

# VitaCholine: The DHA Booster

*Why formulating supplements with both DHA and choline better promotes healthy infant cognitive development*

## INTRODUCTION

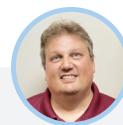
Choline's public profile is rising as consumers learn more about the contributions of the nutrient most recently established as essential—supporting health benefit areas such as heart health and mood management to memory and brain function. Now, as a new study in pregnant women positions choline as something of a “force multiplier” for DHA, consumers have yet another powerful lesson to learn. Specifically, a clinical trial<sup>1</sup> published earlier this year showed that when expectant mothers supplemented with a combination of DHA and choline, their DHA status improved significantly over what was observed in women supplementing with DHA alone.

This outcome has profound implications both for fetal development and for prenatal product formulation. However, choline's implications don't end in the delivery room; this hard-working transport molecule supports growth and development throughout life. As such, it is a nutrient that wellness industry formulators would be wise to explore.

## The Super-Transporter

It was only in 1998 that the National Academy of Sciences designated choline an essential nutrient, establishing adequate daily intake levels (AIs) of 550 mg for adult males and lactating females, 450 mg for pregnant women, and 425 mg for adult females. Despite its short history, choline already claims a lengthy list of health benefits that rank it among nutrition's “royal family” with the likes of vitamin A, folic acid, iron, and more.

Choline affects its health benefits largely through serving as the body's “super-transporter.” By delivering key compounds like fatty acids and methyl groups to the tissues and organs that need them, choline makes possible a variety of functions and processes, ranging from cell membrane maintenance to one-carbon metabolism. First, as a component of the neurotransmitter acetylcholine, choline helps control



**Tom Druke**

Marketing Director, VitaCholine®  
Balchem Corporation

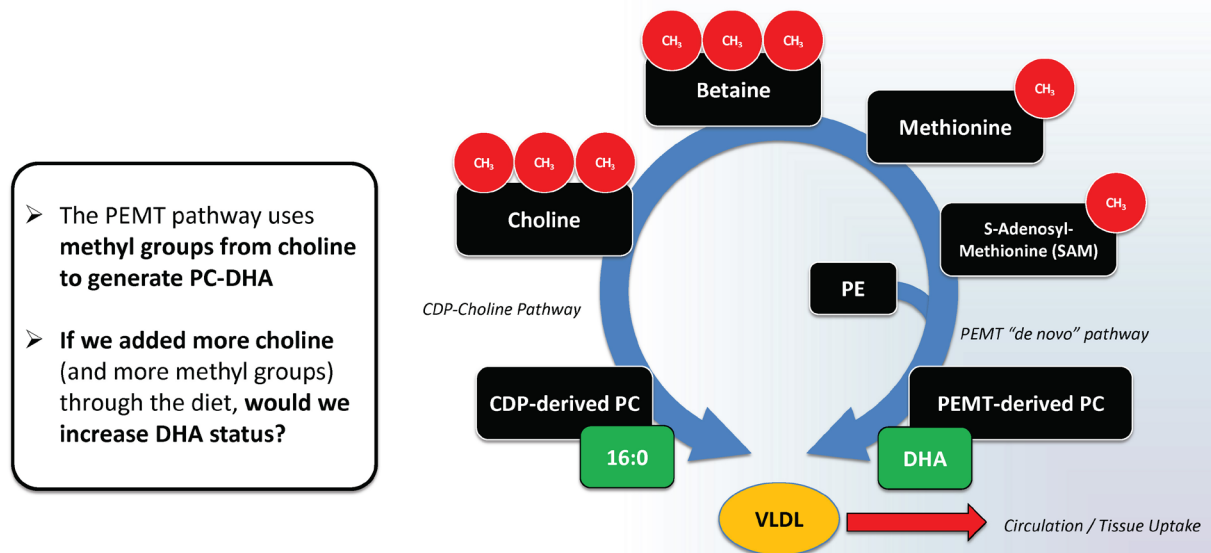


**Eric Ciappio**

Strategic Development Manager,  
Nutrition Science  
Balchem Corporation

Sponsored by



**FIGURE 1:** Choline and DHA's Interaction

Adapted From: Yan J, et al. *Am J Clin Nutr* 2013; 98: 1459-1467; PC = Phosphatidylcholine; PE = Phosphatidylethanolamine; PEMT = Phosphatidylethanolamine-N-methyltransferase



several higher order functions in the brain, including mood, memory, cognition, attention and—at an even more complex level via its regulation of DNA methylation—the expression of genes related to these functions. Further, choline is a building block of phosphatidylcholine, a phospholipid that not only makes up the architecture of cell membranes but, like choline itself, is a crucial transport molecule.

