Growth performance of pigs fed hand-chopped sugar cane stalks

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Abstract

Two experiments were conducted to study feed intake and growth performance of growing-finishing pigs fed either fresh, hand-chopped unpeeled stalks from sugar cane (SC) or fresh unpeeled milled SCI. In experiment 1, 20 crossbred castrate male pigs were allotted at random into five treatments consisting of milled fresh SC stalks or stalks chopped at different sizes (3, 5, 20 and 40 cm length) and offered ad libitum plus a supplement containing protein, vitamins and minerals (NUPROVIM) given at a restricted level (crude protein from soybean, 190 g/day). The trial lasted approximately seven weeks. In experiment 2, 27 crossbred castrate male pigs were allotted at random into three treatments consisting of the same milled SC stalks and chopped SC stalks (3 and 40 cm length) given ad libitum as in experiment 1, but given a supplement (NUPROVIM, crude protein, 34.7%) to supply 225 g protein/day per animal. The trial lasted approximately from 20 to 25 weeks.

In experiment 1, average daily gain was 348, 392, 375, 408 and 405 g for pigs fed SC freshly milled or the stalks with increasing length respectively. In experiment 2, fresh consumption of milled SC was 3.3 kg/day whereas chopped SC stalk consumption was 11.1 and 9.9 kg/day for pieces of 3 and 40 cm length respectively. Pigs fed the milled SC significantly less (378 g/day) than animals fed SC stalks of 3 and 40 cm length (451 and 378 g/day respectively). Final live
weight of pigs eating SC stalks of 3 cm length was 94.3 kg, higher than that of animals eating either milled SC (86.3 kg) or SC stalks of 40 cm length (90.3 kg).

It is suggested that small scale pig production can be sustained if animals are fed ad libitum sugar cane stalks hand-chopped to pieces of 3 cm length plus a protein supplement offered to supply a relatively low level of protein (200 g/day) in the entire daily ration as compared to what is currently recommended in intensive, high input pig production systems. The fibrous sugar cane residue mixed with pig excreta could be a valuable substrate for culture of earth worms. An economical evaluation of this feeding system for small scale animal production is recommended.

**Key words: Growth, intake, pigs, sugar cane stalks**

**Introduction**

The use of sugar cane for feeding pigs has been mainly focused on the use of the plant soluble carbohydrate fraction, either as sugar cane juice or as sugar cane molasses (MacLeod et al 1968; Velázquez 1970; Preston 1980; Figueroa and Ly 1990; Figueroa 1996), due to the monogastric characteristics of this animal species.

Nevertheless, the production of juice and molasses from sugar cane requires the use of several simple or complex machineries, ranging from rustic mills to factories. In fact, this type of equipment is not generally available to the majority of farmers raising pigs. However, the possibility of on-farm direct use of harvested sugar cane for immediate feeding of pigs should not be overlooked. In this case, sugar cane stalks could be freshly hand-chopped and then given to the animals. This practice is even more easy to perform than chopping sugar cane in any type of mechanical device (Bravo et al 1996).

The objective of the present communication is to report two feeding trials with growing and growing-finishing pigs given fresh sugar cane stalks of different lengths offered ad libitum with a restricted amount of a protein supplement.

**Materials and methods**
Experiment 1

In experiment 1, 20 crossbred (YLxDCC21) castrate male pigs averaging 34.5 kg initial live weight were randomly allotted into five treatments, consisting of milled, fresh sugar cane (SC), or SC stalks hand-chopped at different sizes (3, 5, 20 and 40 cm length) offered ad libitum, plus a protein and mineral and vitamin premix supplement (NUPROVIM) given at a restricted level (average for the overall growing period, 190 g crude protein/day). The feeding scale of the supplement for the entire growing and finishing stages (Table 1), was in accordance with NRC (1998) for minerals and vitamins, but was low in protein as compared to NRC (1998) recommendations, according to previous observations conducted at the Institute (Mederos 2003).

Table 1. Feeding scale of the protein supplement given to pigs fed ad libitum milled or chopped sugar cane stalks

<table>
<thead>
<tr>
<th>Live weight range, kg</th>
<th>Crude protein, g/day</th>
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<tbody>
<tr>
<td>30.5 – 40</td>
<td>160</td>
</tr>
<tr>
<td>40.5 – 50</td>
<td>180</td>
</tr>
<tr>
<td>50.5 – 60</td>
<td>220</td>
</tr>
<tr>
<td>60.5 – 70</td>
<td>240</td>
</tr>
<tr>
<td>70.5 – 80</td>
<td>260</td>
</tr>
<tr>
<td>80.5 – 95</td>
<td>290</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>225</strong></td>
</tr>
</tbody>
</table>

The supplement (crude protein, 34.7% in fresh basis) contained soybean meal as the only protein source and was given daily at 8:00 as a mash (mixed with water, 1:1 by weight). After the total consumption of this supplement, the sugar cane was offered ad libitum.

