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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.

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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 measure-
ments (9,10), the decaffeinated coffee used in our study provided 264 mg chlorogenic acid and 72 mg trigonelline. All supplements were dissolved in 270 ml water, and treatments except for decaffeinated coffee were double blind. Starting 1 week before the trial, participants were requested to restrict their coffee consumption to maximally one cup per day, and on the days before each study visit no coffee was allowed.

The study consisted of four visits separated by at least 6 days. During each visit, participants 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 inter-assay 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

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

Glucose (mmol/l) Insulin (pmol/l)

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Placebo</th>
<th>Chlorogenic acid</th>
<th>Decaffeinated coffee</th>
<th>Trigonelline</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5.7</td>
<td>5.5</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td>15</td>
<td>8.7</td>
<td>7.0</td>
<td>8.6</td>
<td>8.9</td>
</tr>
<tr>
<td>30</td>
<td>13.4</td>
<td>13.4</td>
<td>13.4</td>
<td>13.4</td>
</tr>
</tbody>
</table>

Data are means using paired t tests compared with the placebo value. AUC, area under the curve.

CONCLUSIONS — In this randomized crossover 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 compared with placebo. 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).

In conclusion, chlorogenic acid and trigonelline reduced early glucose and insulin responses during the OGTT. This finding is consistent with the hypothesis that these compounds contribute to the putative beneficial effect of coffee on development of type 2 diabetes.

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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.

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References

3. Clifford MN. Chlorogenic acids and other cinnamates: nature, occurrence and di-