Effect of drying methods on proximate and Antinutrients Composition of Cocoa (The obroma cacao) Pod

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Abstract : **This study evaluated the effect of drying methods on the proximate and antinutritional composition of Cocoa Pod. The cocoa *(Theobroma cacao)* pod that was used for this study was sliced into three different sizes (1/2,1/4 and 1/8) and was dried using three different drying methods (Cabinet dryer at a temperature of 70°C), and the other analyzed fresh. The result was analyzed using standard methods and procedures. Changes in moisture content of the cocoa pod were monitored every 30min the moisture content of the sample became constant. The result shows that the cabinet drying was found to be more effective for moisture removal compared to other drying methods open sun and solar drying (10.811 ± 0.023%), (14.15 ± 0.127%) and (14.295 ± 0.035%). The Ash content of the dried sample for open sun drying range (11.06 ± 0.679%), solar dryer (8.175 ± 0.474%), and cabinet dryer (10.854 ± 0.038%). Crude protein content for the fresh analyzed sample is (11.71 %), open sun drying (10.4 %), solar drying (7.77 %) and cabinet dryer (10.40 %). Crude fibre for fresh sample (2.39 %), solar dryer (58.13 %), open sun dryer (51.93 %) and for cabinet dryer (31.56 %). The result shows that the drying significantly (P<0.05) increased the fibre content of the sample. The result of fat content for the fresh sample (4.105 %), solar dryer (2.47 %), open sun drying (2.49 %), and cabinet dryer (4.11 %). The carbohydrate content of cabinet dryer (35.50%), open sun drying (9.94 %), solar dryer (9.31 %) and the fresh sample (4.23 %). The result of antinutritional composition also shows the following; Saponin mg/g for the fresh analyzed sample is (19.569), open sun drying (6.541), solar drying (9.767), and for cabinet dryer (11.650). Tannin mg/g for the fresh analyzed sample is (5.055), open sun drying (1.064), solar drying (1.408), and cabinet dryer (4.900). Steroid mg/g for the fresh analyzed sample is (3.356), open sun drying (2.509), solar drying (2.806), and for cabinet dryer (1.650). flavonoid mg/g for the fresh analyzed sample is (2.808), open sun drying (1.161), solar drying (1.859), and cabinet dryer (2.900). Terpenoid mg/g for the fresh analyzed sample is (15.350), open sun drying (6.714), solar drying (11.919), and cabinet dryer (0.235). Alkaloid mg/g for the fresh analyzed sample is (43.597), open sun drying (21.940), solar drying (28.314), and cabinet dryer (36.700).This finding shows that the increase in the intensity of heat might not significantly destroy the antinutrient composition of dried cocoa*(Theobroma cacao)* pod as much as spending longer time in the system.**

Keyword: **Anti nutrient, Proximate analysis, Drying, Cocoa Pod husks, Drying methods**

I. INTRODUCTION

Cocoa pod husks are waste from cocoa bean processing. currently, which give rise to the environmental pollution problem in cocoa-producing areas of the world, serve as possible sources of disease transmission when used as mulch in cocoa farms. However, the cocoa pod can be used in livestock feed formulation as a valuable ingredient in meal form, when processed properly it reducesthe theobromine content and contributes to digestibility. In preserving cocoa pod various techniques have been embraced in the treatment and processing of cocoa pod meal for the motive of animal feed formulation. Some of the technique include hot-water treatment by (Adegbola and Omole, 1973); alkali treatment adopted by Isika *et al.*, (2012); Bedford, (2000); Zakaria *et al.*, *(*2008); reported enzyme (mannanase) treatment, urea treatment was carried out by Olubamiwa and Akinwale, (2000); Iyayi *et al.*, (2001)., fungal treatment (Adamafio *et al.*, 2011) and microbial detheobromination (Mazzafera, 2002). These treatment techniques are somehow expensive and complex for the local farmers to adopt, hence there is a need to devise cheaper and less cumbersome methods like drying of cocoa pod meal and further ascertaining their nutrient/chemical compositions and their suitability for animal feeding trials.

