* breaking force (P=0.01), which was higher in broilers supplemented with linseed oil. Interaction between type of oil and plant extract was significant only in *Humerus* weight (P=0.02). In conclusion, supplementation with olive leaves and marigold extract had no detrimental effect on broiler bone mineralisation irrespective of the use of walnut or linseed oil in the diet.

Key words: Broilers, animal welfare, bone characteristics, plant bioactive supplements.

Poultry red mite (*Dermanyssus gallinae)* infestation in layers: increasing impact on welfare and effect of a new fluralaner systemic mite treatment on welfare-indicating production parameters

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Abbreviated Title: Red mite fluralaner treatment

Summary

Poultry red mite (PRM) infestation represents a major threat to layer welfare, with up to 94% of production houses infested in Europe. The recent ban of traditional cages has caused the move to complex housing environments, favouring the proliferation of PRM. Mite populations induce a high level of stress, due to the massive density of mites feeding on birds, repeated pain and skin irritation due to parasite bites, and the increased risk of feather pecking and cannibalism. PRM decreases general health and productivity parameters; mortality is increased only in case of severe infestations. The ban on beak trimming is expected to increase the severity of injuries and mortality resulting from cannibalistic and aggressive behaviors. Convenient, safe and effective mite control methods are urgently needed. The few treatments approved for use in the presence of hens are mostly sprays that are stressful to treated animals. In addition, the furnished cages and non-cage housing systems tend to decrease the access of sprayed products to the mites, which further reduces their efficacy. The new systemic mite treatment, containing fluralaner, is administered orally to the birds through drinking water, which is not stressful to the birds and ensures that mites are exposed to the product when feeding. A negatively-controlled GCP field study, involving five mite-infested enriched caged layer farms in France and Spain, evaluated the effects of fluralaner treatment on production well-being indicators 89 to 178 days post-treatment. In all farms, the control of mite populations was associated with increased laying rates (0.9 to 5.7%) and decreased mortality (0.01 to 0.15%). No treatment related side effects were observed. The proportion of downgraded eggs, measured in one farm, decreased by 3.4%. This study demonstrated that systemic treatment with fluralaner resulted in safe and non-stressful control of PRM, which positively impacted layers' welfare.

Key words: Red mites, laying hens, fluralaner, drinking water, welfare.

Prolonged thymol dietary supplementation does not affect liver histomorphology of laying quail

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Abbreviated Title: Liver histomorphology of laying quail fed thymol

Summary

Phytogenic feed additives, such as thymol, operate as growth and health promoters, which could lead to major improvements in modern intensive poultry production. The concentration of phytogenics appears to be one of the most important factors in achieving the aforementioned effect. However, conflicting results have been reported regarding thymol influence on histopathology/toxicology of organs such as the liver. We assessed semi-quantitative potential histopathological changes in quail liver caused by a 4-week dietary supplementation with thymol and the effect of a recovery period following cessation of dietary supplementation. Fifty adult female quail were randomly assigned to 1 of 10 treatments depending on the diet supplied (CONTROL: basal diet; VEHICLE: basal diet plus ethanol; THYMOL80, 160 and 250: basal diet supplemented with 80, 160 or 250mg of thymol/day/animal, respectively) and whether the birds went through a 3-week recovery period (R) or not (NR). In 89% of the livers, regardless of treatment, lipid degeneration was observed, which may be due to high food intake or to the bird's reproductive status (laying). Reversible changes such as sinusoidal dilatation and vascular congestion were found in 35% and 26% of livers, respectively. Small necrotic foci (12%), oval cell foci (5%, associated with tissue regeneration), infiltration (<5%) and pycnotic nuclei (<5%) were observed at a low frequency. Among the histopathological alterations, the regressive changes (lipid degeneration and necrosis) recorded the highest frequency followed by circulatory disturbances (sinusoidal dilatation and vascular congestion) and finally progressive and inflammatory changes (oval cell and inflammation). Total histopathological index varied between 17.6 and 27.6 with exception of THYMOL160-NR, which was lower. There were neither significant differences between the histopathological indices corresponding to different thymol doses (VEHICLE) in comparison to CONTROL, nor between R and NR. Thus,

thymol supplementation could be used to provide beneficial effects in poultry, without compromising animal liver function.

Key words: Poultry nutrition; natural products, histopathology, liver damage.

Biological control of the chicken red mite in layer farms in Europe: state of the art and perspectives

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Abbreviated Title: Biological control of the chicken red mite

Summary

Almost every type of commercial agricultural production has pest organisms that thrive on it. Conventionally, these pests are treated with a chemical pesticide. Use of natural enemies to control pest populations is called biological control. This method is known since decades in crop protection
and particularly in protected environments such as greenhouses. Control and reduction of pests can be further improved by using a combination of tools and methods; this is called Integrated Pest Management (IPM).
Chicken red mite infestations are causing serious problems on almost every commercial egg production farm. Several species of natural enemies have been studied for their ability to control the red mite and a few of those are now commercially available. Among those are *Hypoaspis sps, Androlaelaps casalis and Cheyletus eruditus*. Due to the biology and ethology of the red mite, an IPM strategy is likely to offer a promising solution for layer farmers. APPI has developed a unique strategy by combining the predatory mites TAURRUS (*Cheyletus eruditus)* and ANDROLIS (*Androlaelaps calasis)* in one releasing protocol. Predators are released in batches between 3 to 6 times per flock cycle in specific locations using the abiotic preferences of the two species. This method is suitable for parent stock flocks, free range and aviary layer farms and is showing significantly improved results on more than 200 farms in 3 European countries so far. The level of control over the red mite is likely to further increase with tactical combinations of biological control and other treatments.

Key words: chicken red mites, biological control, Integrated Pest Management

Testing a dietary acute tryptophan depletion mixture in feather pecking birds

(*Gallus gallus domesticus***)**

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Abbreviated title: Acute tryptophan depletion in laying hens

Summary

Feather pecking in laying hens is one of the most prevalent production and welfare issues in modern egg production systems. It is assumed that serotonergic dysfunction is involved in the pathology of feather pecking behaviour. Dietary acute tryptophan depletion (ATD) is commonly used in humans and rodents to investigate dysfunctions of the serotonergic system and related behavioural disorders. When a dietary mixture of amino acids lacking tryptophan (TRP) is orally administered, the influx of TRP across the blood brain barrier (BBB) is temporarily compromised. This results in a reduced central availability of TRP, the substrate for serotonin (5-HT) synthesis. However, ATD has yet to be adapted for and assessed in an avian species. The present experiment compared the effects of an ATD and a TRP-balanced control mixture (administered orally to hens via gelatine capsules) on blood aromatic amino acid levels using ten feather pecking birds. We report that the ATD mixture used in the present study results in a significant depletion of TRP, decreasing to 50% of the baseline concentration in plasma. Furthermore this ATD mixture reduces the ratios of TRP towards aromatic amino acids (AAA) by 60% and the ratio of TRP towards large neutral amino acids (LNAA) by 70%, occurring three hours after administration. These ratios are indicators of competitive effects at the BBB between TRP and AAA or LNAA respectively. These ratios are used to estimate TRP availability for central 5-HT synthesis. This study thereby suggests that the particular dietary ATD mixture effectively alters blood amino acid levels and might therefore present a useful tool for studying underlying 5-HT-related mechanisms contributing to feather pecking in laying hens.

Keywords: Feather pecking, serotonin, tryptophan, acute tryptophan depletion

Essential oils: do they have positive impact on broiler welfare?

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Abbreviated Title: Essential Oils in Broiler welfare

Summary

The aim of this study is to analyze the effect of essential oils spread by air on animal welfare on broiler chickens. The specific objective is to demonstrate the relaxing effect of essential oils through the qualitative assessment of behavior and animal's fear of humans.
The study was done in 6 houses of female's broilers 40 to 45 days old at the time of the test 22.680 animals in average per house, 136.080 animals in total, with 12,6 animals per square meter.
Using a simple random sampling, 6 houses of female broilers randomly selected. Four houses were used as the treated groups (GT) and the other two as control (GC). Treatment consisted of application of a blend of essential oils, scattered by air through a diffusor.
The mixture was composed of three essential oils cajeput (antiseptic, expectorant and stimulant), Litsea cubeba (calming, sedative, anti-inflammatory and anti-fungal) and Tea tree (anti-inflammatory, antibacterial, antiviral, immunostimulant). The study lasted 3 days, with 3 successive applications at 24 hour intervals in a dose of 0.3 g / m3 were performed for 30 minutes at the time of day with the lowest temperature (less than 26 ° C).
The following behavioral tests were performed: Tonic Immobility in 120 animals, qualitative assessment of behavior in the whole of the animal house, flight distance test in 42 sites of at least 3 animals.
These tests are designed to measure animal's fear of humans, animal's social interactions and their relationship with the environment.
The only test with statistical differences is the flight distance test ($p<0,0001$), indicating that treated animals present smaller flight distance.
The process of loading birds is highly stressful and affects animal welfare. The use of essential oils, promotes a better adaptation of the birds to this type of stressful conditions.

Key words: animal welfare, essential oils, chicken Broilers, behavior

Evaluation of sedative plants to limit nervousness in force-fed duck production

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Abbreviated Title: « Control of nervousness with plants extracts in duck gavage »

Summary

Animal welfare has been an increased concern in animal production within the last decades. Collective caging in force-fed duck production seems to pursue this goal by allowing animals to move more easily. However, it sometimes fails when nervous animals tend to be more aggressive towards others and may induce damage – basically scratches- on them. Since anxiolytics are prohibited in poultry production because of residue in meat, the use of plants with soothing properties is an interesting option to explore.
A test was conducted on a same batch of ducks in collective cage type Palmistar with 4 rows of 280 subjects: 2 rows each received different solutions of extracts of plants, another one a mix of plant extracts and essential oil and a control, receiving no herbal medicine. Plants well known for their sedative properties - *Passiflora incarnata, Melissa officinalis, Valeriana officinalis*, *Humulus Lupulus* and essential oil of *Citrus aurantium var amara*- were tested in combination or in varying doses.
Each treatment was administered in the force-fed feed in the 10 first meals, followed by 14 meals without administration. A daily observation of animals was conducted during this trial in order to evaluate physical damage and mortality. Difficulties and duration of force-feeding were also considered for each row in order to evaluate the most efficient combination plants.

