FEASIBILITY OF USING PRESSED SUGAR CANE STALK FOR THE PRODUCTION OF CHARCOAL

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A simple technique for making charcoal from pressed sugar cane stalk is described. It was found that a 200 litre oil drum with holes drilled in it would serve as an efficient oven. From 15kg of dried stalk 2.34kg of charcoal were produced with a calorific value of 7.0 kcal/g. Sun drying of the pressed stalk for 24 hours increased the dry matter of the stalk from 53.42 to 93.5:, this being suitable for charcoal production. With a suitable binder the charcoal can be made into briquettes.

Key words: Charcoal, pressed sugar cane stalk, briquettes.

In the greater part of the developing world , the source of fuel for cooking and heating water is charcoal. This is made in the country by small industries or by the family itself from hard wood that is burnt in simple ovens.

The principle of making charcoal from wood is to get an intense burn throughout the material in the presence of oxygen, meanwhile evaporating the water in the material. There follows a rapid increase in the temperature as various substances are distilled and the wood itself begins to decompose. At this point the reaction should be stopped by blocking the entrance of oxygen or by putting out the fire with water.

The process of making charcoal can be separated into 3 phases;

1. Elimination of water from the wood.
2. Thermal decomposition of the wood that produces gas, wood tar and pyrolonic acid.
3. Oxidation of some volatile substances and carbon.

During the ultimate phase of carbonization, the level of CO_2 should be reduced as the volatile substances are used up. This is followed by an increase in temperature giving favourable conditions for the reduction of CO_2 to CO, which is a reaction very similar to that producing Producer Gas. When the point of CO production has been reached, the size of flame is reduced and the reaction should be stopped by damping with water.

With the growing possibility of using sugar cane juice as animal feed, it is necessary to resolve the problem of the waste of pressed cane stalk. This investigation examines the possibility of making charcoal in the form of briquettes from this waste product.

Materials and Methods

Development of the Oven: At first the oven developed by the Tropical Products Institute (UK) for making wood charcoal was used. After a burn of 12 hours the air inlet was closed and the reaction was allowed to cool. However, it was found that either the material had not burned or was completely reduced to ashes.

Subsequently it was discovered that when the pressed cane stalk was burned in an open fire it could be seen that after the initial burn, a large quantity of charcoal remained and this could be prevented from turning to ashes by saturation with water. Further, this process only took a short time and gave a 100% consistency of charcoal. Thus the type of oven used was a simple brazier made from a standard oil drum with some holes in the sides near the bottom.

Plate 1: Charcoal oven in operation

Experiment 1 : Some observations were made on the effect of drums with and without holes, and the density of material inside the drum, on the burning period and yield of charcoal. The densities of dried pressed cane stalk were compared with 20, 15 and 10kg/drum equivalent to a density of 97.9, 73.4 and 49kg/m^3. In all cases it was necessary to compact the material by trampling.

The fire was started from the top and a pitch fork was used now and again to check the rate of burning . The duration of the burn was recorded and the fire extinguished with water from a hose pipe. When it had cooled the charcoal was laid out on a metal sheet. The quantity of wet charcoal was weighed and samples were taken to determine the dry matter and calculate the charcoal yield.

Experiment 2: Known quantities of fresh pressed cane stalk were separated and laid out on a concrete slab to dry under the sun in periods of 1 - 3 days. After the respective drying time, the cane stalk was weighed and then burned in a standard oil drum with holes as described above. The weight of material in the drum varied between 10 and 15kg depending on the quantity of pressed cane that remained after drying. Samples were taken at each step in order to obtain the dry matters of the drying treatments for the pressed cane stalk and for the production of charcoal and measurements were also made of Brix and rate of extraction of juice from the cane. A comparison was made of the calorific value of wood charcoal, and of our briquettes and crude charcoal from pressed cane stalk.

Briquettes were made by pulverising the charcoal and then adding a small amount of water and 6% weight of raw starch. This thick slurry was pressed into moulds and dried at 90!C for 6 hours.

Results

Experiment 1: The use of the oil drum without holes was abandoned because it was obvious that the burn was delayed by the restriction of air intake. For example, the treatment with 20kg of pressed cane in the oil drum took twice as long as for a drum with holes.

It can be seen from Table 1 that there was no real difference in the yield of charcoal at various levels of compaction but there was a tendency for the process to be delayed by increased weight of material in the drum.

Experiment 2: The mean dry matter for six samples of fresh pressed cane stalk was 47.9 ± 2.5 (SE) and because of this it did not burn. After 24 hours of sun drying there were no real differences between the dry matters of the treatments (Table 2).

Throughout the 2 experiments the Brix of cane was 17 and the rate of extraction of juice from the cane varied between 44.7 and 53%.

Table 3 shows some general data for yield and calorific value of charcoal made from pressed sugar cane stalk and wood.

