Genetically Engineering the *Lactobacillus* Probiotic for Atherosclerosis Plaque Prevention

18–19 million adults in the United States have a diagnosis of atherosclerotic cardiovascular disease (ASCVD), which is the clinical disease caused by atherosclerosis. Atherosclerosis is the condition when fatty deposits build up inside the arteries, causing them to narrow and harden. This plaque development causes restriction of blood flow, increasing the risk of heart attacks, strokes, and peripheral artery disease. Current treatments focus on reducing cholesterol levels and do not address the underlying metabolic or gut-derived causes. Recent studies implicate that trimethylamine-N-oxide (TMAO)—a compound produced when gut bacteria metabolize choline into trimethylamine (TMA)—is a key factor of plaque formation. To prevent this choline-to-TMA-to-TMAO conversion, we propose a probiotic solution that engineers *Lactobacillus*, a common gut bacterium, to express the enzymes Choline Dehydrogenase (CHDH) and Betaine Aldehyde Dehydrogenase (BADH), native to *Paracoccus denitrificans* bacteria. In addition, a riboswitch or negative feedback loop will be coupled with this design to regulate gut microbiome competition and choline levels. Because the choline is redirected to be converted to betaine (a beneficial nutrient) instead of TMA/TMAO, plaque buildup will be inhibited, therefore reducing the risk for atherosclerosis.