The association of *Melissa, Passiflora and Valeriana* enabled a reduction in force-feeding time and mortality, and also improved the ease of feeding. Compared to the control, the time taken for 280 treated animals was reduced of 14 minutes. More interestingly, the sedative activity is probably persistent since a positive effect on force-feeding time continues to be observed after cessation of the supplementation. During this essay, *Humulus* and essential oil *Citrus aurantium* did not bring any improvement on selected parameters.
The combination of plants - *Melissa, Passiflora and Valeriana*- is a relevant option to reduce nervousness during the force-feeding of ducks. It could have additional application in poultry production to facilitate caging period and loading.

Key words: Nervousness, phytotherapy, force-fed duck, poultry.

Lameness related to Femoral Head Necrosis in broilers: study of bone micro-architecture and histology and test of feed additives

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Abbreviated Title: Femoral head necrosis in broilers

Summary

Over the past 50 years, a strong increase in broiler growth rate has led to the appearance of skeletal and locomotor problems such as femoral head necrosis (FHN). FHN causes higher mortality and downgrading at slaughter with significant economic losses. Two studies were carried out to better understand the mechanisms behind FHN and reduce its prevalence. The first consisted in harvesting the femurs of 11 healthy chickens and 11 chickens with lameness at 16 days of age. Analysis of bone micro-architecture by imaging showed decreased bone volume ($p<0.01$) and mineral density ($p<0.05$) in the bone growth plate, without any modification in the cortical region. Histology highlighted that lame animals had more severe and frequent lesions with vascular dilatation, reduced vascular penetration in the growth plate, delayed ossification and cartilage necrosis. Inflammatory foci were observed in both groups with low incidence. In a second study, a FHN reproduction model was applied to five groups of 100 chickens from 5 to 42 days of age, and five treatments were compared: negative control (C), 13 ppm colistin and 200 ppm amoxycillin (CA), additives for bone mineralization (MIN), gut microflora regulators (FLO) and a combination of MIN and FLO (MIN+FLO). After the observation of the first lameness cases at 13 days, a walking ability scoring was performed every two to three days. At 42 days, femoral heads of five lame chickens per group were necropsied. Tibia were collected from healthy chickens aged 14 days (n=6) and 42 days (n=5) in each group for ash analysis. At 41 days, CA and MIN+FLO respectively reduced lameness by 67 and 47%. CA, MIN and FLO reduced severity of femoral head lesions ($p<0.1$). Tibia ash content at 14 days increased significantly with MIN+FLO ($p<0.01$). In conclusion, micro-architectural and histological differences related to lameness are observable very early. Feed additives can help to reduce FHN.

Key words: Lameness, bone micro-architecture, feed additive, broiler chicken

Impact of an algae extract on liver function and laying performance of breeding turkeys

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Abbreviated Title: Turkey digestion and laying performance

Summary

The hepatic system of breeding turkeys is highly solicited specifically at the end of the egg production period. Therefore, the digestive system needs to be regularly drained and stimulated in order to maintain a good health status and egg production. In this context, Olmix (Brehan, France) has developed a complementary feed containing a MSP (marine sulfated polysaccharide) with anti-hyperlipidemic properties extracted from macroalgae. A trial was carried out, during 5 weeks in two buildings with 2000 turkeys each, to evaluate the impact of this complement on liver function and laying performance (from week 23 to week 28 of egg production period). The control group received choline and sorbitol at 1l /1000l of drinking water while the test group received only the algae-based complement at 0.5 l/1000 l of drinking water. The products were distributed during 10 days from week 23 and during 5 days from week 27 of laying. Egg production was monitored weekly. Histological evaluation was performed on 20 livers from each group at slaughter (week 28). Histological examination of the test group showed a significant reduction of the biliary canal hyperplasia and leukocytosis of the blood capillaries present in the portal area ($P<0.01$). Blood capillaries had a lower congestion in the test group. The decreased hyperplasia allowed an improvement of the biliary excretion and thereby an improved enzymatic activity. In addition, the increased blood flow due to the reduction of the congestion and leukocytosis on blood capillaries, improved the hepatic substance exchange (nutrients and toxins). The figures showed an increase in egg production in the test group compared to control (+0.5 eggs/turkey/week). The algae-based complement administration improved hepatic metabolism and laying performance was slightly increased.

Key words: Turkey, algae extract, digestive health

Effects of chronic heat stress on cellular immunity in Japanese quail (*Coturnix coturnix*)

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Abbreviated Title: Heat stress and avian cellular immunity.

Summary

The continued or repetitive exposure to stressors along time leads to a physiological state defined as chronic stress. This phenomenon affects different biological processes including the immune response, clearly impacting on the animals´ welfare. Avian species are endothermic and require comfortable temperatures for optimal development (22ºC- 24ºC). Consequently, heat stress is one of the main concerns in warm weather countries. The objective of this study was to analyse the effect of chronic heat stress and its recovery on cellular immune response in juvenile Japanese quail (*Coturnix coturnix*) females. One hundred and eighty quail were housed in 6 rearing pen boxes. Birds in 3 of the boxes were exposed to a temperature increase (from 24°C to 34ºC) during the lighting period throughout 9 days (Stress treatment). Birds in the other 3 boxes remained at 24°C during the whole study (Control treatment). Once stress protocol ended, subsequent 15 days were considered as the recovery period. Different sets of 6 birds per treatment were sampled at day 0 (basal), 3, 6, and 9 (heat stress), and at days 12, 15, 18, 21 and 24 (recovery). Percentage of inflammation and Heterophil/Lymphocyte (H/L) ratio were determined as cellular immune response variables. A two-way ANOVA showed an alteration in both cases in just 3 days of heat exposure and maximum effects on day 9. The percentage of inflammation recovered basal levels 6 days after heat exposure and H/L ratio required an extra 3 days. Results suggest differential modulation of immune variables with negative consequences after exposure to high temperatures. Findings are consistent with increased stress induced circulating mediators. Heat stress would represent an immune threat when sustained for 3 or more days therefore affecting animal welfare and fitness. However, cellular immune responses also appear resilient needing 6 to 9 days to recover basal levels.

Key words: Japanese quail, heat stress, immunity, dynamic.

Wooden breast myopathy affects gait score in broilers

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Abbreviated title: Myopathy affects gait score in broilers

Summary

Wooden breast myopathy, a condition where broiler breast muscles show a hardened consistency when palpated post mortem, as well as bulging out and paleness, has been reported lately in fast growing broiler hybrids. However, there is no published literature of how wooden breast myopathy affects bird activity or welfare. Altogether, 310 broilers of 5 commercial hybrids were housed in 25 pens and 47 to 65 birds were killed at ages of 22, 32, 36, 39, or 43 days. Their breast muscle condition was assessed post mortem by palpation. The birds were gait scored and their willingness to stand was measured prior to killing. Gait was scored using a 6 level scale (0 to 5) by two observers. The latency to lie down was measured in the home pens, three times per bird. The effect of wooden breast myopathy, hybrid, age and breast muscle yield on mean gait score and latency to lie was analysed with linear mixed models.
The gait score of birds affected by wooden breast myopathy was higher than of non-affected birds (2.7 ±0.2 vs. 2.9 ±0.2; $p = 0.004$), indicating a higher level of locomotor difficulties. There was an interaction between age and hybrid on gait score ($p = 0.010$) indicating hybrid differences in gait score as the birds aged. The latency to lie decreased with higher breast muscle yield ($p = 0.031$). Wooden breast myopathy was not related to latency to lie. It was concluded that wooden breast myopathy was associated with an impairment of gait scores, and could thus be partly linked to the decreased ability to walk in broilers.

Key words: Broiler, Lameness, Muscle

Can observation of leg or foot pathology serve as a surrogate measure of leg weakness assessment in meat chickens?

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Abbreviated Title: Predictors of meat chicken locomotory ability

Summary

Broiler leg strength and ability to walk is assessed in the field by gait scoring (GS) or latency-to-lie testing (LTL). GS is subjective and variable. LTL requires equipment, care with bird handling and is time consuming.
We performed a series of five experiments, evaluating incubation effects on subsequent broiler leg strength. In each, 5 week old broilers were subjected to LTL testing, euthanised and then examined for body weight (BW), foot pad dermatitis (FPD) score, hock marks (HB), leg deviation from straight (SL), detached femoral cartilage upon dis-articulation of the ischio-femoral joint (DC), tibial dyschondroplasia (TD) and visible distension of the right ventricle (RV; indicative of subclinical ascites). Associations between LTL and BW, HB, SL, DC and RV were seen using Kaplan-Meier survival analysis. It was considered that some of these observable abnormalities might be useful as predictors of general bird mobility. Data were combined into Cox's Proportional Hazard model with LTL as dependent variable (n=466).
BW had a significant but weak negative correlation with LTL (r = -0.15). The final model revealed only HB (median LTL 131s and 44s with no HB or HB respectively, $P<0.001$) and RV ($P<0.001$) to be significantly associated with LTL. Birds with a distended RV (sub-clinical ascites syndrome) had longer median LTL (94s) than birds with normal hearts (56s) or with hydropericardium (40s). Birds with normal hearts had higher weights than those with distended RV. Perhaps there is suppressed BW with subclinical ascites and this lower BW may allow birds to stand longer in LTL if the condition has not progressed to clinical.
HB lesions were minor and their presence indicates that affected birds were more sedentary. Prevalence of HB in birds may be useful as an adjunct, non-invasive estimation of overall mobility. Leg health assessment is difficult with only a single measure.