The sugar cane was harvested daily in the same farm where the pigs were raised. The fresh, unpeeled sugar cane stalks (SC) were: (i) milled in a high speed mill specially designed to avoid losses of sugar cane juice during milling; or (ii) hand-chopped with a machete to obtain pieces of 3, 5, 20 and 40 cm length. In the case of the two longest pieces, these were cut longitudinally in order to facilitate their gathering by the pigs. A machete is similar to a big sharp knife, but of
approximately 60 cm length, commonly used to harvest manually the sugar cane in Cuba and other countries from the Caribbean basin. The pigs were individually penned. Every pen had a feed trough and a drinking nipple to provide water ad libitum. The trough was used to offer either the supplement given as a mash, or the milled SC, but the SC stalks were offered on the pen floor. The supplement was given to the pigs first, and after its entire consumption, the stalks or milled SC were given ad libitum. Every day feed refusals were recorded. The animals were weighed biweekly and the duration of the experiment was of approximately seven weeks.

**Experiment 2**

In experiment 2, 27 crossbred (YLxDCC21) castrate male pigs of 32.0 kg initial live weight on average were used in a growing-finishing trial. The animals were distributed at random into three treatments consisting of the supply ad libitum of SC stalks with a minimum or a maximum length (pieces of 3 and 40 cm), compared to a third treatment consisting in the supply ad libitum of freshly milled SC. The average amount of crude protein offered to the pigs during the entire test was 225 g/day (see Table 1). The pigs were housed in groups of three per pen. Other details concerning the conduct of the trial were as described in experiment 1. The trials ended when the animals attained a slaughter weight of 90 kg on average, therefore overall lasting approximately 20 to 25 weeks. In both experiments, the data were analysed by ANOVA following Steel and Torrie (1980) with the multiple comparison test according to Duncan (1955).

**Results and discussion**

Overall, it was found that the pigs had a high consumption of SC stalks when these were chopped with a machete (Table 2). Intake was negatively related with
the length (Figure 1). It was observed that the animals chewed the pieces of stalk to extract the juice and then "spat out" the residual fibre, which remained on the floor of the pens. In this connection, it could be said that the pig's prandial activity was similar to that of an artisan sugar cane mill. The hygienic conditions in the pig pens was satisfactory, since the consistency of the faeces appeared to be normal, in contrast to what currently occurs in pigs fed different types of SC molasses. The residual fibre originating from the pig feeding activities was seen to be well mixed with saliva, faeces and the urine of the animals. Therefore, it could be thought that this material could be considered as a potential feedstock for earth worms.

### Table 2. Performance traits of growing pigs fed milled or chopped sugar cane stalks (experiment 1)

<table>
<thead>
<tr>
<th></th>
<th>Milled sugar cane</th>
<th>Sugar cane stalks, cm</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Live weight, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>35.2</td>
<td>35.0</td>
<td>35.0</td>
</tr>
<tr>
<td>Final</td>
<td>51.3</td>
<td>53.0</td>
<td>52.3</td>
</tr>
<tr>
<td>Sugar cane intake, kg/day&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.52</td>
<td>18.5</td>
<td>16.9</td>
</tr>
<tr>
<td>Daily gain, g</td>
<td>348</td>
<td>392</td>
<td>375</td>
</tr>
</tbody>
</table>

<sup>1</sup> Fresh basis with no adjustment for the residual fibre ejected from the pigs’ mouths after chewing

The feed intake of the pigs given the milled SC was extremely low, probably because the small size of the particles precluded the opportunity for separating the juice from the fibre by chewing, as happened with the whole cane stalk. The NDF content of the milled stalk has been reported to be as high as 48.4% in the
DM (Cuarón and Shimada 1981; Ly and Castro 1995). The pigs fed the milled SC had a lower live weight gain than those fed the chopped SC, with no apparent difference due to the length of chopping.

