Endogenous Losses of Calcium in the Growing Chick

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Introduction

Feed expenses account for nearly 70% of poultry production costs. Since 2006, producers have been facing rising feed prices due to the increasing demand of corn for the ethanol market (Donohue & Cunningham, 2009). In order to bring profitability back to the poultry industry, efforts to more precisely formulate poultry rations are needed to eliminate the practice of over supplementing.

The most recent National Research Council (NRC) dietary recommendations for poultry were published in 1994. Since then, genetic selection has made great improvements to the broiler industry, increasing nutrient efficiency such that birds today are heavy breasted and reach full market weight at only 6wk of age.

Calcium (Ca) is closely linked to the utilization of the mineral phosphorus (P). Excess phosphorus in the excreta consequentially has been linked to environmental pollution via eutrophication of water sources. The strong interaction between Ca and P has set a standard regulation in diets for poultry at a ratio of 2:1 (Ca:P). Therefore, if we can estimate an available calcium requirement of chickens, we can better formulate both Ca and P values.

To continue to prosper and minimize costs, new nutrient recommendations are needed for modern day poultry. The more precisely we can formulate diets means increased health for the birds and cost savings for producers. This study seeks to remedy this situation by determining the endogenous losses of calcium in growing broiler chicks.

Objectives

- Determine the endogenous losses of calcium and growth performance data in the growing chick fed various types of diets and levels of calcium.
- Evaluate the tibia ash (%) among chicks.

Materials and Methods

- This research was performed with approval and conducted with the standards of the University of Illinois (UIUC) Institutional Animal Care and Use Committee (IACUC)
- Water and feed were provided ad libitum.
- All experimental diets were formulated to meet or exceed NRC requirements except calcium and phosphorus.

Growth Performance

- Ross 308 Male d old broilers (n=510;BW=36+/-0.09g)
- 17 Experimental Diets
  - 1 calcium free diet
  - 4 graded levels of limestone (LIME)
  - 4 graded levels of limestone + phytate (LIME+PHYT)
  - 4 graded levels of canola (CAN)
  - 4 graded levels of canola + 1500FTU phytase (CAN+PHYS)
- 6 replicate pens with 5 birds/pen
- Chick WT & feed disappearance recorded weekly (2, 9, 16d) to calculate ADFI, ADG, & G:F.
- Diets were composed of corn and soy protein isolate.

A Calcium-free diet is used to measure endogenous losses of Ca by looking at the loss of calcium at a zero intake level.

14d chick tibia bone

Tibia Ash

- 1 bird/pen was harvested and tibias were extracted where they were stored in -20^{0}C freezer until further processing
- From each bird, the right tibia was then autoclaved for 35 min.
- Tibias were placed in ceramic crucible and dried in oven at 105^{0}C for 24 hours to determine dry bone wt.
- Bones were then placed in muffle oven at 600^{0}C for 36 hours do determine % ash.

Results

Growth performance results are presented in Figure 1 and Figure 2 illustrating feed intake and body gain, respectively. Similar results were also found for the G:F ratio (graph not shown).

Mortality can be found in Figure 3. The % ash of the chicken tibia is found in Table 1.

Figure 1. Mean Feed Intake (g) d2-d16

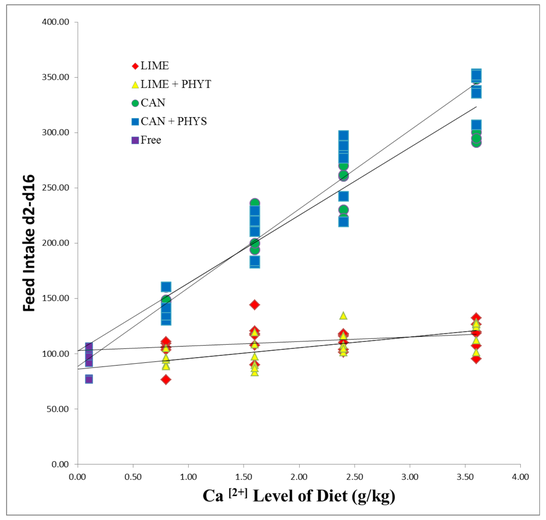

Figure 2. Mean Body Gain (g) d2-d16

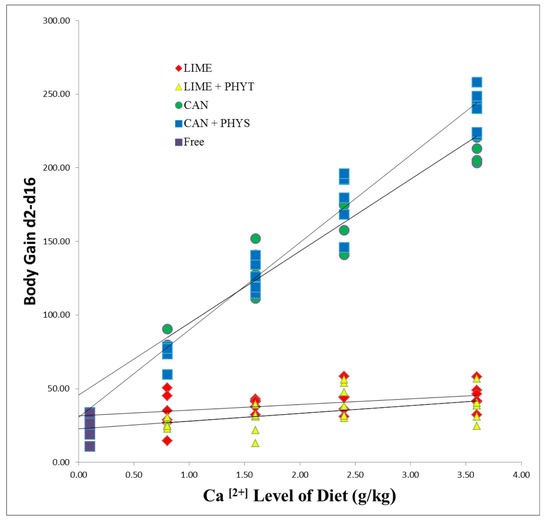

Figure 3. Percent Mortality

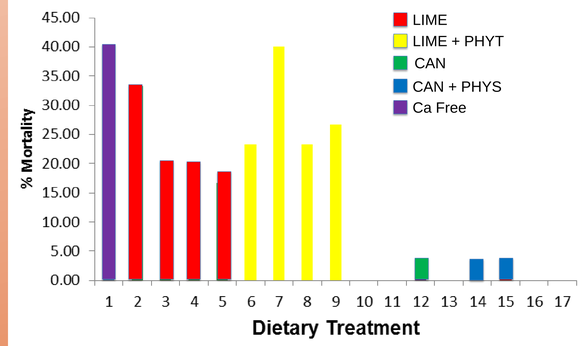

Table 1. Percent Ash in Right Chick Tibia.

	Dietary Treatment[1]			
Ca (%)	**LIME[2]**	**LIME+PHYT[3]**	**CAN[4]**	**CAN+PHYS[5]**
0.01 [6]	34.36^{abcde}	N/A	N/A	N/A
0.08	28.84^{e}	30.99^{de}	31.98^{cde}	32.44^{cde}
0.16	32.63^{cde}	27.87^{e}	38.18^{abcd}	38.89^{abc}
0.24	33.45^{bcde}	32.6^{cde}	40.49^{ab}	42.56^{a}
0.36	34.72^{abcde}	33.63^{bcde}	43.47^{a}	43.25^{a}

[1] Pooled SEM = 1.52; [2] LIME = containing Limestone as Ca source; [3]LIME+PHYT= diet containing Limestone + 1% Phytic Acid; [4]CAN= Diet containing Canola; [5] CAN+PHYS = diet containing Canola as Ca source and 1500 FTU/kg; [6]0.01= Ca free diet

Conclusions

- Endogenous losses of calcium may be observed in the growing chick.
- Tibia ash levels are greater at higher Ca levels indicating that these tibia contained greater concentrations of calcium.
- Further research is warranted to determine bioavailability of commonly used calcium ingredients.

Acknowledgments

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References

Donohue, M., & Cunningham, D. L. (2009). Effects of grain and oilseed prices on the costs of US poultry production. Journal of Applied Poultry Research, 18(2), 325-337. Retrieved from www.scopus.com

National Research Council (1994). 2. Nutrient Requirements of Chickens. Nutrient Requirements of Poultry: Ninth Revised Edition. Washington, DC: The National Academies Press. Print.

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