The hypocholesterolemic effects of

Actinidia deliciosa

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Popular literature and the kiwifruit industry have been promoting the antilipemic effects of *Actinidia deliciosa*. These promotions claim that the soluble fiber, and antioxidants contained in the fruit improve lipoprotein profiles. A seven week single-blind study was performed to test the veracity of this claim. Sixteen college-aged males consumed three kiwifruit per day. This study found triglycerides, LDL, HDL and Total cholesterol levels were not significantly lowered after the seven week test period. Kiwifruit was not found to significantly alter lipoprotein profiles due, perhaps, to the fact that the quantities of antilipemic phytoconstituents were not sufficient to alter plasma lipid levels.

**Introduction**

Cardiovascular disease (CVD) is the leading cause of death in the United States, Asia, and the Pacific Islands. Coronary Heart Disease (CHD) accounts for 54% of all deaths. (Nicolosi et al. 2001). The three major atherogenic dietary risk factors of CVD are; saturated fat, cholesterol, and obesity. Increased serum cholesterol levels were shown to have a positive curvilinear relationship with CHD risk (Thompson 1999). The incidence of CHD diminishes when low density lipoprotein (LDL) cholesterol levels are reduced (Gard 2000). High-density lipoprotein (HDL) cholesterol levels less than 40mg/dL and LDL levels greater than 159mg/dL increase the risk of CHD. Lowering LDL levels not only prevents, or slows, the development of atheromatous plaques which engender CHD, but in some cases reverses the process of atheroma development. A major breakthrough in lipidology occurred during the early 1990s with the testing of 3-Hydroxy-3-methylglutaryl coenzyme A reductase inhibitors, or statins. Statins reduce hepatic synthesis of cholesterol by inhibiting the enzyme and increasing the number of LDL receptors causing increased clearance of LDL and a reduced concentration of LDL cholesterol in plasma (Mukherjee 2003). Statins reduce LDL-cholesterol by 20-40%,
triglycerides by 10-20%, and raise HDL-cholesterol by 5-10% (Gard 2000). Studies have shown statins to cause low, but significant side effects such as rhabdomyolysis and liver dysfunction (Pierre-Paul & Gahtan 2003).

Despite the effectiveness of standard pharmaceuticals many patients prefer allopathic alternatives. Numerous studies have quantified the antilipemic effects of the natural constituents of food (Nicolosi et al. 2001, Kurkowska et al. 2000, Fernandez 2001). Several phytoconstituents such as dietary fiber, sterols, and flavonoids have been shown to reduce LDL cholesterol levels (Mukherjee 2003, Devaraj et al. 2004). A recent study demonstrated that orange juice fortified with plant sterols reduced LDL cholesterol by 12.4% (Devaraj et al. 2004).

Lowering plasma cholesterol levels is only one facet of reducing the risk of CHD. Studies have also documented that dietary antioxidants inhibit the oxidation of LDL cholesterol and moderate platelet aggregation (Mee & Gee 1997, Kuroska et al. 2000, Shikany et al. 2000, Samman et al. 2003). *Actinidia deliciosa* [(A. Chev.) the kiwifruit] is currently heralded in popular literature the most nutrient-dense commonly consumed fruit (Lachance & Sloan 1997). It is a significant source of the antioxidants ascorbic acid (Vitamin C) and α-tocopherol (Vitamin E) (Collins et al. 2001.) One large peeled kiwifruit measuring 91g contains 84.4mg [141% of the USDA recommended daily value (DV)] of ascorbic acid and 1.3mg (4% DV) of α-tocopherol. The same quantity of kiwifruit also contains 2.9g of dietary fiber or 39% DV. Companies such as Zespri™ Organic Kiwifruit, and the California Kiwifruit Association, are claiming, in their marketing campaigns, that the dietary fiber and antioxidants in their fruit help lower cholesterol. Currently, no evidence can be found in the scientific literature to substantiate
kiwifruit consumption altering plasma lipid concentrations. The purpose of this study was to quantify the hypocholesterolemic effects of the kiwifruit in college-aged males.