Among phosphatidylcholine's most important payloads are omega-3 fatty acids, such as DHA. This relationship laid the groundwork for the study in pregnant women.<sup>2</sup>

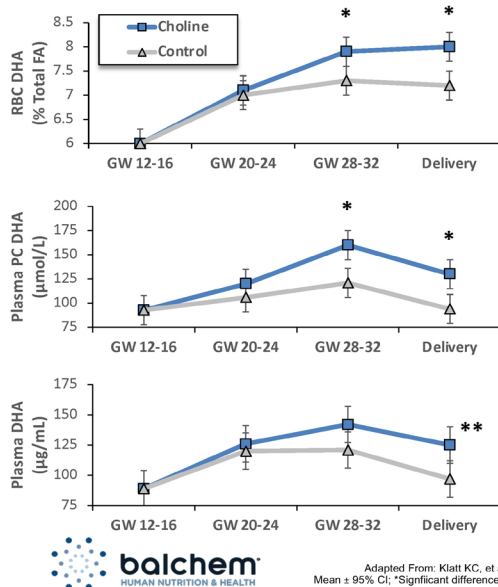
DHA plays an essential role in a baby's brain, eye, and nervous system development both *in utero* and early childhood, when these organs and functions form at lightning speed. Yet, evidence shows that pregnant women often do not get sufficient DHA to support their growing baby's neural development.<sup>3</sup> Since choline is a component of phosphatidylcholine, and phosphatidylcholine helps carry DHA to the organs that need it—including the fetal brain—a question arose. Would boosting

pregnant moms' consumption of DHA and choline both raise their DHA levels and help them share that DHA with their growing babies (**FIGURE 1**)?

### DHA's "Force-Multiplier"

To arrive at an answer, researchers conducted a controlled feeding study in which women entering the second trimester of pregnancy received one of two treatment conditions: supplementation with 200 mg of DHA plus 25 mg of choline (an almost nominal amount), or 200 mg of DHA plus 550 mg of supplemental choline, or 100 mg above the AI for pregnant women.

At the end of the study, measures of the subjects' red blood cell DHA, phosphatidylcholine DHA, plasma DHA, and other key biomarkers, reflected significantly higher levels in the higher choline cohort than in the cohort receiving a minimal quantity of choline. This indicated that maternal supplementation with a combination of DHA and increased levels of choline raised pregnant women's DHA status better than supplementing with DHA alone (**FIGURE 2**).

**FIGURE 2:** Choline Supplemental During Pregnancy Improves DHA

### Results & Conclusions

- Prenatal **choline supplementation increases maternal DHA status** across multiple measures

**Maternal supplementation of choline and DHA increases mother's DHA status better than DHA alone**

**Adequate maternal DHA status during pregnancy is critical to ensure proper supply of nutrients to baby**



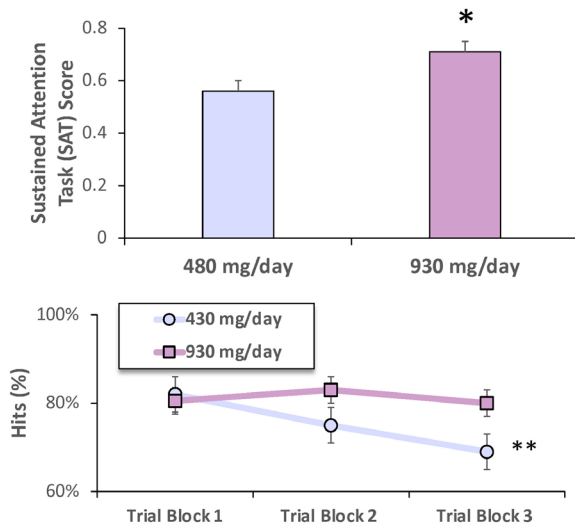
Choline's synergistic effect on DHA isn't unlike that observed between vitamin D and calcium. Like that relationship, it is just as important not only during pregnancy but well into childhood, too. A 2018 study<sup>4</sup> investigating the effects of prenatal choline supplementation on infant cognition provided evidence for this. In the study, two groups of women in their third trimester of pregnancy consumed a standardized daily diet while also supplementing with key prenatal nutrients including, among others, DHA and choline. However, while one group received only roughly the AI of choline—480 mg per day comprising of 380 mg from diet plus 100 mg in the form of Balchem's VitaCholine® choline chloride—the other got nearly twice that amount: 880 mg per day, with 380 mg coming from diet and 550 mg from VitaCholine®.

