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Analysis of the Physico-Chemical Quality of Cocoa Beans (Theobroma Cacao) From a Daloa Cooperative (Côte d'Ivoire)

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Abstract

Côte d'Ivoire is the world's leading producer of cocoa beans. The aim of this study was to analyse the physico-chemical quality of cocoa beans received in a Daloa cooperative. These beans come from 10 sections (village). Several parameters were evaluated: pH, total acidity, volatile acidity, humidity, grazing, broken beans, mouldy beans and defective beans. Results showed that pH (0.32 ± 0.01 - 5.75 ±0.07), total acidity (0.32 ± 0.01 - 0.45 ± 0.03), moisture (8.45 ± 0.36), grazing (85.33 ± 5.03 - 93.33 ±5.77), broken beans (0.3 ± 0.09 -1.04 ± 0.05) and mouldy beans (0.00 ± 0.00 – 3.33 ± 1.15) vary from section to section. In addition, physico-chemical analyses of the bean samples from the 10 sections showed significant differences ($p<0.05$). In addition, the variance analysis showed that the differences were significant ($p<0.05$) regardless of the parameter considered. It is clear from the analyses that the planters of the Balea and Bowaly sections have beans that have a physico-chemical quality inferior to that of the Bandiahi, Bonoufla, Kamblesso, Sikaboutou, Luenoufla, Mossikro, Blaisikro and Ourouta on the basis of rank. But the Bandiahi, Sikaboutou, Bonoufla and Mossikro sections have the best beans. Overall, the various sections meet the standards with more than 70% of the parameters assessed.
Keywords: Côte d'Ivoire; cocoa beans; Daloa cooperative.

1. Introduction

Cocoa is native to South America and has been used at least 1400 years before Jesus Christ [1]. It occupies a prominent place in the global economy with 3,740,000 tonnes/year, for about $7.5 billion [2]. Africa alone provides 70% of the world's production. Côte d'Ivoire is the world's largest producer of cocoa beans, accounting for more than 43 % of world production [3]. This makes cocoa an agricultural commodity of great economic importance to the country [4]. This sector accounts for more than 20 % of gross domestic product (GDP), more than 50% of export earnings and, above all, two-thirds of jobs and incomes of the population, according to the World Bank [5]. The technological transformation of beans into chocolate and related products requires a primary post-harvest handling process involving shelling, fermentation and drying [6, 7]. A good implementation of these various operations ensures that quality products are obtained. As a result, cocoa beans used in the manufacture of chocolate and other products must be subject to thorough quality control. In Côte d'Ivoire, producers are affiliated with cooperatives that are responsible for assessing and monitoring the quality of cocoa before export. These various cooperatives are

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themselves under the control of the Coffee and Cocoa Council, which in turn must confirm the quality of the cocoa before it is shipped for export. The term "quality" in cocoa covers several criteria, including the size of the beans, the homogeneity of the seed, the content and quality of the butter, the content of heavy metals, the volatile and total acidity content, humidity, pH, mold, slate and defective beans. However, it is clear that the quality control and analyses carried out in cooperatives are limited and do not involve all the quality criteria. In order to ensure the good quality of the beans from these different planters grouped in section, this study has been undertaken. The theme is "Analysis of the physico-chemical quality of cocoa beans from a cooperative in Daloa (Côte d'Ivoire)". The general objective is to assess the quality of the beans of the cooperative and above all to provide physico-chemical data to be taken into account for a better quality of the cocoa beans.

2. Material and Methods

2.1. Material

2.1.1. Plant Material

The plant material consists of cocoa beans received by the cooperative. These samples come from groups of peasants subdivided into sections and affiliated to the cooperative.

2.2. Methods

2.2.1. Sampling

L'échantillonnage a été réalisé sur des fèves de cacao fermentées et séchées provenant de dix sections suivantes : *Bandiahi* ; *Bonoufla* ; *Kamblesso* ; *Sikaboutou* ; *Bowaly* ; *Luenoufla* ; *Mossikro* ; *Blaisikro* ; *Ourouta* et *Balea*. Once the beans arrive in the cooperative, the bags containing them are probed. After sampling, a quantity of 3 kg of beans is taken, making up the sample for the section.

