The Effects of Dietary Omega 3 Fatty Acids on Commercial Broiler Lameness and Bone Integrity from Hatching to Market

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Summary and Implications

The objective of this experiment was to investigate how different dietary ω-3 sources affect lameness and bone integrity of commercial broiler chickens from hatching to finishing. One hundred and twenty male Ross 308 broiler chicks were assigned to three dietary treatments; control, flaxseed oil and fish oil for 4 consecutive weeks. From week 1 to 4, broilers were visually assigned a lameness score (2 non-lame to 5 non-ambulatory) and a bone integrity score (score 2 normal bones to 5 bird was non-ambulatory and was removed from the trial). There were no observed differences for the dietary treatment and week interaction for lameness or bone integrity ($P = 1.00$). There was no observed lameness or bone integrity differences ($P \geq 0.93$) between dietary treatments. There were no observed differences for lameness ($P = 0.92$) and bone integrity differences ($P = 1.00$) over the four consecutive weeks. In conclusion, regardless of dietary treatment, birds in this study were not lame and had normal bone integrity.

Introduction

Wild Red Jungle fowl spend approximately 90% of their active time engaged in feeding activities; in contrast, commercial broiler chickens spend 76% of their day lying down. This increased inactivity in commercial broiler chickens is likely multifactorial, for example feed and water are readily available, and/or birds have a heavier body weight and/or there is an increased prevalence in skeletal deformities. According to Dunkley "*all broiler flocks contain birds with skeletal abnormalities. In the United States up to 6% of broilers may have obvious skeletal abnormalities and losses of up to 2% in their flocks due to lameness*." Consideration has been given to the effects of dietary manipulation that may enhance broiler bird welfare on farm. Research suggests that there are beneficial bone health effects in laying hens fed rations supplemented with omega-3 fatty acids, such as those found in flaxseed- and fish oils. The rapidly growing bones of commercial broiler chickens make them an ideal model for investigating the effects of flaxseed- and fish oil on bone strength and the impact on lameness. Therefore, the objective of this experiment was to investigate how different dietary omega-3 sources affect lameness and bone integrity of commercial broiler birds from hatching to finishing.

Materials and Methods

The protocol was approved by the ISU-IACUC committee. This work was conducted between December 7th, 2015 and January 4th, 2016.

Animals and identification: One hundred and twenty male 308 Ross broiler chicks were procured from a local hatchery on hatching day and transported directly to the Poultry Research and Teaching Unit. Chicks were wing banded at the start of the experiment.

Housing: Chicks were acclimated for 6 days and fed a common corn-soybean meal starter ration with a calculated CP of 25.43%, ME of 3,200 kcal/kg, 1% calcium, and 0.45% available P. Four chicks were housed in a 1.2 m × 1.2 m (3.3 ft. x 3.3 ft.) pen with 10.2 cm (4m inches) depth of pine bedding. The house was heated to 29° C, (98 ºF) and reduced until 21° C (70 ºF) was attained. One supplemental lamp heat source per pen was provided from arrival to day 6. Incandescent lighting was used in the house, with approximately 1 m (3 ft.) high candles. The lighting program was 23L:1D (30 to 40 Lux) from arrival to 7 days of age, and then 20L:4D (20 to 30 Lux) for the remainder of the experiment. Feed was provided in round feeders 30.5 cm diameter × 29.2 cm high (Brower Equipment, Houghton, IA) *ad libitum* along with Ziggity waterlines and 360° nipple drinkers (Ziggity Systems Inc., Middlebury, IN), 5 nipple drinkers per pen. Waterlines were set at 2 to 5 cm of column pressure from 0 to 14 days of age, and increased to 10 cm of column pressure for the remainder of the experiment.

