REARING HONEY BEES IN VITRO: EFFECTS OF FOOD QUANTITY ON SURVIVAL AND DEVELOPMENT
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History of in vitro rearing of honey bees

- Himmer, 1927;
- Rhein, 1933;
- Michael and Abramovitz, 1955;
- Hanser and Rembold, 1960;
- Dixon and Schuel, 1963;
- Rembold and Hanser, 1964;
- Rembold, 1965; Jay, 1965;
- Dietz, 1967 and 1973;
- Shuel and Dixon, 1968;
- Haydak, 1970;
- Hanser, 1971;
- Dietz and Haydak, 1971;
- Rembold et al, 1974;
- Asencot and Lensky, 1976;
History of in vitro rearing of honey bees

• Rembold and Lackner (1981)

Royal jelly (20 g)  44 %
Glucose       (2.5 g)  5.5 %
Fructose      (2.5 g)  5.5 %
YE            (0.5 g)  1.0 %
Distilled water (20 g)  44 %

Larval survival 80% and queen formation was up to 30%.
History of in vitro rearing of honey bees

- Vandenberg and Shimanuki (1987).

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royal jelly</td>
<td>50%</td>
</tr>
<tr>
<td>Glucose</td>
<td>6%</td>
</tr>
<tr>
<td>Fructose</td>
<td>6%</td>
</tr>
<tr>
<td>Water</td>
<td>37%</td>
</tr>
<tr>
<td>YE</td>
<td>1%</td>
</tr>
</tbody>
</table>

- 90% larval survival in beeswax cups and 57% survival in plastic cell cups
History of in vitro rearing of honey bees

- Peng et al., (1992)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>RJ (powder)</td>
<td>4.2 g</td>
<td>60 %</td>
</tr>
<tr>
<td>=12 gr fresh RJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose</td>
<td>0.6 g</td>
<td>3 %</td>
</tr>
<tr>
<td>Fructose</td>
<td>0.6 g</td>
<td>3 %</td>
</tr>
<tr>
<td>Distilled water</td>
<td>14.6 g</td>
<td>33 %</td>
</tr>
<tr>
<td>YE</td>
<td>0.2 g</td>
<td>1 %</td>
</tr>
</tbody>
</table>
History of in vitro rearing of honey bees

- Aupinel et al., (2005)

<table>
<thead>
<tr>
<th></th>
<th>Day 1-2</th>
<th>Day 3-4</th>
<th>Day 5-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royal Jelly</td>
<td>50 %</td>
<td>48.3 %</td>
<td>46.5 %</td>
</tr>
<tr>
<td>Glucose</td>
<td>6%</td>
<td>7.5 %</td>
<td>9%</td>
</tr>
<tr>
<td>Fructose</td>
<td>6%</td>
<td>7.5 %</td>
<td>9%</td>
</tr>
<tr>
<td>YE</td>
<td>1 %</td>
<td>1.5 %</td>
<td>2 %</td>
</tr>
<tr>
<td>Water</td>
<td>37 %</td>
<td>35.2 %</td>
<td>33.5 %</td>
</tr>
<tr>
<td>Total Sugar</td>
<td>12 %</td>
<td>15 %</td>
<td>18 %</td>
</tr>
</tbody>
</table>
Kaftanoglu, et al., (2010, 2011) studied the effects of:

- Sugar composition,
- Feeding intervals
- Feeding regimes
- Yeast extract concentration

on the development of larvae reared in vitro.
History of in vitro rearing of honey bees

MATERIAL AND METHODS

• Basic larval diet 53% RJ+6%G+6%F+1%YE +34% H2O
• 5 Groups x 5 replicates x 22 larvae/replicate
  - Group 1: 100 mg diet / larva
  - Group 2: 150 mg diet / larva
  - Group 3: 200 mg diet / larva
  - Group 4: 250 mg diet / larva
  - Group 5: 300 mg diet / larva
• Larvae were reared individually in plastic queen cell cups
• All the groups were fed once
• Larvae were kept in the growth chamber at 34°C and 90% RH
• Pupated at 34°C and 70% RH.
1 Day old larvae were transferred on BLD in individual queen cell cups.
Spinning stage larvae
Pupated in the queen cell cups
Pupated in the 24 well plates
Effects of food quantity on the survival of larvae and adults
Effects of food quantity on adult weights (mg)
Effects of food quantity on ovariole numbers

*Diet / bee (mg)*

*P<0.0001*
CONCLUSIONS

• Honey bees can be reared *in vitro* with single feeding.
• It reduces the labor and times spend for feeding the larvae.
• Less handling reduces the probability of damaging the larvae especially during molting.
CONCLUSIONS

• Feeding regime or the quantity of food determines the size of the worker bees.

• The weights and the ovariole numbers increase with the increased food consumption.

• Large or small size bees and/or big or small ovary size bees can be reared by the feeding regime
Food quality and quantity causes the development of queens, intermediates and workers.
• Toxicology
  • Hladun, K., Kaftanoglu, O., Parker, D., Tran, K., Trumble, J. (2013) Effects of selenium on development, survival and accumulation in the honey bee (*Apis mellifera* L.). Environmental toxicology and chemistry (Accepted for pub)

APPLICATIONS

• Development and epigenetics