Key words: Leg weakness, chicken, assessment

Session 11

Posters

What do hens want: Testing nest surface preference and determining the effect of enclosure on settled nesting behaviour

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Abbreviated Title: Nest preference and nesting behaviour

Hens have a demonstrated preference for turf-lined nests in furnished cages (FC) over other plastic linings; however, turf has been associated with increased bacterial load and fecal contamination. Other nest surface types are being installed in FC without quantifying the preferences of hens. The current experiment tested the preferences of laying hens for two non-turf nest surfaces. We hypothesized that hens would have no preference for nest surface material. A secondary objective was to explore hens' nesting behaviour when given either enclosed or open nests to quantify the importance of providing enclosure. We hypothesized that hens with enclosed nests would demonstrate more settled pre-laying behaviour (decreased aggression, increased sitting) than hens with open nests. After conventional rearing, 996 pullets were placed in 12 large (41,296 cm^2; 55 hens/FC) or 12 small (20,880 cm^2; 28 hens/FC) FC at week 15. Each FC had two nests, one with a plastic mesh surface and one with a smooth plastic surface (3368 cm^2). Half of the FC had both nests enclosed with plastic red curtains (ENCL, n=12) and half had two open nests (OPEN, n=12). Egg location was recorded from first egg to week 28. Focal hens were marked at week 20 and observed from week 22–24. Oviposition times were recorded during week 21 and 27. Scan samples of sitting and aggressive behaviour were conducted during weeks 25–26. Unexpectedly, hens laid more eggs on smooth than mesh mats in OPEN cages (66.8±1.8% vs. 31.2±1.8%; $P<0.0001$), but more on mesh mats than smooth in ENCL cages (62.1±2.1% vs. 36.7±2.1%; $P<0.0001$). Hens in ENCL cages were less aggressive ($P=0.006$), displaced less ($P=0.03$), and sat more ($P<0.0001$) than hens in OPEN cages. Therefore, enclosure influenced nest surface preference and facilitated the expression of settled nesting behaviour.

Key words: Laying hen, nesting behaviour, cage design, aggression, furnished cage.

Laying eggs for 80 weeks – effects on feather cover, keel bone condition and production performance

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Abbreviated title: Laying eggs for 80 weeks

Summary

Laying hens are increasingly being housed for egg production to >90 weeks of age. On the condition that persistency in lay, egg quality and layer well-being are maintained at acceptable levels, ending the production cycles for layer at older ages is a way to increase the sustainability of egg production. The aim of the present study was to investigate effects of layer age on egg production performance and layer integument in two commercial layer hybrids on an 80-week long laying cycle. As zinc, and in particular organic zinc, is considered important for shell formation, bone development and integument integrity, effects of using an organic zinc source in layer diets were included in the study. The study used 720 Bovans Robust and 720 Lohmann Selected Leghorn Classic (LSL) hens, housed in 180 furnished 8-hen cages. In the organic zinc diet, organic zinc constituted 51% of the total added zinc in the first feeding phase (20-40wk) and 100% in the remaining period. Five adjacent cages were considered a replicate, implying 9 replicates per combination of diet and hybrid. Statistical analyses were performed using SAS 9.4. Egg production and mortality were recorded daily between 20-100wk and were both considered to be at normal levels. Feather cover and keel bone condition, scored at 33, 55, 84 and 100wk, both deteriorated with age ($P<0.001$). Egg shell weight% and shell thickness, recorded at 44, 59 and 86wk, and shell breaking strength, measured at 44, 59, 86 and 100wk, decreased with bird age ($P<0.05$). Hybrid differences were detected in laying percentage, egg weight, feather cover, keel bone condition and egg quality parameters ($P<0.05$) but not in mortality rates. The organic zinc improved keel bone condition ($P<0.001$), but did not affect any other parameters. Results from analyses of skeletal breaking strength at 100wk are in progress.

Internal roosting location influences use of the outdoor range by free-range hens

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Abbreviated title: Roosting location affects range use

Summary

Modern multi-tier systems provide basic resources such as feed and water in many locations, so birds, even in large houses, need not travel far to access them. However, free-range units often provide access to the range in one location only. Five free-range, multi-tier flocks were studied that had access to the range on one side of the house only. During the night 400 birds from one internal colony (per flock) were leg marked. 200 birds sleeping/resting on the tiers furthest from the popholes ('far' area: 9.65-12.8m from popholes) were marked with pink marker and 200 birds sleeping/resting on the tiers closest to the popholes ('near' area: 2.60-4.00m from popholes) were marked with green marker. To investigate whether sleeping location affects short-term range use, counts of marked birds on the range were taken the following day. Additionally, counts of marked birds on the tiers in the 'near' and 'far' areas were taken to establish whether birds remained in their sleeping location. The next day, more green than pink birds on average were found both in the range area near the studied colony (16.2 vs 5.3; $t(4)=-3.739$, $P=0.020$) and in the wider range (11.5 vs 4.0; $t(4)=-3.454$, $P=0.026$) suggesting that birds that sleep near the popholes range more than birds that sleep far from the popholes. Fewer green birds were found the next day in the 'far' area inside the house (6.9 vs 15.9, $t(4)=4.302$, $P=0.013$). However the numbers of marked birds in the 'near' area did not differ significantly ($P=0.068$). This suggests that birds spread out better in areas of the house closer to the popholes, potentially because of the ability to move onto the range. This study provides the first evidence that providing popholes on one side of the house only may limit range access to a proportion of birds in the house, potentially decreasing their welfare.

Keywords: Laying hens, multi-tier, free-range, range use, movement.

Restraining laying hens for radiographic diagnostics of keel bones

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Abbreviated title: X-rays and keel bone damage

Summary

Keel bone damage is one of the greatest welfare concerns of the laying hen industry and likely also represents significant productivity detriments. A considerable obstacle in investigating keel damage is the difficulty in accurate diagnosis, particularly when done by palpation. Radiography was previously shown to hold several advantages over palpation including repeatable production of high resolution images over the life of the animal that can be subsequently re-evaluated. Despite these benefits, a drawback of the radiography protocol is that hens are anaesthetized for the procedure to ensure immobilization and therefore needed to be removed from the home pen (to the radiographic facility) leading to additional stress. Also, once removed from a commercial flock, birds cannot easily be returned, thus longitudinal observations are not possible. The method described in the current effort sought to use radiography on six non-anaesthetized birds with portable radiography equipment that would allow images to be taken directly on farms. In order to restrain animals, a custom-designed shackle was used that suspended the hens upside down inducing the hens to remain still. To provide a comparison to radiography, hens were euthanized, keels removed, and further assessments made of the excised bone by visual inspection and computed tomography. Although the study size did not allow for statistical analysis, our effort suggests the use of the shackle restraint method with radiographical assessment allow for the benefits of superior imaging to evaluate the keel bone (as well as other bones and tissue) without anaesthesia and thus in a more diverse range of settings such as commercial barns. Future efforts are needed to evaluate the technique in terms of its specificity and sensitivity in relation to other techniques, e.g. palpation, and visual inspection after removal.

Keywords: X-raying, hen, keel bone damage.

Effect of litter depths on general and dustbathing behaviour in laying hens

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Abbreviated Title: Litter behaviour laying hens

Summary

The presence of litter in laying hen houses results in high concentrations of fine dust (PM10). Decreasing the litter depth is proposed as a PM10 reduction method. However, hardly any information is available about the effect of a thin layer of litter on behaviour of the birds. Therefore an experiment was carried out to investigate the effect of different litter depths on general and dustbathing behaviour of laying hens. Brown Nick birds (age 53 to 55 wk) from a commercial flock housed in an aviary system were used for this experiment. Three test pens (1.22 × 1.22m) were daily randomly filled with three different litter depths (2, 5 or 10cm). Every day, 8 birds per pen were randomly placed in the different pens. Digital cameras were positioned above the test pens, and birds' behaviour was videotaped continuously between 09:00 and 16:00h during three consecutive weeks with four observation days (12 days). The scan sample method (every 15min) was used to analyse general behaviour. Birds housed on 2cm litter showed more sitting (14.4 vs. 10.6%) and foraging (22.7 vs. 18.0%) and less walking (10.0 vs. 12.8%) compared to the birds on 10cm, whereas birds on 5cm showed intermediate behaviour. An interaction effect (P=0.027) between litter depth and time of the day was found for feeding. Less feeding (was observed at 13:00h for the birds on 2 and 5cm litter whereas this not was found for the birds on 10cm litter. A tendency to an interaction effect (P=0.070) was observed for dustbathing behaviour. Birds on 2cm litter showed postponed dustbathing behaviour compared to the birds on 5 and 10cm litter. No differences between the different litter depths on dustbathing duration and percentage dustbaths were found. It was concluded that different litter depths showed small effects on behaviour of laying hens.

Key words: Laying hens, litter depth, behaviour, dustbathing.

