

Short Communication

Development of a method for the mineralization of coffee husk (*Coffea canephora* P.) to obtain raw material for soap factories

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Every year, large quantities of husk resulting from the dry method of treatment of robusta coffee are dumped into nature. This generates multiple harmful ecological effects. The downward trend of coffee prices and the rise in the cost of manure has urged coffee farmers to better exploit the by-products of coffee transformation. Thus, a test for the mineralization of coffee husk to obtain soap factory raw material was carried out in the coffee – cocoa technology laboratory at Nkolbisson in Cameroon. To start and improve combustion, three types of fuel namely; cocoa husk, palm bunches and palm nut cake was used. After 16 h of combustion, the highest rate of mineralization was obtained with the palm nut cake (86%) followed by cocoa husk (55%) and the palm bunches (43.4%). This first result turns out to be interesting for further research.

Key words: Coffee husk of coffee, mineralisation, fuel.

INTRODUCTION

Cameroon is one of the main coffee producing countries. Its annual production is estimated at approximately 60,000 tons of commercial coffee. Considering the important mass that agricultural by-products (coffee, cocoa, palm tree) represent during harvest, their valorisation has been the subject of many research projects. The treatment of one ton of chery coffee using the wet process, generates 0.28 ton of parchment, 2 tons of pulp and 22.73 litres of waste water (Adams and Dougan, 1987; Company Information Booklet, 1996). On the other hand, for each ton of commercial coffee produced using the dry treatment process, one ton of husk is dumped into nature (Adams and Dougan, 1987; Vincent, 1987; Company Information Booklet, 1996)

In Cameroon, 60,000 tons of coffee husk are accumulated at the level of dehusking factories. This creates multiple harmful effects like the pollution of ground water, ecological imbalance and even certain fires during hot

periods. Many studies have been carried out in order to valorise the by-products of coffee transformation. The fresh coffee pulp was used by Calzada et al. (1984) to produce a biogas.

After a retention time of 10 days, a biogas output of 55 g/l was recorded (Calzada et al., 1984). A juice rich in sugar (14°brix), polyphenol, NO₂ and caffeine was obtained from sweetened pulp which contains mucilage. This pulp can be used in the production of microbial biomass (Rolz et al., 1980).

The valorisation of coffee husks began in the seventies in Kenya where a co-operative of farmers manufactured coal bricks intended for domestic use from coffee husk (Adams and Dougan, 1987). The production of energy by mineralisation of husks has been studied but, it remains very complex because of the poor elucidation of the emission kinetics of the volatile compounds (CO₂, CO, NO, N₂O) (Anonymous, 1995; Company Information Booklet, 1996). In spite of numerous studies carried out, no work has been done on the rational exploitation of the nutritive element of coffee husk which is potassium. Thus our study aims at exploiting the potash contained in the ash resulting from the combustion of coffee husk as a

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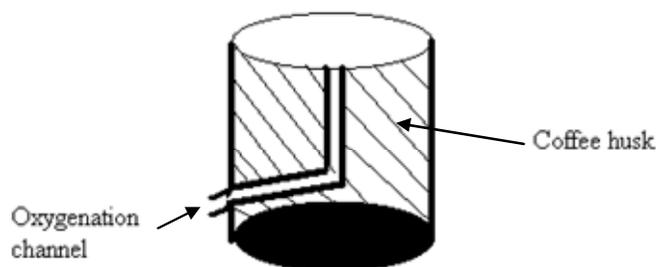


Figure 1. Mineralisation barrel.

Table 1. Potash content of each fuel.

Fuel	Potash (%)
Cocoa husk	36.3
Palm bunches	3.4
Palm nut cake	1.0

raw material for the soap factory.

MATERIALS AND METHODS

Coffee husk and natural fuel

Coffee husk is recovered at the level of the discharge culverts of dehusking factories in the west of Cameroon. If necessary, the water content is lowered to a value ranging from 10 to 11%. The average composition of the coffee husk is a function of the variety of the coffee, the cultivation method and the soil type (Elias, 1979). Coffee husks are characterized by a high content of volatile compounds (62 - 72%), and low ash content (1 - 4%). The nitrogen content is 0.6 to 1.6% while that of sulphur is only 0.1% (Bapat et al., 1997).

The fuels used are cocoa husk, and certain by-products of palm tree (brunches and palm nut cake). They contain 46.3% of volatile compounds, and 5.3% of ash (Bapat et al., 1997). These fuels are collected from small scale family plantations, and their water contents are lowered to values ranging from 10 to 11 if necessary.

