Effect of aerobic exposure before and after ensiling on maize silage quality

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Introduction

- Maize silage is one of the world’s most significant forage
- Air supply before and after the preservation causes spoilage of silage by undesirable microorganisms

Consequences can be:
- Increase in microbial population and temperature
- Loss of dry matter (DM) and nutritive value
- Less aerobic stability
- Impaired feed intake and animal performance
Aim of the study

Evaluation of the impact of aerobic exposure before and after ensiling at two densities on:

- DM losses during ensiling
- Aerobic stability
- Microbial counts
- Chemical composition, especially volatile organic compounds (VOC)
- Feed intake and preference by goats

Source: landesempach-emmen.ch
Materials and methods

Density

Whole-crop maize (28 % DM)

Low (194 kg DM/m³)

High (234 kg DM/m³)

Sealing time

0d (prompt)
Lo0

2d (delayed)
Lo2

4d (delayed)
Lo4

0d (prompt)
Hi0

2d (delayed)
Hi2

4d (delayed)
Hi4

Aerobic exposure after opening

Anaerobic storage

Aerobic exposure 0 - 6 d

n = 6 per treatment
Materials and methods

- Anaerobic storage under constant ambient temperature
- Opening after > 90 d of ensiling
- Homogenizing of silages
- Aerobic storage – quadratic heap; constant layer height of 12 cm, ambient temperature (20 ± 1.5°C)
- Mixed and sampled per day of aerobic exposure
Materials and methods

- **Silo filling**
- **Sealing**
- **Opening**
- **Conservation**
- **Aerobic exposure**

- **d0**
- **d4**
- **d0**
- **d6**

- **DM losses (%)**
- **Aerobic stability (h)**
- **Microbial counts**
- **Chemical composition (proximate analysis, fermentation pattern)**

- **Microbial counts**
- **Chemical composition (proximate analysis, fermentation pattern)**

- **Statistical analysis: completely randomized design (PROC MIXED of SAS 9.2)**
## Results – Silage characteristics

Dry matter, chemical composition and microbial counts of freshly chopped whole-crop maize before ensiling (% of DM unless stated otherwise)

<table>
<thead>
<tr>
<th>Item</th>
<th>Whole-crop maize</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM* (%)</td>
<td>27.7</td>
</tr>
<tr>
<td>Ash</td>
<td>3.9</td>
</tr>
<tr>
<td>CP</td>
<td>6.9</td>
</tr>
<tr>
<td>Ether extract</td>
<td>2.5</td>
</tr>
<tr>
<td>aNDFom</td>
<td>44.3</td>
</tr>
<tr>
<td>ADFom</td>
<td>22.9</td>
</tr>
<tr>
<td>ADL</td>
<td>2.9</td>
</tr>
<tr>
<td>WSC</td>
<td>16.0</td>
</tr>
<tr>
<td>Yeasts (Log_{10} cfu/g)</td>
<td>6.04</td>
</tr>
<tr>
<td>Moulds (Log_{10} cfu/g)</td>
<td>5.63</td>
</tr>
<tr>
<td>Aerobic mesophilic bacteria (Log_{10} cfu/g)</td>
<td>&gt;7.30</td>
</tr>
</tbody>
</table>

*corrected dry matter, CP = crude protein, aNDFom = neutral detergent fibre treated with α-Amylase and expressed exclusive residual ash, ADFom = acid detergent fibre expressed exclusive residual ash, ADL = acid detergent lignin, WSC = water-soluble carbohydrates
Results – Silage characteristics

Effect of silage density (D) and sealing time (S) on dry matter (DM) losses during ensiling and aerobic stability of maize silage

<table>
<thead>
<tr>
<th>Sealing time (d)</th>
<th>Silage Density</th>
<th>Effects</th>
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<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>0</td>
<td>3.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>5.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>4</td>
<td>10.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>0</td>
<td>5.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>5.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>4</td>
<td>10.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>5</td>
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</tbody>
</table>

DM losses (%)

Aerobic stability (h)

n

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DM losses (%)

Aerobic stability (h)

n
Effect of aerobic exposure on yeast, aerobic mesophilic bacteria and mould counts (n = 6 per day; cfu = colony forming units)
Results – Ethanol and ethyl esters

Effect of silage density and aerobic exposure on contents of ethanol and ethyl esters in promptly sealed silages (n = 6 per treatment)

Ethanol and ethyl acetate, ethyl lactate concentrations over time. Bars with different letters indicate significant differences (p < 0.05).
• Delayed sealing by 4 d caused high DM losses and low aerobic stability
• The longer the aerobic exposure the more pronounced was the microbial development
• The highest contents of ethanol and ethyl lactate were found in the high density silages on the day of opening
• With increasing aerobic exposure the contents of ethanol and ethyl esters decreased
Conclusions

Prolonged air supply

- before (sealing time, density) and 
- after (aerobic exposure) ensiling

can cause a **decline** of the quality of the silage in terms of DM-losses, aerobic stability and microbial counts

Avoid air supply through good agricultural practice!
Thank you for your attention!

Source: landesempach-emmen.ch