Journal of Global Biosciences
ISSN 2320-1355
Volume 4, Number 8, 2015, pp. 3201-3206
Website: www.mutagens.co.in
E-mail: submit@mutagens.co.in
researchsubmission@hotmail.com

Research Paper

CONTRIBUTION TO THE STUDY OF THE COCOA POD CORTEX VALORISATION

A. D. Sahoré, J.K. Afferi, L. Oka, J.L. Abouattier and K. B. Boua

Research Institute for the New Energies, Nangui Abrogoua University,
02 BP 801 Abidjan 02, Ivory Coast.

Abstract

The use of renewable energy supply non-polluting, nowadays an alternative to fossil fuels and the use of agricultural residues (also called biomass) as a source of renewable energy is increasingly considered. According to some analyzes this energy could be the most suitable for the rural population of Ivory Coast largest cocoa producer. This work aims therefore to value as a source of energy production, the cortex of cocoa pods, and an agricultural residue, often left as waste in plantations. This work aims therefore to develop, as a source of energy production, the cortex of cocoa pods, an agricultural residue, often left as waste in plantations. Our investigations for the assessment of the availability of the biomass showed significant amounts of cortex left on cocoa plantations. The cortex is what remains of the cocoa pod beans after recovery. The objective of our study focuses on the assessment of the availability of the cortex as an energy resource and its physico-chemical characterization. The physico-chemical analyses have shown that the proportion of the cortex in fresh pod is about 71%. The physico-chemical composition of the cortex, from different regions of Ivory Coast, varies very little and is close to that of literature. Our analyses show that the cortex has about an average dry matter content of 19% and an average raw energy of 16.1 MJ / kg. On this basis, that is an energy of 106 MJ 50,400 which remains available each year from the cortex of the cocoa pod in Ivory Coast. The study showed that the cortex of the cocoa pod remains an important energy source. The tracks of exploitation of this potential source of energy are to explore.

Key words: Renewable energy, cortex; pod, cocoa, valorisation.

INTRODUCTION

The development of a country is based on availability and access to numerous and abundant energy sources. However, the choice of energy source, it is necessary to take into account its impact on the environment and rural populations in their quest for wellness. It is also important to be worried at first of energy consumption before choosing a renewable energy source, because the best way to conserve resources is to consume the least possible [1]. The use of renewable energies can develop local resources (wood, wind, solar, agricultural co-products...) and to prevent the import of fossil fuels. In addition, compared to other energy sources, their use generates a limited impact on the environment. Indeed, in the case of biomass CO_2 from its energy recovery or degradation is again absorbed by plants to produce biomass. It therefore does not participate in the greenhouse effect. The rising cost of fossil fuels undermines the

ability of developing countries to improve access to energy. The use of clean, renewable energy, inexhaustible, abundant, accessible and cheap offers an alternative to fossil fuels aggravating climate change. Energy from biomass appears to be the most suitable for the rural population. [2]. In Ivory Coast, the cortex of the cocoa pod is a significant amounts of residue often abandoned in cocoa plantations. According to a study by the National Centre for Agronomic Research (NCRA), the annual average production of Ivory Coast in the period 2007 to 2009 was 1.2 million tones of commercial cocoa. Are at least 17.4 million tons of cocoa pods? Thus, cortex pod is an important amount of [3] biomass [4] including energy recovery should be encouraged to reduce the share of fossil energy in the supply of energy Ivory Coast. It will also promote the creation of new economic activities; improve the level of incomes and quality of life in rural areas. The study conducted here aims to quantify the available biomass and determine the energy potential of the cortex. Specifically, it will determine: zones of concentration of cocoa pods, identification of potential uses of the cortex

MATERIALS AND METHODS

Vegetable Material

The studied vegetable material is constituted by a sample of 86 fresh pods from various production areas of Ivory Coast (Figure 1). [5]. Sampling was done in January and February and cortex pod stored in jute bags before laboratory analysis.

