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Citation

Published Version
doi:10.2337/dc09-0207

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Acute Effects of Decaffeinated Coffee and the Major Coffee Components Chlorogenic Acid and Trigonelline on Glucose Tolerance

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OBJECTIVE — Coffee consumption has been associated with lower risk of type 2 diabetes. We evaluated the acute effects of decaffeinated coffee and the major coffee components chlorogenic acid and trigonelline on glucose tolerance.

RESEARCH DESIGN AND METHODS — We conducted a randomized crossover trial of the effects of 12 g decaffeinated coffee, 1 g chlorogenic acid, 500 mg trigonelline, and placebo (1 g mannitol) on glucose and insulin concentrations during a 2-h oral glucose tolerance test (OGTT) in 15 overweight men.

RESULTS — Chlorogenic acid and trigonelline ingestion significantly reduced glucose (−0.7 mmol/l, P = 0.007, and −0.5 mmol/l, P = 0.024, respectively) and insulin (−73 pmol/l, P = 0.038, and −117 pmol/l, P = 0.007) concentrations 15 min following an OGTT compared with placebo. None of the treatments affected insulin or glucose area under the curve values during the OGTT compared with placebo.

CONCLUSIONS — Chlorogenic acid and trigonelline reduced early glucose and insulin responses during an OGTT.

Diabetes Care 32:1023–1025, 2009

RESEARCH DESIGN AND METHODS — Fifteen male, healthy, nonsmoking, overweight (BMI 25.0–35.0 kg/m²) coffee consumers were enrolled. All subjects provided written informed consent.

Subjects were randomly assigned to a unique treatment order through computer-generated randomization by the pharmacy. Four supplements were tested in this crossover trial: 12 g decaffeinated coffee (Nescafé Gold, Nestlé, the Netherlands), 1 g chlorogenic acid (Sigma Aldrich, Switzerland), 500 mg trigonelline (Sigma Aldrich), and 1 g mannitol as placebo (Spruyt Hillen Bufa, the Netherlands). Based on laboratory measurement of the supplement, subjects ingested one of the supplements 30 min before a 75-g oral glucose tolerance test (OGTT). Seven venous blood samples were taken via a cannula in the antecubital vein on each visit following an overnight fast. The first blood sample was taken 30 min before the start of the OGTT, immediately followed by ingestion of the supplement. The second blood sample was taken just before the OGTT, and the other samples were taken 15, 30, 60, 90, and 120 min after the start of the OGTT.

Laboratory analyses were conducted at the VU University Medical Center. Plasma glucose concentrations were measured using the glucose hexokinase method with an interassay coefficient of variation (CV) of 1.3% (Roche Diagnostics, Mannheim, Germany). Serum insulin concentrations were measured using an immunoradiometric assay (Bayer Diagnostics, Mijdrecht, the Netherlands); the intra-assay CV was 4%, and the interassay CV was 8%.

The area under the curve values for glucose and insulin were calculated using the trapezoidal method. Main treatment effects were analyzed using linear mixed regression models. Comparisons of mean glucose and insulin concentrations for individual time points were conducted using paired t tests. All tests were two-sided, and P values <0.05 were considered statistically significant. Analyses were conducted using SPSS (version 15.0).

RESULTS — The participants had a mean ± SD age of 39.9 ± 16.5 years and a mean BMI of 27.6 ± 2.2 kg/m². There
Coffee components and glucose tolerance

**Table 1. Glucose and insulin concentrations during an OGTT following ingestion of chlorogenic acid, decaffeinated coffee, trigonelline, or placebo in 15 healthy overweight men.**

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Glucose (mmol/l)</th>
<th>Insulin (pmol/l)</th>
<th>AUC (pmol·l⁻¹·min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.1±0.7</td>
<td>62.5±23.6</td>
<td>1843±503</td>
</tr>
<tr>
<td>15</td>
<td>5.3±1.0</td>
<td>92.7±53.7</td>
<td>7327±919</td>
</tr>
<tr>
<td>30</td>
<td>5.9±0.5</td>
<td>92.2±67.3</td>
<td>8322±134</td>
</tr>
<tr>
<td>60</td>
<td>5.1±0.5</td>
<td>73.7±57.5</td>
<td>8962±101</td>
</tr>
<tr>
<td>90</td>
<td>4.7±0.3</td>
<td>69.5±47.4</td>
<td>9122±144</td>
</tr>
<tr>
<td>120</td>
<td>4.6±0.2</td>
<td>74.5±56.6</td>
<td>9021±151</td>
</tr>
<tr>
<td>180</td>
<td>4.5±0.2</td>
<td>83.6±58.7</td>
<td>9673±114</td>
</tr>
</tbody>
</table>

Data are means ± SE unless otherwise indicated. Baseline values are fasting concentrations and were determined right before supplement ingestion; Time 0 was half an hour after supplement ingestion and right before the start of the OGTT.

**CONCLUSIONS**—In this randomized, cross-over trial in healthy men, chlorogenic acid and trigonelline ingestion led to significantly lower glucose and insulin concentrations 15 min after an oral glucose load but did not significantly reduce the OGTT insulin and glucose areas under the curve compared with placebo.

Trigonelline also resulted in significantly lower glucose (−0.51 mmol/l [95% CI −0.95 to −0.08]; P = 0.024) and insulin (−117.0 pmol/l [−196.5 to −37.4]; P = 0.007) concentrations at 15 min after the start of the OGTT. Decaffeinated coffee did not significantly change mean glucose or insulin concentrations at any of the time points following the OGTT, although the insulin concentration tended to be lower at 15 min. None of the treatments significantly changed the insulin or glucose area under the curve values (Table 1).

**Acknowledgments**—The research for this study was financially supported by the Dutch Diabetes Research Foundation (Stichting Diabetes Fonds Nederland Grant 2006 11 020).

R. J. Heine is currently employed at Eli Lilly and Company, Indianapolis, Indiana. No other potential conflicts of interest relevant to this article were reported.

We thank the participants of the Coffee Study for their participation and the Clinical Research Unit Internal Medicine of the VU University Medical Centre for use of the facilities. We are very grateful to Peter C. Hollman and Dini Venema (RIKILT, Institute of Food Safety, Wageningen, the Netherlands) for the careful measurement of chlorogenic acid and Sandy Slow (Centerbury Health Laboratories, Christchurch, New Zealand) for the careful measurement of trigonelline in the coffee supplement.

References

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