Harvesting and Processing

PROCEEDINGS OF A WORKSHOP HELD AT
LAJAL, CAL., COLOMBIA
1-21 APRIL, 1978

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Cassava Harvesting and Processing

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Prospects of Cassava Fuel Alcohol in Brazil

Wilson N. Milfont Jr
Centro de Tecnologia Promon, Rio de Janeiro, Brazil

Abstract. Alcohol production in Brazil increased 100% in 1 year and will continue to rise rapidly in the next 10 years, reflecting the government's plans to expand the use of ethanol as a motor fuel. Sugarcane alcohol constitutes a major proportion of the current increase, but cassava alcohol is expected to account for much of the growth later on. Production of the latter is expected to receive marked impetus from agronomic improvements and better processing technology.

In Brazil, alcohol production from fermented vegetable products (ethanol) has increased 100% in 1 year, owing partly to financial incentives offered by the National Alcohol Program and partly to the low sugar price on the international market (Yang and Trindade 1978). By 1980, the Brazilian government forecasts that production will even outstrip official estimates (Brazil Industry and Commerce Ministry 1978), and by 1985 it is expected to reach 4–6 million m³, providing that the present trend continues. More than half the output will come from the 163 projects approved to February 1978 by the National Alcohol Committee; the new projects are more capital intensive and target-oriented than existing units.

Cassava alcohol production alone is projected to reach 1 million m³ by 1985 (Fig. 1), starting from a standstill in 1978. The first cassava alcohol distillery, which is owned by the Brazilian oil monopoly Petrobras, has a capacity of 60 000 m³/day.

The increase in production corresponds to new plans and patterns for alcohol consumption. In 1975, the pharmaceutical, cosmetics, etc. industries dominated consumption, accounting for 50.9% of the total produced; fuel alcohol and the chemical industry represented only 35.6% and 13.5%, respectively. In 1985, fuel alcohol is expected to constitute 73%, the chemical industry 20%, and other industries, a mere 7%.

Economics of Cassava Alcohol Production

In the first quarter of 1978, costs for sugarcane alcohol production were slightly less than those for cassava. From juice extraction, the process using sugarcane is semicontinuous (Fig. 2), whereas cassava alcohol processing is primarily done in batches (for a more complete description, see Menezes p. 41). There are four major steps in cassava processing, namely, preparation of the cassava mash, conversion, fermentation, and distillation (Yang et al. 1977). Conversion
Table 1. Economics of production of anhydrous ethanol from cassava and sugarcane (150 m³/day cassava distillery operating 330 days/year, 49,500 m³/year; 150 m³/day sugarcane distillery operating 180 days/year, 27,000 m³/year).

<table>
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<th>Cost item</th>
<th>Cassava distillery</th>
<th>Sugarcane distillery</th>
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<td>Fixed investment (10⁶ U.S. $)</td>
<td>16.8</td>
<td>14.0</td>
</tr>
<tr>
<td>Working capital (10⁶ U.S. $)</td>
<td>1.1</td>
<td>2.1</td>
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(U.S. $/m³) (%) (U.S. $/m³) (%)

Feedstock:
- Cassava roots at U.S. $31.2/t 214 59.3 - -
- Sugarcane at U.S. $11.6/t 58 16.0 175 49.3 1.4

Enzymes, chemicals, and utilities
- By-products a (20) (5.5) (17) (4.7)
- Labour 10 2.8 12 3.4

Maintenance materials, operating supplies, insurance, and administrative expenses
- 18 5.0 26 7.3

Taxes b 16 4.4 52 14.6

Depreciation 34 9.4 50 14.1

Net operating profit e 31 8.6 52 14.6

Selling price 361 100.0 355 100.0

aDifference between the cost of direct application of stillage as fertilizer and the credit of sales of hydrated ethanol and fusel oil.
bIncludes income tax, value-added tax (sugarcane), and social tax (sugarcane and cassava).
cReturn on investment of 12%/year, DCF, based on the annual sum of depreciation and net operating profit, and 15-year operational life for the distillery.

Fig. 2. Alcohol production from sugarcane (Yang et al. 1977).

Fig. 3. Calculated prices of cassava and sugarcane alcohol compared with market price (fuel utilization).
comprises cooking, liquefaction, and saccharification. Cooking of cassava mash is done to disperse the starch molecules into solution, forming a gel. Liquefaction and saccharification are steps in which enzymes are used to convert starch into fermentable sugars.

The calculated prices are substantially the same for cassava and sugarcane alcohol (Table 1) — both are around 20% higher than the official price at U.S. $294/m³ and lower than gasoline price at the station (U.S. $429/m³).

The required fixed investment is higher for cassava alcohol production than for sugarcane, but the difference is partially offset by the higher working capital required for the latter because of the limited sugarcane harvesting season and the higher alcohol storage capacity needed for year-round supply. Earlier figures reported by Carvalho Jr et al. (1977) do not correspond to the author’s calculations due to a lower official exchange rate of U.S. dollars to cruzeiros based on Brazil’s internal inflation rate.

Cassava and sugarcane alcohol production in independent distilleries could be modified to lower costs. New developments in processing are especially likely in cassava alcohol because of its shorter history of intense research. Other cost reductions will result from the Brazilian government’s intention to decrease taxes in official prices for fuel alcohol. The combination of improved agroindustrial processes and lower taxes could make a substantial impact on cassava alcohol cost (Fig. 3).

Possibilities for improving operations of the typical cassava alcohol distillery (Table 2) include more efficient use of energy and by-products (Centro de Tecnologia Promon 1977; Yang et al. 1977). Continuous starch conversion and the use of cassava stalks as cooking fuel in the distilleries are two examples. Within 1–5 years industrial yield should improve 10%, corresponding to better distillery design and processes, and improved agronomic practices should increase agricultural yield by 50% in 5 years and as much as 100% within 10 years.