Physicochemical Analysis

The physico-chemical Analyses were made in the cortex. These include the biochemical composition: dry matter, moisture content, ash, total fiber, crude protein, crude fiber, [6]. The mineral composition: calcium, phosphorus, potassium and sodium. [7] As well as various characteristic parameters of the biomass: Chemical Oxygen Demand (COD); Biochemical oxygen demand (BOD 5) [6] and organic carbon [8]. The calorific value of the cortex samples was determined using an adiabatic bomb calorimeter Parr brand (model 1341EE, Parr Instrument Company, IL, and USA).

Statistical Analysis

The coefficient of variation (CV), which expresses the standard deviation in percentage of the average, was used to estimate the homogeneity (or the heterogeneousness) of the chemical composition of the cortex stemming from various regions of Ivory Coast. He (it) was determined by the software statistics 7.1.

RESULTS

The proportion of the cortex in the fresh pod is shown in Table 1 for the various cocoa pod collecting areas. The proportion of the cortex in the pod varied from 68 to 75% by weight is one cortex rate of about 71% by weight, Cortex from Ivory Coast different regions. It was determined with statistics 7.1 software.

The biochemical and mineral composition of cocoa pod cortex from different cocoa pod collecting areas is indicated in Table 2. The average rate and the variation coefficient determined for each factor are shown in Table 2. It will be noted the humidity reported in a fresh weight range from 75.92 to 84.52% f.w, averaging 80.83% f.w the dry matter matching is between 15.48 and 24.08% f.w an average of 18.89% f.w.

The rate of nitrogenous material reported to the dry material varies from 0.28 to 0.42 % d. m, with an average of 0.38 % d. m. The values obtained from the fat are between 1 and 1.35 % d. m, with an average of 1.25 % d. m). Regarding the calorific values obtained range between 15.8 and 16.6 MJ / kg d. m, with an average of 16.1 MJ / kg d. m.

DISCUSSION

The proportion of cortex by fresh pod for the various collecting regions is on average about 71% (Table 1). This value is close to that about 70% reported by Alemawor *et al.* [9]. This value is close to that about 70% reported by Alemawor et al. [9]. The average rate and the variation coefficient of the factors studied are shown in Table 2. The variation coefficients are all well below 30%. It is generally accepted that when the variation coefficient of the studied factors is less than 30%, they are homogeneous and conversely, when it is higher than 30%, they are heterogeneous. So the composition of cocoa cortex varies little from region to region on the Ivorian territory. The values of the calculated average rates (Table 2) are representative of the various factors discussed: Thus, humidity varies between 75.92 and 84.52% fresh weight with an average 80.83% is a dry matter between 15.48 and 24.08% fresh weight with an average of 18.89%.These values are similar to those reported in the literature. Van Hall [10] obtained moisture content between 82.9 - 84.5% fresh matter IE dry matter 15.5% - 17.1% fresh weight; Meffeja et al. [11] obtained moisture 85.5% fresh matter IE dry matter about 14.5% fresh weight; Oddoye et al. [12] obtained moisture content is 87% dry matter about 13% fresh weight. The nitrogenous matter content is between 0.28 and 0.42% dry matter, with an average of 0.38% dry matter, this rate is close to that about 0.2% reported by Van Hall ms [10], but lower than the rates given by Tuah and Orskov [13] Moyin-Jesu [14] which are the order 1.12 to 1.44% dry matter. The values obtained from the fat are between 1.00 and 1.35% dry matter, with an average of 1.25% dry matter. They are far superior to those of Van Hall [10], 0.1%, d.m and less than the value reported by 2.1% d.m Meffeja et al. [11]. For the calorific value, the values obtained are between 15.8 and 16.6 MJ / kg, with an average of 16.1 MJ / kg).

They remain below the values reported by Meffeja *et al.* [11] Oddoye *et al.* [12] and Aregheore [15] varying from 18.7 to 21.3 MJ / kg. The results obtained in this study are so close to those obtained in various other works on cocoa and also those reported in the literature pertaining to other organic biomasses such as wood (14.2 to 19.2 MJ / kg [16]), sugar cane bagasse, (14.8 MJ / kg) and the raid of palm tree (21.6 MJ / kg). [4]. These remarks still attest to the variability of the chemical composition of an agricultural byproduct according to its origin, variety, and even underwent treatment before analysis, as already noted Meffeja *et al*.[11] and Aregheore [15]. Indeed, Aregheore [15] reported that a long exposure to sun distorted components of the cortex of the cocoa pod.

