

Comparison of Ethanol Fuel Productivity of Some Selected Varieties of Tropical Crops

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Ethanol and its Attributes

- Ethanol (ethyl alcohol) is the same type of alcohol found in alcoholic beverages. It is used mainly as a biofuel alternative to gasoline.
- A litre of ethanol contains approximately 66 percent of the energy provided by a litre of petrol, but has a higher octane level and when mixed with petrol for transportation it improves the performance of the latter.

Benefits of Using Ethanol

- 98% pollution free
- Biodegradable
- Renewable
- Does not cause climate change
- No carbon is left after combustion
- Non-toxic, edible by-products
- Does not hamper food or fibre production
- Environmentally compliant
- Improves urban air quality
- Reduces CO₂ emissions by 68%
- Increases farm employment



Some tropical crops: Cassava (*Manihot species*)

Root tuber. Annual global production of 160million tonnes.
Key producing countries are Nigeria, Brazil, Thailand,
Indonesia, Congo DR.



Cocoyam (*Colocasia* and *Xanthosoma* species)

Underground corms. Annual global production of 10million tonnes. Key producing countries are Nigeria, Ghana, Kenya, Malawi , India, Indonesia.



Maize (*Zea mais, L*)

Global production of 822 million tonnes from 160million hectares. The third most traded cereal after wheat and rice. Nigeria produces 26 million tonnes from 8.85 million hectares.



Sorghum (*Sorghum vulgare*)

Annual global production of 62 million tonnes. The top producing countries are United States (17%), Nigeria (14%), India (14%) and Mexico (11%).