Drying is a system of preserving produces, also drying is a mass transfer process made up of eliminating water or solvent by evaporation from a solid, semi-solid, or liquid. It is also the reduction of moisture content from agricultural produce to allow products that can be safely kept for a considerable length of time (Alamu *et al.*, 2010). The drying step is a critical operation in the harvesting – drying – storage – handling – transportation sequence of agricultural material processing. It is generally agreed that improper drying is the major cause of agricultural material deterioration in this series of processes. A large amount of moisture is vapourised from the material in the drying process. This process is often used as the final production step before selling or packaging a product (King and Ann, 1992). (Meisamiasl *et al.*, 2010; Pandey *et al.*, 2010; Kumar *et al.*, 2012). Reported that, air velocity, drying temperature, size and shape of the material, and the relative humidity are various factors affecting the drying of fruits and vegetables. Amongst the aforementioned conditions, the most influential factors are thickness and temperature of the material It has been explained that the drying process of food and agricultural products is significantly affected by air velocity rate (Yaldiz *et al.,* 2001; Krokida *et al.,* 2003). The rate of drying is affected by physical properties of the drying environment, air temperature, humidity and air velocity, the physical and chemical properties of the agricultural material to be dried i.e., shape, size, composition, moisture content, etc., The characteristics of the dryer and the heat transfer efficiency (Brooker *et al.,* 1992). Thus, this research work aims to evaluate the effect of drying methods on proximate and Antinutrients Composition of Cocoa *(Theobroma cacao)* Pod.

II. MATERIALS COLLECTION AND EXPERIMENTAL PROCEDURE

The raw material (Cocoa *(Theobroma cacao)*pod husks) that was used for this study were purchased from Ijan – Ekiti, Ekiti State. and brought to the Department of Agricultural and Environmental Engineering and Food Science and Technology Laboratory of the Federal University of Technology, Akure, Ondo State. The Fresh cocoa husks were cleaned, sorted and cut into different sizes with three replicates the thickness of each sample was taken using a verniercaliper. The initial and final moisture contents of each cocoa husk were determined before and after drying as M_1 and M_2. Three drying media were used in drying the cocoa husks which are electric cabinet dryer (D_1), each sample was dried at temperatures 70 ^{0}C for 30 minutes until the weight became constant, this procedure was repeated for the Solar cabinet dryer (D_2), and Sun drying, (D_3). The electric cabinet dryer used was modified by replacing some of the missing and faulty components, the temperature control, speed reducer, thermocouple, contractor and the wiring were fixed. The weighing was performed on a digital balance, and moisture content (wet basis) was calculated using equation (1) and the tests were performed in triplicate

$$\boldsymbol{MC = \frac{M_w - M_d}{M_w} X100} \qquad (1)$$

Where MC is the moisture content on wet basis, $\boldsymbol{M_w}$ is the weight of the wet sample and $\boldsymbol{M_d}$ is the weight of a dried sample of cocoa pod husk (Diamante and Munro, 1993). Chemical Properties of both Fresh and Dried Cocoa Husks The laboratory analysis was carried out on both the fresh and dried cocoa husks on the three-drying media. The anti-nutrient (such as saponin, tannin, Steroid, flavonoid, and terpenoid) and proximate (such as Ash, Fibre, Protein, and carbohydrate) were determined. Tannin was prepared by (Makkar and Goodchild. 1996), The spectrophotometric method of Brunner (1994) was used for Saponin determination, Harbone (1973) method was adopted in analyzed the Alkaloid, Terpenoid the procedure described by Sofowora (1995) was used. The steroid was determined by a blank. Sofowora (1995). The proximate analysis was determined in terms of moisture content, crude protein, fat, ash content, crude fiber and caloric value according to the standard methods AOAC, (1990).