Nighttime preference for roosting height and substrate type among four strains of laying hens in an aviary system

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Abbreviated Title: Roosting by four laying hen strains in an aviary

Summary

Multi-tiered aviaries for laying hens are designed to provide resources, such as perches, that allow birds to perform natural behaviours, thus improving their welfare. However, behavioural differences could influence different strains' suitability for particular aviary designs. We examined nighttime roosting heights (60, 120, 180 cm) and substrates (wire floor, metal ledges, round metal perches) for 4 strains of laying hens (Hy-Line Brown; HB, Bovans Brown; BB, DeKalb White; DW and Hy-Line; W36) in an aviary system at peak lay (25-28wk old). A secondary objective was to examine immediate and acclimated responses of hens gaining access to litter on the floor. Direct observations of hens' nighttime roosting patterns at the beginning and end of the night were conducted over 3 days before, immediately after, and 3 wk after litter provision. Occupancy rates were calculated using 15 cm/hen for perches and 318cm^2/hen for ledges and floors, following industry and kinematic recommendations. Over-occupancy of upper tiers was only observed for white hens, with average occupancy rates for W36 ranging from 133% before litter access to 106% 3wk after litter access. In contrast, average occupancy rates of upper tiers for brown hens ranged from 48% to 22% before and 3wk after litter access for BB hens. Brown hens occupied more perch and wire floor space in aviary enclosures than white hens, and brown hens occupied perches in lower and middle tiers at higher rates while white hens occupied perch space in the upper tier at a higher rate (all $P \leq 0.05$). However, following litter provision, white hens occupied lower tiers at greater rates and brown hens occupied middle and upper tiers at higher rates (all $P \leq 0.05$). This study indicates the importance of examining the match between specific aviary designs, management practices and preferences of different hen strains for optimal system use to improve hen welfare.

Key words: Aviary, laying hen, behaviour, night, perch.

Variation of beak length in two layer strain pullets

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Abbreviated Title:

Summary

Injurious pecking is a welfare concern in poultry, particularly in laying hens, where beak trimming is a widespread practice to reduce damage. As part of a study examining management practices and genetic influences, we report here differences in beak lengths (n=720 birds) in six commercial flocks for each of two genotypes. Birds in half the flocks were infrared beak-trimmed after hatching, with matched flocks left intact. Three different beak measurements were taken from the right side of the beaks of 45 randomly selected birds/flock at three ages between 6 and 15 weeks, using Vernier callipers. These comprised: the lengths from the base on top of the beak to the tip, along the side from level with the front of the nares to the tip and of any overhang of the upper over the lower mandible. For intact beak flocks, independent t-tests revealed all measures were significantly longer ($P<0.027$) in British Blacktails (n=75, mean = 18.6425 mm, SD = 6.70452) at 6 weeks compared with Lohmann Brown birds (n=45, mean = 16.8231 mm SD = 1.53965). These preliminary results indicate genotypic and phenotypic variation in beak dimensions, which will be presented and discussed in full at the symposium.

Key words: Injurious pecking, beak measurements, genotypes, Vernier callipers, British Blacktails, Lohmann Brown.

Nest substrate preferences of laying hens in a cage-free system

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Abbreviated Title: Laying hen nest substrate preference

Summary

Inclusion of a suitable nesting area is important for hen welfare, and to reduce floor laying in cage-free systems. Nest substrate affects nest use, egg quality, hen feather condition, pre-laying behaviour, and mortality. The effects of nest substrate on nest preference, behaviour and wellbeing have not been examined in cage-free environments where hens have the additional choice of laying on the littered floor. The objectives of this study were to examine 1) the preferences of laying hens for one of three nest substrates (AstroTurf® (AT), bare wire (WI) and plastic coated wire (PL) and the floor, and 2) the impacts of nest substrate on hen welfare. Hy-Line W-36 laying hens were housed in groups of 10 to 11 in 8 littered (wood shavings) floor pens (n=8) from 16 to 28 weeks of age. Hens were provided with three nests, each containing one of three nest substrates (AT, WI or PL). Nest substrate location was balanced across pens. Nest substrates were rotated at 20 and 24 weeks to examine whether hens chose nest sites based on substrate or nest location. Eggs were collected daily and the locations of eggs were noted. Hen behaviour was recorded and hen welfare measures (feather condition, feather cleanliness, and footpad condition) were scored at 16, 18, 22 and 26 weeks. Results were analysed using the GLIMMIX procedure (SAS 9.4). The majority of eggs were laid in nests containing AT (82.5±2.4%), followed by the floor (10.7±1.5%), in nests with PL (4.2±0.8%) and in nests with WI (2.7±1.4%) (F_{77}=422.0, P<0.0001). Individual hens were consistent in their nest substrate choice regardless of location and there was little change in hen welfare measures over the course of the study. Results indicated that hens consistently preferred to lay their eggs in nests containing AT.

Key words: Laying hen, behaviour, animal welfare, nest substrate, preference test.

Adding value to end of lay hens: improving welfare, sustainability and credibility

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Abbreviated title: Adding value to end of lay hens

Summary

Currently the majority of hens at the end of lay are treated as a low value by-product of egg production to be disposed of as cost-effectively as possible, making hens vulnerable to mishandling. Such reduced welfare hampers the credibility of 'welfare-friendly' eggs and is an important driver for industry stakeholders to improve their image. Two case studies will be presented as examples of the innovative trials in the EU Hennovation project involving grassroots-led networks. In the Netherlands, the issue of hen carcases being rejected if contaminated by unsuitable material ingested by hens during feed withdrawal is being addressed. By altering management of the feed withdrawal period on farm, the aim is that hens are better prepared for transport. Preliminary data from trials of an energy-rich electrolyte solution in the drinking water or providing birds with clean small pebbles to eat, show promise that carcase contamination could be reduced. Concomitantly, reductions of inappropriate foraging behaviour and levels of hunger would indicate improved hen welfare. Avian influenza restrictions have delayed completion of the trials, but more results should be available at the symposium. Adding value to the end of lay bird is likely to translate into better handling and bird welfare. Thus, the Swedish partnership has developed cooking techniques and recipes to make hen meat more attractive for human consumption. The dishes were prepared and presented to food journalists and other stakeholders, who voted for their favourite (Sprängd höna, resembling Peking duck recipe). Consequent media reporting was very positive and could drive a demand for hen meat. Currently, partly as an effect of Hennovation, there is a Swedish company setting up production of hen meat products from non-organic hens. The network is seeking uses for more parts of the hen (e.g. feet and combs) to further increase the end of lay value. General positive outcomes include an appreciation of the value of sharing knowledge and practices between countries and

bringing together people who would not otherwise have met or explored the range of opportunities available for adding value in every sense of the word.

Key words: Hens, transport, handling, networking, end of lay, welfare.

The effect of handling on peripheral temperature in laying hens

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Abbreviated title: Changes in peripheral temperature after handling

The husbandry-relevant procedure of handling has been found to produce stress-induced hyperthermia in numerous species, including laying hens. This phenomenon is characterised by a core body temperature rise and decreased peripheral temperature. Comb and feet temperatures were measured to investigate the effect of repeated handling on peripheral temperature changes. Heat radiation was measured by a thermal camera during catching and gentle manipulation in 36 laying hens (18 hens regularly handled as a part of behavioural tests, and 18 hens manipulated only during temperature measurement) on three different days. There were no significant differences in comb and feet surface temperature between regularly handled and non-handled hens. However, when we analysed the surface temperature in relation to number of previous handling bouts, while the comb temperature did not change with repeated manipulation ($r = 0.075$, $P = 0.443$), feet temperature was significantly positively correlated with number of handlings (left foot $r = 0.217$, $P < 0.05$; right foot $r = 0.169$, $P = 0.081$). These results indicate a decrease of the stress response with repeated handling. To conclude, infrared thermography represents a feasible method for assessment of temperature changes in peripheral body parts of laying hens after human manipulation. Possible use of this tool for detecting valence of human-animal interactions should be considered.

Key words: infrared thermography, stress induced hyperthermia, handling, welfare laying hens

Footpad dermatitis does not affect environmental usage in laying hens

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Abbreviated Title: Footpad dermatitis and environmental behaviors

Summary

Nocturnal perching behaviours are a behavioural priority for many terrestrial birds, including domestic laying hens. Given the commercial environment in which laying hens live and move, they are also at high risk of footpad dermatitis, which may impact locomotor behaviours. The compensatory effects of lower extremity injury such as footpad dermatitis on priority behaviours such as ascending to nocturnal perching is unknown. We undertook the present study to test whether footpad dermatitis may result in a bird requiring a discontinuous path to perch, rather than a direct path. In this study, 120 adult laying hens from four different strains were housed in aviary pens with elevated perches at 175 cm in height accessed by ramp or ladder with intermediate platforms. Over a period of four months, video recordings were taken of each pen at sunset. Weekly footpad dermatitis status of each bird was recorded by a blinded assessor. Ascent to perch behaviour was classified as: Perched with No Ascent Observed; Direct Ascent to Perch; Indirect Ascent to Perch; and No Ascent or Perching observed. Within the third week of observation, 37.5% of birds presented with footpad dermatitis; 75% of birds presented with footpad injury in the third month. Eight birds (7%) presented without footpad injury throughout the observation period. Birds were equally likely to ascend directly or indirectly. A minimum sample of n=112 was required to adequately power a multiple regression model with 3 predictors. Mixed effects modeling with main effects of footpad dermatitis status, weight, and strain demonstrated a significant effect of strain ($p<0.0001$) but no significant effect of injury ($p=0.84$) or weight ($p=0.1$) on ascent to perches. Whether a bird utilizes a direct or indirect pathway when ascending to perch, a priority behaviour, thus varies by strain, but does not vary with footpad dermatitis.

