Decaffeinated Coffee and Glucose Metabolism in Young Men

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Decaffeinated Coffee and Glucose Metabolism in Young Men

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OBJECTIVE — The epidemiological association between coffee drinking and decreased risk of type 2 diabetes is strong. However, caffeinated coffee acutely impairs glucose metabolism. We assessed acute effects of decaffeinated coffee on glucose and insulin levels.

RESEARCH DESIGN AND METHODS — This was a randomized, cross-over, placebo-controlled trial of the effects of decaffeinated coffee, caffeinated coffee, and caffeine on glucose, insulin, and glucose-dependent insulinotropic polypeptide (GIP) levels during a 2-h oral glucose tolerance test (OGTT) in 11 young men.

RESULTS — Within the first hour of the OGTT, glucose and insulin were higher for decaffeinated coffee than for placebo (P < 0.05). During the whole OGTT, decaffeinated coffee yielded higher insulin than placebo and lower glucose and a higher insulin sensitivity index than caffeine. Changes in GIP could not explain any beverage effects on glucose and insulin.

CONCLUSIONS — Some types of decaffeinated coffee may acutely impair glucose metabolism but less than caffeine.

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Nineteen of 22 epidemiological studies concluded that long-term consumption of coffee, both caffeinated and decaffeinated, can reduce the risk of type 2 diabetes (1–3), but several investigators have warned that the cafeine in caffeinated coffee can impair glucose metabolism (e.g., 4,5). While decaffeinated coffee contains very little caffeine and may safely protect against diabetes, there have been conflicting reports on decaffeinated coffee’s acute effects on glucose metabolism (6–9). Our objective was to assess whether ground decaffeinated coffee enhances glucose metabolism and whether glucose-dependent insulinotropic polypeptide (GIP), an incretin hormone that stimulates insulin secretion (10), plays a causal role.

RESEARCH DESIGN AND METHODS — Eleven healthy male nonsmokers signed an informed consent and participated. The following participation requirements were started 1 week prior to the first lab visit: keep diet, exercise, and alcohol intake stable; no caffeinated drinks, foods, or medications; no smoking; and no alcohol or exercise during the 48 h prior to each visit.

There were four visits separated by at least a week. Participants ingested one of four beverages assigned by researchers in a single-blinded randomized fashion at a temperature of 43–49°C (caffeinated coffee, decaffeinated coffee, caffeine in warm water, or warm water [placebo]). An oral glucose tolerance test (OGTT) was initiated 1 h later (t = 0 min) with ingestion of 75 g of glucose in water. Blood was drawn at time −90, −60, 0, 10, 30, 60, 90, and 120 min.

Participants drank 500–600 ml of drip-filtered ground coffee (Chock Full O’Nuts Original; Massimo Zanetti Beverage, Portsmouth, VA). The recipe was eight cups of water with 40 g of grounds for decaffeinated and 57 g of grounds for caffeinated coffee. For the caffeine and hot water (placebo) beverages, we ran eight cups of water through the machine with filter paper without coffee grounds. For the caffeine beverage, we added food-grade caffeine powder (Spectrum Chemical Manufacturing, Gardena, CA). The volume ingested was the same for each beverage and differed by participant to yield 6 mg caffeine/kg of body wt in the caffeine and decaffeinated coffee beverage. The caffeine content of the decaffeinated coffee was measured as 0.73 mg/ml coffee, by high-performance liquid chromatography.

Glucose was assayed in plasma using the oxygen rate method (Beckman Glucose Analyzer 2; Beckman, Brea, CA). Insulin was assayed in plasma (human-specific radiimmunoassay kit no. M114886; Millipore, Billerica, MA). GIP (total) was measured in plasma (human GIP [total] enzyme-linked immunosorbent assay kit no. M116520; Millipore).

The trapezoidal rule was used to calculate area under the curve (AUC). The insulin sensitivity index (ISI) was calculated using the formula of Belfiore et al. (11). All blood data were analyzed for time and beverage effects using two-way repeated-measures ANOVA. AUC and ISI data were analyzed using one-way repeated-measures ANOVA. All tests were adjusted for multiple comparisons by means of Tukey Studentized range adjustments. Two-sided P < 0.05 was considered significant. We used SPSS 11.5 for all statistical analyses.

RESULTS — The subjects had a mean (± SD) age of 23.5 ± 5.7 years, BMI 23.6 ± 4.2 kg/m², fasting glucose 4.41 ± 0.49 pmol/l, and fasting insulin 109.0 ± 91.7 pmol/l. Participants reported no minor adverse reactions.

During the first 30 min of the OGTT, decaffeinated coffee yielded significantly higher glucose than placebo (Table 1).
Conclusions: Decaffeinated coffee actually impaired glucose metabolism in healthy young men. Within the first 60 min of the OGTT, both glucose and insulin AUC and higher ISI than after placebo. Decaffeinated coffee was significantly higher in the whole OGTT, and significantly lower for caffeine than after placebo. Decaffeinated coffee was significantly higher in the whole OGTT, and significantly lower for caffeine than after placebo. CIP was significantly lower than for caffeine. CIP was significantly lower than for caffeine.

Table 1—Glucose, insulin, and CIP concentrations and AUC during an OGTT following ingestion of placebo, decaffeinated coffee, caffeinated coffee, and caffeine

<table>
<thead>
<tr>
<th>Beverage</th>
<th>Glucose (mg/dL)</th>
<th>Insulin AUC</th>
<th>CIP (μmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo</td>
<td>105.3 ± 10.8</td>
<td>0.67b</td>
<td>0.15 ± 0.05</td>
</tr>
<tr>
<td>Caffeine</td>
<td>113.3 ± 10.9</td>
<td>0.80a</td>
<td>0.38a,b</td>
</tr>
<tr>
<td>Decaffeinated coffee</td>
<td>4.55 ± 0.70</td>
<td>0.70a</td>
<td>0.17 ± 0.05</td>
</tr>
<tr>
<td>Placebo</td>
<td>109.8 ± 10.9</td>
<td>0.67b</td>
<td>0.15 ± 0.05</td>
</tr>
<tr>
<td>Caffeine</td>
<td>115.6 ± 11.0</td>
<td>0.80a</td>
<td>0.38a,b</td>
</tr>
<tr>
<td>Decaffeinated coffee</td>
<td>4.50 ± 0.69</td>
<td>0.67b</td>
<td>0.15 ± 0.05</td>
</tr>
</tbody>
</table>

Data are means ± SEM.
Our study has several limitations. We only had 11 volunteers. More volunteers would have yielded more statistical power. Our study also has some strengths. Our protocol allowed us to convincingly separate the effects of each beverage from the effects of the OGTT glucose because ingestion of the beverages was separated by 60 min from ingestion of the glucose.

In conclusion, our human trial appears to be the first to find that decaffeinated coffee can acutely impair glucose metabolism, but less than caffeine, in healthy young men.

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No potential conflicts of interest relevant to this article were reported.

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