Lecithin (Phosphatidylcholine), Carnitine, And The Role Of Intestinal Bacteria In Health And Disease

Phosphatidylcholine (lecithin)

Gobley originally isolated the phospholipid lecithin from *egg yolk*—λέκιθος (*lekithos*) is 'egg yolk' in ancient Greek—and established the complete chemical formula of phosphatidylcholine in 1874. Phosphatidylcholine, the key component of lecithin, is a vital substance found in every cell of the human body.

Lecithin is sold as a food supplement and for medical uses. In cooking, it is sometimes used as an emulsifier and to prevent sticking, for example in nonstick cooking spray.

Below is the structure of phosphatidylcholine, a type of phospholipid in lecithin. Red - choline and phosphate group; Black - glycerol; Green - unsaturated fatty acid; Blue - saturated fatty acid.

![Phosphatidylcholine Structure]

**Note:** The choline group is a quaternary ammonium compound represented by:

![Choline Structure]
Carnitine

Carnitine is also a quaternary ammonium compound. It is biosynthesized from the amino acids lysine and methionine. In living cells, it is required for the transport of fatty acids from the cytosol into the mitochondria during the breakdown of lipids (fats) for the generation of metabolic energy. It is widely available as a nutritional supplement, and in energy drinks.

Note the similarities of the structure of carnitine to the structure of the choline group in lecithin.

TMAO and Heart Disease

When intestinal bacteria digest phosphatidylcholine (lecithin) or carnitine, a chemical byproduct called trimethylamine N-oxide (TMAO) is produced.

Research has shown that TMAO levels in the blood were associated with heart disease. Scientists have confirmed that gut flora are essential in forming TMAO in humans and demonstrated a relationship between TMAO levels and future cardiac events like heart attack, stroke, and death -- even in those with no prior evidence of cardiac disease risk.

Similarly, the same scientists have found that humans need gut microbes to form TMAO from dietary carnitine. More importantly, they found that if someone regularly eats red meat or drinks energy drinks, "microbes that like carnitine become more abundant [in the gut], and now you are much more capable of making this metabolite . . . trimethylamine-N-oxide (TMAO)," he said. "This paper showed [that TMAO] . . . essentially leads to an enhanced capacity to deposit cholesterol on the cells of your artery wall." It also shows that your choice of diet can select the growth of gut bacteria that have an enhanced capacity to produce TMAO.
This offers a potential explanation for the relationship between dietary red meat and enhanced frequency of heart disease.