CALCIUM PIDOLATE IMPROVES EGG QUALITY WHEN IT IS FED TO COMMERCIAL LAYERS FROM 50 WEEKS OF AGE

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Summary

Calcium pidolate is claimed to have a positive impact on bone quality (in rearing) and to improve egg quality (in lay). Supporting data, however, are quite limited and often relate to studies carried out on small numbers of birds. In this study, we compared egg quality and bone strength in eight commercial free range flocks which received either a standard diet supplemented with 300ppm of calcium pidolate (Treatment n=4) or just the standard diet (Controls n=4) from 50 weeks of age. The results show that there were 0.89% fewer eggs graded as seconds (P < 0.001) in the treatment group and 1.4% increase in eggs graded as large (P < 0.001). A small but significant increase in eggshell breaking strength (P = 0.004), shell weight (p = 0.38) and shell colour (P < 0.001) was also observed. No evidence was found that bone quality at 70 weeks of age was better in the treatment group (tibia or humerus breaking strength, keel bone radiographic density and keel bone deformity scores). It can be concluded from the study that supplementing a layer diet with 300ppm calcium pidolate from 50 weeks of age could be a cost-effective way of maintaining egg quality in longer laying cycles.

I. INTRODUCTION

With the current genetic focus being on longer laying cycles, there is a need to look for new ways of improving calcium metabolism in laying birds which are prone to osteoporosis in the latter stages of lay (Bain et al, 2016). Calcium pidolate (a highly soluble, absorbable salt with excellent gastrointestinal tolerance) has been around for 10-15 years in the commercial sector of the egg industry. Existing evidence suggests that this supplement has beneficial effects on egg and bone quality (Agblo and Duclos, 2011; Valderrama and Roulleau, 2013). Additional independently derived data from commercial flocks fed this supplement are needed to help farmers make a decision about using calcium pidolate since it adds a significant cost to production.

The aim of this study was to provide reliable data to support the hypothesis that providing laying hens with a 300ppm of calcium pidolate supplementation from 50 weeks of age improves egg quality and bone health. A unique design feature of this study was the access to eight commercial free range (FR) flocks that were located across four different study sites. Each site offered two identical sheds with flocks of the same stocking density (12,000-16000), genotype and age. By providing one flock at each site with the calcium pidolate supplement (treatment) and the other the control diet, the four study sites served as replicates in our statistical models.

II. MATERIALS AND METHODS

Pre-trial baseline data (egg grading, egg quality and bone quality) were collected for all eight study flocks between 45 and 50 weeks of age. From 50-70 weeks of age, one flock per site

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was given a calcium pidolate supplemented diet (300ppm), the other flock received the same standard layer diet without supplementation (control).

Weekly egg grading data (% extra large (XL), % large (L), % medium (M), % small (S), % extra small (XS), % Seconds, First quality (Doz), Seconds (Doz), Total Eggs (Doz) and Average Egg Weight (g) were provided for each flock pre and post intervention from 45 to 70 weeks of age.

For egg quality and bone quality parameters, power calculations were used to determine the optimal sample sizes (total eggs and bones for analysis per flock) using published data. Egg quality was assessed on 120 eggs per flock every five weeks from 45 to 70 weeks of age. Egg quality was assessed in terms of egg weight (g), dynamic stiffness (Kdyn) (N/mm), breaking strength (N), shell colour (% reflectance @ 640nm), shell thickness (mm) and shell weight (g). 31 birds from each flock were culled at 45 (pretrial data) and at 70 to assess their bone health status. The right wing, right distal limb, and keel (whole with muscle still attached) were carefully excised, bagged, labelled and deep frozen prior to testing. Bone breaking strength (tibia and humerus) was determined by a three-point destructive bending test, Keel bone radiographic density measurements were made by taking a radiograph of each keel bone and analysing each image using Image J1.32 as described by Fleming et al. (2004). Keel bone damage was visually assessed by scoring each keel on a scale of 0-3, 0 being no damage and 3 being severely deformed involving evidence of bone fracture.

Multivariable linear regression models were built for each outcome variable within each of the egg grading, egg quality and bone quality data sets. Age (or sample number as a proxy of age) was included in all models, because of known associations between age and many of our measured outcomes. 'Site' (n=4) was included as a random effect variable in all models to account for between 'site' variations. Thus, variation in the measured outcomes that was associated with age and any unmeasured variables or differences that existed between sites was accounted for in the analyses.

For the bone data the primary variable of interest, representing the control or treatment group, was forced into each model. For both the egg grading and egg quality datasets, two sets of models were developed for each of the measured outcomes. The first model included the primary variable of interest which compared the control group samples and the treatment group samples with the pre-trial samples. The second model included only the data post intervention and so compared the treatment group using the control group as the reference for each of the measured outcomes.

III. RESULTS AND DISCUSSION

Model 1 compared the post intervention treatment group and the control group with the pre-trial data. For the egg grading data set, the only significant effect we observed was a small reduction in the average egg weight (-0.8g; P = 0.025) in the Control group. For the egg quality data set, a significant post intervention effect was observed for breaking strength and shell colour in both the Treatment and Control groups: respectively a reduction in breaking strength of 5.5N, (P < 0.001) and 6.2 N (P < 0.001) and a reduction in shell colour of 10.73%, (P < 0.001) and 11.48 %, (P < 0.001). The fact that both post intervention treatments were different to the pre-trial data suggests that there could have been errors associated with using 'bird age at sampling' as a proxy for age in the egg quality data set model. For the bone quality data set, no significant post intervention effects were observed.

