



## **EU COST KBD meeting 28 Feb – 1 March 2018 Zagreb, Croatia**

### **Wed 28<sup>th</sup> Feb**

#### 1. Welcome and programme (Zlatko Jancecic)

##### 1.1. Introduction Faculty of Agriculture

1.2. Introduction from ZJ about Croatia and poultry industry: broilers 48 million, hens 2 million, about 1.4 million of those in ECs over 65 farms. Some barn and free range also, and 300 birds in organic over 2 farms. Info on the Faculty of Agriculture, Dept of Animal Nutrition.

#### 2. Meeting objectives +"who is who" (Ine Kempen)

IK thanked various members for helping

##### 2.3. Objectives

###### 2.3.1. To close the gap between science and practice, by:

- Defining what kind of information farmers need to reduce KBD, and in what format. VS – don't we need to engage farmers to find out what/how they want the information? MJ and AJ are connection to Swedish industry, MW is connection to UK industry, but perhaps we need to speak to a few key farmers within our countries to find out how they would like the information.
- Evaluating strategies on feasibility, investments, applications in practice
- Discussing how to implement advice: output materials
  - Agree it needs to be short, relevant and easily accessible
  - One leaflet (or whatever media) with all aspects or split the information into topics (management, nutrition, etc)
  - One leaflet for farmers and industry? Basic vs advanced? Or give all same information?
  - Format needs to be easy to adapt: information can differ between nations
  - If produce a video – show palpation, demonstrate good and bad practice (e.g. birds landing badly). How would it be distributed? How many videos? – one on palpation, one on causes and solutions? Include profitability analysis (how KBD affects egg output, mortality etc)?

###### 2.3.2. Produce clear recommendations in a useable format for industry and farmers

##### 2.4. Present at the meeting: who is who:

Zlatko Jancecic (Univ of Zagreb, Croatia), Ine Kempen (Experimental Poultry Centre, Belgium), Bjorn Andersson (Lohmann Tierzucht, Germany), Laura



Bignon (Technical Poultry Institute, France), Paolo Ferrari (CRPA, Italy), Elisa Folegatti (DSM, Italy), Daniel Hoop (Agroscope, Switzerland), Magnus Jeremiasson (Swedish Egg Association, Sweden), Alexandra Jeremiasson (Swedish Egg Association, Sweden), Dragan Zikic (Faculty of Agriculture, University of Novi Sad, Serbia), Joergen Larsen (Danish Egg Association, Denmark – from Thursday), Bas Liebrechts (Vencomatic, Netherlands), Vicky Sandilands (SRUC, UK), Michael Toscano (Univ of Bern, Switzerland), two visiting staff (Faculty of Agriculture, Croatia)

Apologies:

Mark Williams (British Egg Industry Council, UK) Charles Saliba Reto Straessle (Gallocircle, Switzerland) Nüssli (Gallosuisse, Switzerland), Mia Fernyhough (RSPCA, UK)

### 3. Keel bone problems in a nutshell (Michael Toscano)

3.1. Thanked ZJ and IK for assisting with the meeting

3.2. Frequency – prevalent in every country that has investigated it, so probably pervasive worldwide. But many countries/producers etc are not aware of it. It isn't obvious without inspecting hens. KBD is in all systems – enriched cages, barn, free range, organic. Damage does not increase linearly with age, but flattens out and even decreases after about 45 weeks of age

3.3. Severity – generally where there is greater frequency, also see greater severity. Severity and frequency also increase with age

3.4. Causes – high and long production period of egg production weakens the bone structure. Bone is demineralised over the lifetime of the bird (calcium extracted for egg shell production). Increasing dietary calcium has a limited effect due to absorption rate. Perches increase the rate of KBD, but this varies depending on placement, if birds are trained to use perches, types of perches, height of perches (and other items to perch on). Birds crash landing which applies force to the keel – contribute to compression factors. Happens in cages too, but they don't tend to fall down, but run into, or jump up badly, to perches.

3.5. Solutions – these must have robust responses (in reducing KBD in hens) and proven mechanisms to recommend to producers

- Management and housing

- Issue: reducing jostling during dusk phase, as they attempt to reach higher perches and knock one another off of perches

- Solutions: Extending the dusk phase so system is well enough lit that birds can see where they are going to (evidence for this, A Stratmann, but analysis still ongoing) e.g. instead of 10 min, 45 min.; increasing the number of perches to prevent crowding; provide ramps between tiers to enable birds to walk up; rear in a system that mimics laying housing – for muscle development, and cognitive development to deal with multiple levels. (is it cost effective in terms of the % reduction in KBD and subsequent effect on eggs/mortality?)