2.3. Determination of the Chemical Parameters of Beans

2.3.1. Determination of Moisture Content

A quantity (20 g) of the sample is spread in a previously dried and tared crucible. The whole thing is put in the oven (MEMMERT, West Germany) at 105°C for 24 hours. The removed sample is cooled in a desiccator and weighed [8]. The water content is then determined according to the following formula.

$$\text{Rate humidity} = \frac{(P_1 - P_2)}{P_1 - P_0} \times 100$$

P0: mass of empty crucible; P1: mass of empty crucible + sample; P2: mass of empty crucible + sample after evaporation

2.3.2. Determination of Total Acidity

Total acidity was determined from free acidity according to ISO [9]. The free acidity, expressed as Zeller acidity of cocoa beans, was determined by titration of an aqueous extract of beans, with soda, according to the classical method No. 9 of the International Coffee and Cocoa Organization adopted in 1963. For example, 5 g of cocoa powder was suspended in 50 ml of distilled, boiled and cooled water. After 1 hour of agitation, the free acidity was measured in the suspension with NaOH (0.1N) up to pH 8.3. The results were expressed in ml of NaOH N/ 10 needed to neutralize the free acidity contained in 1 g of cocoa powder or in meq of NaOH per gram of cocoa powder.

$$\textbf{Free acidity} = \frac{(V \times N)}{Pe} \text{ (meq / g)}$$

V: Volume of NaOH poured; N: normality of NaOH solution; Pe: test sample (g). The Zeller coefficient is used to calculate the total acidity, which is the sum of water-soluble acids, leached fatty acids and salified acids:

$$\textbf{Total acidity} = \text{free acidity} \times \frac{1}{0{,}5782} \text{ (meq / g/ mL)}$$

2.3.3. Determination of pH

The pH was measured using the method described by Lopez, *et al.* [10]. A quantity of cocoa powder (10 g) was prepared in 90 ml of boiling distilled water. The mixture was homogenized and cooled to 25°C. A pH meter was used to determine the pH of the solution placed on a magnetic stirrer.

2.3.4- Determination of Volatile Acidity

Volatile acidity was determined using ISO [11]. One (1) g of cocoa powder was introduced into a 500 ml round-bottomed flask with 2 drops of steaming sulphuric acid. After adding 400 ml of distilled water, the flask was placed in a flask heater (Electrothermal, United Kingdom) and adjusted under the extractor.Subsequently, a distillation column connected to a refrigerant was placed at the top of the extractor and a 500 ml Erlenmeyer containing 50 ml of distilled water was placed at the outlet of the refrigerant. The flask was then heated to 300 ml of distillate. Finally, the distillate was measured in the presence of phenolphthalein, with a 0,10 N soda solution placed in a 2 ml burette.

$$\textbf{Volatile acidity} = \frac{\text{(Volume (mL) of NaOH poured)}}{\text{g of cocoa powder}}$$

2.4. Determination of Physical Parameters

2.4.1- Determination of Grazing

For the determination of seed, three hundred grams of beans were weighed in accordance with ISO 2292 cocoa beans – sampling (ISO 1973) and then cleared of all residues, foreign objects, flat beans and crabots which are then weighed and disposed of. An equivalent weight of whole beans taken from the whole sample is added. The 300 g of beans are counted so as to obtain three heaps of 100 beans. The bundle of beans in the three piles is then counted and divided by three (3) to obtain the seed.

$$\textbf{Grazing} = \frac{\text{number of beans in 300 g}}{3}\ (\text{g})$$

2.4.2. Determination of the Level of Waste, Foreign Matter, Breakage and Crabot

Weigh three hundred grams of beans, separate the waste, crabots, foreign matter and chips, then weigh each separately. The percentage (%) of broken bones, crabots, foreign matter and waste is determined according to the formula:

$$\textbf{Pourcentage (X)} = \frac{\text{Mass of X}}{\text{Me}} \times 100$$

With: Me: sample mass; X: (Crabot; foreign material; breakage; waste).

