Comparison of aerobic and anaerobic methods to assess quality of tropical multipurpose shrub legumes

K. Tscherning1,2, E. Barrios2, C. Lascano2, M. Peters2 and R. Schultze-Kraft1

1 University of Hohenheim (380), 70593 Stuttgart, Germany
2 Centro Internacional de Agricultura Tropical (CIAT), A.A. 6713, Cali, Colombia

Methods

• Litterbag experiment (soil science)
• Gas production experiment (animal nutrition)
• In-vitro dry matter digestibility (IVDMD) (animal nutrition)
• Indigestible fiber (INDF) (animal nutrition)
• Condensed tannin (CT) and lignin analysis

Research Questions

To what extent could in vitro digestion by rumen microbes be used as a guide to assess decomposition of three tropical legumes with contrasting quality (Calliandra sp., Cratylia argentea, Indigofera constricta)?

How do different pre-treatments (fresh, frozen, freeze-dried, oven-dried, sun-dried) of this legume material influence quality characteristics and long-term degradation processes (in the rumen and on the soil)?

Results - Decomposition

Decomposition rates (k) of leaf tissue applied to the soil surface differed significantly and were

• fastest for Indigofera (no CT, low lignin content): k = 1.35 / day
• medium for Cratylia (low CT, high lignin content): k = 0.33 / day
• slowest for Calliandra (high CT, high lignin content): k = 0.19 / day

Pre-treatments ⇒ no effect for Cratylia and Calliandra
⇒ significant difference for Indigofera between treatments

Results – in-vitro Rumen Digestion

Gas production rates (k) differed significantly among species being

• fastest for Indigofera (no CT, low lignin content): k = 8.57% / h
• medium for Cratylia (low CT, high lignin content): k = 6.16% / h
• slowest for Calliandra (high CT, high lignin content): k = 2.51% / h

Pre-treatments ⇒ no effect for Cratylia
⇒ significant difference for Indigofera and Calliandra between treatments

Correlations between quality factors (INDF, IVDMD, lignin, CT) and degradation in soil and rumen

<table>
<thead>
<tr>
<th>Quality parameters</th>
<th>Soil (aerobic)</th>
<th>Rumen (anaerobic)</th>
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<tbody>
<tr>
<td></td>
<td>Rate of decomposition</td>
<td>Extent of decomposition</td>
</tr>
<tr>
<td>INDF</td>
<td>-0.746 (P&lt;0.0004)</td>
<td>-0.920 (P&lt;0.0001)</td>
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<tr>
<td>IVDMD</td>
<td>0.749 (P&lt;0.0001)</td>
<td>0.868 (P&lt;0.0001)</td>
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<tr>
<td>lignin + CT</td>
<td>-0.680 (P&lt;0.0001)</td>
<td>-0.906 (P&lt;0.0001)</td>
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Conclusions

Aerobic (decomposition) and anaerobic (rumen digestion) degradation of these legumes are a function of indigestible fractions of the cell wall, such as lignin alone or lignin corrected by the presence of condensed tannins.

Differences in decomposition and digestibility were more related to intrinsic plant quality parameters than to changes in quality induced by pre-treatments.

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