- Genetics – different strains reared and fed the same way respond differently to impact tests –but they also differ in egg production rates. Commercially viable effects on KBD take time – improvements are 5-10 years off.
    - Bone health – Ian Dunn, Roslin, UK, working on genetic markers of bone assessment detection
    - Egg production
    - Behaviour
  - Nutrition – flexible because can be changed rapidly
    - Opportunities: Ca, P and Vitamin D concentrations; Omega-3 fatty acids (but expensive, niche market as a value-added egg for human health); Ca loading to improve egg shell quality (not giving MORE calcium, but choosing WHEN and in what FORM to give it so that hens can absorb it i.e. 2-3 h before dark phase so that Ca is in the crop and slowly released– then less mineral is taken from bone, to improve bone strength)
  - Tough job ahead!
  - Need ideas on how to spend the money – meetings, producing and distributing dissemination information, training schools (VS – KBD assessment for egg production companies – high level staff that can then train their staff, or carry out assessments on farms). MT envisions 50% to be used for output materials to get information to the producers.
    - BL suggests a mind map (flow chart) to show how KBD is linked and can be influenced
4. Key factors in coaching/informing producers (Alexandra Jeremiasson)
- 4.1. Implementing science into practice
- Bearing in mind costs to producers, is it worth it – can they still make money?
  - To see the whole picture – impacts of one change on others, for example where there are ramps and perches there is greater manure, which if it does not go onto the manure belts will affect the ammonia in the house. Increasing light so birds can see perches etc but may increase feather pecking; rearing birds in aviaries even if going to ECs – not allowed in some countries, and does not match rear to lay which is discouraged (even though evidence in a study showed it reduced KBD).
  - Reference groups – round table discussions between researchers and farmers, meet regularly through a project, to reach a mutual understanding. Commonly required to secure research grants
  - Closing the gap – SCIENTISTS: understanding the conditions in the stable, what are the management routine and WHY, what does the system look like, why is the light intensity what it is, what is the farmer paid for eggs (understanding the margins and thus what costs they can bear). FARMERS want – how to improve production, how to improve income,



what methods work, what do other producers do that work, prefer information/advice from other producers

- How? Produce short articles for farmer's magazines, for each country in their home language; printed and electronic material that can be distributed by post/at visits or by email; basic and more advanced – targeted at different groups; different information based upon housing systems used, country etc; tutorial information should be short, use images and laminated for durability/cleaning; eye catching and brief – can someone read it over their lunch break?; produce 3D models of KBD (or dissected, preserved KBDs) and share with producers; use of web pages to distribute e.g. videos; producer meetings – give the theory, and then put into practice on a visiting farm.

#### 4.2. Discussion

- Using existing materials that the group has produced to make materials for local members to distribute
- MT notes that we can pay someone to produce things for us (leaflets) so please offer suggestions.

### 5. Effect of keel bone fractures on production (Michael Toscano/Daniel Hoop)

#### 5.1. Reasons to reduce KBD – pain, suffering; possible effects on production

- MT: Production evidence – Thiruvankadan et al (2010) suggested there may be repartitioning of resources where there is KBD; Nasr et al (2012) showed reduce egg numbers, increased food costs, but done in small groups; Heerkens et al (2013) found no effect in commercial flocks with various KBD levels, but too much variation in KBD and palpation, which is less objective (so greater room for error).
- C Ruefener compared production in aviaries with 220 hens/pen x 10 pens, in which 15 focal hens/pen were given dye to affect yolk colour and hens radiographed at 11 time points for KB status (birds hung by legs, xrayed in the barn). Study drawbacks: focal birds (which were always different colour to the main flock e.g. 15 brown hens with 205 white hens) tended to clump; repeated handling of birds, 5 days of egg collection means that production % was crude: in increments of 20%, evaluation of fractures – multiple sites, big vs small fractures, in various stages of healing (what is important to the bird?)
- Results – repeated handling affected white hens more, with decreased production, than brown hens. KBD was assessed for severity using a validated system, and KBD was assessed for status (fresh, healing, healed, no fracture). % of birds, and severity, increased with bird age. At 37 weeks, the birds with greater production have more severe KBD; at about 45 weeks production and severity are quite flat, and then from 49-61 weeks, birds that have more severe KBD have reduced production. No effects of KBD on egg quality. Do not have individual feed intake data per hen, but this would be interesting to know... (VS could you use a marker like titanium dioxide and collect droppings from indiv bird – measure relative amount of TiO<sub>2</sub>...?)