Key words: Laying hens, footpad dermatitis, perching

The effects of nest box floor type and curtain length in enriched cages on hens' choice of laying location and egg quality

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Abbreviated Title: Nest box attributes and hens' choice of laying location

Summary

Nesting and pre-laying behaviours are considered behavioural needs for laying hens. Hens housed in cages in Europe must be provided with nest areas. Variable use of cage nest boxes, with estimates ranging from 77- 95%, may indicate that hens' behavioural need for a nest box is not being met. This study investigates nest box use in enriched cages on commercial farms in the UK. Part 1: 48 cages were fitted with one of four nest box floor types (artificial turf, hard plastic grid, textured rubber mat, plastic-coated wire), and two curtain lengths (short and long, with 22cm and 11cm between the bottom of the curtain and the cage floor, respectively). Each floor-curtain combination was applied in six cages. Eggs were collected from each cage during seven visits throughout the laying period (23-75 weeks of age); numbers laid inside and outside nest boxes were recorded and eggs were assigned grades based commercial standards. At 23 weeks more eggs were laid outside nest boxes in plastic coated wire (χ^2=11.6, df=3, p=0.009), and short curtain cages (χ^2=5.40, df=1, p=0.020). Eggs laid outside nest boxes were less likely to be graded 1st quality at all ages, and more likely to be graded melange for older birds (χ^2=285.8, df=3, p<0.001). Part 2: 21 commercial flocks with nest box floors of artificial turf (n=10), plastic coated wire (n=8), and hard plastic grids (n=3), were visited at 25±2 weeks of age. Numbers of eggs laid inside and outside nest boxes were recorded in eight cages in each flock, and quality graded. A greater proportion of eggs were laid outside nest boxes when floors were plastic coated wire (χ^2=24.0, df=2, p<0.001) and a lower proportion were graded 1st quality if laid outside nest boxes (χ^2=39.2, df=6, p<0.001). These results suggest hens are less motivated to use nest boxes with plastic-coated wire floors; there are economic implications for poorer quality eggs in these cages. We will also present analyses of behavioural data from the same studies, examining nesting and pre-laying behaviour.

Key words: Laying hens, laying location, welfare, egg quality

Effects of keel bone fractures on individual productivity of laying hens

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Abbreviated Title: Keel bone fractures productivity

Summary:

Up to 90% of laying hens housed in aviary systems are affected from keel bone fractures (KBF) which likely cause pain and suffering. In this study, the link between KBF and productivity was investigated as a measure of welfare. Brown and white hens were housed in 10 identical pens containing a commercial aviary system (15 focal hens of one hybrid + 210 non-focal hens of the other hybrid per pen). Eggs from focal hens were identified by orally administering a dye on three consecutive days, resulting in specific colour patterns in the yolk. At 11 time points (22-62 weeks of age; WoA), eggs were collected over a five day period to determine individual laying performance. Egg quality was assessed in all eggs laid on the first three days of collection. Radiographs of the keel bone were performed on the last day of data collection to detect fractures. Linear mixed effects models were used for statistical analyses. Fractures occurred more often in white hens until 38 WoA and more often in brown hens from 39 WoA until 62 WoA ($p=0.001$). The presence of new fractures had no effect on productivity ($p>0.05$). Egg mass was affected by age ($p=0.016$) and hybrid ($p=0.007$). Laying performance ($p=0.02$), shell breaking strength ($p=0.0001$) and shell width ($p=0.001$) changed with age and were all lower in eggs of brown hens. Our results suggest that laying hens did not alter their individual productivity in the period after a fracture occurred, though future analysis will consider characteristics of KBF like severity, fracture type and/or location. Additionally, a hen with a broken keel bone might develop other strategies (e.g. increased feed intake, reduced mobility) to adapt to this physiological challenge. These potential strategies have to be investigated further in order to better understand the effect of KBF on laying hen welfare in its entirety.

Key words: Laying hen welfare, keel bone fractures, productivity

Session 12

Posters

Footpad dermatitis in broiler breeders in Finland

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Abbreviated Title: Footpad dermatitis in broiler breeders in Finland

Summary

Footpad dermatitis is a common pathological finding in broilers. However, there is little knowledge about footpad lesions in broiler breeders. This study followed the occurrence and severity of footpad dermatitis in broiler breeders and impact of litter conditions on footpads during the production period. The study was performed in 10 broiler breeder farms with 18 flocks altogether. Both footpads were lesion scored, from 100 hens per flock, at transport to the laying farm, three times during the production period (weeks 24, 36, 48) and at slaughter using a 5-point-scale. Litter condition was assessed at 24, 36 and 48 weeks and before slaughter as 0 (dry) to 4 (wet and sticky), and litter moisture was determined. Effects of age and litter quality on mean lesion score and the percentage of severe lesions was analysed using mixed models. Mean footpad lesion scores increased as the birds aged (P=0.001). Mean litter condition score over the entire production period was 0.2 ±0.1. Poor litter quality was associated with higher lesion scores (P=0.001) and more severe lesions (P =0.031). Even in the flocks with good litter quality (0) throughout the production period, 53% (range 51 to 55%) of birds had severe lesions at slaughter. The average litter moisture remained <30% and the litter layer became drier over time (P=0.001). Higher litter moisture was associated with inferior footpad condition (P=0.001). Towards the end of the production period footpad dermatitis become more common and severe. Dry and friable litter delivered better results compared to poor litter quality, however, it appears that good litter condition alone is not enough to completely avoid footpad dermatitis in broiler breeders.

Key words: Broiler breeder, footpad lesions, litter condition, litter moisture.

Peat, wood shavings or ground straw – which is the best bedding material for broilers?

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Abbreviated Title: Peat, wood shavings and ground straw as broiler bedding material

Summary

Good litter quality is considered the most important factor preventing contact dermatitis in broilers. Moist litter also affects broiler behaviour and results in dirty plumage. Although literature offers plenty of information about suitability of different materials for bedding in broilers, peat, a standard bedding material in Finnish broiler production, has only seldom been investigated. This study compared the suitability of peat with wood shavings and ground straw (fine crushed straw) as a bedding material for fast-growing broilers in commercial farms. Mean bird density was 39kg/m^2. Altogether 8 flocks on wood shavings, 8 flocks on ground straw, and 16 control flocks on peat were monitored. Litter condition was assessed following Welfare Quality® protocol with a 5-point scale, height was measured and moisture and pH were determined before chick delivery and 1-3 days before slaughter. Mean litter condition score for all 3 bedding materials at the end was 0.7±0.07. Litter condition on wood shavings and peat did not differ whereas peat appeared more friable than ground straw (P=0.014). The peat layer was lower at the beginning compared with wood shavings (P=0.001), but by the end the difference had disappeared. Initial peat pH was lower and moisture higher than those of wood shavings (P=0.001, each), at the end no difference was detected. At both samplings, peat layer was higher than ground straw layer (P=0.001 and P=0.002, respectively). Peat had lower initial and higher end pH than ground straw (P=0.001 and P=0.015, respectively). Peat was more moist in the beginning than ground straw (P=0.001), in the end moisture was similar. Summarising, a possible advantage of low initial pH of peat vanished during the rearing period. Regarding litter condition, wood shavings and peat appear equally suitable bedding materials for broilers. Enhanced litter condition on peat compared to ground straw cannot be explained by moisture differences.

Key words: Broiler, bedding material, litter condition, peat.

The relationship between fear of humans and leg health in Norwegian broiler chicken flocks

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Abbreviated Title: Fear of humans and leg health in broilers

Summary
In the Welfare Quality® assessment protocol for broilers, the touch test is included to assess the human-animal relationship in the flock. The touch test is designed to test the animals' fear of humans, where it is expected that broilers will withdraw from the observer if they are fearful. However, many broilers close to slaughter age suffer from lameness, which may impair walking ability. The results from the touch test may thus be biased by lameness and poor leg health. As the touch test is currently being used in several countries to assess human-animal relationship in broilers, there is an urgent need to examine this potential relationship for a further validation of the test. Fear of humans was assessed in 50 randomly selected Norwegian broiler flocks, using the touch test as described in the Welfare Quality protocol for broilers. Leg health was assessed by examining the gait of 150 random birds in each of the flocks, using a six point gait score scale from 0 to 5. An ordinal regression analysis showed that flocks with increased lameness had a higher touch test score, indicating that the lame flocks were less fearful ($P<0.01$). The results may suggest that the touch test may be confounded by impaired walking ability and therefore represents a suboptimal, if not directly misleading, method of assessing fearfulness and human-animal relationship in broilers. In conclusion, the touch test must be further validated and possibly supplemented or replaced with a fear test that is not relying on walking ability in broiler chickens.

Key words: Broiler, fear, leg health, touch test, Welfare Quality.

Commercially reared chicks use ramps to access elevated structures during first week of life, a preliminary study

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Abbreviated title: Chicks use ramps during first week

Summary

In commercial rearing of laying hens, UK assurance schemes state chicks must be provided with the opportunity to perch by 10 days of age. Typically the perches provided are at least 25cm in height, which may limit accessibility for young chicks. It is not known whether chicks would use elevated structures at a younger age if provided with access ramps. This study examined three organic commercial flocks of 2000 birds/flock provisioned with six elevated structures (ES). Each ES comprised 9 perches (length 302cm, width 3.5cm), with three perches (25cm apart) at three heights (43cm, 73cm and 103cm). Each ES had two additional plastic slats (width 60cm, length 115cm) on top of perches. Three of the ES were fitted with plastic ramps (width 60cm, length 74cm, angle 35.5°) leading up to the low perch and three ES had ramps (width 60cm, length 115cm, angle 40°) leading up to the middle perch. Chicks had free access to the structures at four days of age. Four scan samples at 5 minute intervals were taken on three randomly selected ES on one day at 1 week and 3 weeks of age to count the number of chicks on the structures. At one week of age the average numbers of chicks were 3.14±2.75 on the ramps, 0.47±1.46 on the slats and no chicks observed on the perches. By 3 weeks of age the average numbers of chicks were 2.75±1.15 on ramps, 14.6±6.72 on slats and 11.7±5.32 on perches. These observations show that if provided with the opportunity, chicks will use inclined surfaces during the first week of life. This work is continuing, by comparing the influence of low and high ramps on ES usage across the entire rearing period to establish the effects of early usage on bird welfare.