III. RESULTS AND DISCUSSION

3.1 Proximate Composition

The results of fresh (control) and dried cocoa *(Theobroma cacao)*pod using different drying systems for moisture, ash, crude fiber, protein, fat contents are shown in Table 3.1.1 to 3.1.1 Overall, there were significant differences ($p<0.05$) between the values recorded for the proximate composition of fresh and dried cocoa pod. The moisture content of the fresh cocoa *(Theobroma cacao)*pod was 73.29 ± 4.327% and statistically different ($p<0.05$) from the moisture content of the dried cocoa pod husk. The moisture contents recorded for cocoa pod dried using open sun drying, solar drying and cabinet drying were (14.295 ± 0.035%), (14.15 ± 0.127%) and (10.811 ± 0.023%) respectively. The cabinet drying was more effective in removing moisture compared to other drying methods. This was also observed by other researchers (Bankole *et al.,* 2005 and Eze and Akubor, 2012). The heat supplied by the convective cabinet is more consistent than the sun which depended on the climate and season at the time of drying (Bankole *et al.,* 2005). Therefore, differences in moisture content may be due to the different drying methods used. The ash content of the fresh cocoa pod was 2.035 ± 0.148% and lower than the dried samples. Ash content of the dried samples for the open sun was (11.06 ± 0.679%), solar dryer (8.175 ± 0.474%), and cabinet dryer (10.854 ±0.038%).

Crude protein content for the fresh sample of cocoa pod husk was significantly higher ($p<0.05$) compared to dried samples. Values ranged between (11.71 ± 1.358%) for fresh cocoa pod husk, (10.4 ± 0.00%) open sun drying, 7.77 ± 1.216% solar drying and (11.3%) for conventional cabinet drying samples. There were significant differences ($p<0.05$) between the protein content of open sun drying of cocoa pod husk and other drying methods.

The result of crude fiber for the fresh cocoa pod husk is (2.385± 1.322%), obtained for the solar dryer (58.125 ± 0.884%), open sun (51.925 ± 0.247%) and cabinet dryer (31.56 ± 0.113%). there were significant differences ($P<0.05$) among the samples.

The fat content of fresh cocoa pod husk (4.105 ± 0.021%) was significantly higher and different from other forms of drying. Values of (2.47 ± 0.014%), (2.485 ± 0.007%) and (4.105 ± 0.021%) were recorded for solar, open and cabinet drying

Carbohydrate content of cocoa pod dried in the cabinet dryer was gotten as 35.496 ± 0.084%and significantly higher compared to the other forms of drying; open sun (9.835 ± 0.884%), solar dryer (9.31 ± 2.461%), and fresh cocoa husk (4.225 ± 0.488%). This is in trend with the report obtained by Isika et.al., (2012). value of processed cocoa bean meal for groundnut cake in rations for fryer rabbits. *Journal Sustainable Technology*, 3(1): 118-127.

Dried cocoa pod husk could be used for animal feed as it is rich in protein, carbohydrate, and proximate composition is in close range with that of maize.

Table 3.1.1: Proximate composition of fresh cocoa pod

Parameters	Values (%)
Moisture content	73.290
Ash content	2.035
Fiber content	2.385
Crude fat content	6.355
Crude protein content	11.225
Carbohydrate content	4.225

Table 3.1.2: Proximate composition Solar drying of cocoa pod

Parameters	Values (%)
Moisture content	14.150
Ash content	8.175
Fiber content	58.125
Crude fat content	2.470
Crude protein content	7.770
Carbohydrate content	9.310

Table 3.1.3: Proximate composition of Cabinet drying of cocoa pod

Parameters	Values (%)
Moisture content	10.811
Ash content	10.854
Fiber content	31.56
Crude fat content	4.105
Crude protein content	7.175
Carbohydrate content	35.495

Table 3.1.4: Proximate composition of open sun drying of cocoa pod

Parameters	Values (%)
Moisture content	14.290
Ash content	11.060
Fiber content	51.925
Crude fat content	2.485
Crude protein content	10.400
Carbohydrate content	9.835