- DH: Goal: estimate which interventions are cheapest? Interventions: change physical environment, change management (labour), change breed or genetics, xxx. Used CR's data above. Looking for the % increase in a change (e.g. 5% increase in labour) = % improvement in KBD. Used standard costs and revenues sited for Swiss production and costs (accepting that not all farms use same housing system). Modelling indicates that for environmental changes every 1% cost increase, must decrease KBD by 3% (which will increase egg output a bit) otherwise it is not cost effective. With labour, for every 1% change must decrease KBD by over 4%, with animal (breed), for every 1% increase in animal costs, must decrease KBD by 8%, with feed for every 1% increase, must decrease KBD by over 11%. Not done with real data yet, e.g. cost of ramps and economic effects on production vs KBD.
- But, we do not know if making the investment WILL decrease KBD accordingly, but we have some evidence that e.g. adding ramps (environmental change) decreases KBD by xx%. But that might have other knock-on effects (manure off the belts) which may increase labour and/or ammonia levels which have other knock-on effects.
- PF suggests working on the principle of improving animal welfare and sustainability among flocks as a way to 'sell' improving KBD to farmers. (Look at the influence of retailers and CIWF and other welfare groups on affecting laying hen housing, which has not necessarily improved profitability). There may be (financial?) incentives to be a top animal welfare provider. Possible need to have individual advice, depending on the housing type, design, etc.

## 6. Genetics - Target audience + interventions (Björn Andersson)

6.1. Who is the target group? KBD = breed x environmental factors

KBD = breeders +farmers, nutritionists, housing suppliers

6.2. How do the target groups divide?

6.3. Current situation: breeding for higher bone strength is possible (Bishop et al 2000); KBD occurs across all hybrids, but at VARYING rates across hybrids; laying cycles are getting longer – KBD risk increases with age, and higher risk of bone fractures at end of lay (but MT's data shows it comes down a bit?); incentive to keep birds for longer (85-110 weeks of age) with good performance

6.4. Challenges: to find a reliable bone phenotype – reliable, easy to use, valid for bone status; many different palpation measuring methods (score 1 = low or score 1 = high; deviation and fractures separate or combined etc).

6.5. Using KB palpation in two lines at two ages, found greater heritability in KBD in one line than another, with no significant influence on body weight or shell breaking strength

6.6. Bottleneck: the breeding programme would then be selecting for yet another breeding trait, of which there are already many others in the mix; breeding is time consuming – initial flock, data collection and selection, then transfer over three generations = 4 years until seen in commercial flocks.

6.7. Impact of environment may be faster – e.g. considerable growth in bone after 15 weeks to 21 weeks (longer in brown egg layers) – possible consideration is to delay transfer/onset of lay? Diet would be important here to make sure bone mineralisation is high? (see Ysilevitz 2007).

6.8. See Lohmann information: [www.ltz.de/en/news/lohmann-information/2017-2/5](http://www.ltz.de/en/news/lohmann-information/2017-2/5).

## 7. Nutrition - Target audience + interventions (Ine Kempen)

7.1. Pullets – want to maximise bone health and development, to minimise structural bone loss when medullary bone is being formed later. Early rear (to 14 weeks) Ca 9 g/kg, then 35 g/kg? Avoid phosphorous deficiency. Optimal balance between Ca:P at 2:1 in starter diets.

- Calcium size
- Vitamin K and D
- Pre-lay feeding – use pre-lay feeding for ~10 days (estimate 100 g/bird/day) smooth transition from pullet to layer feed: 2-2.5% Ca with other nutrients similar to layer feed. Higher levels of protein mean late maturing birds can catch up, but higher levels of Ca prevents decalcification in early maturing birds (Pottgüter, 2016)

### 7.2. Laying hens

- Provide Ca at appropriate TIME, in appropriate FORM (late in the day in coarse particles, not powder)
- Split feeding (provide extra coarse limestone in feed in the afternoon or at last meal of day, from a separate silo) but this is hard to manage to ensure birds get the right diet at the right time
  - Top dress the feed instead: add to the top of feed via a separate hopper just before it enters the shed or passes the bird
- P level and phytase: avoid P deficiency, optimal balance between Ca:P, use phytase for better availability
- Add Omega-3 fatty acids, shown to reduce KBD at 50 and 70 weeks (when inspected at 30, 50 and 70 weeks, when used flaxseed), but adds cost to the eggs, and if consumer will not pay (sold as a human health benefit) then producer unlikely to use. Using too early (from 16 weeks) has detrimental effects, however.
- ZJ – in a study done at U of Z, using organic vs inorganic minerals in hen diets from 35 weeks to EOL resulted in higher breaking strength, less KBD, and improved shell strength.
- DSM – using HyD (first metabolite of vit D<sub>3</sub>) to affect Ca absorption, this resulted in larger long bones in pullet phase, this may result in benefits in lay as there is larger bone volume (and thus Ca reserve?).