**Figure 1**: Relationship between length of cane stalk offered, the intake (quantity taken by mouth for chewing) and live weight gain of growing pigs (Experiment 1)

The performance traits of the pigs in experiment 2 (Table 3) exhibited the same trend observed in experiment 1. In fact, animals eating SC stalks had an apparent SC consumption very high (P<0.001), as compared to that of animals fed SC meal. However, comparing both trials, pigs fed SC meal increased its feed intake whereas animals given SC stalks reduced its consumption of cane. On the other hand, feed consumption was determined with less accuracy in the second trial, due to the fact that the pigs were housed in groups of three, and in practical conditions, SC bagasse became more mixed with faeces and urine.

**Table 3.** Performance traits of growing-finishing pigs fed milled or whole sugar cane stalks of different lengths (experiment 2)

<table>
<thead>
<tr>
<th>Milled sugar stalks, cm</th>
<th>Length sugar cane stalks, cm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cane</td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
</tr>
<tr>
<td>Live weight, kg</td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>32.2</td>
</tr>
<tr>
<td>Final</td>
<td>86.3&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sugar cane eaten, kg/day&lt;sup&gt;1&lt;/sup&gt;</td>
<td>3.3&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Daily gain, g</td>
<td>316&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup> Fresh basis with no adjustment for the residual fibre ejected from the pigs’ mouths after chewing

<sup>*</sup> P<0.05; <sup>***</sup> P<0.001

<sup>abc</sup> Means without letter in common in the same row differ at P<0.05

In spite of the apparent reduction of feed intake, there was not a concomitant decrease in daily gain of pigs, and as a result, feed conversion must have been improved in experiment 2. In fact, the best daily gain values were obtained from pigs fed chopped SC stalks (P<0.001). Furthermore, animals fed the cane pieces of 3 cm length had the best final live weight (P<0.05) as compared to that of the other treatments. These results could be a consequence of a more efficient extraction of juice from SC stalks of small dimensions. Even though it must be taken into account that in rustic mills, 1 l kg of fresh sugar canes yield approximately 5 to 6 litres of juice. This amount of feed, together with the daily supply of restricted levels of soybean meal, cannot support daily gains higher than those found in the current study.

In a previous assay, Bravo et al (1996) studied different levels of offer of chopped cane stalk for growing-finishing pigs, and encountered that growth rate decreased linearly as the offer level of cane stalk was reduced (Figure 2).
However, results reported by Bravo et al (1996) are not strictly comparable to those of the current study, where different sizes of sugar cane stalks instead of graded level of the product were supplied to the pigs.

In fact, even if the animals have restricted access to feeds supplying 200 g protein/day but given ad libitum sugar cane juice (DM, 15-20%; total sugars, 88-90%), pigs can "drink" from 8 to 10 litres of juice, thus attaining daily gains of 640 to 780 g (Sarría et al 1990; Motta et al 1994). Similarly, with a low protein intake (225 g/day), but consuming ad libitum SC molasses type B (DM, 78%; sugars, 70%), animal consumption of molasses can be from 2.2 to 2.5 kg DM/day, therefore determining a daily rate of body gain of 600 to 630 g (Mederos et al 1996, 1997, 1998).

A high daily protein intake from either soybean meal or other protein sources, as commonly recommended elsewhere (NRC 1998), has not resulted in any improvement in animal performance when pigs have been given chopped sugar cane stalk as the basal diet for fattening pigs (Bravo et al 1996).

On the other hand, results from the current study concerning the use of fresh SC meal are in accordance to the available information related to the limited nutritive value of SC stalks for pigs, even if transformed by a solid state fermentation.
process (Elías et al 1990). As a result, it has been claimed that no more than 20 to 30% SC meal is the maximum level of inclusion in diets for pigs (Lamazares et al 1988; Castro et al 1990; Ly et al 1991; Lezcano et al 1992, 1994, 1996; González et al 1995; Ly and Castro 1995; Martí et al 1997).

Conclusions

- A feeding system based on the supply of approximately 11 kg/day of hand-chopped, unpeeled sugar cane stalks in pieces of 3 cm length, plus a supplement supplying 200 g protein daily from soybean meal, can support a pig growth rate of 450 g/day during the growing-finishing stages. This feeding system does not require any machinery for feed processing and thus can be extensively used in small-scale pig farming.
- An economical evaluation of the use of chopped sugar cane stalks in feeding systems for pigs is highly recommended according to local conditions of production throughout the tropics.
- It is also recommended the evaluation of the use of the sugar cane refusal or bagasse, mixed with pig excreta, as substrate for culture of earthworms.

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