Mineralisation

The mineralisation of the husk is done using local materials found in the rural zone. In order to start and improve the combustion of coffee husk, certain agricultural by-products are used as natural fuel. A half open barrel equipped with a small opening at the side (see Figure 1) is used as a device for the mineralisation. The coffee husk is introduced into the barrel leaving an open channel from the top to the small opening at the bottom. This channel helps to ensure oxygenation during combustion. Two thousand grams of husk are used for 140 g of a given fuel. The fuel is spread at the bottom of the barrel and at the opening. A blank determination which consists of mineralizing the pure fuel is done in order to estimate its potash content.

Extraction of potash

The ash resulting from mineralisation undergoes an extraction at ambient temperature in a polar solvent (water). The extract obtain-

ed is filtered on fabric and is evaporated by heating to obtain potash crystals. Thereafter, the potash contained in each sample is measured using the volumetric method.

RESULTS AND DISCUSSION

Blank determination

The extraction of potash from the ashes resulting from the mineralisation of pure fuel gives variable values (Table 1). The ash from cocoa husk is richest in potash while that of the palm nut cake is poorest. The average rates are 36.3% dry matter (ms), 3, 4 and 1% ms for cocoa ash, palm bunches, and palm nut cake, respectively. The potash contents of agricultural by-products are relatively variable in literature. The differences could stem from the treatment undergone or washing away (Caliman et al., 2001).

Mineralisation of coffee husk

Table 2 below indicates the average rate of combustion recorded after 16 h for 2000 g of coffee husk and 140 g of the given fuel. An ease of combustion of coffee husks is observed with the palm nut cake. The combustion rate obtained is highest (86.2%). When the palm bunches is used, combustion starts with difficulty. This causes us to blow regularly at the beginning of the tests. Thus, it records the lowest combustion rate (43.4%), with the cocoa husk as fuel, a combustion rate of 55.3% is obtained.

The use of agricultural by-products as natural fuel considerably improves combustion of coffee husk. Compared to Werther et al. (1995) and Miles and Miles (1980) who found a combustion rate of 10% for coffee husk, improvements of 76.2, 33.4 and 45.3% have been made for the palm nut cake, palm bunches and cocoa husk, respectively.

Extraction of potash

The potash contained in each sample of ash is extracted and measured (Table 3). The potash supplied is 74.8, 41.7, 39.5% for coffee ashes resulting from mineralisation in the presence of cocoa husks, palm bunches, and palm nut cake, respectively. The potash content of pure coffee husk ash obtained from the difference with the potash content of the pure fuel is 38%.

These results agree with those of Saenger et al. (2001) who found a rate of 38.3% following mineralisation of the coffee husk in a fluidized bed on a pilot plant (Saenger et al., 2001). The ash of coffee husk is very rich in potash (38.8%), compared to that of wood (0.5%) and coal (3.2%) (Rolz et al., 1980). High potash levels are also obtained with other agricultural by-products like those of

Table 2. Average combustion rate.

Type of fuel	Mass of husk used (g)	Mass of fuel used (g)	Mass of ash obtained (g)	Average rate of combustion (%)
Cocoa husk	2000	140	1183.4±1.2	55.3
Palm bunches	2000	140	928.7±0.9	43.4
Palm nut cake	2000	140	1845.0±0.5	86.2

Table 3. Potash content of ash samples.

Sample	Potash content of ash sample (%)	Potash content of pure fuel (%)	Real Potash content of coffee husk (%)
Ash containing cocoa husk	74.8	36.3	38.5
Ash containing palm bunches	41.7	3.4	38.3
Ash containing palm nut cake	39.5	1	38.5

cotton, pepper and soya (Rolz et al., 1980). This can be explained by the use of large quantities of manure during cultivation (Adams et al., 1987, Grubor et al., 1995).

Conclusion

The valorization of agricultural by-products such as coffee husk cleans the environment by reducing the large volumes obtained during harvest. This valorization helps the peasants in the fight against poverty as coffee prices have dropped in the international market. Potash which is a raw material for soap factories is obtained from the mineralisation of coffee husk. The combustion rate has been improved by the use of local materials and other agricultural by-products as natural fuel. The best rate is obtained with palm nut cake, followed by cocoa husk, and finally the palm bunches. This implies that, peasants or promoters can produce potash using this simple mineralisation method. They can use this potash to manufacture their soap without any fears.

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