Effects of substitution of kikuyu forage by oat silage on milk production and quality in dairy cows

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Introduction

Milk production and quality

Breed

Feed

Pasture and forage intake

Dairy grazing systems
Introduction

African star (*Cynodon nlemfuensis*)

Kikuyu (*Kikuyocloa clandestina*)

Ryegrass (*Lolium sp.*)

Rotational grazing systems

2350 m.a.s.l

18.8 % CP

14.2 % DM

*Kikuyu* (*Kikuyocloa clandestina*)
Introduction

Energy requirements are not covered

→ Concentrate and forage supplementation

High-quality forage supplementation

Milk production

Usual in the highlands of Costa Rica

Mature kikuyu forage → Oat silage??

Low-quality forage supplementation
Objectives

To determine the effects of supplementation with oat silage or kikuyu forage on

• kikuyu pasture dry matter intake
• milk production and quality
• urinary excretion of purine derivatives
Materials and methods

Group A
- Jersey * Holstein (50:50)
- 350 kg
- 12th week of lactation

Group B

Period 1
- Oat silage
- 1.5 kg DM/day
- 7d adaptation
- 5d measurements

At milking (4 and 16 h)
- 0.9 kg DM/day Citrocón
- 1.75-3.5 kg DM/day Vapp Feed
+ Kikuyu pasture
¿DMI?

Period 2
- Kikuyu forage
- Oat silage
- 1.5 kg DM/day
- 7d adaptation
- 5d measurements
### Materials and methods

#### Sample Analysis

<table>
<thead>
<tr>
<th>Sample</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kikuyu pasture, kikuyu forage, oat silage, Citrocón and Vapp Feed</td>
<td>DM, CP, OM, NDF, ADF, NE_L</td>
</tr>
<tr>
<td>Milk</td>
<td>Fat, protein, lactose</td>
</tr>
<tr>
<td>Urine</td>
<td>Purine derivatives</td>
</tr>
</tbody>
</table>

**Statistical analysis:** PROC GLM of SAS v. 9.2

**Model:** \( y = \mu + T_i + P_j + A_{k(ij)} \)

- \( T_i \) = fixed effect of treatment (oat silage or kikuyu forage)
- \( P_j \) = fixed effect of period of supplementation
- \( A_{k(ij)} \) = random effect of animal nested within treatment and period
**Materials and methods**

**DM intake estimation of kikuyu pasture**

Requirements (NRC, 2001):

✓ Maintenance: 0.080 Mcal NE\(_L\)/kg BW\(^{0.75}\)
✓ Milk production:
   \[ \text{NE}_L \text{ (Mcal/kg)} = 0.0929 \times \% \text{ Fat} + 0.057 \times \% \text{ Protein} + 0.0395 \times \% \text{ Lactose} \]
✓ No changes in BW assumed (INRA, 1988)

\[ \text{NE}_L \text{ Requirements (per day)} = \text{NE}_L \text{ concentrates} + \text{NE}_L \text{ forages} + \text{NE}_L \text{ kikuyu pasture} \]

**Daily NE\(_L\) requirements from pasture**

\[ \text{NE}_L \text{ content of grazed kikuyu} = \text{Intake of kikuyu pasture (DM)} \]
Results

Pasture intake

<table>
<thead>
<tr>
<th></th>
<th>Oat silage</th>
<th>Kikuyu forage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kikuyu pasture intake (kg DM/cow/day)</td>
<td>5.96</td>
<td>5.65</td>
</tr>
</tbody>
</table>

Animal effect (P<0.05)

Milk composition

<table>
<thead>
<tr>
<th></th>
<th>Oat silage</th>
<th>Kikuyu forage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat (%)</td>
<td>4.44</td>
<td>4.58</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>3.56</td>
<td>3.54</td>
</tr>
<tr>
<td>Lactose (%)</td>
<td>4.75</td>
<td>4.74</td>
</tr>
</tbody>
</table>

Animal effect (P<0.05)
Results

Milk production

Animal effect and grazing period (P > 0.1)

Daily production of protein and lactose

Animal effect and grazing period (P > 0.1)
Results

Purine derivatives

- Oat silage
- Kikuyu forage

Animal effect (P > 0.1)

\[ \approx \text{Metabolizable fermentable energy} \]

\[ \text{Xanthine} \rightarrow \text{Degradation to Uric acid Allantoin} \]

\[ \text{Hypoxanthine} \]
• Substitution of kikuyu forage by oat silage seems to be an advisable practice for dairy milk producers in the highlands of Costa Rica.
Thank you for your attention
### Chemical composition and estimated $\text{NE}_L$ of the feedstuffs

<table>
<thead>
<tr>
<th></th>
<th>OM</th>
<th>CP</th>
<th>NDF</th>
<th>ADF</th>
<th>$\text{EN}_L$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Period 1</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Grazed kikuyu</td>
<td>87.67</td>
<td>21.47</td>
<td>56.53</td>
<td>25.82</td>
<td>1.61</td>
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<td>Oat silage</td>
<td>89.34</td>
<td>7.18</td>
<td>63.56</td>
<td>43.81</td>
<td>1.05</td>
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<tr>
<td>Kikuyu forage</td>
<td>89.38</td>
<td>7.52</td>
<td>69.53</td>
<td>36.93</td>
<td>1.14</td>
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<tr>
<td>Vapp Feed concentrate</td>
<td>94.15</td>
<td>19.70</td>
<td>12.34</td>
<td>5.67</td>
<td>2.12</td>
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<tr>
<td>Citrocnón concentrate</td>
<td>93.32</td>
<td>6.54</td>
<td>19.70</td>
<td>18.29</td>
<td>1.76</td>
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<tr>
<td><strong>Period 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grazed kikuyu</td>
<td>86.42</td>
<td>25.20</td>
<td>53.01</td>
<td>24.71</td>
<td>1.63</td>
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<tr>
<td>Oat silage</td>
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<td>19.55</td>
<td>12.03</td>
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<td>2.10</td>
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<tr>
<td>Citrocnón concentrate</td>
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<td>6.51</td>
<td>19.02</td>
<td>18.15</td>
<td>1.69</td>
</tr>
</tbody>
</table>

OM: organic matter; CP: crude protein; NDF: neutral detergent fibre; ADF: acid detergent fibre; ADL: acid detergent lignin; EE: ether extract; $\text{NE}_L$: net energy for lactation (Mcal/kg dry matter), estimated according to the NRC (2001); n.d.: not determined