The effect of PEG on *in vitro* organic matter digestibility and metabolizable energy of *Lotus corniculatus* L

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Abstract

The aim of this experiment was to determine the effect of polyethylene glycol (PEG) on the *in vitro* organic matter digestibility and metabolizable energy of *Lotus corniculatus* using Menke gas production technique. The PEG supplementation had a significant effect on the gas production, organic matter digestibility (OMD) and metabolizable energy (ME). PEG inclusion increased the gas production and estimated parameters such as OMD and ME of *Lotus corniculatus*. The improvement in gas production, OMD and ME with PEG emphasizes the negative effect of tannins on digestibility.

Key words: *Lotus corniculatus*, Digestibility, Metabolizable energy, Condensed Tannin, PEG

Introduction

*Lotus corniculatus* is a temperate plant containing condensed tannin which is well known to improve the efficiency of protein digestion in ruminants (Waghorn *et al*., 1987). However the effect of condensed tannin in *Lotus corniculatus* on organic matter digestibility and metabolizable energy has not been tested in details. The PEG is widely used to determine the effect of condensed tannin in Menke gas production technique.

The aim of this experiment was to determine the effect of PEG on the *in vitro* organic matter digestibility and metabolizable energy of *Lotus corniculatus* using Menke gas production technique.

Materials and Methods

*Lotus corniculatus* were hand harvested at flowering stage and oven dried at 60 °C at 48 h. Dry matter (DM) was determined by drying the samples at 105 °C overnight and ash by igniting the samples in muffle furnace at 525 °C for 8 h. Nitrogen (N) content was measured
by the Kjeldahl method (AOAC, 1990). Crude protein was calculated as N X 6.25. Condensed tannin was determined by butanol-HCl method as described by Makkar et al. (1995). All chemical analyses were carried out in triplicate.

Rumen fluid was obtained from two fistulated sheep fed twice daily with a diet containing alfalfa hay (60%) and concentrate (40%). Samples were incubated in vitro rumen fluid in calibrated glass syringes following the procedures of Menke and Steingass (1988). 0.200 g dry weight of the sample was weighed into calibrated glass syringes of 100 ml in the absence and presence of 1 g PEG. The syringes were pre-warmed at 39°C before the injection of 30 ml rumen fluid-buffer mixture into each syringe followed by incubation in a water bath at 39°C. Readings of gas production recorded at 24 h incubation time.

The metabolizable energy (MJ/kg DM) of sample was calculated using equations of Menke et al. (1979) as follows:

\[
\text{ME (MJ/kg DM)} = 2.20 + 0.136 \text{GP} + 0.057 \text{CP} + 0.0029\text{CP}^2
\]

Where,
GP is 24 h net gas production (ml/200 mg),
CP = Crude protein (%)

The OMD of sample was calculated using equations of Menke et al. (1979) as follows:

\[
\text{OMD (\%)} = 14.88 + 0.889 \text{GP} + 0.45 \text{CP} + 0.0651\text{XA}
\]

Where,
GP is 24 h net gas production (ml/200 mg),
CP = Crude protein (%)

The t-test was used to determine the effect of PEG supplementation on in vitro gas production, organic matter digestibility and metabolizable energy of \textit{Lotus corniculatus} using Statistica for Windows (1993).

\textbf{Results and Discussion}

The chemical composition of \textit{Lotus corniculatus} harvested at flowering stage is given in Table 1. The effect of PEG on the gas production, organic matter digestibility and ME content of \textit{Lotus corniculatus} harvested at flowering stage is given in Table 2. The PEG supplementation significantly (P<0.001) increased the gas production, OMD and ME content of \textit{Lotus corniculatus} harvested at flowering stage.
Table 1. The chemical composition of *Lotus corniculatus* harvested at flowering stage

<table>
<thead>
<tr>
<th>Chemical constituents</th>
<th>% (of DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>17.2</td>
</tr>
<tr>
<td>Ash</td>
<td>7.3</td>
</tr>
<tr>
<td>Condensed tannin</td>
<td>2.2</td>
</tr>
</tbody>
</table>

This result is in agreement finding of Kamalak *et al.* (2005), Getachew *et al.* (2001), Getachew *et al.* (2002) and Seresinhe and Iben (2003) who found that PEG supplementation increased the gas production and volatile fatty acid production. The increase in the gas production in the presence of PEG is possibly due to an increase in the available nutrients to rumen micro-organisms, especially the available nitrogen.

Table 2. The effect of PEG on the gas production, organic matter digestibility and ME content of *Lotus corniculatus* harvested at flowering stage

<table>
<thead>
<tr>
<th>Parameters</th>
<th>O PEG</th>
<th>1 g PEG</th>
<th>SEM</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 h GP</td>
<td>54.7</td>
<td>63.5</td>
<td>0.443</td>
<td>***</td>
</tr>
<tr>
<td>OMD</td>
<td>71.7</td>
<td>79.5</td>
<td>0.404</td>
<td>***</td>
</tr>
<tr>
<td>ME</td>
<td>10.6</td>
<td>11.8</td>
<td>0.047</td>
<td>***</td>
</tr>
</tbody>
</table>

*Means within the same row with differing superscripts are significantly different*  
GP: Gas production (ml) at 24 h incubation, OMD: Organic matter digestibility (%), ME: Metabolisable energy (MJ/kg DM), SEM: standard error of mean, Sig: Significance level,

This result is also in agreement with findings of Rubanza *et al.* (2005) who found that PEG supplementation resulted in the increase in OMD of leaves from Acacia species. Rubanza *et al.* (2003) also found that PEG supplementation resulted in the increase in ME of leaves from browse fodders.

**Conclusion**

PEG inclusion increased the gas production and estimated parameters such as OMD and ME of *Lotus corniculatus*. The improvement in gas production, OMD and ME with PEG emphasizes the negative effect of tannins on digestibility.

**References**


