Comparisons of pupae oil fatty acids composition and development parameters in a mulberry- and artificial diet- fed insect pest, *Spodoptera litura*

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Naxos, Greece
06/15/2018
1. Background

Linseed
Silkworm pupae
Deep-sea
Perilla frutescens

α-linolenic acid (ALA)
C18:3

Perilla frutescens

Linseed

Silkworm pupae

Deep-sea

Perilla frutescens

α-linolenic acid (ALA)
C18:3
**common cutworm**

*Spodoptera litura* (Lepidoptera, noctuidae)

Major destructive insect pest in China and Asian countries

- **Eggs**
- **Newly hatched larvae**
- **Later stage larvae**
- **Adult moth**
- **Pupa**
Fatty acid composition

Metabolic pathways

Lepidoptera Insects
Similar Feeding habit
2. Experimental design

- *Developmental parameters of S. Litura When feeding different foods*

- *Measurements of fatty acids composition and contents in S. Litura pupae oil*

- *Identifications of different expressed genes related to development and fatty acid biosynthesis in S. Litura pupae*
3. Results

3.1 Bodyweight dynamics

Mixed effect models
Food have a great impact on body weight dynamics
\( (AIC=31794.66, BIC=31823.68, \loglik=-15892.33, t=-2.69, P=0.007) \)
3.2 Development time

Mulberry-fed larvae: 21.70±0.68d
Artificial diets-fed larvae: 15.53±0.62d

Longer developmental time in MF larvae

$h(t) = h_0(t) \exp \left( \sum_{i=1}^{n} \beta_i z_i \right)$
3.3 Compositions of pupae oil fatty acid
### 3.4 Relative contents of pupae oil fatty acid

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Palmitic acid (%)</th>
<th>Palmitoleic acid (%)</th>
<th>Stearic acid (%)</th>
<th>Oleic acid (%)</th>
<th>Linoleic acid (%)</th>
<th>α-Linolenic acid (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>44.13±0.0057&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.28±0.0004&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.60±0.0026&lt;sup&gt;a&lt;/sup&gt;</td>
<td>26.33±0.0025&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>4.21±0.0006&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.45±0.0050&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>AF</td>
<td>35.53±0.0072&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.77±0.0003&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.73±0.0002&lt;sup&gt;d&lt;/sup&gt;</td>
<td>24.40±0.0002&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>32.61±0.0042&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.92±0.0007&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>L2F</td>
<td>42.76±0.0067&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.21±0.0007&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.22±0.0043&lt;sup&gt;a&lt;/sup&gt;</td>
<td>25.72±0.0025&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>4.86±0.0006&lt;sup&gt;c&lt;/sup&gt;</td>
<td>19.24±0.0051&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>L3F</td>
<td>41.26±0.0116&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.00±0.0054&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.28±0.0017&lt;sup&gt;b&lt;/sup&gt;</td>
<td>27.52±0.0070&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.45±0.0010&lt;sup&gt;c&lt;/sup&gt;</td>
<td>19.48±0.0031&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>L4F</td>
<td>48.23±0.0614&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.14±0.059&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.34±0.0046&lt;sup&gt;c&lt;/sup&gt;</td>
<td>23.39±0.0307&lt;sup&gt;b&lt;/sup&gt;</td>
<td>22.18±0.0226&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.72±0.0136&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

MF: Mulberry-fed, AF: Artificial diets-fed; L2F: 2<sup>nd</sup> instar changing food; L3F: 3<sup>rd</sup> instar changing food; L4F: 4<sup>th</sup> instar changing food
3.5 Absolute contents of pupae oil fatty acid

- Palmitic acid
- Oleic acid
- Linoleic Acid
- a-Linolenic Acid
### 3.6 Differentially expressed genes identified from pupae transcriptome

<table>
<thead>
<tr>
<th>Gene ID</th>
<th>Log₂FoldChange</th>
<th>Padj Value</th>
<th>Up_Down</th>
<th>Gene description</th>
<th>KEGG/GO term</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOC111364978</td>
<td>1.63</td>
<td>0.013</td>
<td>Up</td>
<td>Broad-complex core protein isoforms 1</td>
<td>response to ecdysone/regulation of development</td>
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<tr>
<td>LOC111365131</td>
<td>-1.97</td>
<td>0.024</td>
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<td>Cytochrome P450 315a1, mitochondrial</td>
<td>ecdysone biosynthetic process</td>
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<tr>
<td>LOC111361108</td>
<td>-2.85</td>
<td>0.0090</td>
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<td>Cytochrome P450 307a1</td>
<td>ecdysone biosynthetic process</td>
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<tr>
<td>LOC111361821</td>
<td>1.72</td>
<td>0.020</td>
<td>Up</td>
<td>Ecdysone 20-monoxygenase</td>
<td>ecdysone 20-monoxygenase activity</td>
</tr>
<tr>
<td>LOC111348433</td>
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<td>0.00031</td>
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<td>Juvenile hormone acid Omethyltransferase</td>
<td>juvenile hormone biosynthetic process</td>
</tr>
<tr>
<td>LOC111351898</td>
<td>-1.39</td>
<td>0.045</td>
<td>Down</td>
<td>Juvenile hormone esterase</td>
<td>juvenile-hormone esterase activity</td>
</tr>
<tr>
<td>LOC111357658</td>
<td>2.15</td>
<td>0.020</td>
<td>Up</td>
<td>Juvenile hormone epoxide hydrolase</td>
<td>Insect hormone biosynthesis</td>
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<td>LOC111358473</td>
<td>3.04</td>
<td>0.0029</td>
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<td>Juvenile hormone esterase</td>
<td>juvenile-hormone esterase activity</td>
</tr>
<tr>
<td>LOC111360436</td>
<td>2.47</td>
<td>0.00024</td>
<td>Up</td>
<td>Farnesol dehydrogenase</td>
<td>juvenile hormone biosynthetic process</td>
</tr>
<tr>
<td>LOC111356099</td>
<td>4.93</td>
<td>0.0024</td>
<td>Up</td>
<td>Phospholipase A2</td>
<td>alpha-Linolenic acid metabolism</td>
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<tr>
<td>LOC111361908</td>
<td>2.15</td>
<td>0.0023</td>
<td>Up</td>
<td>Acyl-CoA desaturase</td>
<td>Biosynthesis of unsaturated fatty acids</td>
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<tr>
<td>LOC111347913</td>
<td>6.31</td>
<td>0.0010</td>
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<td>Acyl-CoA desaturase</td>
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<tr>
<td>LOC111355209</td>
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<td>0.0049</td>
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<td>Acyl-CoA desaturase</td>
<td>Biosynthesis of unsaturated fatty acids</td>
</tr>
</tbody>
</table>
3.7 KEGG Pathway enrichment of insect hormone biosynthesis
3.8 KEGG Pathway enrichment of ALA

α-LINOLENIC ACID METABOLISM

LOC111356099
Conclusion

1 Body weight dynamics were different when fed on artificial diet and mulberry, while pupae weight were not different significantly.

2 The content of α-linolenic acid was dramatically different between mulberry-fed pupae and artificial diets-fed ones, and the scenario of linoleic acid was opposite.

3 Four candidate genes which up-regulated in mulberry-fed pupae were identified by transcriptome deep sequencing.
THANKS for your attention!