Experimental design and dietary treatments: At the beginning of the experiment (day 0), 6 day old chicks

were weighed using an Ohaus Defender 3000 digital scale (Ohaus Corporation, Parsippany, NJ) and placed into pens (pen was the experimental unit; n=10/dietary treatment) balanced by broiler body weight (BW). The average broiler chick BW was 147.9 g (control) 149.6 g (flaxseed oil) and 149.5 g (fish oil). Three dietary treatments were compared and all diets were formulated to meet or exceed the Nutrient Requirements of Poultry guidelines (NRC; Table 1). Two phases were formulated for the experimental diets, a starter phase for weeks 1 to 3 of the experiment and a grower/finisher phase for the remaining week. Diets within each phase were formulated to be isocaloric, isonitrogenous, and contain the same percentage total fat.

Table 1: Dietary treatment composition

Diet	Composition
Control	No supplemental ω-3 source
Flaxseed oil	4% total omega-3 using flaxseed oil (50% alpha-linolenic acid)
Fish oil	4% total omega-3 using bulk fish oil (18% eicosapentaenoic acid and 12% docosahexaenoic acid)

Lameness score: From week 1 to 4, broilers were visually assigned a lameness score in their home pen. A handler selected one bird to move, using a 50 cm plastic paddle that was positioned behind the bird. After the bird had attempted to, or completed a 1-m walk, the researcher assigned a lameness score (Table 2). This method was repeated until all birds had been assessed.

Table 2: Broiler bird lameness score

Score	Definition
2	Bird walked normally without limping and took 10 uninterrupted steps within a 1-m distance
3	Bird walked with some difficulty and took between 6 and 9 uninterrupted steps within a 1-m distance
4	Bird walked with much difficulty and took ≤5 uninterrupted steps within a 1-m distance
5	Bird was non-ambulatory and was removed from the trial

Bone integrity: Each bird was picked up and supported under the abdomen. Each bird had their keel, long and wing bones gently palpated by a trained poultry veterinarian and a bone integrity score was assigned (Table 3).

Table 3: Broiler bird bone integrity score

Score	Definition
2	Bird had normal keel, long and wing bones
3	One of these aforementioned bones was curved less than 45 degrees from normal
4	One of these aforementioned bones was curved more than 45 degrees from normal
5	One bone was sigmoid, multiple bones were curved, or if any were broken

Statistical analysis: Data were analyzed using SAS software (V 9.4). Lameness and bone integrity data were analyzed separately using a generalized linear mixed model (PROC GLIMMIX) with a Poisson distribution. The statistical model included week (four weeks), dietary treatment (control, flaxseed oil, fish oil), and the week*treatment interaction as fixed effects. Three random effects, pen nested within treatment, pen nested within week and bird nested within pen and treatment were used. The I-Link option was used to transform the LSMeans and standard errors back to the original units. A PDIFF was used to identify significant differences. A P-value ≤ 0.05 was considered to be significant.

Results and Discussion

There were no observed differences for the treatment*week interaction for lameness (P = 1.00) or bone integrity (P = 1.00) and the LSMeans will not be reported. There were no observed lameness (P = 0.99) or bone integrity differences (P = 0.93) between the dietary treatments (Table 4).

Table 4: LSMeans and (SE) comparison of broiler lameness and bone integrity scores between the three dietary treatments

	Diet		
Score	**Control**	**Flaxseed**	**Fish**
Lameness	2.06±0.11	2.04±0.11	2.04±0.11
Bone integrity	2.06±0.11	2.01±0.11	2.00±0.11

There were no observed differences for lameness (P = 0.92) and bone integrity differences (P = 1.00) over the four consecutive weeks (Table 5).

Table 5: LSMeans and (SE) comparison of broiler lameness and bone integrity scores over the four consecutive weeks

	Week			
Score	**1**	**2**	**3**	**4**
Lameness	2.00±0.13	2.01±0.13	2.06±0.13	2.12±0.13
Bone integrity	2.00±0.13	2.02±0.13	2.02±0.13	2.03±0.13

Conclusion

In conclusion, regardless of dietary treatment, birds in this study were not lame and had normal bone integrity. Therefore, the inclusion of omega-3 in the broiler diet warrants further investigation, as they relate to other potential broiler welfare benefits.

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