2.5. Classification of Bean Samples

2.5.1. Determination of Defects Through the Cut

For the determination of the various defects, ISO 1114 (1977) stipulates a cut of 300 beans.In the study, three samples of 300 beans per sample were split longitudinally, for a total of 900 split beans per sample. Then the various defects such as slatted, mouldy and defective beans are counted per pile of 100 split beans, then a percentage for each defect has been determined per sample.

2.5.2. Determination of Different Grades of Bean Samples

The grade of beans was assigned according to ISO [12], based on the percentages of mouldy, slatted and defective beans.

2.6. Statistical Analysis of Data

The data collected from the physico-chemical characterisation of the cocoa bean samples were subjected to statistical analyses. For these statistical processing, STATISTICA 7.1 was used.

3. Results and Discussion

3.1. Results

3.1.1. Characterization of Chemical Parameters

The moisture content of the beans from the sections varies between 6.69± 0.24% and 8.46± 0.39%. The majority of the samples (60%) have a moisture content above the standard of 8%. Only bandiahi sections, bonoufla, sikaboutou and blaisikro have a moisture that meets the standard.

Concerning pH, of the ten sections analysed, 6 sections namely bowaly, luenoufla, blaisikro, ourouta, Balea and sikaboutou have a pH between 5,18 ± 0,03 and 5,5 ± 0,06 and 4 sections namely kamblesso, bandiahi, bonoufla and mossikro have a pH greater than 5.5±0.06. The bowaly section obtained the lowest pH (5.18± 0.03) and the kamblesso section the highest pH (5.75 ±0.07). All the cocoa beans analysed have acidic pH.

For the total acidity content of the samples, the values range from 0.32± 0.01 meq/g/ml to 0.45 ± 0.03 meq/g/ml. The sikaboutou section records the lowest acidity (0.32± 0.01 meq/g/ml) and the bowaly section the highest acidity (0.45± 0.03 meq/g/ml).

Finally, the volatile acidity determined for each sample shows that of the 10 samples analysed, 7 have a volatile acidity ranging from 0.35 ± 0.05 ml NaOH/g to 0.5± 0.1 ml NaOH/g and 3 have a volatile acidity greater than 0,5± 0.1 ml NaOH / g. The kamblesso and sikaboutou sections with volatile acidities of 0.35 ± 0.05 ml NaOH / g and 0.9± 0.1 ml NaOH / g respectively record the smallest and largest (Table I)

Table-I. Chemical parameters of cocoa beans of the ten sections

Sections	Bandiahi	Bonoufla	Kamblesso	Sikaboutou	Bowaly	Luenoufla	Mossikro	Blaisikro	Ourouta	Balea	CV (%)
pH	$5,58^{cd}$±0,01	$5,64^{fg}$±0,01	$5,72^{gh}$±0,07	$5,5^{c}$±0,06	$5,18^{a}$±0,03	$5,49^{de}$±0,06	$5,75^{h}$±0,07	$5,4^{cd}$±0,06	$5,26^{ab}$±0,04	$5,32^{bc}$±0,08	3,52
Total Acidity	$0,37^{bc}$±0,01	$0,36^{bc}$±0,01	$0,36^{bc}$±0,02	$0,32^{a}$±0,01	$0,45^{d}$±0,03	$0,34^{ab}$±0,02	$0,38b^{c}$±0,04	$0,33^{a}$±0,01	$0,4^{c}$±0,01	$0,34^{ab}$±0,03	11,53
Volatil acidity	$0,45^{ab}$±0,04	$0,4^{ab}$±0,05	$0,35^{a}$±0,05	$0,9^{d}$±0,1	$0,4^{ab}$±0,005	$0,38^{ab}$±0,02	$0,63^{c}$±0,05	$0,5^{b}$±0,1	$0,45^{ab}$±0,05	$0,7^{c}$±0,1	34,28
Humidity (%)	$7,78^{bc}$±0,13	$6,69^{a}$±0,24	$8,26^{cde}$±0,14	$7,86^{bc}$±0,16	$8,16^{cde}$±0,14	$8,35^{de}$±0,14	$7,59^{b}$±0,47	$8,35^{de}$±0,32	$8,35^{de}$±0,27	$8,46^{e}$±0,39	7,12

The identical letters (a, b, c, d, e) on the same line indicate whether or not there is a significant difference between the average chemical parameters of bean samples (P > 0.05).
Total Acidity (Mesh/ g/ ml)
Volatile Acidity (ml NaOH/ g cocoa powder)
CV: coefficient of variation

