DECEMBER 15, 2017

HIGH DENSITY LIPOPROTEIN (HDL) CHOLESTEROL

BIOLOGY, PATHOLOGY, METHODS TO INCREASE HDL-C LEVELS

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Executive Summary

High-density lipoproteins or HDLs are commonly known as the "good cholesterol" because they are known to improve blood vessel and heart health. For years scientists thought that the low-density lipoproteins (LDLs), or bad cholesterol, in egg yolks increased cholesterol in humans. This has since been proved to be false. In fact, **egg yolks have been shown to increase HDL in the blood** and have little to no effect on increasing LDL and cholesterol levels. Recent animal studies prove even further that **the HDL in egg yolks have a positive affect** on the body and can reduce plaque in animal arteries. We offer egg yolk HDL as an ingredient (with most of the LDL and other bad cholesterols removed) for a supplement to be taken as part of a heart and cardiovascular health program.

Background

HDL stands for High-Density Lipoproteins, which are also known as the "good cholesterol" because they remove Low-Density Lipoproteins (LDLs) and macrophages from the blood and artery walls, preventing a buildup of "plaque". This "plaque" can restrict blood flow in arteries, leading to high blood pressure, or completely close off smaller blood vessels, leading to heart attacks and strokes. Many studies and clinical trials show that increasing HDL levels can help reduce risk of heart attack, stroke, and peripheral artery disease[1,2]. LDLs and HDLs are both found in egg yolk, which is why egg yolks are thought to be "high in cholesterol". **Ecovatec's proprietary processes** process this egg yolk to **remove the "bad cholesterol"** or LDLs, **and leave in the good HDLs.**

HDL's Functions in the Human Body

Why is HDL Cholesterol Good? How does it work?

The primary function of HDL's is to remove excess "bad" cholesterol from the blood and carry it to the liver to be metabolized into bile salt, also known as reverse cholesterol transport. High HDL levels also stimulate more natural HDL production and improve endothelial function (acting as an anti-inflammatory for blood vessels). A good (high) level of HDL in the blood is 60 mg/dL, whereas levels below 40 mg/dL put an individual at risk for coronary heart disease and other associated disorders.

HDL Disorders in Humans

The primary disorder associated with low HDL levels in the blood is coronary heart disease (CHD) or cardiovascular diseases (CVD), which is a major cause of death and disability in humans. CVDs account for **16.7 million deaths** worldwide per year[5]. CHD is caused by atherosclerosis, a condition characterized by cholesterol deposits in the walls of arterial blood vessels. The cholesterol deposits are a result of elevated LDLs (low density lipoproteins), lipoprotein(a), triglycerides (TG) and remnant lipoproteins and decreased HDLs.[1] HDL cholesterol is known to remove these cholesterol deposits from the artery walls as well as reduce arterial inflammation.[2] Dietary fats, proteins and cholesterol play a major role in CHD development by modifying the blood plasma lipoprotein levels.

HDL and Egg Yolks

Many studies have been done to look at the effect of consuming egg yolks on levels of LDL and HDL in the blood. *Clayton et al. (2017)*[2] published a review of this scientific literature and noted that many researchers have found the egg yolks, when consumed in a carbohydrate-restricted diet, increase HDL cholesterol levels in overweight individuals **without** increasing LDL.[2,6]

Other researchers have found that even when the consumption increases LDL, the ratio of LDL: HDL remains constant due to the increase in HDL, and the added nutrients provided by egg yolk cholesterol such as lutein and zeaxanthin (antioxidants) provide an overall positive health benefit[2]. For example, *Blesso et al.* (2013)[3] found that the experimental group that consumed egg yolks (EGG), compared to the egg substitute (SUB) in the control group, had an 8% higher increase in HDL levels, despite only a minor increase in total cholesterol. They also found 21% and 48% increases in plasma lutein and zeaxanthin, respectively, in the EGG group compared to decreases in plasma lutein (-16%) and zeaxanthin (-20%) in the SUB group.

