Recycling lignocellulosic wastes for mushroom production and livestock feed

Ofer Danay\textsuperscript{1}, Nirit Ezov\textsuperscript{1}, Edith Yosef\textsuperscript{2} and Dan Levanon\textsuperscript{1}

\textsuperscript{1}Migal, Galilee Technology Center, Kiryat Shmona, Israel

\textsuperscript{2}Institute of Animal Sciences, ARO The Volcani Center, Bet Dagan, Israel
Preface

- Global warming and water scarcity.
- Forage availability is decreasing and its price is increasing.
- Alternative lignocellulosic waste (environmental restrictions) materials for: Mushroom production.
- As potential alternative for livestock feed.
- Use of spent mushroom substrate (SMS) for ruminants feed.
Vine trimmings

Forest trimmings

Olive oil cake- Oilcake
Eyal Kedoshim

Dana Siso
Ido Amar

Reut Dagan
Materials and Methods

- Substrates
- Waste materials of agricultural crops.
- Forest wood remains.
- Fungal Growth (Linear growth), fruit Bodies Development (Biological efficiency)
  - *Flammulina velutipes* (Enoki). (As an example)
- Substrate Digestibility
  - *Pleurotus ostreatus, P. pulmonarius, P. salmoneo, P. cornucopiae* (Oyster).
Substrate Digestibility

- In vitro organic matter digestibility (IVOMD).
- The effect of adding manganese and adding oil cake on in vitro organic matter digestibility.
- Measurements of spent mushroom substrate (SMS) were made on raw substrate, at spawning, at the end of spawn run, at the middle of mushroom picking period, and at the end of the cultivation cycle.
The effect of adding manganese on in vitro organic matter digestibility

![Bar chart showing dry matter digestibility (%) with and without manganase for different species.](chart_image)

- **Ostreatus**
  - With manganase: 32%
  - Without manganase: 28%

- **Salmoneo**
  - With manganase: 35%
  - Without manganase: 31%

- **Eucalyptus**
  - With manganase: 29%
  - Without manganase: 25%

- **Salmoneo**
  - With manganase: 34%
  - Without manganase: 30%

- **Pine**
  - With manganase: 27%
  - Without manganase: 23%
The effect of adding oil cake on biological efficiency (*P. salmoneo*)

<table>
<thead>
<tr>
<th>Oil Cake Percentage</th>
<th>Pine Efficiency</th>
<th>Eucaliptus Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>15.09</td>
<td>19.8</td>
</tr>
<tr>
<td>44%</td>
<td>24.15</td>
<td>22.44</td>
</tr>
<tr>
<td>88%</td>
<td>30.56</td>
<td>40.16</td>
</tr>
</tbody>
</table>
Use of spent mushroom substrate (SMS) for cattle feed
Table 1: The impact of *Pleurotus spp.* cultivation on organic matter digestibility of cotton (25%)-wheat (75%) straw mixture.

<table>
<thead>
<tr>
<th>Pleurotus var:</th>
<th>Raw</th>
<th>At spawning</th>
<th>End of spawn run</th>
<th>Mid fruiting</th>
<th>End of fruiting</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>ostreatus</em></td>
<td>30.4</td>
<td>33.4</td>
<td>39.0</td>
<td>52.6</td>
<td>60.1</td>
</tr>
<tr>
<td><em>salmoneo-stramineus</em></td>
<td>30.4</td>
<td>32.7</td>
<td>33.1</td>
<td>40.6</td>
<td>51.8</td>
</tr>
<tr>
<td><em>cornucopiae</em></td>
<td>30.4</td>
<td>32.5</td>
<td>23.7</td>
<td>42.9</td>
<td>51.9</td>
</tr>
</tbody>
</table>
Flammulina velutipes (Enoki)
Fig. 1 *Flammulina velutipes* var: M 4600, M 4622 colony diameter after 19 days of growth on the substrates
Fig. 3 *Flammulina velutipes* var: M 4600 mushroom yields as BE on the substrates
Results

- **Substrate Digestibility** of pine trimmings was improved by addition of Mn. Addition oil cake to eucalyptus and pine trimmings Substrates improved Digestibility.
- The Digestibility of spent mushroom substrate of *Pleurotus ostreatus* resend from 30% to 60%.
- **Mushroom production.**
- Fastest mycelium linear growth, of *Flammulina velutipes*, was on vine and apple trimmings and oak wood wastes. Highest BE was fond on vine variety Sauvignon blanc trimmings substrate.
Discussion

• Fruit orchard and forest trimmings and cotton and wheat straws, which are waste materials, were studied for the dual purpose: mushroom production and cattle feed.

• Vine trimmings was the preferred substrates for the cultivation of both *Flammulina velutipes*.

• A considerable increase in SMS digestibility was shown:
  • With Addition of Mn to pine and oil cake.
  • After *Pleurotus ostreatus* cultivation on cotton (25%) – wheat (75%) straw mixture.
The mushroom and truffle team

Sharon Yizhaki, Hila Hanani & Rami Chohen, mushroom functional food

Nirit Ezov, lab manager

Lotem Asoli & Pisko Truffle collecting

Prof. Dan Levanon, substrat
Utilization of Mushroom Industry Waste for Production of Chitosan and its Application as Active Coating Material for Agricultural Products

DEFINITION OF THE GENERAL MODEL AND POSSIBLE VARIATIONS

(Task 4.3)

WP4. DEFINITION OF THE GENERAL MANAGEMENT MODEL
Drip irrigation, a new way for watering, during *Agaricus bisporus* cultivation: increased production and lower carbon footprint

DANAY\(^1\), DOV RAZ\(^2\), NIRIT EZOZ\(^1\), ILANA BARSKI\(^3\) and DAN LEVANON\(^1\)

\(^1\) Migal, Galilee Technology Center, Kiryat-Shmona, Israel

\(^2\) Netafim Irrigation systems, Tel-Aviv, Israel

\(^3\) The Champignon Farm in Zarit, Israel
Development of vitamin D enriched food supplements made of edible mushrooms for the treatment of liver disease

Ariel Drori, Yaron Ilan, Dan Levanon and Ofer Danay
Hadassah medical center and Migal research institute

Jerusalem
October 29th, 2014
BARD Research Project IS-4777-14 Increasing the value of mushrooms as functional foods: induction of alpha and beta glucan content via novel cultivation methods
Schwartz, Betty, Hadar, Yitzhak HU, Vetvicka, Vaclav Louisville, U, Ofer Danay
Thank you for your attention