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DETERMINATION OF THE FREE FATTY ACID CONTENT OF COCOA BEANS FROM THE INDENIÉ-DJUABLIN REGION CÔTE D'IVOIRE

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ABSTRACT
The quality of cocoa beans is a major concern for cocoa farmers, manufacturers and consumers of cocoa products. Thus our study proposes to determine the content of free fatty acids in cocoa beans in the Indenié-Djuablin region, which is one of the major cocoa production areas in the Ivory Coast. A total of 20 cocoa bean samples were taken from the Indenié-Djuablin region. These samples were transported to the laboratory for analysis of free fatty acids. These free fatty acids were determined by titrimetry. The results of this study showed that all samples contain free fatty acid. The contents of these free fatty acids vary from 1.91% to 2.42% and the highest contents are found in the samples from the locality of Bondoukou while the lowest contents come from the samples from the locality of Dimbokro. These levels obtained lead to a risk of exposure of the population to the harmful effects of these molecules. In general, the high levels of free fatty acid in samples of cocoa beans from Indenié-Djuablin could be due to poor agricultural practices, from harvesting to packaging of the beans in warehouses. Added to this is also the failure to comply with the construction standards for storage warehouses and the lack of maintenance of these premises.

KEYWORDS: Cocoa beans, free fatty acids, producers.

INTRODUCTION
Cocoa cultivation was introduced in Ivory Coast at the end of the 19th century thanks to colonization.[1] Its development really began with the independence of the country in 1960. Since 1970, the culture has experienced a boom which has allowed the Ivory Coast to occupy the first place in the world among cocoa producing countries, with productions often reaching 1.2 million tonnes of beans per year, or nearly 40% of world production.[2,3] But following liberalization in 1999, there has been a drop in the quality of Ivorian cocoa on the world market. Indeed, the content of free fatty acids in Ivorian cocoa exceeds the accepted standards of 1.75%; which considerably reduces its marketability.[4] This deterioration in quality leads to financial loss for producers and additional processing costs for butter dishes.[5]

Black beans appear to be the main agents of high free fatty acid (FFA) levels. If late harvests linked to work constraints partly explain it, this document introduces two new hypotheses: on the one hand, the seasonal climate and the drought from January to March play a key role in the rotting and drying out of the pods, and this is why at this time in particular, the over-mature pods produce real black beans.[6]

The quality of cocoa beans is a very important factor in cocoa marketing as it influences the market value of cocoa. This is because poor quality beans are of no commercial value and exporters suffer enormous economic losses.[7,8] To ensure the good quality of the cocoa, several works including the determination of mycotoxins, pesticide residues and fatty acids are carried out on the cocoa beans before they are offered for export.

This is why our work study falls within this context of quality control of cocoa beans and intends to determine the content of free fatty acids in cocoa beans in the Indenié-Djuablin region.

MATERIAL AND METHODS

1-Material

Biological material

Dried cocoa beans represent our biological material. They come from the Indenié-Djuablin region, a production area in eastern Ivory Coast. Fig.1 below shows our biological material.

Fig. 1: Cocoa beans.

Methods

Preparation and conditioning of samples

The samples taken were followed up in the laboratory. The mass of the primary sample is 1 kg. Each primary sample was, ground, homogenized then a sub sample of 200 g was made from the homogenized ground material.

Extraction of fat from cocoa beans

To extract the fat, 25g of the ground material was weighed and 100 ml of n-hexane was added thereto, then the mixture was homogenized using an Ultra-Turax mixer. The resulting solution was filtered through paper containing filter glass wool. The filtrate solvent was completely evaporated to obtain the fat. This fat was heated in an oven at 105°C to remove traces of water.

The mass of the fat was determined according to the formula below:

$$M_G = M_2 - M_1$$

M_2: mass of the balloon with the fat (g)
M_1: mass of empty balloon (g)
M_G: mass of fat (g)

Determination of Free Fatty Acid Content (FFA)[9]

The fat was dissolved in 100 ml of the ether di-ethyl ethanol mixture containing the phenolphthalein. The acidity of the mixture was titrated using 0.1N NaOH solution in a burette. The NaOH solution was dropped into the mixture until the persistent light pink color was obtained. The volume of NaOH poured in was noted.