Most studies to date on the cortex of the cocoa pod focused on its value as a nutritional supplement for animals. [13] [4]; [15]; [11]; [12]. Some work has focused on the production of potash and soap from the cortex [17]; [18]. The work of Syamsiro *et al*.[19] by evoking energy recovery against the cortex of the cocoa pod.

Given the results obtained could be inferred from this study that the cortex of the cocoa pod is a potential source of energy.

Table 1: pod weight and amount of cortex in various regions of Ivory Coast

Regions	Sample	Pod weight (kg)	Average weight pod (kg)	cortex Weight (kg)	Quantity cortex (%)
Sud Comoé	4	1,65	0,413	1,15	70
Bas-Sassandra	20	13,25	0,663	9,9	75
Sud Bandama	5	3,2	0,640	2,3	72
Agneby	16	8,2	0,513	5,55	68
N'Zi Comoé	11	4,9	0,445	3,35	68
Lacs	11	6,3	0,573	4,7	75
Marahoue	10	6,5	0,650	4,65	72
Haut Sassandra	9	4,5	0,500	3,2	71
Total	86	48,5	0,564	34,8	71

Table 2: Chemical Composition of the Cortex of the Cocoa Pod in various regions of Ivory

Localities	Moisture % pf	Dry matter % pf	Nitrogen %ms	Fat %ms	Fiber %ms	Cellulose %ms	Organic Carbon %ms	Ashes %ms	Ca %ms	P %ms	K %ms	Na %ms	DCO mg/gms	DBO5 mg/gms	Energy MJ/kgms
Yakro	75,92	24,08	0,42	1	50,28	25,66	56,79	2,1	1,3	0,05	36,75	0,25	880,8	520	16,6
Daloa	82,5	17,49	0,4	1,25	50,25	25,5	56,93	1,86	1,3	0,05	36,88	0,26	799,8	480	15,9
Agboville	77,98	22,02	0,35	1,15	50	24,12	57,2	1,39	1,3	0,05	36,88	0,24	888	340	-
Soubré	78,95	21,05	0,45	1,28	50,35	25,76	57,1	1,63	1,28	0,03	36,88	0,26	893,2	298	16,4
Bouaflé	81,6	18,38	0,28	1,25	50,08	24,46	56,76	2,15	1,28	0,05	36,5	0,26	788	360	-
Dimbokro	80,34	17,12	0,3	1,35	49,65	24,05	56,82	2,05	1,3	0,05	36,35	0,26	860,6	425	-
Abosso	82,33	17,67	0,42	1,3	50,37	25,5	56,84	2	1,3	0,05	36,65	0,26	875	270	-
San-Pedro	83,3	16,7	0,56	1,28	50,04	24,89	56,98	1,75	1,26	0,04	36,18	0,26	879,4	360	15,8
Divo	84,52	15,48	0,28	1,35	50,25	25,63	56,86	1,98	1,26	0,05	36,75	0,26	889,7	350	15,8
Average	80,83	18,89	,38	1,25	50,14	25,06	56,92	1,88	1,29	0,05	36,65	0,26	861,61	378,11	16,1
CV	**3,43**	**15,05**	**23,99**	**8,82**	**0,45**	**2,77**	**0,26**	**13,23**	**1,35**	**15,15**	**0,69**	**2,75**	**4,60**	**21,67**	**0,14**

Coast
NB:
% f.w= % fresh weight; **% d.m** = % r matter; **DBO**= Biochemical oxygen demand; **DCO** = Chemical Oxygen Demand**,** **CV**: coefficient of variation

CONCLUSION

The objective of this project was to identify the user as the cortex best way of producing electricity. And conducted study showed a significant deposit of the cortex of the cocoa pod. The recovery methods for this potential energy source remain to explore. The investigations also show that the cortex of cocoa pods is an animal feed and a raw material for the production of potash and soap.