**Methods**

Sixteen males aged 22-29 were selected to participate in this single-blind study. Exclusion criteria were food allergies and the consumption of statins. Blood was obtained from a finger prick, following an eight hour fast, at the commencement and conclusion of the study. A standard cholesterol test was performed to quantify each subject’s current total cholesterol, triglycerides, HDL, and LDL cholesterol levels. Nine subjects were given 250mL/day kiwifruit juice to consume with their evening meal. The juice was prepared from three pealed kiwifruits with a total mean mass of 222g, 85mL of filtered water and five grams of sugar. The remaining subjects were given a placebo consisting of 250mL/day Country Time™ Lemonade. The subjects were given strict instructions to not significantly alter their daily eating or exercise habits. Compliance to this program was monitored every three days when the subjects were given fresh samples of juice. The test period was seven weeks after which a second cholesterol test was administered.

**Results**

Although 16 subjects entered the study two withdrew due to personal reasons and two were excluded for noncompliance (three in the placebo and one in the test group). The remaining twelve subjects adhered to the parameters of the study. The test subjects who consumed kiwifruit had a mean initial BMI of 25±2 while the placebo group had a mean BMI of 26±4. High variance among the subjects was clearly evidenced in the baseline lipid profile, with the largest standard deviation occurring in the test group’s
triglyceride levels (SD±105) (table 1). Despite the variance among individuals in each group there were no significant differences in the mean baseline lipoprotein profiles of the two groups. The mean BMI was not significantly altered in either group after the seven week test period.

Table 1. Subject Lipoprotein Profiles (Data are expressed as mean ± standard deviation)

<table>
<thead>
<tr>
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<th>Test Group</th>
<th>Control Group</th>
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<tbody>
<tr>
<td>Age (y)</td>
<td>26 ± 2</td>
<td>25 ± 1</td>
</tr>
<tr>
<td>BMI (kg/m^2)</td>
<td>25 ± 3</td>
<td>25 ± 3</td>
</tr>
<tr>
<td>Total Cholesterol (mg/dL)</td>
<td>172 ± 40</td>
<td>161 ± 28</td>
</tr>
<tr>
<td>Total Triglyceride (mg/dL)</td>
<td>117 ± 105</td>
<td>110 ± 58</td>
</tr>
<tr>
<td>LDL-Cholesterol (mg/dL)</td>
<td>112 ± 29</td>
<td>95 ± 15</td>
</tr>
<tr>
<td>HDL-Cholesterol (mg/dL)</td>
<td>37 ± 6</td>
<td>45 ± 13</td>
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*(Paired samples, 1 tailed based on expectation of greater difference after kiwifruit consumption)

Mean total cholesterol readings were higher, but were not significantly altered at the end of the study (Figure 1). Individual results in both groups varied with regards to lower or higher triglyceride levels but the mean difference was not significant (Figure 2). LDL and HDL cholesterol levels were unchanged after the seven week test period (Figures 3&4).

![Total Cholesterol Levels](image_url)

Figure 1: Mean Total Cholesterol Levels
Figure 2: Mean Triglyceride Levels

Figure 3: Mean LDL Cholesterol Levels
Figure 4: Mean HDL Cholesterol Levels

Conclusion

This study found no evidence to suggest that kiwifruit improves lipoprotein profiles. Any differences in the test groups; total cholesterol, triglyceride, LDL-C, or HDL-C levels were not significant (p>.05). These data support a recent study (published after the data collection and analysis of this project) which found that the consumption of two to three kiwifruit per day did not alter the plasma concentrations of total cholesterol, HDL, or LDL (Duttory and Jorgensen 2004). That study did determine, however, that triglycerides were lowered by 15% (Duttory and Jorgensen 2004). The discrepancy between the triglyceride findings in this study is most likely due to the degree of initial variance among the test subjects. The standard deviation in the test group was 105, a value almost double the standard deviation of the control group’s triglyceride levels. No other category tested for exhibited such variance. Although kiwifruit contains proven hypocholesterolemic agents such as soluble fiber and plant sterols, the quantities may be insufficient to reduce cholesterol levels in individuals who consume three kiwifruits per
day. Popular literature and the California Kiwifruit commission should cease claiming
that kiwifruit may lower cholesterol. It is not sufficient for a fruit to merely contain
phytoconstituents with antilipemic ability, that fruit must possess antilipemic agents in
sufficient quantities to significantly alter an individual’s plasma levels in order to be
classified as hypocholesterolemic.
Literature Cited