3.2. Characterization of the Physical Parameters of Cocoa Beans in the Ten Sections

Sample graining ranges from 85.33 ±5.03 g to 93.33± 5.77 g. Bandahi and Balea sections with a graining rate of 85.33± 5.03 g and 93.33 ±5.77 g, respectively, have the lowest and highest contents. It appears here that the bandiahi section has the best graining and the Balea section the worst graining compared to the other sections. In terms of fracture rates, the 10 sections analysed had rates ranging from 0.3 ±0.09% to 1.04 0.05%. The mossikro and bonoufla sections had the lowest (0.3± 0.09%) and the highest, respectively. (1.04±0.05%). The mossikro section records the best breaking rate.

For the foreign matter rates of the various samples, the values are between 0.03 ±0.05% and 0.43± 0.07%. The Balea section had the lowest rate (0.03± 0.05%) and the blaisikro section the highest rate (0.43±0.07%).

In terms of the waste rates of each sample, of the ten sections analysed, 4 have a waste rate of between 0.41 ±0.12% and 0.63 ±0.01% and 6 have a waste rate of more than 0,63 ±0.01%. The bandiahi and mossikro sections with rates of 0.41 ±0.12% and 1.39± 0.09% respectively recorded the lowest and highest rates.

Finally, the rate of Crabot in samples is between 0.4± 0.69% and 1.4± 0.1%. Of the 10 sections analysed 4 have a Crabot rate between 0.4± 0.69% and 0.93 ±0.45% and 6 have a Crabot rate greater than 0.93 ±0.45%. The lowest rate (0.4 ±0.69%) was obtained by the Urouta section and the highest rate (1.4 ±0.1%) by the Bonoufla section. The bonoufla section has the lowest Crabot level (Table II).

Table-2. Paramètres physiques des fèves de cacao des dix sections

Sections	Bandiahi	Bonoufla	Kamblesso	Sikaboutou	Bowaly	Luenoufla	Mossikro	Blaisikro	Ourouta	Balea	CV(%)
Braining (g)	85,33^{a}±5,03	91,66^{a}±8,50	89,66^{a}±1,5	91,33^{a}±9,01	89,00^{a}±5,56	87,00^{a}±6,08	90,00^{a}±5,29	89,33^{a}±2,51	91,33^{a}±3,51	93,33^{a}±5,77	5,87
frature (%)	0,70^{cd}±0,10	1,03^{e}±0,07	0,55^{bc}±0,15	1,04^{e}±0,05	0,43^{ab}±0,03	0,73^{d}±0,15	0,3^{a}±0,09	0,62^{cd}±0,07	0,7^{cd}±0,005	0,75^{d}±0,04	34,28
Foreign materials (%)	0,10^{a}±0,17	0,43^{b}±0,07	0,7^{c}±0,1	0,4^{b}±0,06	0,34^{b}±0,05	0,10^{a}±0,01	0,10^{a}±0,10	0,9^{d}±0,13	0,06^{a}±0,10	0,03^{a}±0,05	94,05
Waste (%)	0,41^{a}±0,12	0,54^{ab}±0,06	0,44^{a}±0,05	0,66^{b}±0,01	0,42^{a}±0,02	0,83^{c}±0,13	1,39^{d}±0,09	0,66^{b}±0,04	0,63^{b}±0,01	0,65^{b}±0,05	42,56
Crabots (%)	1,22^{b}±0,02	1,4^{b}±0,10	1,10^{b}±0,10	1,33^{b}±0,005	1,33^{b}±0,02	0,93^{ab}±0,45	0,93^{ab}±0,35	1,13^{b}±0,06	0,40^{a}±0,69	0,83^{ab}±0,7	39,87

The identical letters (a, b, c, d) in the same line indicate the existence or no significant difference between the average physical parameters of the bean samples (P > 0.05) CV: Coefficient of Variation

3.3. Classification of the Various Defects and Classification by Grade

The percentage of mouldy beans in the samples tested is between 0.00 ±0.00% and 3.33 ±1.15%. The majority of sections (90%) have rates between 0.33± 0.03% and 2.00± 1.00%. Bonoufla (0.33 ±0.03%) and bowaly (3.33± 1.15%) recorded the lowest and highest rates.