REFERENCES

[1]. Anonyme[1]. Plan 2003 pour la Maîtrise Durable de l´Energie à l´horizon 2010 en Wallonie

[2].Anonyme[2] .SOPIE- Société d'Opération Ivoirienne...www.izf.net/entreprises/...dop-ration-ivoirienne-delectricit

[3].Donkoha A., C.C. Atuahene, B.N. Wilson and D. Adomako (1991) Chemical composition of cocoa pod husk and its effect on growth and food efficiency in broiler chicks. *Animal Feed Science and Technology*, 35 (1-2) : 161-169

[4]. Temmerman M. (2006) Caractéristiques physico-chimiques des biocombustibles et systèmes d'approvisionnement. Formation aux études de préfaisabilité de projets de bioénergie – Méthodologie pour l'identification de projets réalistes, Mbour, Sénégal, 04-07 septembre 2006.

[5] http://lemondeetnous.cafe-sciences.org/2014/04/de-la-cabosse-au-chocolat/ 26/06/015.

[6] Rodier, J., Bazin, C., Broutin, J.P., Chambon, P., Champsaur, H. et Rodi, L. 1996. L'analyse de l'eau. Eaux naturelles, eaux résiduaires, eaux de mer. Dunod, 8ème édition, Paris, pp. 1384

[7] BIPEA (Bureau Inter Professionnel d'Etudes Analytiques). 1976. Recueil des Méthodes d'Analyses des Communautés Européennes.

[8] (Anonyme[3], 1988. Protocole du Conseil des Producteurs Végétales du Québec/

[9]Alemawor F., Dzogbefia V. P., Oddoye E. O. K. and Oldham J. H.. 2009. Effect of Pleurotus ostreatus fermentation on cocoa pod husk composition: Influence of fermentation period and Mn2+ supplémentation on the fermentation process. *African Journal of Biotechnology*, 8 (9): 1950-1958.

[10] Van Hall C.J.J. 1914. Cocoa. MacMillan and Co., London, 515p.

[11] Meffeja F., N. Njifutié, Y. Manjeli, J. Tchoumboué et J. Tchakounté/ 2009. Digestibilité comparée des rations contenant de la drêche ensilée des brasseries, du tourteau de palmiste ou des coques de cacao chez le porc en croissance finition au Cameroun. 17p.

[12] Oddoye E. O. K., S. W. A. Rhule, K. Agyente-Badu, V. Anchirinah and F. O. Ansah. 2010. Fresh cocoa pod husk as an ingredient in the diets of growing pigs. *Scientific Research and Essays*, 5(10): 1141-1144.

[13] Tuah, A. K. and Orskov, E.R. 1989. Overcoming constraints to the efficient utilization of agricultural by products as animal feed Proceedings of the Fourth Annual Workshop held at the Institute of Animal Research, Mankon Station. Bamenda, Cameroun. 20 - 27 October 1987.

[14]. Moyin-Jesu E. I. 2007. Use of plant residues for improving soil fertility, pod nutrients, root growth and pod weight of okra (Abelmoschus esculentum L) *Bio resource Technology*, 98: 2057–2064.

[15]. Aregheore E. M. 2002. Chemical evaluation and digestibility of cocoa (Theobroma cacao) by-products fed to goats. *Tropical Animal Health and Production* 34(4): 339-348.

[16], Ndour B. 1986. Carbonisation du bois et de la tourbe en four métallique transportable-Analyse du produit final-. Mémoire de confirmation de chercheur à l'ISRA, Dakar, 80 p.

[17] Simpson, B.K. and Oldham J.H.1985. Extraction of potash from cocoa pod husks. *Agricultural Wastes*, 13(1), 69-73.

[18] Taiwo O. E. and Osinowo F. A.O. 2001. Evaluation of various agro-wastes for traditional black soap production *Bio resource Technology*, 79: 95-97.

[19] Syamsiro M. , Saptoadi H. , Tambunan B.H., Pambudi N.A.. 2012. A preliminary study on use of cocoa pod husk as a renewable source of energy in Indonesia. Energy for Sustainable Development Volume 16, Issue 1, Pages 74–77