Key words: Laying hens, rearing, ramps.

Effect of essential oils on broiler chickens welfare during loading

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Abbreviated Title: Effect Essential Oils in Broiler load

Summary

This study assesses the use of essential oils spread by air on animal welfare of broiler chickens during loading. The work was held in 2 productive sectors of poultry. A simple random sampling was used, 4 houses of female broilers of a minimum of 37 days old were selected (90,720 animals), 2 houses were used as treatment groups (GT) and 2 as control group (GC). Treatment consisted of a blend of essential oils, scattered by air through a diffusor. The mixture was composed of three essential oils: cajeput (antiseptic, expectorant and stimulant), Litsea cubeba (calming, sedative, anti-inflammatory and anti-fungal) and tea tree (anti-inflammatory, antibacterial, antiviral, immunostimulant). 3 successive applications at 24 hour intervals, at a dose of 0.3g/m^3 were performed for 30 minutes at the time of day with the lowest temperature (less than 26°C). Loading was performed 6 hours after the final application. Slaughter plant records: disjointed wing, torn skin (tailbone, breast), bruises (breast, legs, wings), scratches, broken wings, were used to assess animal welfare at loading. The main effect was found in the reduction of torn skin on the breast with decreases of up to 80% in treated animals, which was statistically significant (P=0.002). The use of the oils (Fumagri® Comfort) had the effect of reducing the number of injuries, mainly rips on the breast. Overall, a reduction of 8% of the lesions was found in the treated group. In economic terms, reducing breast lesions is relevant since the breast corresponds to the most commercially valuable meat. The reduction in the number of injuries has implications for animal welfare and the animals were less hit because they were calmer at the time of capture.

Key words: Animal welfare, essential oils, chicken, broilers, behaviour.

The impact of ultraviolet wavelengths on broiler chicken welfare indicators

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Abbreviated Title: Ultraviolet light for broiler welfare

Summary

The aim was to investigate the impacts of Ultraviolet wavelengths (UV) on broiler welfare indicators. UV-A is visible to chickens, which may provide valuable environmental enrichment. UV-B promotes endogenous vitamin D synthesis, and could support the rapid skeletal development of broilers. Lameness and skeletal abnormalities represent an important welfare issue. Day-old Ross 308 broilers were randomly assigned to one of three treatments: 1) White Light Emitting Diode (LED) control group (18-hour photoperiod). 2) White LED with supplementary UV-A LED lighting (18-hour photoperiod) 3) White LED (18-hour photoperiod) with supplementary fluorescent lighting including UV-A & UV-B wavelengths (30 micro watts/cm^2 UV-B at bird level). The fluorescent light was used for 8 hours of the photoperiod to avoid over-exposure of UV-B. Birds were kept at a stocking density of 33 kg/m^2 and fed ad-lib on a commercial diet. Welfare indicators measured were: feather condition (day24, n=546), tonic immobility duration, a measure of stress responsiveness (day 29, n=308), and gait quality using Bristol Gait Score (day31, n=299). For statistical analysis, generalised linear or ordinal logistic regressions models were fitted in R statistical software. Results showed improved feather condition in treatment 2 compared the control (P=0.03). Treatment 2 birds also had lower average tonic immobility duration of 1.02 ± 0.10 (SE) minutes, compared to 1.52 ± 0.12 (SE) minutes in the control group (P=0.03). Lighting condition did not influence gait score. Results suggest UV-A may be beneficial for broiler welfare. While both treatment 2 & 3 provided supplementary UV-A, the improvements in welfare indicators were not consistent. One possible explanation is that the beneficial effects of UV-A are exposure-time dependent. Further study investigating links between UV-A exposure, feather condition and stress are of importance to broiler welfare.

Key words: Broiler chicken, welfare, ultraviolet, LED, lighting.

A meta-analytical approach to broiler performance and welfare

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Abbreviated Title: Meta-analysis on broiler performance and welfare

Summary

With the larger aim of developing a model for optimal broiler management, that considers welfare and sustainability aspects, the impact of main management factors on broiler welfare and performance reported in the scientific literature between 2000 and 2016 was quantified through a meta-analysis. Predictive equations of effects of gender (female/male/mixed), genetics (A/B/A×B/C/other), initial age (days), density (SD; kg/m^2), group size (GS; n), bedding material (yes/no), hours of light (HL; h), scotoperiod division (yes/no), feeding phases (1/2/3/>3), environmental control (EC; yes/no), environmental enrichment (yes/no), medication (yes/no) and significant interactions on average daily gain (ADG; g/day), average daily feed intake (ADFI; g/day), feed conversion ratio (FCR; ADFI/ADG), mortality (%), behaviour (% of time) and gait score (mean value/treatment) were developed using multiple regression, linear mixed models on 75 experiments. At higher SD and smaller GS, ADG and ADFI were higher (P<0.001) and time resting longer (P=0.022). FCR was higher at high SD, although increase with SD was more apparent at larger GS (P=0.027). The increase of ADG (P=0.002), ADFI (P<0.001) and FCR (P=0.042) when SD increased was less apparent when more HL were provided. Gait score was worst with increased SD and with higher light hours (HL; P=0.006). With no EC, an increase of ADG and ADFI (P<0.001), and a decrease of FCR (P<0.001) were detected when SD was higher, while effects were much smaller with EC. Moderately high SD appeared to increase bird growth, but also FCR, thus not necessarily leading to economic profit. In addition, welfare indicators such as gait score and behaviour were negatively affected by SD. These results also showed that the impact of SD is modulated by management aspects such as GS, HL or EC. Thus these aspects have to be considered jointly with the effects of SD.

Key words: Meta-analysis, broiler, welfare, performance, management.

The effect of cellulose arbocel on pododermatitis in broiler chickens

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Abstract

Incidence of footpad dermatitis (FPD) is one of the welfare indicators during broilers fattening period. The incidence and severity of FPD are affected mainly by litter quality, especially its moisture, which is also influenced by nutrient density in the diets. Serious FPD can negatively affect broiler performance including carcass quality. In this study the effect of cellulose Arbocel addition to the starter and grower diets on FPD incidence was observed in broilers. Two identical commercial hoses with the same age and origin of broilers were used. The cellulose Arbocel supplemented the starter and grower diets at 0.7% level till 21 days of age for the chickens in one house. At the end of the fattening period, 34 day of age, approximately 3500 footpads were scored for each flock.
Chi-square test was used for evaluation the effect of Arbocel on FPD. Addition of cellulose Arbocel at 0.7% level to the diets for 21 days had a significantly positive effect on the severity of FPD ($P < 0.05$). Very serious footpad damage was lower with Arbocel use ($P < 0.05$, 67.9 vs. 83.2%). In slight or undamaged footpads there was no significant difference between the houses.

Key words: footpad, arbocel

The effect of dark brooders on fearfulness and free-range use of slow-growing broiler chickens

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Abbreviated Title: Dark brooders for slow-growing broiler chickens

Summary

Free-range use in broiler chickens with outdoor access is often limited, perhaps because they are fearful to use the (entire) range area. Fearfulness might be reduced by providing dark brooders during the rearing period. To test this hypothesis, three production rounds with 400 mixed-sex slow-growing (Sasso T451) broiler chickens each were conducted. In each round, chickens were housed indoors in four groups of 100 from do – d 25, of which two groups had access to a dark brooder instead of conventional heating lamps. On days 22 and 23, an open field and a tonic immobility (TI) test were performed with 25 birds per group. From d 25-70 the chickens were housed in four mobile houses, in the same groups as indoors. These houses were positioned on an 80x80m field, split into four plots. Each house had a free-range area that consisted of 50% short rotation coppice with willows (dense vegetation) and 50% grassland with artificial wooden shelters. Free-range use was monitored three times daily (0900, 1300 and 1700h) on week days; the number of animals outdoors per shelter type was recorded, as well as their distance from the house (0-2, 2-5 or >5m). Preliminary analysis showed no effect of dark brooders on the behaviours observed during the open field test, except on escape attempts (brooders: 24.4% vs. no brooders: 38.6% of birds with ≥1 escape attempt; P=0.075). TI duration and number of inductions were not affected by the presence of dark brooders. No effects of dark brooders or their interaction with shelter type, distance from the house, and age on free-range use were found. This may be due to a possible limited use of the dark brooders by the chicks. Alternatively, fearfulness may not be affected by rearing with dark brooders, although a relationship may still exist between fearfulness and free-range use.

Key words: dark brooder, open field, tonic immobility, outdoor use

The use of perches and platforms by broiler chickens

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Abbreviated title: Use of perches/ platforms by broilers

Perching is believed to alleviate leg problems in broilers and enhance mobility, as it stimulates diverse locomotion. The use of perches is, however, low in broilers, indicating a need to investigate elevated structures that are better accepted by broilers. In this study, elevated plastic platforms, 30 cm high with ramps, were compared with perches, 10 and 30 cm high, in a commercial farm setting. We followed 4 flocks with perches and 6 flocks with platforms, and respective control flocks. The use of the elevated structures and the activity, measured as locomotive behaviour, of broilers in an area with no elevated structures was video recorded. The behaviour of the birds was analysed during two two-hour-periods starting at 1am (night) and 9am (day), respectively, and at three ages: D11, D19 and D32. The development in use of perches and platforms with age was analysed with linear mixed models.
A mean of 0.4 (SD 0.5) birds used perches (per 10 m), while 48 (18) birds used a platform structure of 3.6 m^2. Broilers used low perches more than high perches at D32 (low: median 0.2 (range 0.3), high 0.0 (0.0), $p < 0.05$). Platforms were used more during day- than during nighttime: D11 (median 62 (interquartile range 22) vs 20 (22), $p = 0.046$, D19 66 (20) vs 56 (18), $p = 0.046$. The presence of platforms had no effect on activity compared with the control ($p > 0.05$).
The frequent use of platforms indicates they are better suited for broilers than perches. However, platforms did not appear to stimulate general activity away from platforms. The fact that the broilers used platforms at a higher degree than perches indicates that broilers are motivated to use elevated structures, or to avoid high bird densities on the floor. It might therefore be that the poor perch use is due to physical challenges, and not to a lack of motivation to use elevated structures.

