EASTMAN Animal nutrition

Eastman™ Choline Chloride

Formulating for real-world choline needs

Over the last few decades, genetic selection in poultry and swine production has transformed growth rates, feed efficiency and lean-tissue deposition. However, nutritional requirement systems have not evolved at the same pace. Traditionally grouped with B vitamins and formerly known as vitamin B4, choline's metabolic role in modern animals requires quantitative amounts that far exceed those of typical vitamins.

Choline plays an indispensable role in lipid metabolism, neuromuscular function and methyl group donation (Mudd et al., 2016). As production efficiency increases, metabolic demand for choline also rises. This makes insufficient supplementation a risk that could result in performance loss, metabolic disorders and reduced economic returns.

Current feeding practices are often guided by established references, such as NRC Poultry (1994) and NRC Swine (2012), that were developed based on the genetics, feed ingredients and production systems available at the time. Animal performance and production intensity, however, have evolved significantly over time. Reevaluating these nutritional recommendations can help ensure they remain aligned with present-day requirements.

Choline from feed ingredients: book values versus reality

Choline is naturally present in most feed ingredients, but its nutritional availability is frequently overestimated. Earlier estimates of choline bioavailability in soybean meal ranged from 60% to 75% (Molitoris and Baker, 1976). However, less than 10% of total choline exists as free choline. Approximately 95% is present as phosphatidylcholine, which primarily contributes to cell membrane structure rather than fully supporting metabolic needs. Moreover, in many formulation settings, choline is not routinely analyzed in feed ingredients, forcing nutritionists to rely on tabulated values that may not reflect real-world conditions.

Several factors contribute to discrepancies between book values and actual choline availability in the field. Genetic selection of crops has altered nutrient composition, while thermal processing of ingredients like soybean meal, canola meal and peanut meal significantly reduces choline bioavailability. Ingredient origin, processing and storage conditions add additional variability. Chick bioassay studies have demonstrated that overheating of protein meals can markedly decrease bioavailable choline, even when total choline content appears unchanged (Emmert and Baker, 1997). Without updated ingredient databases, diets formulated to meet "requirement" levels may still leave animals with choline deficiency.

The effects of choline on animal performance

Choline supports animal performance and health through three fundamental metabolic pathways:

- First, as a structural component of phospholipids, choline is essential for fat transport and cell membrane integrity. Inadequate choline compromises hepatic lipid export, increasing the risk of fatty liver syndrome in poultry and impaired liver function in swine (Baker and Sugahara, 1970; Jukes et al., 1945; Emmert and Baker, 1997).
- Second, choline is a precursor of acetylcholine, a neurotransmitter that is essential for muscle control and neuromuscular coordination (Lowry et al., 1987; Emmert and Baker, 1997). Deficiencies have been directly associated with skeletal abnormalities such as perosis (slipped tendon) in poultry, which negatively affects mobility, welfare and growth performance (Santiago et al., 2020).
- Third, choline serves as a major source of labile methyl groups, interacting with methionine, betaine, folate and vitamin B12 metabolism. Although animals can synthesize choline endogenously, that is insufficient to meet their needs in modern, high-performance systems, particularly in early growth, during reproduction or under environmental stress (Romano et al., 2015; Zhong et al., 2022).

Choline's core metabolic roles

Fat transport and liver integrity

Neuromuscular function

Methyl groups for one-carbon metabolism

Reassessing requirements using modern genetics

The rapid improvement in feed efficiency and growth potential of modern poultry and swine have fundamentally shifted nutrient requirements. Increased protein accretion, higher energy intake and intensified metabolic activity all elevate the demand for choline. At the same time, changes in crop genetics and ingredient processing may have altered choline bioavailability from common feed.

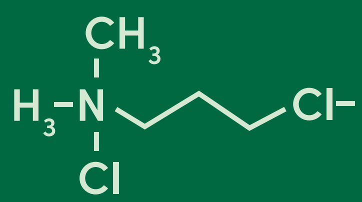
These dynamics highlight the need to reestablish choline requirements based on contemporary genetics and production conditions. It is equally important to reassess choline bioavailability of ingredients, as values generated decades ago may no longer apply to today's feed materials.

Choline chloride versus biocholine

Some plant-derived products marketed as biocholine are positioned as alternatives to choline chloride. These are often complex mixtures; their choline content and bioavailability can vary by product and processing. Some studies, including a conference abstract presented at the Poultry Science Association Annual Meeting, suggest that dietary supplementation with biocholine in broilers may reduce growth performance and increase the incidence of leg deformities (Santiago et al., 2020; Longo et al., 2025, PSA Annual Meeting abstract).

Since natural feed ingredients typically lack sufficient bioavailable choline, supplementation is necessary to meet animal nutritional requirements. Choline chloride remains the industry standard due to its high concentration, and well established safety and efficacy for target species under specified conditions, as confirmed by EFSA.

Choline chloride



- High concentration
- High bioavailability
- Well-established safety and efficacy

VS.

Biocholine

- Complex mixtures
- Bioavailability uncertain
- Reported performance/ leg issues in an internal study

Economic returns of choline chloride supplementation

As previously mentioned, natural feed ingredients rarely supply sufficient available choline to meet physiological demands. Supplemental choline chloride enhances nutrient utilization, which ultimately improves feed efficiency. It's also critical for maintaining cell membrane integrity and proper development of the nervous system, leg joints, liver and other organs.

A recent study of dietary choline levels in gestating sows also identified that increasing choline intake improves piglet birth weight and uniformity, reduces mortality and enhances overall reproductive performance (Zhong et al., 2022).

Liquid choline chloride formulations offer additional operational benefits, including improved mixing homogeneity, reduced dust and consistent delivery. When applied at appropriate levels, supplemental choline chloride may contribute directly to improved growth performance, reproductive efficiency and overall economic returns.

Conclusion

Outdated requirement values and ingredient databases underestimate the importance of choline in modern animal production. It can no longer be treated as a secondary micronutrient in poultry and swine nutrition. Establishing updated choline concentration databases, reassessing bioavailability in current feed ingredients, and redefining requirements based on modern genetics are essential steps to optimize performance and profitability.

Supplemental choline chloride remains a critical nutritional tool to bridge the gap between natural supply and physiological demand. Reevaluating choline nutrition is not merely an academic exercise but a practical strategy to support animal health and productivity, which may ultimately improve economic outcomes in today's high-performance poultry and swine operations.

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