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Choline Chloride

Balchem Research Summary

Evaluation of Increasing Concentrations of Supplemental Choline Chloride on Modern Broiler Chicken Growth Performance and Carcass Characteristics

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Introduction

The last poultry NRC was published in 1994 and a lot has changed in 30 years. The broiler chicken has undergone significant genetic and phenotypic changes over the past three decades, resulting in birds that grow faster, convert feed more efficiently, yield more meat, and exhibit improved health and disease resistance. The nutrient requirements for these birds are significantly different from those in 1994, the question is, how much have they changed?

Furthermore, the nutrient content of typical feedstuffs like corn and soybean meal has evolved due to several factors including advancements in plant genetics, agronomic practices, and processing technologies (Estes et al., 2019; Estes et al., 2021).

As a result, the remarkable transformation of modern broiler and their feedstuffs necessitates a reevaluation of their nutrient requirements.

This paper will seek to evaluate how broiler requirements for choline have changed since 1994 and the implications for animal performance and producer profitability. Furthermore, researchers have recently hypothesized that current broiler diets are being formulated with excess methionine and that this excess may be utilized as a methyl donor. Choline is a superior methyl source to methionine (Met) because it's less expensive per unit and has 3 methyl groups per molecule while methionine only contains one. The objective was to evaluate the effect of increasing additions of choline chloride (CC) on performance and carcass characteristics of broilers fed reduced methionine diets and reared under summer environmental conditions.

Methods

Ross 708 x Yield Plus male broilers were reared for 41 days on used litter in floor pens (n = 2,232; 31 birds per pen). Birds were fed 1 of 6 corn and soybean meal-based diets containing 0, 400, 800, 1,200, 1,600, or 2,000 mg/kg added choline chloride (equates to 0, 298, 597, 895, 1,194 and 1,492 mg/kg of added choline ion). Diets were provided in 3 phases: starter from d 0 to d 15, grower from d 16 to d 28, and finisher from d 29 to d 41. Analyzed choline levels for each diet and phase as well as NRC (1994) and Aviagen (2022) choline intake recommendations for broilers are shown in Table 1.

Minimal nutritional and environmental stressors were incorporated into the experiment to amplify differences across treatments due to choline addition. To achieve this, Met was minimally reduced (15% reduction in digestible Met) and rearing temperatures were set at 34.4°C for the first 21 d and then lowered to 26.7°C for the remainder of the experiment to mimic summer conditions.

Mortality-corrected feed intake, bodyweight gain, and feed conversion ratio were calculated throughout the experiment. On day 43, 10 birds per pen were processed for hot and cold carcass weights, abdominal fat pad weight and carcass part yields.

Table 1. Recommended choline intake for broilers as well as analyzed dietary choline ion values in each diet (mg/kg; as fed)

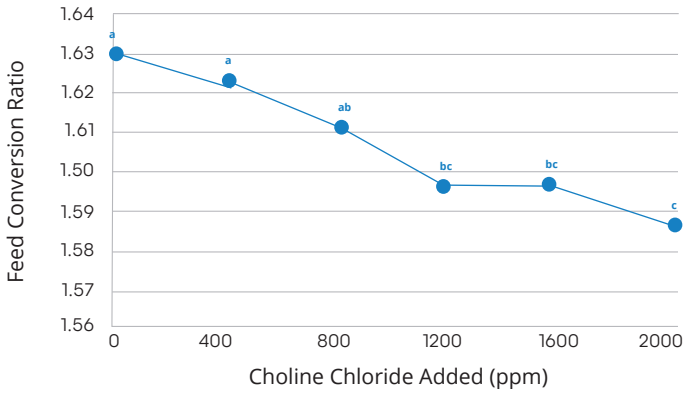
Feeding Phase	NRC[1]	Aviagen[2]	Dietary Treatment					
			0	400	800	1,200	1,600	2,000
Starter, d 0-15	1300	1700	910	1120	1400	1650	1950	2330
Grower, d 16-28	1000	1600	977	1190	1500	1750	2050	2380
Finisher, d 29-41	750	1500	987	1230	1550	1880	2060	2270

[1]NRC (1994) recommended choline intake for broilers.
[2]Aviagen (2022) recommended choline intake for broilers.