Key words: Broiler, perch, elevated platform, activity

Advantages and perceived disadvantages of combining free-range chickens with production of short rotation coppice

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Abbreviated Title: Combining free-range chickens and short rotation coppice

Summary

Free-range broiler chickens often make limited use of the available outdoor area. Free-range use may be improved by providing suitable shelter. This also provides opportunities for dual land use, and perhaps also a diversified and larger income for the farmer. We have conducted two experiments to assess the effects of shelter type on free-range use, behaviour, leg health measures, and meat quality of broilers. In the first study, slow-growing broiler chickens (n=400 per round, 2 rounds) were either kept with access to grassland with artificial shelters (AS) or with access to short rotation coppice (SRC). Free-range use was higher in SRC than in AS groups (42.8% vs. 35.1%; P<0.001), and in SRC more chickens ranged >5m from their house (10.6% vs. 4.1%; P<0.001). Shelter type did not affect hock or foot pad dermatitis and gait. A blind taste panel judged meat from SRC chickens to be more tender (P=0.003) and less fibrous (P=0.013) than that of AS chickens. In the second study, the birds (n=400 per round, 3 rounds) could chose if they ranged on AS or in SRC. Regardless the distance from the house (<2m, 2-5m, >5m) they showed a preference for SRC over AS (7.7% vs. 2.0%; 8.9% vs. 0.8%; 6.7% vs. 0.4%; all P<0.001). A higher percentage of birds in SRC were standing (8.5% vs. 5.5%; P<0.001) or sitting (35.7% vs. 18.1%; P<0.001), perhaps because the cover provided a sense of safety, while foraging occurred more in AS (50.2% vs. 27.8%; P<0.001). Lastly, interviews with 18 free-range chicken farmers showed the majority perceived coppice to have a positive effect on free-range use and chicken welfare. However, they were hesitant about practical implications (planting and maintenance) and costs of planting. Together, these results show that SRC could have several benefits, but

that practical and economic concerns are holding farmers back from planting it in the free-range area.

Key words: free-range, broiler chicken, shelter, behaviour, interviews

The effects of reduced balanced protein diet on litter moisture, pododermatitis and feather condition of broiler breeders over three generations

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Abbreviated Title: Protein level affects broiler breeder welfare

Summary

Broiler breeders reared on low protein diets are characterised by poor feather condition. Furthermore, polydipsia induced by controlled feed intake increases litter moisture and hence pododermatitis. This study was aimed to establish the welfare status of breeders fed with 25% reduced balanced protein (RP) diet over three successive generations. The experiment started with two treatments for F0 generation: control (C) group fed with standard diet (SD) and RP group fed with RP diet. The F0-progeny of each treatment was divided into the two diet treatments again, resulting in four treatments for the F1 generation: C/C, C/RP, RP/C and RP/RP (breeder feed in F0/F1 generation). The RP diet fed groups received 10% more feed than SD fed groups to maintain the target body weight. The F1-progeny of each treatment were all fed with SD in F2 generation: C/C/C, C/RP/C, RP/C/C and RP/RP/C (breeder feed in F0/F1/F2 generation). Litter moisture, foot pad and hock dermatitis were recorded regularly throughout the three generations. Feather condition of 24 birds of each group was scored during the laying period for each generation. For F0 and F1, the pens of breeders receiving SD had significantly higher litter moisture than the corresponding groups, resulting in an elevated foot dermatitis incidence. F0 and F1 breeders reared on the RP diet had a significantly poorer feather condition than those receiving the SD. C/RP breeders had a significantly poorer feather condition than RP/RP breeders. For the F2 generation, RP/RP/C breeders had a significantly better feather condition compared to the other 3 groups, whereas the RP/C/C breeders were better feathered than C/C/C breeders. In conclusion, providing a RP diet improved litter condition and hence reduced foot dermatitis incidence. Furthermore, transgenerational effects of the RP diet in maternal generations on metabolic or behavioural aspects, thereby influencing feather condition, can be inferred.

Key words: litter moisture, foot dermatitis, feather condition, broiler breeder, generation

A

Abdelfattah E. 110
Aerts J. 184
Ajuda I. 108; 139
Aleksandrova Y. 12
Ali B.A. 164
Alinier A. 61
Ampe B. 102; 184
Aon M.A. 104
Arrazola A. 9
Asher L.G. 179
Avéros X. 119; 180

B

Baeza E. 61; 80
Baker P.E. 140; 165
Balaine L. 109
Ballesteros M.L. 145
Bandara R.M.A.S. 75
Bano L. 65
Bartels T. 53
Baur S. 172
Becerra R. 79; 149; 178
Ben Sassi N. 119; 180
Bennewitz J. 48
Berckmans D. 98
Berg C. 81; 113
Berghof Tom V.L. 57
Bergoog H. 18
Berk J. 41; 53
Bessei W. 48
Bestman M. 130
Bignon L. 80; 109; 117; 121
Bilcik B. 168
Birkl P. 178
Blaha T. 125
Blanchet M. 61
Bolhuis J.E. 23
Bonfanti L. 65
Bonnaud V. 117; 121
Booth F. 100; 120
Bordeau T. 61
Boscarato M. 65
Bourin M. 80
Bouvarel I. 114; 117; 121
Boyner M. 160
Brame C. 117
Brantsæter M. 15; 51
Brinch-Riber A. 27
Brown B. 142
Brümmer N. 137
Brunetta R. 65
Buijs S. 100; 120
Buller H.J. 1
Bussy F. 152
Buyse J. 89; 185

C

Cadot P. 71
Calendreau L. 35
Campbell D.L.M. 164
Cardinaels S. 22
Casey-Trott T.M. 14
Caston L.C. 14

Caston L.J. 75
Caucci C. 65
Cavero D. 50
Chartrin P. 61
Chimenti C. 138
Chiron G. 109
Christensen K. 86
Christoph-Schulz I. 137
Cooley L. 14
Coton J. 109
Criel J. 102
Cronin G.M. 57; 59

D

Daw F. 171
Dayioglu M. 52
De Baere K. 22
De Haas E.N. 41; 101
De Jong I.C. 69; 176
De Konning D. 160
Delezie E; 89; 93
Dennery G. 109; 117
Descamps M. 109
Descombes M. 109
Di Martino G. 65
Dimitrov I. 41
Duchateau L. 89; 93
Dunn I.C. 12
Duquenne B. 184

E

Edgar J. 41
Elias A. 170
Elson H.A. 88; 167
Elwes S. 118
Erasmus M. 166
Estevez I. 41; 111; 119; 180;
Everaert N. 185

F

Facon C. 138
Farish M. 115
Farquharson C. 142
Fernandez M.E. 145
Fernyhough M. 118
Ferrante V. 41
Flesia A.G. 104
Flochlay Sigognault A. 144
Forsythe P. 148

G

Gabarrou J.F. 21
Galliot P. 18
Garbo A. 65
Garcia V. 79
Gebhardt-Henrich S.G. 10; 99
Geissbühler U. 172
Ghibaudo A. 19
Gigaud V. 61
Gobbo F. 65
Goërtz M. 69
Goethals K. 89; 93
Granquist E.G. 92; 176
Grashorn M. 48
Groot T. 147
Groves P.J. 59; 155
Guarino M. 98
Guerin M. 9

Guesdon V.	35; 109; 114; 117; 121
Guillon-Kroon C.	108
Guinebretière M.	18; 109
Güney A.	17
Gunnink H.	91; 163
Guzmán D.A.	104

H

Hampel D.	181
Hansen T.B.	15; 51
Harlander A.	170
Harlander-Matauschek A.	148
Hartcher K.M.	57
Hieu Nguyen Ba	57
Hinrichsen L.K.	49
Hoel K.	92
Hopcroff P.J.	155
Horvath M.	37
Huneau-Salaün A.	109
Hunniford M.	14; 159

J

Jacobs L.	89; 93
James C.	179
Janczak A.M.	15; 41; 51
Jeremiasson A.	113
Jordan D.	143
Jozefová J.	167

K

Karcher D.M.	164
Karrow N.A.	20
Kaukonen E.	70; 174; 175; 183
Kembro J.M.	104; 145; 153
Kemp B.	23
Kempen I.	22; 66
Kikianne C. Kroeske	57
Kittelsen K.E.	92
Kjaer J.B.	48; 148
Klein S.	151
Kostal L.	37; 41; 168

L

Labaque M.C.	145
Lagadec-Pelle S.	151
Lambton S.L.	171
Lammers A.	60
Laravoire A.	109
Le Goff M.	152
Lebouquin S.	18
Legrand A.	108; 139
Leskovec J.	143
Lessire M.	61
Lesuisse J.	11; 185
Leterrier C.	35; 61
Levart A.	143
Levraud C.	121
Li C.	11
Liaubet L.	41
Lichovniková M.	181
Lindsjö	81
Lingaas M.	81
Litt J.	117
Liu S.Y.	57