The FFA percentage was calculated according to the following formula:

$$\% \text{ F.F.A} = A \times N \times 282/10 \times W$$

A: Volume of NaOH poured in (ml)
W: mass of the sample (g)
N: Normality of 0.1 N NaOH solution
282: Molecular weight of oleic acid

RESULTS

A total of 20 samples of cocoa beans were analyzed. These samples are distributed between the towns of Arrah, Dimbokro, Bondoukou and Bongouanou on the basis of five (05) samples per town. The percentages of free fatty acids in cocoa beans from these localities are shown in the table below.

Table 1: Percentage of free fatty acids.

City	Percentage of free fatty acids (%)
Arrah	2.36
Dimbokro	2.42
Bondoukou	1.91
Bongouanou	1.93

The content of free fatty acids in cocoa beans is between 1.91% and 2.42%. The lowest FFA content (1.91%) corresponding to Dimbokro cocoa beans while the highest FFA content (2.42%) goes to Bondoukou cocoa beans. The average FFA content of cocoa beans from the Indénié-Djuablin region is 2.16%.

The comparison of the FFA contents of cocoa beans to the[10] (< 1.75%) is shown in Fig. 2.

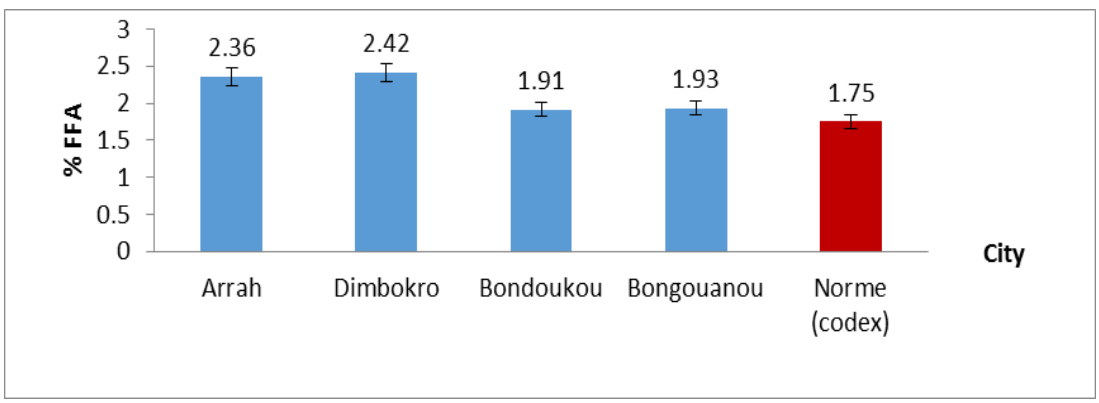

Fig. 2: Comparison of the content in % FFA with the Codex Alimentarius standard.

DISCUSSION

The results obtained after the analysis of the various samples show the presence of free fatty acids in cocoa beans from the Indenié-Djuablin region.

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The high rate of FFA could be due to poor agricultural practices from harvesting to storage of the beans. Indeed, failure to follow good practices for picking, fermenting, drying and storing cocoa beans can lead to an increase in the acidity of cocoa.[12] Picking unripe pods, the presence of black cocoa beans, poor fermentation, poor drying of the beans as well as the presence of impurities of various kinds, are among the bad practices likely to increase the content of free fatty acids from cocoa beans.

CONCLUSION

The Indénié – Djuablin region, which is located in the small cocoa production area of Côte d'Ivoire, has an average FFA content (2.16%) above the fatty acid standard of cocoa butter. of the Codex Alimentarius (< 1.75%). This high rate of FFA could be due to the non-respect of good practices ranging from the picking to the obtaining and storage of cocoa beans, adopted by actors in the cocoa sector such as producers and cooperatives. This situation deserves special attention from the public authorities in order to rectify the situation and avoid the economic losses that could result from the poor quality of the first export commodity from the Ivory Coast.

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