ECO-RESPONSIVE FEEDING AND NUTRITION
LINKING LIVESTOCK AND LIVELIHOOD
ABSTRACT PAPERS

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Spin-off from 2nd Generation Biofuel Technologies to Upgrade Ligno-cellulosic Biomass for Livestock Feed: Steam Explosion

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SUMMARY: One maize stover from a superior dual purpose hybrid and three sorghum stovers that differed in nutritive quality were subjected to a commercial steam pre-treatment procedure used in 2nd generation biofuel production from ligno-cellulosic feedstock. Treatment effects were investigated by in vitro studies measuring gas production and true organic matter degradability after 24 and 48 hrs of incubation in rumen microbial inoculum. Steam treatment increased significantly gas production and true organic matter degradability at both incubation times indicating further evaluation by in vivo studies.

Keywords: 2nd generation biofuel spin off technologies, Ligno-cellulosic pretreatment, Stover upgrading, Steam treatment

BACKGROUND
Since the early 20th century, the abundance of ligno-cellulosic biomass and the potential nutritive quality of its basic sugar constituents have attracted animal nutritionists who searched for physical and chemical treatments to make those sugars more accessible. The work on second generation bio-fuels (bio-fuels derived from ligno-cellulosic biomass) was motivated by reasons very similar to those of the early animal nutritionists: the abundance of ligno-cellulosic biomass and its content of polymerized sugars. This work has attracted US multi-billion dollars of investment during the last two decades. It may be feasible to utilize spin-offs from 2nd generation bio-fuel technologies to upgrade ligno-cellulosic biomass for animal feeding, particularly combinations of pretreatment approaches that render the hemicellulose, pectins and celluloses more accessible to enzymes, and enzymes applications (Blummel et al., 2014).

METHODOLOGY
One maize stover from a superior dual purpose hybrid (NK 6240) and one dual purpose sorghum variety (BJV 44) identified from multidimensional crop improvement and two sorghum stovers were chosen for the experiment. About 75 g of dried stover with a particle size of 2.5 to 5.0 cm, was used for each experimental run. The material was loaded into the steam explosion reactor of 1.4 L capacity to which live steam was injected to heat the contents to a desired temperature of 160°C. The contents of the reactor were held at the said temperature for 10 min with intermittent steam injection when required. After 10 min the contents were exploded into a receiver tank of capacity 20 L by opening the blow down valve of the reactor. After a few minutes, the receiver was opened to collect the pretreated material. The excess water in the material was removed by simple filtration through a muslin cloth. After drying steam treated samples as well as untreated control samples were ground to pass a 1 mm mesh and 200 mg of substrate was weighted in to glass syringes of the Hohenheim gas production test and gas volume and in vitro true degradability after 24 and 48 hrs were determined (Blummel and Orskov, 1993). Results were analyzed by paired t-test.

RESULTS
Steam treatment on average increased gas production significantly by 13 and 10% and in vitro true organic matter degradability by 17 and 14% after 24 and 48 hrs of incubation, respectively (Table 1). The lower increase in the latter might be to some degree an artifact caused by the loss of soluble but unfermentable substrate generated during the steam treatment process. Using gas production as the more meaningful measurement, highest steam treatment effects were observed on maize stover which had also the highest initial stover fodder quality.

Table 1. In vitro gas production (GP; ml/2000mg DM) and true in vitro digestibility (TIVOMD;%) of untreated (U) and steam treated (ST) maize and sorghum stovers after 24 and 48 hrs of incubation.

<table>
<thead>
<tr>
<th>Stover</th>
<th>GP 24</th>
<th>U</th>
<th>ST</th>
<th>U</th>
<th>ST</th>
<th>GP 48</th>
<th>U</th>
<th>ST</th>
<th>TIVOMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize NK 6240</td>
<td>39.5</td>
<td>46.6</td>
<td>62.2</td>
<td>65.8</td>
<td>51.7</td>
<td>59.3</td>
<td>65.4</td>
<td>75.5</td>
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<tr>
<td>Sorghum Telangana</td>
<td>31.0</td>
<td>35.9</td>
<td>51.1</td>
<td>63.8</td>
<td>42.9</td>
<td>45.5</td>
<td>58.0</td>
<td>69.4</td>
<td></td>
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<tr>
<td>Sorghum Raichur</td>
<td>36.1</td>
<td>41.3</td>
<td>54.5</td>
<td>62.7</td>
<td>47.9</td>
<td>53.4</td>
<td>64.3</td>
<td>70.4</td>
<td></td>
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<tr>
<td>Sorghum BJV 44</td>
<td>38.7</td>
<td>41.3</td>
<td>52.3</td>
<td>62.0</td>
<td>51.9</td>
<td>56.1</td>
<td>63.7</td>
<td>71.8</td>
<td></td>
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<tr>
<td>SEM</td>
<td>0.4</td>
<td>1.1</td>
<td>1.76</td>
<td>0.98</td>
<td>0.3</td>
<td>1.1</td>
<td>0.93</td>
<td>1.04</td>
<td></td>
</tr>
</tbody>
</table>

U- Untreated, ST- Steam treated

P > F

CONCLUSION
Steam treatment processes used in second generation biofuel technologies can increase significantly maize and sorghum stover fodder quality traits in vitro. However in vivo trials are now required to assess the actual impact on livestock productivity and the economic viability of the treatment.

REFERENCES

Eco-responsive Feeding and Nutrition: Linking Livestock and Livelihood