## 8. Different formats of output material (Ine Kempen)



### 8.1. Instructional video

- With text and voice over, translated to other languages
- 2-3 min x 2 videos:
  - .1. Awareness of KBD, Mention effect on bird welfare, positive message, no production info (?)
  - .2. Show palpation, and what the keel looks like when dissected
- Should create awareness in a positive way
- Online access
- MT has found a company to film palpation instruction in Switzerland
- Impact: who will use, likely benefit
- To be led by MT's group

### 8.2. Interventions leaflet (not part of the small group discussions)

- MT thinks we do not have enough information at this stage to produce an entire leaflet on nutrition, for example
- Want the intervention to have been proven in commercial systems

### 8.3. CPD course, for industry

- Free of charge
- Dragan has experience of Moodle and how to use, can be free of charge
- VS has experience of Coursera
- Target: producers and staff, egg company advisors, poultry vets, egg inspectors, feed producers,
- Material to teach (MAYBE do at two levels, basic (1 h material) and more advanced (2-3 h)):
  - What is KBD, how does it happen
  - Wider implications on general bird welfare, might affect other aspects of bird welfare
  - Possible preventions/ways to reduce: management, nutrition, genetics (not great detail – ramps are useful, but not e.g. how many, what angle, where...) More focus on things that producer can control.
  - Ways to monitor KBD in your flock, referring them to the training video (part 2), then quiz to check.
  - A questionnaire – to assess risk for KBD (e.g. type of housing system, height of structures, ) with selections per question – give level of risk. (in the basic model for people on the ground to use)
- A formative quiz at the end of each section to check understanding – if they do not pass, they should review the material and retake the quiz (prevent them taking the quiz for e.g. 30 min)
- Then a formal summative quiz at the very end that they must pass.



- WE NEED TO PRODUCE: material (PPTs, story boards, images), needs voice overs in various languages and transcripts translated – professional speakers, paid for by the COST.
- Certificates produced at the end of it. EG 'Keel Bone Damage elementary level' and Keel Bone Damage advanced level'
- (Could pay a company to produce this for us – then we can make it freely available.)
- How long for someone to complete it (once signed up, can take it in e.g. one day or 10 weeks – open ended)
- Material is downloadable, so that someone can always return to the information – PDFs of the lecture material (script of transcript from e.g. Jubler).

8.4. PPT presentation that is translated into different languages, to present to producers etc (not part of the small group discussions)

8.5. Profitability analysis

- Based on published studies, doing X would reduce KBD by Y-Z%
- Have a weekly analysis and adjustment
  - Make it clear where data is extrapolated
- Online tool with production of article for national trade poultry magazines
- Test out if this is going to be useful: produce some graphs for industry reps to share with industry – is this helpful?
- Use egg packers to as an additional incentive for producers
- To be led by MT

## GROUP SESSIONS

9. What information should be produced and what format?

9.1. In groups, we discussed the KBD training video, CPD online course, and profitability analysis

## **Thursday 1<sup>st</sup> March**

IK reviewed the previous day, and welcomed Joergen

10. Future research KBD – summary of the research meeting in Slovakia (Ine Kempen)

- 10.1. Presentations will be available on our website
- 10.2. How the training school went (Bern, Switzerland WG 1) – standardising KBD – palpation, xray and dissection
- 10.3. Plans to hold another training school at Benelux, Belgium mid-June 2018. Training by Ine, Frank Tuytens, and Bas Rodenburg. One day course (lectures on bone physiology, healing, KBD assessment, and then handling –





palpation and xray on birds from two different systems. Target at advisors, vets, vet students, egg producers. Held in a mix of English and Dutch.