3.2 Anti-Nutrient composition of cocoa pod

Anti-Nutrient isa biologically active compound, found in plants in small amounts, which are not established nutrients but which nevertheless contribute significantly to protection against degenerative disease (Dreosti, 2000). Table 3.2.1. to 3.2.4 showed the Anti-Nutrient screeningand amount present in the quantity of the dried cocoa pod husk from different drying systems. the Saponin mg/g for the fresh analyzed sample is (19.569), open sun drying (6.541), solar drying (9.767), and cabinet dryer (11.650). Tannin mg/g for the fresh analyzed sample is (5.055), open sun drying (1.064), solar drying (1.408), and cabinet dryer (4.900). Steroid mg/g for the fresh analyzed sample is (3.356), open sun drying (2.509), solar drying (2.806), and for cabinet dryer (1.650). flavonoid mg/g for the fresh analyzed sample is (2.808), open sun drying (1.161), solar drying (1.859), and cabinet dryer (2.900). Terpenoid mg/g for the fresh analyzed sample is (15.350), open sun drying (6.714), solar drying (11.919), and cabinet dryer (0.235). Alkaloid mg/g for the fresh analyzed sample is (43.597), open sun drying (21.940), solar drying (28.314), and cabinet dryer (36.700).

It is a known fact that these anti-nutrients reduce the bioavailability of nutrients in food and plants (Akindahunsi and Salawu, 2005). The fresh cocoa pod had the highest presence of all of the anti-nutrients, However, alkaloid, flavonoid, Saponin, tannin content is lower in the open sun-dried sample followed by the solar-dried sample, and the highest was found in the cabinet dried sample. This finding shows that the increase in the intensity of heat might not significantly destroy the antinutrient composition of dried cocoa pod husk as much as spending longer time in the system and this result agrees with the finding of Akinsami*et al.* (2015) who reported that the best methods of reducing anti-nutrients are through open air and for a while.

Table 3.2.1: Antinutrients compositions of fresh cocoa pod

PARAMETERS	VALUES
SAPONIN mg/g	19.569
TANNIN mg/g	5.055
STERIOD mg/g	3.356
FLAVONOID mg/g	2.808
TERPENOID mg/g	15.350
ALKALOID %	43.597

Table 3.2.2: Antinutrients compositions of cabinet drying of cocoa pod

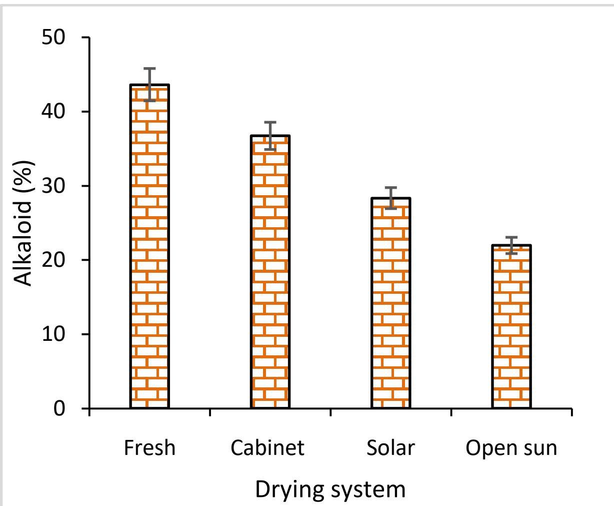
PARAMETERS	VALUES
SAPONIN mg/g	11.650
TANNIN mg/g	4.900
STERIOD mg/g	1.650
FLAVONOID mg/g	2.900
TERPENOID mg/g	0.235
ALKALOID %	36.700

Table 3.2.3: Antinutrients compositions of solar drying of cocoa pod

PARAMETERS	VALUES
SAPONIN mg/g	9.767
TANNIN mg/g	1.408
STERIOD mg/g	2.806
FLAVONOID mg/g	1.859
TERPENOID mg/g	11.919
ALKALOID %	28.314

