Malolactic conversion of lingonberry juice – impact on sensory properties and microbial stability

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Background

• Lingonberry is uniquely a fruit of the nordic countries and is popular in many variations.
• High antioxidant content and antimicrobial substances.
• The pH of the berries are low, which are considered sour.
• Various organic acids present in the berries but malic acid contributes greatly to the sourness
• Transformation of lingonberries through fermentation could increase the potential for their applications
Objectives

• Determine sensory properties of (un)fermented lingonberry juices that are combined with different proportions of blackcurrant juice.

• Investigate the microbial stability of the fermented juices and their blends through challenge tests
Methods – Juice preparation

- Frozen lingonberries were thawed and pressed
- *pH of the juices were adjusted from 3.0 to 5.2*
- Juices were fermented with *Lactoplantibacillus plantarum*
- Fermented for 7 days
- Tracked malic and lactic acids
Methods - Samples

• Samples for challenge tests and sensory evaluation

• 6 samples - 4 were blends with diluted blackcurrant juice

• Blackcurrant juice
  – Diluted to adjust for the mouthfeel to be equal to the fermented lingonberry juice (25% BCJ diluted with water).
  – Samples pasteurised and then frozen at -20°C

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Unfermented lingonberry juice</th>
<th>Fermented lingonberry juice</th>
<th>Blackcurrant juice*</th>
</tr>
</thead>
<tbody>
<tr>
<td>L0</td>
<td>-</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>L25</td>
<td>-</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td>L50</td>
<td>-</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>L75</td>
<td>-</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>L100</td>
<td>-</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>U100 (control)</td>
<td>100%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Methods – Challenge test

• The five blends, and the unfermented control were challenged with three well known spoilage organisms

  Listeria monocytogenes  Candida albicans  Aspergillus brasiliensis

• Test period of 2 weeks at 25 °C (samples with A. brasiliensis were continously read up to six weeks)
Hypothesis - Challenge test

Benzoic acid in combination with low pH prevents microbial growth

Benzoic acid, pKa = 4.20

Only active in its undissociated form

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>pH</th>
<th>Benzoic acid (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L0</td>
<td>3.30</td>
<td>0.00</td>
</tr>
<tr>
<td>L25</td>
<td>3.98</td>
<td>0.27</td>
</tr>
<tr>
<td>L50</td>
<td>4.40</td>
<td>0.56</td>
</tr>
<tr>
<td>L75</td>
<td>4.68</td>
<td>0.84</td>
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<tr>
<td>L100</td>
<td>4.90</td>
<td>1.10</td>
</tr>
<tr>
<td>U100 (control)</td>
<td>3.00</td>
<td>1.10</td>
</tr>
</tbody>
</table>
Methods – Sensory evaluation

• Juices were profiled using descriptive analysis
• RISE’s sensory panel - N = 9
• Trained on samples and evaluated
• Duplicate measurement of 6 samples
• Attributes measured for aromas, tastes, flavours, and mouthfeel
• 100pt scales used
Conclusions

- *L. plantarum* converted malic acid to lactic acid under adjusted pH conditions.
- Lingonberry blends prevents growth of yeasts delays mould growth. Hence, fermented lingonberry juice have potential to serve as a natural preservative.
- Fermentation has the potential to produce palatable fermented lingonberry juice that could be used in blends with other juices.
- Further optimisation is required to address potentially problematic sensory characteristics such as stables and bitterness.
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