Once the subjects delivered their infants, tests of information processing speed and visuospatial memory at four, seven, 10 and 13 months showed the children born to the higher choline subjects exhibited faster reactions times and greater cognitive function than did those born to the subjects who consumed choline at the adequate intake levels.

Seven years after that initial research, a follow-up study<sup>5</sup> published earlier this year revisited those same children with the goal of determining if choline's cognitive effects persisted. The researchers evaluated the children's sustained attention—that is, their ability to maintain focus on a given task over time. This involved showing the children a series of signals that flashed rapidly across a computer screen and cueing them to respond when they noticed a signal appear.

The researchers were less interested in the children's overall accuracy than in their ability to stay focused and perform the task for its 12-minute duration—an eternity to a seven-year-old. Results showed that the children of the moms in the choline cohort that received twice the adequate intake exhibited both greater signal-detection performance and attention control than did those moms who received the adequate intake of prenatal choline.

What really stood out was when the results were segmented into time blocks, the higher choline group's performance remained almost as strong at the end of the 12-minute test as

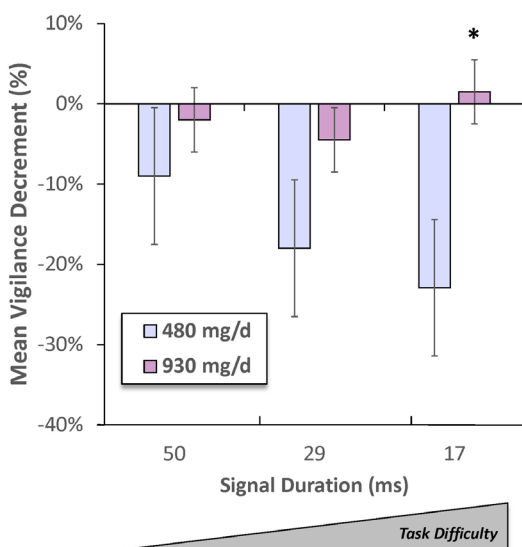
**FIGURE 3:** Long-Term Effects of Choline

Adapted From: Bahnfleth CL, et al. *FASEB J* 2022; 36(1): e22054;  
Mean  $\pm$  SEM; \*Significant main effect of choline treatment,  $p < 0.05$   
\*\*Significant decline across trial blocks,  $p < 0.05$



### Results

- Children born to high choline consuming mothers **showed greater attention control and signal detection performance**
- Children born to high choline consuming mothers showed a **superior ability to maintain correct signal detections** across the 12-min session, indicating **improved sustained attention**

**FIGURE 4:** Choline Effects on Sustained Attention

Adapted From: Bahnfleth CL, et al. *FASEB J* 2022; 36(1): e22054;  
\*Significant difference between groups,  $p < 0.05$  (Bonferroni corrected)

### Results

- Children born to high choline consuming mothers **maintained their attention during the most difficult task**, while children born to lower-choline consuming moms showed significant declines in attention

***VitaCholine*** supplementation during pregnancy contributes to **improvements in children's sustained attention & cognitive function at age 7**

*"Sustained attention (and attentional control more broadly) contributes to a wide variety of higher cognitive functions such as problem-solving and working memory and is positively associated with school performance"*



it was at the start—indicating the children’s sustained attention was still high. Meanwhile, the adequate intake choline children saw a significant performance decline by the second- and third-time blocks (**FIGURE 3**).

When researchers analyzed the subjects’ detection ability with respect to test difficulty, they found that the higher choline group’s detection remained steady whether the signals dwelt onscreen for a longer or shorter time, while that of the subjects that had the adequate intake of choline fell as difficulty rose (**FIGURE 4**).