Table 3.2.4: Antinutrients compositions of open sun drying of cocoa pod

PARAMETERS	VALUES
SAPONIN mg/g	6.541
TANNIN mg/g	1.064
STERIOD mg/g	2.509
FLAVONOID mg/g	1.161
TERPENOID mg/g	6.714
ALKALOID %	21.940



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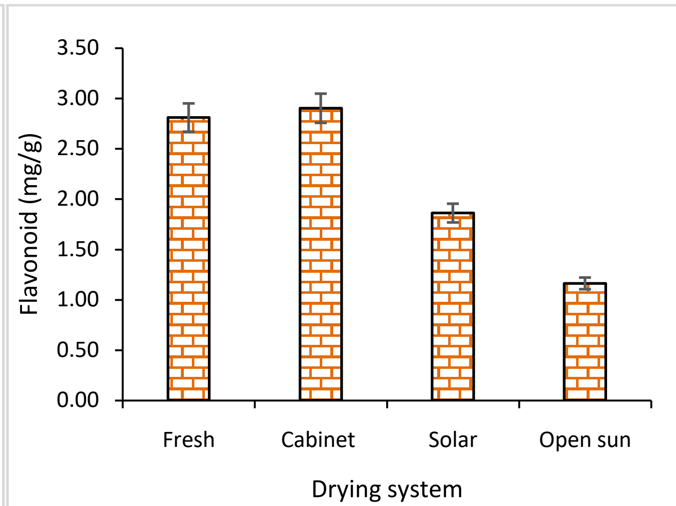

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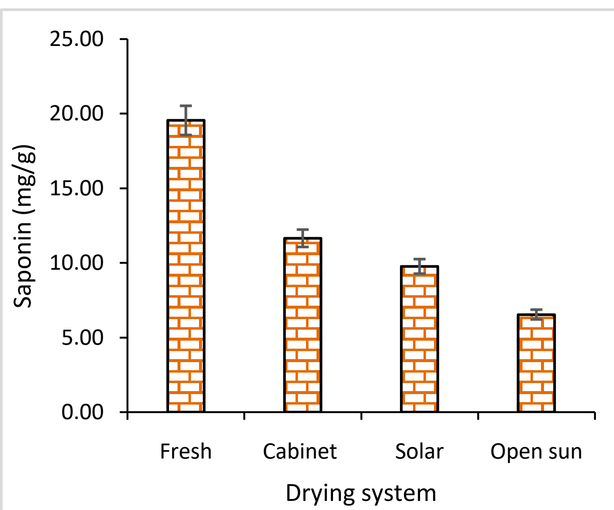

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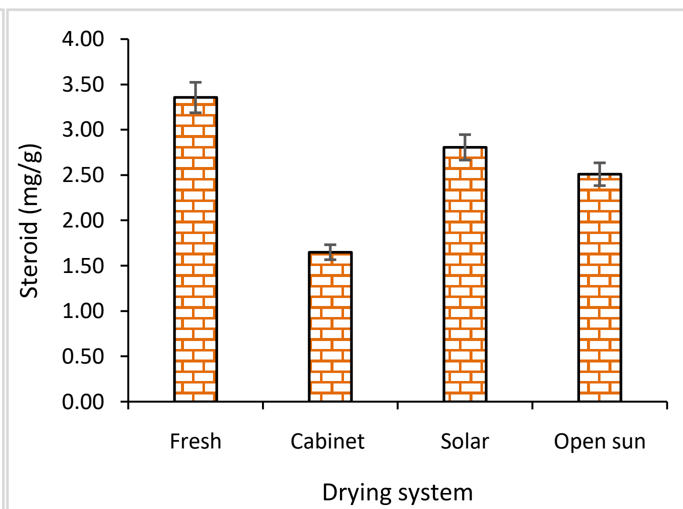

