Letter to the Editor

EFFECT OF VARYING DOSES OF CAFFEINE ON LIFE SPAN OF DROSOPHILA MELANOGASTER

To the Editor:

Despite a considerable interest in the effect caffeine has on metazoan life span, the extent, as well as the direction, of this effect is still unclear. One of the most extensively used metazoan models in longevity studies is the fruit fly Drosophila melanogaster (1). There are a number of studies on the effect of caffeine on Drosophila, most of them conducted using natural populations. However, flies derived from natural populations for longevity studies display substantial variations in longevity (2), most likely brought about by heterogeneous population-specific genetic background. In addition, the genetic instability brought about by an unbalanced genetic background can significantly affect the outcome of a longevity analysis.

A good scientific experiment requires fixing of all variables except for the one under investigation. A control-experiment comparison analysis cannot be adequately achieved in longevity analyses involving natural populations due to their inherent genetic variability and, thus, varying genetic background of organisms involved in the study.

In the present study, we used a co-isogenic inbred line of D. melanogaster derived from the Canton-S (CS) stock to assess the effect of varying dietary doses of caffeine on life span in an equalized genetic background. Being a laboratory strain of D. melanogaster, CS has reduced genetic variation within the strain (1). Another feature of CS is that it is reported by the Drosophila Stock Center to have no potentially transpositionally active transposable elements (TEs), such as P or hobo, in its genome (3). Transposable elements can introduce additional genetic heterogeneity and, thus, additional instability in response to environmental stress (4). Previous studies with fruit fly longevity did not take the TE factor into account.

In our experiment, we observed a significant reduction in life span of male flies reared on food containing 2.5 mg/ml and 1.25 mg/ml of caffeine (Table 1, Figure 1). There was a significant decrease in life span in the experimental group in one out of three replicates with 0.625 mg/ml and 0.3125 mg/ml caffeine concentrations. In two out of three replicates with 0.625 mg/ml and one out of three replicates with 0.3125 mg/ml of caffeine, flies lived longer on caffeine than on control food, although the difference in life span was not significant. The overall relationship between caffeine concentration and Drosophila life span in our experiment is presented in Figure 1.

A previous report on caffeine effect in Drosophila examined the development of resistance to caffeine in 10 generations of Drosophila prosultans, a tropical fruit fly (5). The results of that investigation suggest a negative dosage-dependent effect of caffeine on longevity and other life history parameters. However, the lack of experimental replicates makes the results of that study difficult to put into perspective. In addition, natural populations of Drosophila, particularly D. prosultans, contain large numbers of TEs in their genome (1,6,7,8,9).

Transposable elements are major contributors to genetic instability in Drosophila, which contributes greatly to variations in life span (4). Somatic movement of TEs found in the D. prosultans genome has been documented to reduce life span in other species of Drosophila (10,11). Transposable element activity could have modified the effect of caffeine on life span in the Itoyama and colleagues study (5).

Data presented here show that high concentrations of caffeine reduce the longevity of an inbred strain D. melanogaster with a co-isogenic background lacking TEs. Whether

---

Table 1. Life Span of Drosophila melanogaster Males Reared on Varying Dietary Caffeine Concentrations (0.3125–2.5 Mg/Ml) in Comparison With the Corresponding Controls (No Caffeine in Food)

<table>
<thead>
<tr>
<th>Caffeine Concentration, mg/ml</th>
<th>Mean Life Span (± SE) (+) Caffeine</th>
<th>Mean Life Span (± SE) No Caffeine</th>
<th>Kolmogorov-Smirnov P</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>Replica 1 16.9 ± 0.6</td>
<td>46.0 ± 1.4</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Replica 2 18.6 ± 0.5</td>
<td>46.7 ± 1.5</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Replica 3 20.5 ± 0.5</td>
<td>45.1 ± 1.3</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>1.25</td>
<td>Replica 1 31.1 ± 1.1</td>
<td>35.6 ± 1.2</td>
<td>0.025</td>
</tr>
<tr>
<td></td>
<td>Replica 2 40.6 ± 1.0</td>
<td>42.3 ± 1.8</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Replica 3 38.0 ± 1.1</td>
<td>43.7 ± 1.2</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>0.625</td>
<td>Replica 1 38.2 ± 1.2</td>
<td>41.7 ± 1.4</td>
<td>.013</td>
</tr>
<tr>
<td></td>
<td>Replica 2 50.4 ± 1.4</td>
<td>47.3 ± 1.6</td>
<td>.367</td>
</tr>
<tr>
<td></td>
<td>Replica 3 43.1 ± 1.3</td>
<td>42.6 ± 1.5</td>
<td>.281</td>
</tr>
<tr>
<td>0.3125</td>
<td>Replica 1 42.2 ± 1.4</td>
<td>43.5 ± 1.3</td>
<td>.588</td>
</tr>
<tr>
<td></td>
<td>Replica 2 50.0 ± 1.6</td>
<td>48.4 ± 1.7</td>
<td>.715</td>
</tr>
<tr>
<td></td>
<td>Replica 3 41.4 ± 1.2</td>
<td>44.5 ± 1.3</td>
<td>.001</td>
</tr>
</tbody>
</table>

Notes: SE = Standard error of mean.
Each concentration was tested in three separate replicas, which are presented in the table individually.

---

Figure 1. Mean life span of Canton-S Drosophila melanogaster males of four dietary concentrations of caffeine with corresponding controls.
the observed relationship between caffeine and life span will hold in other genetic backgrounds, whether or not they contain TEs capable of transposition, remains the subject of further investigation.

Alexey G. Nikitin
Serena Navitskas
Lee-Ann Nicole Gordon

Biology Department
Biomedical and Health Sciences Department
Grand Valley State University
Allendale, Michigan

Address correspondence to Alexey G. Nikitin, Biology Department, Grand Valley State University, 1 Campus Dr., Allendale, MI 49401. E-mail: nikitin@gvsu.edu

REFERENCES


