The relationship of diet to bone growth and bone discoloration

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Background

❖The growth rate of birds effects bone growth with higher growth rate resulting in less bone mineral content and greater bone porosity as compared to slow growing birds.
❖The long bones (broiler thighs) contain pigment hemoglobin and high bone porosity causes its leakage onto bone surface.
❖After freezing and cooking hemoglobin along with the muscle pigment myoglobin undergo oxidation and denaturation discolouring the bone and meat adjoining bone.
❖This oxidation depends on state of iron (ferrous or ferric) present in these pigments.
❖Type of diet fed effects bone growth of broilers and vitamin D is the major feed component as it effects Ca and P metabolism.

Purpose of study

❖Vitamin D from diet or in skin from UV radiations of sun undergo enzymatic hydroxylation to form 25-hydroxyvitamin D_3 (25-OHD_3) in liver and further to 1,25-dihydroxyvitamin D_3 in kidney (1,25-OHD_3).
❖The under developed enzyme system in the bird's early life and certain stresses or diseases of liver may impair hydroxylation of vitamin D to 25-OHD_3.
❖Feeding of the 25-OHD_3 directly instead of vitamin D may be helpful and so the study was designed to study the effect of feeding 25-OHD_3 on the meat characteristics as well as meat and bone color in broiler chicken thighs.

Experimental Design

❖320 broilers (Male Ross 302) were raised at PRC unit of U of A and fed 3 diets: vitamin D, 25-OHD_3 and 1,25-OHD_3.
❖At 40 d age 120 left broiler thighs were recovered after bird slaughtering and air chilling.
❖Thighs were divided into 3 groups of 40 thighs each based on diet fed and each diet group had four sub-groups with 10 thighs in each: fresh raw, fresh cooked, frozen raw, frozen cooked.
❖Freezing was done at -20°C for 4 wks and cooking in hot air oven was done at -180°C till core meat temp. reached 80°C.
❖Heme iron, nonheme iron, total pigments, total myoglobin, pH and colour were measured for each thigh.

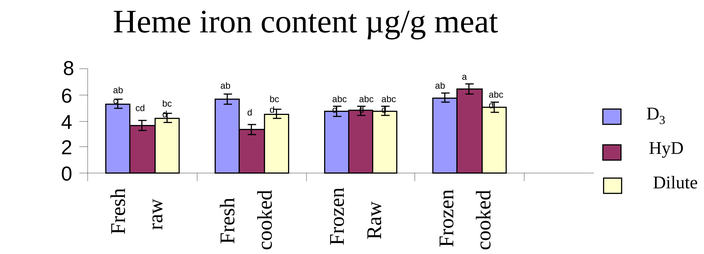

Figure 1: Diet x freezing x cooking interaction

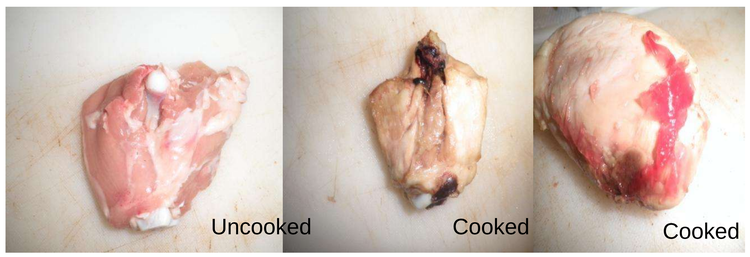

Figure 2: Effect of cooking on broiler bone-in thighs

Results and Discussion

❖The lower heme iron in 25-OHD_3 fed birds than vitamin D and dilute groups (Figure 1) indicates lower pigment leakage from bones which may be due to increased bone mineralization. However after freezing or cooking differences were not found.
❖The denaturation of total pigments and myoglobin lead to their decrease after freezing and cooking.
❖Freezing favored myoglobin oxidation indicated by decrease in oxymyoglobin and an increase in metmyoglobin content with no diet effect.
❖The color of meat become lighter after cooking although there was a pigment leakage (Figure 2).

Conclusion and Relevance

❖25-OHD_3 supplementation may be useful in improving bone quality but the diets fed did not darken color of meat under the applied conditions.
❖Genetics of birds also affect their growth rate so different broiler strains with 25-OHD_3 supplementation need to be studied.

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