- 10.4. Presentation on calcium timing and tocopherol trial (MT and DSM)
  - 10.5. Presentation about split feeding (IK) with different Ca levels; as opposed to gap feeding (Mark W) – in which there is a relatively large gap between two feeds to allow egg laying in nest boxes)
  - 10.6. Presentation on lighting programmes during rearing (slower step down in young birds, and delaying onset of sexual maturity with a slower increase at end of rear)
  - 10.7. Presentations on genetic studies on bone strength (Dirk de Koning)
  - 10.8. Presentation by Mia Makagon on three KBD projects going in at UC Davis.
  - 10.9. Presentation by B Rodenburg on early life experiences on KBD– 24 h light resulted in larger embryos, and on Core Organic free birds (optimising free range use and welfare of laying hens, use of dark brooders, use of trees)
  - 10.10. Presentation by B Eusemann on effect of Suprelorin supplement (inhibits egg production) on KBD – caused differences in structural bone compared to control
  - 10.11. Presentation by A Stratmann about use of ramps in laying phase. Extended to providing ramps in rear – chicks use immediately, study ongoing to look at subsequent effects in lay.
  - 10.12. Presentation by I Dunn about finding a phenotype for bone density using xrays.
11. Management - Target audience + interventions (Vicky Sandilands)
- 11.1. Further evidence gathering to support various points is required.
  - 11.2. Perhaps need to have a 'however' section if the outcomes have not been tested in commercial systems.
12. Housing - Target audience + interventions (Ine Kempen)
- 12.1. Housing pullets: use aviary-type system in rear when planning to house in an aviary during lay – increases bone loading/strength through greater activity
  - 12.2. Providing perches in rear
  - 12.3. Early exposure to inclines/ramps (< 40°) to encourage navigation, improves accurate negotiation of complex environments (BL points out should be steep enough to discourage sitting on it, and MT says wide enough that if a bird does sit, that others can pass)
  - 12.4. Angles between perches not more than 45°, gap between perches not more than 60 cm, gap between perches not too great.
  - 12.5. Perch shape (Pickel, Scholz papers). Vencomatic use mushroom shape, which hens seem to prefer – duration on perches is greater, more birds perch on them. (Also used in the Q-perch, electrified to kill red mites)
  - 12.6. Soft perches reduces KBD but hygiene and red mites possibly issues.



- 12.7. Perch space – obstructed perches (i.e. those with limited space, which bird is accurately trying to reach), particularly for landing, are harder to negotiate on descent than ascent
- 12.8. Ramps reduce KBD
- 12.9. Aerial perches (Wilkins 2011) – but this shows perches sandwiched into existing sheds in vertical configuration... Still, risk for greater KBD as perches get higher.
- 12.10. Aviary design and type of slatted floors (Heerkens 2016) affect KBD.

### 13. Review output material + conclusions on input/format (Moderator: Michael Toscano)

- 13.1. Productivity and costs analysis tool (MT, DH)
- 13.2. KBD training videos: 1) assessing KBD (MT) 2) awareness of KBD - by system, what causes them, including poor landings, effects on animal welfare (who –no volunteers as yet) In spoken English, and then subtitles in each language OR voice over in each language
- 13.3. CPD training course (IK, DZ, VS) IK will be producing material for the Benelux training course in June, then Dragan and VS can assist with prep for e.g.Moodle
- 13.4. Leaflet – printed and translated, PDFs also. Posted out by the company if required. Development of the leaflet then took place (**see Annex**). MT aims to produce draft by 19<sup>th</sup> March, respond with comments by 23<sup>rd</sup> March. To be printed in this grant period.

### 14. General conclusion (Michael Toscano)

- 14.1. Usefulness of meeting, etc. People generally agree that it is useful to meet around a table (cf. video conference or using Skype), especially with a small group, and where plan is to generate something concrete. AJ and MJ, and JL agree that meeting with scientists is useful, to ensure the practicality of the suggestions. BA suggested that the meetings should be somewhere more central to make them easier to get to – a hotel airport for example.
- 14.2. Next Management Committee meeting will be at Dubrovnik, Mon 17<sup>th</sup> Sept 2018 (conference is Mon night reception – Thurs 20<sup>th</sup>)
- 14.3. Next dissemination production meeting will be roughly Feb 2019 in a more central location (e.g. Amsterdam, Brussels); review dissemination tools that come out of this meeting (Feb 2018).



### **Annex – development of leaflet**

Genetics: do not have strong recommendations at this stage

Nutrition: perhaps not enough here? Some information about Omega 3, and particulate calcium. Include but short section.

Housing and management – enough data here, to be general so that it doesn't need adapting by country