With regard to the rate of slate beans, it appears that the 10 sections analysed have a rate of slate beans ranging from 0.33± 0.3% to 2.22 ±1.01%. The bowaly and luenoufla sections have rates of 0.33± 0.3% and 2.22 ±1% respectively,01% have the lowest and highest rates. All sections have a slate bean rate that meets the standard (3%).

In terms of defective bean rates, 9 out of 10 samples have a defective bean rate less than or equal to 2.99± 0.3% and only one section has a defective bean rate greater than 3%. The Balea section (3.33± 0.67%) with a defective bean rate above 3% does not meet the grade 1 (3%) cocoa standard, unlike the other sections. The results for the grade of beans show that out of the ten samples, according to their percentage of mouldy, slate and defective beans, eight samples have grade 1 (bandiahi, bonoufla, kambglesso, sikaboutou, mossikro, luenoufla, blaisikro, ourouta) et deux échantillons (bowaly, balea) ont le grade 2 (Tableau III).

Table-3. Default percentage and classification by grade of the ten sections

Sections	Bandiahi	Bonoufla	Kamblesso	Sikaboutou	Bowaly	Luenoufla	Mossikro	Blaisikro	Ourouta	Balea	CV(%)
Mouldy beans (%)	2,00^{bc}±1,00	0,33^{a}±0,57	0,66^{ab}±0,87	1,33^{ab}±0,88	3,33^{c}±1,15	1,00^{ab}±1,00	1,99^{bc}±0,88	0,00^{a}±0,00	0,33^{a}±0,03	0,99^{ab}±0,66	98,71
Beans Slated (%)	1,66^{a}±1,52	1,00^{a}±1,73	1,66^{a}±0,57	1,99^{a}±0,88	0,33^{a}±0,3	2,22^{a}±1,01	1,66^{a}±1,52	1,00^{a}±1,73	2,00^{a}±1,73	1,99^{a}±0,3	77,11
Beans Defective (%)	1,00^{a}±1,00	2,99^{bc}±0,3	0,99^{a}±0,88	2,66^{abc}±0,57	1,66^{ab}±0,3	1,00^{a}±1,00	1,00^{a}±0,00	1,00^{a}±1,73	2,00^{abc}±1,00	3,33^{c}±0,67	65,61
Grade	1	1	1	1	2	1	1	1	1	2	

The identical letters (a, b, c) in the same line indicate the existence or no significant difference between the grades and the average defects of the bean samples (P > 0,05).CV: Coefficient of Variation

4. Discussion

The results revealed that the physico-chemical parameters differ significantly ($p < 0.05$) from one sample to another. Analysis of the pH values of the different cocoa bean samples from the cooperative revealed low pH values for the bowaly, ourouta, blaisikro and balea sections and higher values for the bandiahi, bonoufla sections, kamblessso, sikaboutou, luenoufla and mossikro. The recorded pH values are higher than the pH values obtained by Nogbou, *et al.* [13] in the case of microwave drying of cocoa beans. The low pH values of the bowaly, ourouta, blaisikro and balea sections (5.18 to 5.4) are consistent with the pH values obtained (4.7 - 5.4) by Kouadio, *et al.* [14] who noticed that the pH drops during fermentation before going back to storage. The pH levels (5.49 to 5.58) of the bandiahi, sikaboutou and luenoufla sections are close to the pH recommended by ISO [12] and would be due to a very good fermentation and a good drying of the beans (pH around 5.5). Higher values were recorded at the kamblessso, luenoufla and mossikro sections (5.62 to 5.75). According to Khairul [15] and Barel [16], low pH levels (4.97 to 5.04) are due to poor fermentation, poor drying of beans and diffusion of organic acids during fermentation. The pH of the different samples is acidic. At this pH, cocoa beans are a favorable substrate for the proliferation of molds and therefore acidify the substrate, because according to Duron [17] fungi can grow at pH between 3 and 8 with optimum growth. between 5 and 6. The pH level gives an indication of the acidity of the beans.