Process Flowchart

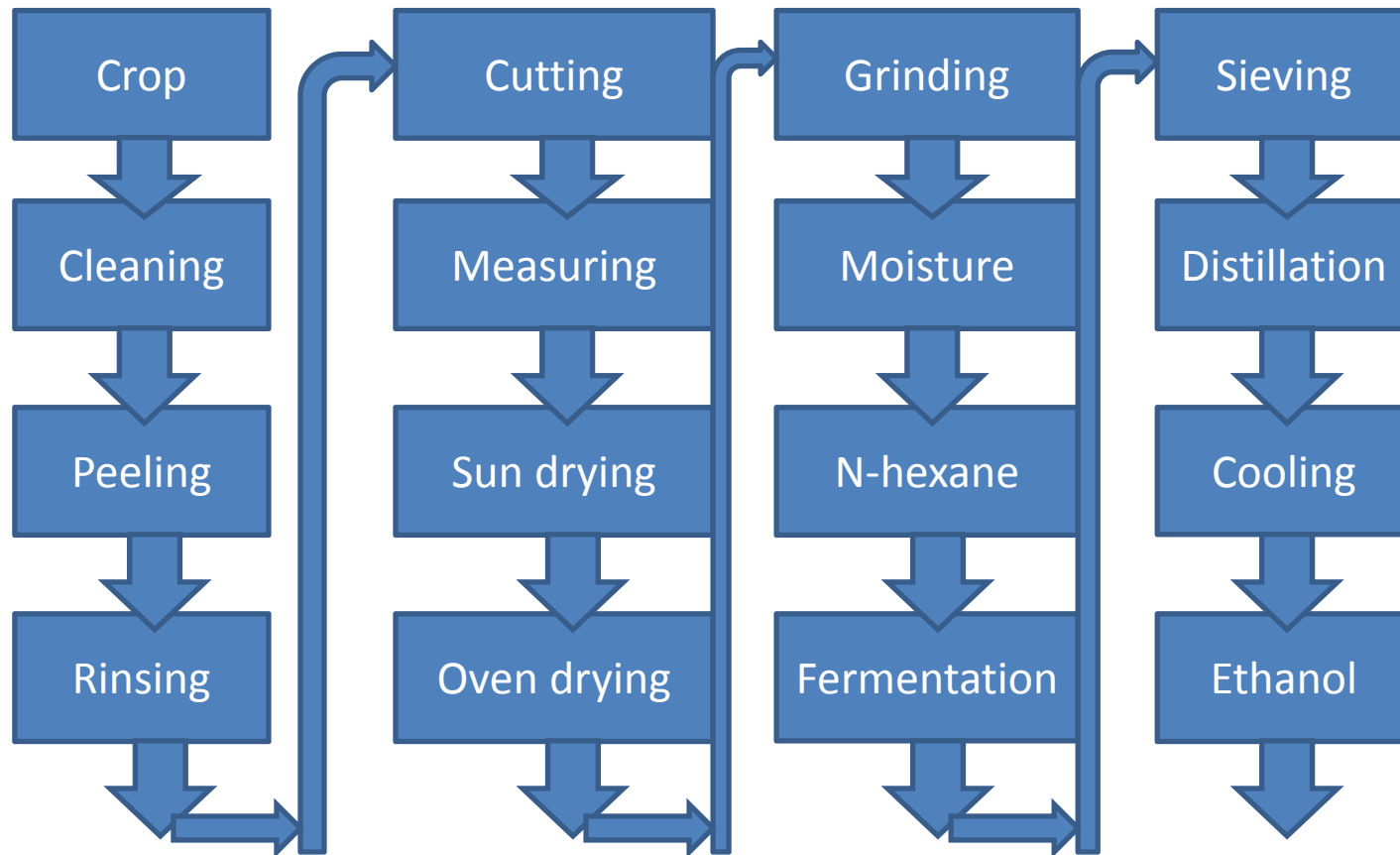


Table 1. Production of Ethanol from Cassava (by volume)

Sample (kg)	Volume of Ethanol Produced (litres)			
	Replicate 1	Replicate 2	Replicate 3	Mean
5	0.72	0.73	0.73	0.73
15	2.17	2.18	2.18	2.18
25	3.62	3.63	3.64	3.63
35	5.08	5.08	5.08	5.08

Table 2. Production of Ethanol from Cocoyam
(by volume)

Sample (kg)	Volume of ethanol produced (litres)			
	Replicate 1	Replicate 2	Replicate 3	Mean
5	0.68	0.69	0.69	0.69
15	2.06	2.07	2.06	2.07
25	3.42	3.43	3.43	3.43
35	4.89	4.89	4.89	4.89

Table 3. Production of Ethanol from Dent Maize
(by volume)

Sample (kg)	Volume of ethanol produced (litres)			
	Replicate 1	Replicate 2	Replicate 3	Mean
1	0.34	0.36	0.35	0.35
2	0.80	0.78	0.81	0.80
3	1.04	1.06	1.06	1.05
4	1.42	1.42	1.42	1.42

Table 4. Production of Ethanol from Sweet Sorghum (by volume)

Sample (kg)	Volume of ethanol produced (litres)			
	Replicate 1	Replicate 2	Replicate 3	Mean
1	0.12	0.11	0.13	0.12
2	0.25	0.25	0.25	0.25
3	0.41	0.40	0.39	0.40
4	0.51	0.52	0.52	0.52

Table 5. Characteristics Measured for Ethanol

Characteristic	Ethanol produced	Standard ethanol
Boiling point	78.5 ⁰ C	78.5 ⁰ C
Relative density (at 20 ⁰ C)	0.791	0.789
Melting point		-114.1 ⁰ C

Table 6. Ethanol Production Rates Measured for Different Crops

Crop	Cassava	Cocoyam	Dent Maize	Sweet Sorghum
Production rate (l/tonne)	145	139	346	135

Table 7. Global Ethanol Production Potential for Selected Crops

Crop	Annual production (million tonnes)	Ethanol production rate (l/tonne)	Ethanol production potential (billion gallons)
Cassava	160	145	5.5
Cocoyam	10	139	0.3
Maize	822	346	67.7
Sweet Sorghum	62	135	2.0

**Table 8. Gasoline equivalent for Ethanol
Produced from Crops**

Crop	Global Ethanol Production Potential (billion gallons)	Gasoline equivalent (billion gallons)
Cassava	5.5	3.3
Cocoyam	0.3	0.2
Maize	67.7	40.6
Sweet sorghum	2.0	1.2

Table 9. Nutritive Analysis of Dried Mash

Nutrient	Cassava	Cocoyam	Dent Maize	Sweet Sorghum	Unit
Food energy	61.8	59.5	59.5	58.1	Calories
Water	2.5	2.1	1.8	1.8	g
Carbo- hydrates	14.4	13.8	12.7	12.2	g
Proteins	1.2	1.5	4.3	4.8	g
Fat	0.1	0.4	0.8	0.6	G
Calcium	153	4.8	28	30	mg
Iron	0.5	0.9	0.3	0.1	mg

Conclusions and Recommendations

- Ethanol production from the fermentation of Cassava, Cocoyam, Maize and Sorghum is an environmental safe and sustainable process.
- Ethanol produced is of a very good quality and has same properties as standard ethanol .
- The mash produced as by-product has excellent nutritive qualities which make it ideal as livestock feed.