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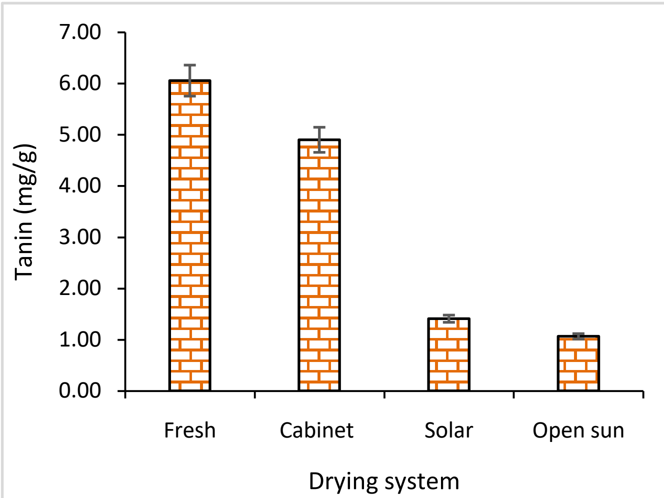

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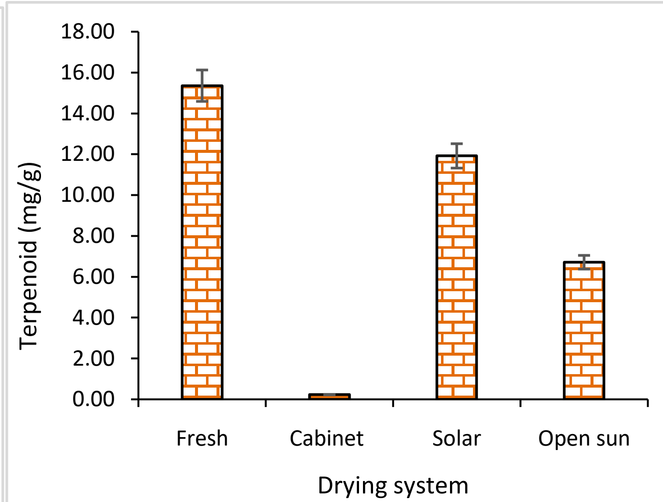

(f)

Figure 3.2: Anti-Nutrient composition of cocoa pod husk; for a, Alkaloid (%); b, Flavonoid (mg/g); c, Saponin (mg/g); d, Steroid (mg/g); e, Tannin (mg/g); f, Terpenoid (mg/g)

IV. CONCLUSION AND RECOMMENDATION

4.1 Conclusions

The following information was drawn from the result and findings of the study on the effect of the drying system (cabinet dryer, solar dryer and open sun drying) on the proximate and antinutrient composition of the dried cocoa husk pod.

Moisture contents recorded for cocoa pod husk dried using open sun drying, solar drying and cabinet drying were (14.295 ± 0.035%), (14.15 ± 0.127%) and (10.811 ± 0.023%) respectively

Ash content of the dried samples for the open sun was (11.06 ± 0.679%), solar dryer (8.175 ± 0.474%), and cabinet dryer (10.854 ± 0.038%).

Crude protein content for the fresh sample of the cocoa pod was significantly higher ($p<0.05$) compared to open sun drying, solar drying andcabinet drying samples

The crude fiber for the fresh cocoa *(Theobroma cacao)* pod and was significantly lower compared to the value for the solar dryer, open sun and cabinet.

This finding shows that the increase in the intensity of heat might not significantly destroy the Anti-Nutrient composition of dried cocoa pod husk as much as spending a long time in the system.

4.2 Recommendations

The following recommendation was made based on the scope, finding, and limitation of study of drying of different pod sizes of cocoa pod under the open sun, solar drying system and cabinet dryer operated at drying air temperature of 70^0C.

The pod husk should be reduced to the minimum possible size to increase the rate of drying and ensure effective drying

Dried cocoa pod husk could be used for animal feed as it is rich in protein, carbohydrate, and proximate composition is in close range with that of maize.

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