Locqueville J. 139
Longmoor G.K. 142
Lormant F. 35
Lutz V. 48

M

MacAllister L.K. 1
Mackay A.H. 57
Mackie N. 97
Main D.C.J. 1
Makagon M. 110; 111
Mansuy E. 151
Marchewka J. 111
Marguerie J. 49; 85 104; 144;
Marin R.H. 153
Martin C. 170
Martin J.E. 68; 86; 115
Maselyne J. 102
Mason G.J. 159
Mauvisseau T. 150
McKeegan D.E.F. 86
Meddle S.L. 12; 142
Michel L. 108
Michel V. 18; 41; 109; 115
Midy G. 108
Mika A. 80; 117; 121
Mindus C. 109; 117; 121
Mitchell M. 68; 86
Moe R.O. 51; 92; 176
Monte F. 171
Morel X. 147
Moronato M.L. 65
Mosco E. 9
Muir W.I 155
Mul M. 140
Musilová 181

N

Nafstad O. 92
Nauholz H. 116
Nazar E.A. 153
Neijenhuis F. 167
Neiwman A.E.M. 20
Nicol C.J. 100; 120; 161; 165; 171; 177
Nødvedt A. 51
Noirot V. 21
Nordensten L. 81
Nordgreen J. 15; 41; 51
Norman K. 177
Norring M. 70; 154; 174; 175; 183
Norton T. 98

O

Ogink N.W.M. 163
Oppermann Moe R. 15
Özkan S. 17; 41; 52

P

Pasquier D. 108
Peixoto M.R.L.V. 20
Pellegrini S. 104
Peña Fernández A. 98
Pencalet F. 139
Perko-Mäkelä P. 116
Petersson I.C. 161

Peuteman B. 35
Phalen D. 59
Picchiottino C. 114; 117
Pichova K. 37; 41; 168
Piette D. 41
Plomp M. 140
Pohjola L. 116
Preisinger R. 50
Prescilla K.M. 57
Puolanne E. 154
Puterflam J. 18

Q

Quero B. 152
Quilléré N. 151

R

Reubens B. 102; 182; 184
Reuvekamp B.F.J. 91
Rezar V. 143
Riber A.B. 41; 49
Richards G. 100; 120
Rodenburg T.B. 15; 23; 41; 51; 57; 60; 101; 102; 182; 184
Rousset N. 18
Rovers A.K. 137
Rufener C. 172

S

Salobir J. 143
Sandberg E. 15; 51
Sandilands V. 27
Schallier S. 11; 185
Schmitt A. 85
Schmutz M. 50
Schwean-Lardner K. 75; 77; 78
Serpa L. 77
Siegford J.M. 164
Sihvo H.K 154
Singh M. 57; 59
Širovnik J. 162
Sleeckx N. 22; 66
Sossidou E. 41
Souchet C. 80; 114; 117
Souillard R. 18
Spencer K.A. 142
Stadig L.M. 102; 182; 184
Stefani A. 65
Stehle E. 53
Stirling J. 12
Stokes J. 140
Stratmann A; 97; 99; 172
Szkotnicki W. 148

T

Tahamtani M.F. 15; 51
Tarlton J.F. 97; 100; 120
Tauson R. 160
Temple D. 140
Thieffry J. 108
Thoby J.M. 61
Thomas E. 144
Thomas R. 18
Tobalske B. 170
Torrey S. 9; 75; 77; 78
Toscano M. 41; 99; 172
Toscano M.J. 10; 27; 97; 162

Tullo E. 98
Turner P.V. 78
Tuyttens F.A.M. 89; 93; 102; 182; 184

V

Valaja J. 154
Valros A. 41; 70; 154;174; 175; 183
van de Ven L.J.F. 23
van den Oever A.C.M. 23
van der Eijk J.A.J. 41; 60; 101
van Dijk L. 1
van Emous R.A. 163
van Niekerk T.G.C.M. 91
Vasdal G. 176
Vermeulen D. 89
Vezzoli G. 110; 111
Videla E.A. 153
Vizzier-Thaxton Y. 86
Vögeli S. 99
Völki B. 99
Voslarova E. 167
Vranken E. 98

W

Wall H. 160
Warin L. 114; 117
Weeks C.A. 1; 88; 161; 165; 167; 177
Wichman A. 140
Widowski T. 9
Widowski T. M. 14; 20; 75; 77; 78; 159
Wiseman 179
Woolcott C.R. 78
Würbel 172

Y

Yngvesson J. 167
Youssef A. 98

Z

Zak J. 140
Zandonà L. 65
Zapata B. 149; 178
Železnikar P. 36
Žgur S. 143
Zoons J. 22; 66
Zupan M. 36; 41

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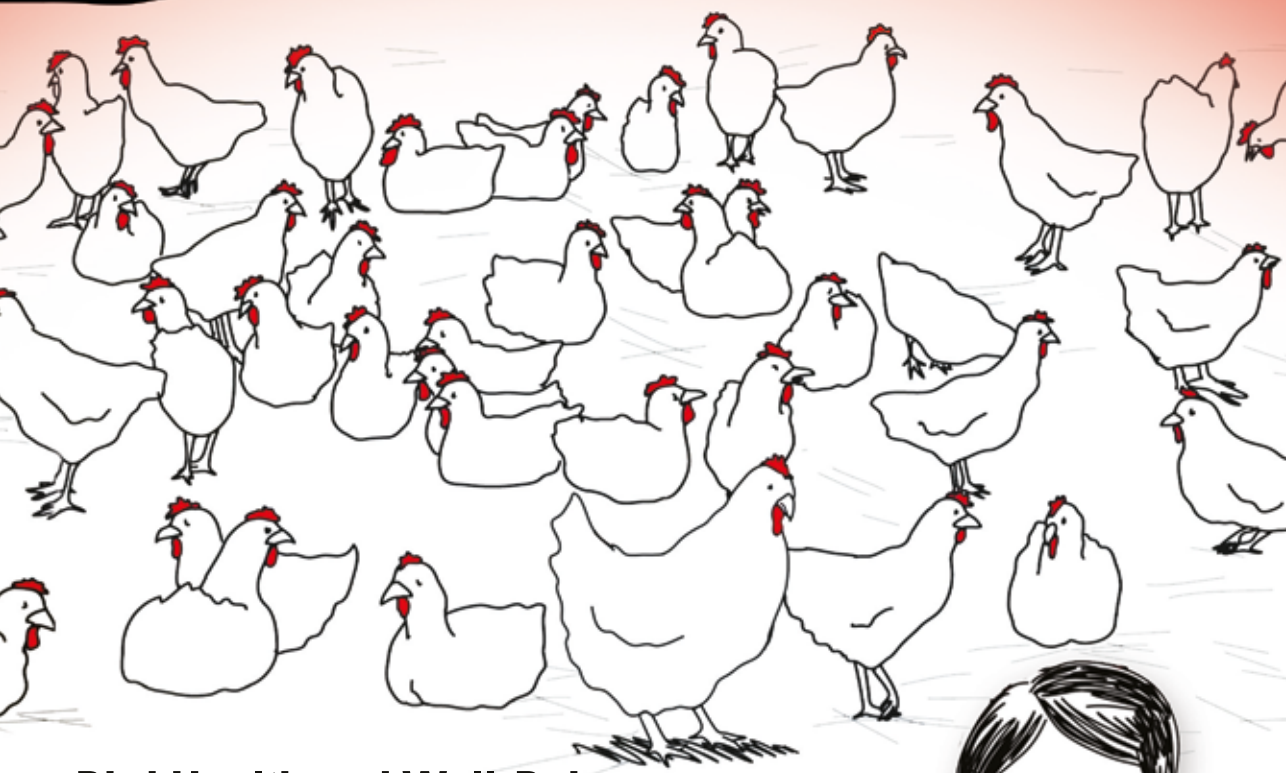

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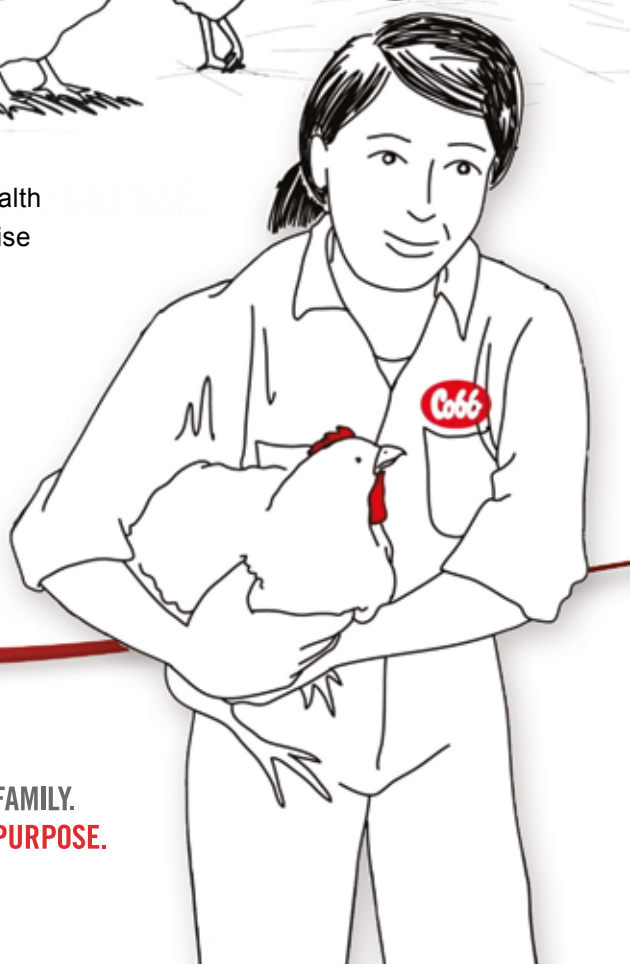

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