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Original Article

Effect of the Probiotic *Saccharomyces boulardii* on Cholesterol and Lipoprotein Particles in Hypercholesterolemic Adults: A Single-Arm, Open-Label Pilot Study

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Abstract

Objectives: Elevated blood cholesterol levels are a major risk factor for coronary artery disease, the leading cause of death worldwide. Probiotics have been investigated as potential cholesterol-lowering therapies, but no previous studies have assessed the effect of the probiotic yeast *Saccharomyces boulardii* on cholesterol levels in human volunteers. The objective of this study was to examine the effect of *S. boulardii* on serum cholesterol and lipoprotein particles in hypercholesterolemic adults.
Design: This study was a single-arm, open-label pilot study.
Subjects: Twelve hypercholesterolemic participants were recruited into the study; one dropped out.
Intervention: Participants took 5.6×10^{10} colony forming unit (CFU) encapsulated *S. boulardii* (*Saccharomyces cerevisiae* var. *boulardii* CNCM I-1079) twice daily for an 8-week period.
Outcome measures: Fasting concentrations of cholesterol (total cholesterol, low-density lipoprotein-cholesterol [LDL-C], high-density lipoprotein-cholesterol [HDL-C], and triglycerides), lipoprotein particles (very-low-density lipoprotein-particle [VLDL-P], remnant lipoprotein particle [RLP-P], total LDL-P, LDL III-P, LDL IV-P, total HDL-P, and HDL 2b-P), and additional cardiovascular biomarkers (apo B-100, lipoprotein [a], high-sensitivity C-reactive protein, homocysteine, fibrinogen, and insulin) were measured at baseline, after 4 weeks, and after 8 weeks.
Results: Remnant lipoprotein particles decreased by 15.5% ($p = 0.03$) over the 8-week period. The remaining outcome measures were not significantly altered.
Conclusions: In this pilot study, 8 weeks of daily supplementation with *S. boulardii* lowered remnant lipoprotein, a predictive biomarker and potential therapeutic target in the treatment and prevention of coronary artery disease.

Introduction

Coronary artery disease (CAD) is the leading cause of death worldwide.[1] Elevated blood cholesterol levels are a major risk factor for CAD, and standard treatment options for elevated cholesterol include pharmacotherapy, and nutritional and lifestyle modifications.[2,3] Probiotics in capsule form and fermented dairy products containing live probiotics have also been investigated as potential cholesterol-lowering therapies. Promising results have included significant reductions in total cholesterol and low-density lipoprotein cholesterol (LDL-C), as well as increases in high-density lipoprotein cholesterol (HDL-C).[4–7]

Various mechanisms of lipid lowering by probiotics have been proposed, including the assimilation and incorporation of cholesterol into bacterial cellular membranes, the binding of cholesterol to bacterial cellular surfaces, and the deconjugation of intestinal bile salts by bacterial bile salt hydrolase.[8] *In vitro* studies have shown that several strains of *Lactobacillus* and *Lactococcus* can remove cholesterol from culture medium.[9–11] Similar to bacterial strains, the yeasts *Saccharomyces cerevisiae* and *Saccharomyces boulardii* can remove cholesterol from laboratory culture medium.[12]

S. boulardii is a probiotic and substrain of the more well-known budding yeast *S. cerevisiae*. Like many other probiotics, *S. boulardii* has been investigated as a treatment for several acute and chronic gastrointestinal diseases. A recent meta-analysis showed that it effectively prevents antibiotic-associated diarrhea and traveler's diarrhea.[13]

Previous human subject investigations that have examined the potential cholesterol-lowering ability of probiotics have focused on bacterial rather than yeast strains, and no

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