Table 1:
The effect the density of pressed cane stalk on burning time and yield of charcoal (X ± SEx).

	Density (kg of dry pressed cane/drum)		
	10	15	20
Number of observations	3	3	3
Weight of charcoal produced/drum, kg	1.47 ± 0.34	2.34 ± 0.29	2.51 ± 0.34
Yield, 2 (charcoal/dry pressed stalk) [a]	14.7 ± 3.4	15.6 ± 1.9	12.6 ± 1.7
Burning time, mins [b]	15.3 ± 2.7	23.3 ± 3.3	47.0 ± 3.0

[a] DM of dry pressed cane stalk in the silo was 91.95 ± .15 (n = 6)

[b] From lighting to the moment before extinguishing.

Table 2:
The effect of sun-drying of pressed cane stalk on charcoal production

	Sun,drying period (hr)			
	0	24	48	72
Dry matter , % of pressed cane stalk	53.4	93.5	95.6	96.5
Burning time, mine.	-	18	11	13
Yield of charcoal, % (charcoal/dry stalk)	-	15.5	22.2	19.1

Discussion

The yield of cane charcoal from the different treatments (dry matter basis) was within a range of 12.6 and 22.2/%, which compared favourably with the yield of wood charcoal (Table 3). The charcoal from sugar cane stalk itself had a calorific value which was higher than local wood charcoal (7.0 vs 6.1 kcal/g), however the energy content of the briquettes was lower probably because of the addition of starch.

The results give an indication of the potential use of the waste product from the process of cane juice extraction. Furthermore it is possible to obtain a small machine that compresses the charcoal powder in the form of briquettes thus reducing the necessity of drying them in an oven .

Table 3:
A general comparison of yield and calorific value of charcoal from pressed cane stalk and wood.

	Cane charcoal	Wood charcoal	Coconut shell charcoal
Dry matter yield, %	17.0 ± 1.3 (n=4)	21.1±- 0.6 (n=3)[a]	24.4[b]
Calorific value; kcal/g	7.0 (5.3[c])	6.1[d]	

[a] Oakwood (TPI)

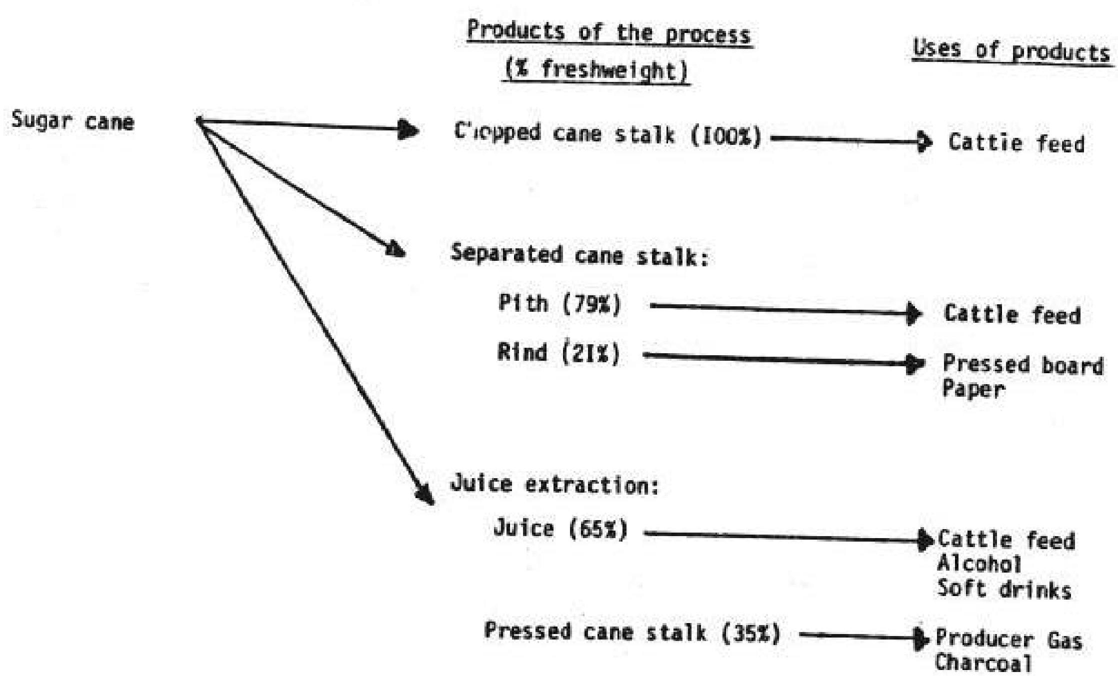
[b] Coconut shells (TPI)

[c] Briquettes with 6% starch

[d] Local hard wood

We can now illustrate the possibilities of vertical integration of sugar cane in small agricultural enterprises and industries in the country (Figure 1).

Figure 1:
Processing of sugar cane stalk



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