Our second model compared the post intervention Control and Treatment data sets with each other. This revealed that there was a significant increase (P < 0.001) of 1.4% in

eggs graded as Large and a significant reduction (P < 0.001) of 0.89% in Seconds from the Treatment group (Figure 1).
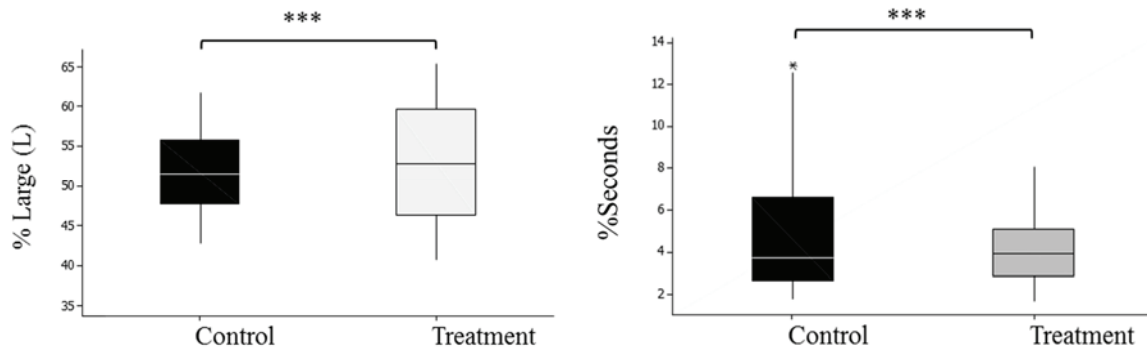

Figure 1 - Comparison of %Large and %Seconds for Treatment (Calcium Pidolate) and Control groups. The combined weekly data from 51-70 weeks of age are presented as medians with 25-75 percentile range as the box and the whisker as 10-90 percentiles (***P < 0.001).

Eggshell breaking strength (+0.7N; P = 0.004), shell weight (+0.48g; P = 0.014) and shell colour (-0.75% delta% ref; P < 0.001) were also significantly improved in the Treatment group (Table 1), although in absolute terms the differences were quite small. Perhaps a more marked difference between the control and treatment groups might be evident if the trial had been continued for longer.

Table 1 - Egg quality data for Treatment and Control groups: Mean and standard deviations for all data collected from the 4 flocks on treatment and the 4 flocks on the control diet (NB: For shell colour, a lower delta %ref corresponds to a browner egg).

	Control (n=4)	Treatment (n=4)	P value	Coefficient of Variation
Breaking strength (N)	41.3 +/- 7.6	42.0 +/- 7.7	0.004	(0.7)
Egg weight (g)	65.2 +/- 5.1	65.4 +/- 5.2	ns	
Kdyn (N/mm)	15457 +/- 2084	15496 +/- 2176	ns	
Shell weight (g)	6.395 +/- 0.619	6.443 +/- 0.597	0.014	(0.05)
Shell thickness (mm)	0.372 +/- 0.282	0.372 +/- 0.281	ns	
Shell colour (delta% ref)*	69.1 +/-6.4	68.4 +/- 6.5	0.001	(-0.75)

As for the previous model, there was no significant difference in any of our bone quality measurements (Table 2).

Table 2 - Bone Quality. Mean and standard deviations for all data collected from the 4 flocks on treatment and the 4 flocks on the control diet.

	Control	Treatment	P value
Humerus BS (N)	225.76 +/- 50.12	224.62 +/- 50.96	ns
Tibia BS (N)	280.75 +/- 78.18	278.21 +/- 59.90	ns
Keel RD	0.6323 +/- 0.1195	0.6155 +/- 0.0989	ns
Keel Score	0.23 +/- 0.63	0.20 +/- 0.61	ns

IV. CONCLUSIONS

This study provides evidence that providing commercial free range layer hens with a diet supplemented with calcium pidolate from 50 weeks of age can improve egg quality: the % seconds decreased and eggshell strength and shell colour were also improved. For the

producer, this means more 'saleable' eggs, which probably justifies the additional cost when laying flocks are to be kept for longer. Confirming the previous experiences of the supplier, no improvement in bone strength or quality was seen in this study with treatment at end of lay, which can be attributed to the fact that the birds were already too old for any significant improvement to occur. It can, therefore, be suggested that to improve bone health, the intervention should be directed towards the rearing period when the medullary bone reserves are first forming.

REFERENCES

Bain MM, Nys Y & Dunn IC (2016) *British Poultry Science* **57:** 330-338.
Fleming RH, McCormack HA, McTeir L & Whitehead CC (2004) *British Poultry Science* **45:** 320-330.
Agblo P & Duclos J (2011) *Proceedings of the WPSA 9th French Poultry Research Days*, 29-30 March 2011, Tours, France, Paper 009.
Valderrama M & Roulleau X (2013) *Proceedings of Research on Poultry and Waterfowl*, 26-28 March 2013, Foie Gras, La Rochelle, France.