### Closing the Gap

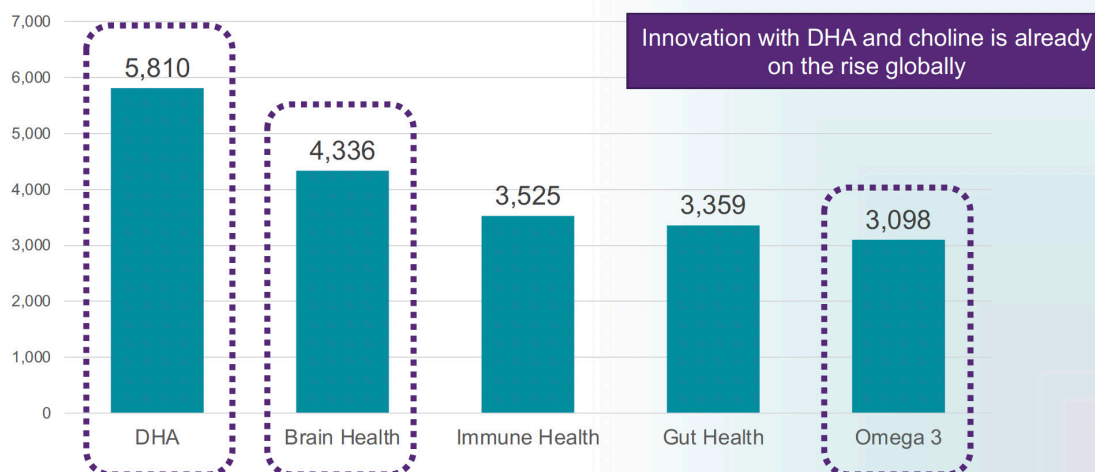
Seven years after moms were supplemented with twice the AI of prenatal choline, children were still reaping the nutrient’s attentional dividends. These dividends continue accruing throughout the lifetime. Nevertheless, less than 5% of women still don’t get enough in their diets during pregnancy and lactation. Nutrition authorities recognize this: the 2020-2025 Dietary Guidelines<sup>6</sup> for Americans states that “many prenatal supplements do not contain choline or only contain small amounts inadequate to meet recommendations”, and the American Medical Association<sup>7</sup> even supports the inclusion of “evidence-based amounts of choline in all prenatal vitamins”.

That sends a clear signal to supplement formulators to ensure that prenatal vitamins and allied products deliver sufficient choline to help close the gap. The market for those products is strong. Despite flat to declining birth rates since the 1970s, prenatal products continue to capture about \$1 billion in value.

Choline is proving to be a powerful driver of innovation in the retail space, too. Nielsen retail data on prenatal supplements featuring choline show that such products account for anywhere from almost \$7 million to more than \$33 million in domestic 2021 sales. However, as the prenatal segment grows, so does the need for brands to differentiate their entries against the competition. In light of the choline-DHA connection, designing products to deliver both critical nutrients is a savvy strategy for building a cognition power-formula.

When Innova Market Insights segmented all choline-containing products launched in the past three years by active health positioning, it found the leading product position—accounting for almost 6,000 choline-containing launches—was the pairing DHA. Coming in second with more than 4,000 product launches was brain health (**FIGURE 5**). It is no

**FIGURE 5:** The Keys to Driving Growth



surprise that in both cases, many of the products launched were targeted toward infant nutrition.

As for concepts that could leverage the interplay amongst choline, DHA, and brain development, a suite of supplements that address the full spectrum of prenatal needs has real appeal. Building out that suite with platforms like choline- and DHA-containing capsules, gummy vitamins, and even prenatal shakes help make the overwhelming task of prenatal nutrition easier to swallow.

Given that latest generation ingredient technologies let brands deliver impressive levels of DHA oil and choline powder in one stable formulation, brands have no reason not to explore the product development options.

## CONCLUSION

Once brands have mom covered, they can turn their attention to ensuring that consumers get sufficient choline at other life stages, as in their teen and adult years—when it's an essential nutrient for brain and nervous system function—and even later in life, when choline helps regulate mood and support cognition and memory. Applications like energy beverages, sports nutrition products, and ready-to-drink nutrition shakes are all ideal vehicles for choline, both from a standpoint of

formulation stability and in terms of giving consumers what they crave.

Getting consumers to crave more choline is no small matter, because this lifeline nutrient is important not just for mom and baby, but for everyone.

## REFERENCES

1. Klatt KC, et al. *Am J Clin Nutr*, 2022; May 16; nqac147. doi: 10.1093/ajcn/nqac147.
2. Klatt KC, et al. *Am J Clin Nutr*, 2022; May 16; nqac147. doi: 10.1093/ajcn/nqac147.
3. Zhang Z, et al., *Nutrients* 2018; 10(4): 416. doi: 10.3390/nul0040416.
4. Caudill MA et al. *FASEB J*. 2018; 32: 2172- 2180.
5. Bahnfleth CL et al. "Prenatal choline supplementation improves child sustained attention: A 7-year follow-up of a randomized controlled feeding trial." *FASEB J*. vol. 36, no. 1 (2022): e22054.
6. 2020-2025 Dietary Guidelines for Americans; <https://www.dietaryguidelines.gov/>
7. Schwarzenberg SJ, et al; *Pediatrics* 2018; 141(2): e20173716. <https://www.ama-assn.org/sites/ama-assn.org/files/corp/media-browser/public/hod/al7-reference-committee-reports.pdf>; <https://www.ama-assn.org/delivering-care/public-health/ama-backs-global-health-experts-calling-infertility-disease>