Results

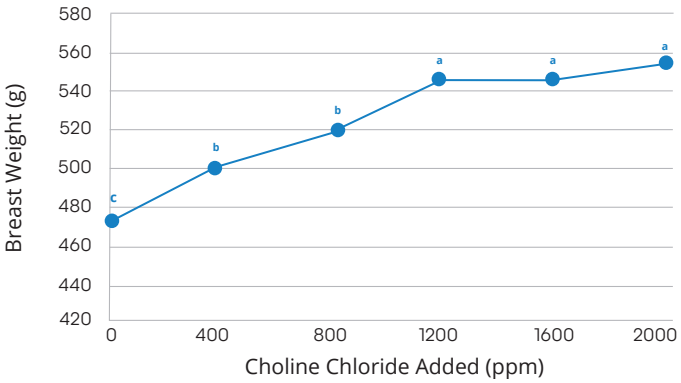
Increasing dietary CC resulted in similar bodyweight gain, reduced feed intake, and improved feed conversion ratio (Figure 1). As choline chloride supplementation increased, wing, thigh, drumstick, and fat pad yields decreased. However, increasing CC supplementation linearly increased breast (Figure 2) and carcass yields (Table 2), suggesting that additional dietary choline may aid in diverting more nutrients to the growth of lean muscle than the less-desirable carcass parts and adipose tissue.

Figure 1. Effects of supplemental dietary choline chloride on Feed Conversion Ratio (FCR) day 41



Gregg et al. 2023
[abc]Treatments with different superscripts differ P ≤ 0.05

Figure 2. Effects of supplemental dietary choline chloride on broiler breast weight (g) day 41



Gregg et al. 2023

[abc]Treatments with different superscripts differ P ≤ 0.05.

Table 2. Effects of supplemental dietary choline chloride on carcass characteristics and yield of 43-day-old broiler chickens

Variable[1]	Added choline chloride, mg per kg of feed						SEM[2]	*p*-value
	0	400	800	1,200	1,600	2,000		
Hot WOG WT, g	1,912^{y}	1,919^{y}	1,950^{xy}	1,945^{xy}	1,957^{xy}	1,978^{x}	17	0.0735
Chilled WOG WT, g	1,940^{y}	1,947^{y}	1,977^{xy}	1,974^{xy}	1,985^{xy}	2,006^{x}	17	0.0681
Fat Pad WT, g	29	27	29	27	27	27	1	0.1394
Fat Pad, % of chilled WOG	1.48^{a}	1.4^{ab}	1.44^{ab}	1.35^{bc}	1.38^{abc}	1.33^{c}	0.04	0.0293
Breast WT, g	475^{c}	502^{b}	519^{b}	548^{a}	548^{a}	553^{a}	8	< 0.0001
Breast, % of chilled WOG	24.48^{c}	25.76^{b}	26.24^{b}	27.76^{a}	27.62^{a}	27.59^{a}	0.26	< 0.0001

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[1]WOG = without giblets, WT = weight. [2] SEM = highest standard error of the LS mean pair-wise comparisons. [abcd]Means within in a row with different superscripts differ P ≤ 0.05. [xy2]Means within a row with different superscripts differ 0.0501 ≤ P ≤ 0.10 and are considered tendencies.

Discussion

Broilers were fed increasing additions of CC in diets where methionine was minimally reduced, reared under summer conditions for 41 days, and then processed. Supplemental choline improved broiler feed efficiency by reducing feed intake without altering bodyweight gain. Increasing dietary choline concentrations also increased breast yield (P<0.0001) and had a tendency to increase carcass yield (P=0.0681). Increasing CC supplementation increased the incidence and severity of wooden-breast-affected fillet, however; in general, incidence of severe wooden breast appears to increase as growth rates and breast yield increases. In modern broilers, it can be concluded that when reared under high environmental temperature and fed diets with minimally reduced methionine, supplemental choline has a positive impact on growth performance and carcass yields.

Summary

Feeding additional choline to high-yielding broilers improved overall feed efficiency and supplementing 1,200 or more mg of choline chloride per kg of feed increased carcass and breast yields when Met was minimally reduced. This evidence supports supplementing choline chloride in high-yielding broiler diets where Met is limiting or as a partial substitute for Met. Given the osmoregulatory qualities of betaine and its ability to be oxidized from choline, dietary choline supplementation may also be beneficial in improving growth efficiency in broilers reared during summer months when heat stress is common.

References

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