The review also notes a different study by *Blesso et al* (2013) that show that an EGG group (vs SUB group) shows an increase in the capacity of HDL particles to accept and carry cholesterol after 12 weeks of consuming 3 eggs per day. This shows that not only does consuming egg yolk HDL **increase the HDL** in the blood, **the HDL is more effective** at clearing cholesterol plaque from the arteries.

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Whole Egg Consumption Improves Lipoprotein Profiles and Insulin Sensitivity[4]

Metabolic Syndrome (MetS) is a clustering of at least three of the five following medical conditions: abdominal (central) obesity, high blood pressure, high blood sugar, high serum triglycerides, and low high-density lipoprotein (HDL) levels. MetS is closely associated with CHD, cardiovascular disease (CVD), and Type 2 Diabetes.

Blesso et al. (2013)[4] showed that feeding MetS individuals 3 eggs per day (with carbohydrate restriction) was associated with elevations in in plasma HDL, whereas this was not shown in the control group consuming egg substitute (cholesterol-free). They also found reductions in total LDL, plasma insulin, and insulin resistance. This shows major improvements in the lipoprotein profile (reducing CHD risk) and insulin resistance (Type 2 Diabetes risk)

Research and Proof

In this study, 40 men and women aged 30-70 years old were enrolled in a 12-week diet intervention. The carbohydrate, fat, and protein composition of the diet was regulated, but the amount of food consumed was not. One group were asked to consume 3 whole eggs per day, whereas the other group was asked to consume the equivalent amount of yolk-free egg substitute.

The results showed that the plasma total cholesterol and LDL-cholesterol were not increased for either group, however the EGG group showed a 13.6% increase in HDL-cholesterol. This increase in HDL-cholesterol means that the EGG group was likely to see reduced LDL from the artery walls, due to higher ratio of HDL:LDL.

Interestingly, plasma insulin levels were also seen to have a reduction in the EGG group, whereas the change in the SUB group was not statistically significant. This decrease in insulin resistance has implications for the benefits of HDL on type 2 diabetes.

Overall, this study suggests that incorporating daily egg yolk intake into a moderately carbohydrate-restricted improves the lipoprotein profile associated with atherosclerosis and CVD.

Reduction in Atherosclerosis Plaque in Rabbits fed with HDL from Egg Yolk[5]

Eftekhar et al. (2015) set out to assess the potential preventative effect of egg yolk HDL on the atherosclerosis plaque formation in rabbits. Their findings showed that treatment with egg yolk HDL increased blood serum HDL-cholesterol and decreased plaque size in rabbis and suggested that egg yolk HDL may be considered as an anti-atherosclerotic treatment for CVD. This was the first study to show this correlation.

Research and Proof

Egg yolk lipoproteins were isolated and fractionated to isolate just the high-density lipoproteins. 30 adult white male rabbits were fed a variety of experimental diets. Group A was fed a normal diet (control group) and Group B received a 3% cholesterol diet (high cholesterol group) for 4 weeks. The high cholesterol diet rabbits were then separated into 2 groups and fed either high (400 mg/kg) or low (100 mg/kg) doses of egg yolk HDL for 6 weeks. The normal diet rabbits were fed 200 mg/kg egg yolk HDL for the same period. The blood serum and aortic plaques were assessed at the end of the experiment.

The results showed that the increased cholesterol diet decreased HDL levels in all groups. These decreased levels were then increased in the groups with high and low doses of egg yolk by 65% and 82% respectively. The egg yolk HDL treatment led to a **significant decrease in artery plaque**, with a significantly higher decrease in the higher dose of HDL. The researchers concluded that **egg yolk HDL can be considered as an anti-atherosclerotic agent** in the treatment of patients with CVD.

Practical Applications

These studies show that if humans were given supplements of HDL protein isolated from egg yolk, such as Ecovatec's HDL products, they could potentially reduce their risk of heart disease and type 2 diabetes. It suggests that it is also possible to reverse the plaque build-up in arteries in individuals who are already experiencing atherosclerosis. These HDL supplements are very beneficial as part of a healthy heart and cardiovascular health program.

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Sources

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