In terms of total acidity, the bowaly, ourouta and mossikro sections have higher values than the bandiahi, bonoufla, kamblessso, sikaboutou, luenoufla, blaisikro and balea sections. Overall, these values are lower than those reported by Akmel, *et al.* [18] and Nogbou, *et al.* [13] in the case of drying respectively on a rack and microwave microwaves of cocoa beans. This asserts that the longer the beans are dry, the higher their total acidity levels. According to Pointillon [19], the weak acidity of beans is caused by drying on a rack (4.10 ± 0.48), a device generally used in village environments. This low acidity observed on this device is certainly attributable to the slow drying it offers unlike bitumen drying (4.52 ± 0.99) and sheet metal (4.22 ± 0.41) Mulato, *et al.* [20]; Godfrey [21].

Concerning the volatile acidity of the cocoa bean samples, the results showed a lower volatile acidity for the leunoufla, bonoufla, kambilesso, blaisikro, urouta, banidiahi and bowaly sections (0.35 - 0.5) compared to sections mossikro, balea and sikaboutou (0.63 - 0.9). The volatile acidity contents of the Mossikro, Balea and Sikaboutou sections are close to those obtained by Nogbou, *et al.* [13] on microwave dried beans (0.71 and 0.74 mL NaOH / g). They noticed that as the power of the microwave increased, so did the volatile acid content. The high values of volatile acidity would be according to Akmel, *et al.* [18], due to devices used for drying beans (bitumen, tarpaulin, sheet metal) and their ability to easily overheat. Indeed, studies have shown that the volatile acid content in beans increases with high temperatures caused by drying devices [22, 23]. Volatile acids (mainly acetic acid) can be the main cause of high acidity of cocoa beans. This assertion is in agreement with the results obtained by Jinap, *et al.* [24].

The moisture content, which is the amount of free water available in the sample, is responsible for several phenomena of biological alteration of the food. Thus, the humidity levels of the cocoa bean samples of the different sections are between 6.69% and 8.46%.

The sections bowaly, luenoufla, blaisikro, ourouta, balea and kamblesso have a non-conforming moisture content (> 8%) and the bandiahi, bonoufla, sikaboutou and mossikro sections have an acceptable moisture content of less than 8% [12]. A non-compliant moisture content would be the effect of inadequate drying and could affect the sanitary quality of the beans [24]. Similarly, the water contents of samples indicating a value of less than 8% indicate that the beans have been properly treated after harvest. When the moisture content is above 8%, there is not only the growth of mold and bacteria but also the risk of loss of edible material, with serious potential consequences for food safety, aroma and quality. of transformation. If it is less than 6.5%, the hull will be too fragile and the beans will disintegrate, resulting in a high level of broken beans [12].

The determination of physical parameters during the quality inspection is an important criterion for the acceptability of cocoa beans. Thus, the graining of the sections is between 85.33 g and 93.33 g. The beans from the ten sections are therefore quite large. The results obtained are close to those obtained by Chen-Yen-Su [25] (grainage = 96). Overall, the graining values of the ten sections meet the grading standard (≤100), ISO 2451, 2017.

In terms of breakage rate, foreign matter, waste rate and claw rate of cocoa beans, all samples comply with ISO [12].

With regard to the determination of the different defects and the classification of the beans in grade, only slate bean yields all conform to the standard (≤ 3%). At the level of defective and moldy beans, 90% of the samples are in agreement with the established standard (rate ≤ 3%) which gives the beans of these sections the grade 1 [12]. The bowaly and balea sections have respective rates of moldy beans (3.3%) and defective beans (3.3%) above the grade 1 cocoa standard. The grade of the samples is determined according to the rates of the different varieties. defects in the bean samples. A high value of the moldy bean rate would be due to slow drying or improper fermentation and moisture absorption during storage under adverse conditions. According to Dodemont, *et al.* [26], the high levels of moldy beans are explained by the moisture absorption of the beans after drying. Indeed, Moreau [27] believes that molds prefer high humidity levels, especially in the fermentation phase where the beans are exposed. The bowaly and balea sections meet the grade 2 cocoa standard, while the bandiahi, luenoufla, blaisikro, kamblesso, bonoufla, sikaboutou, uruta and mossikro sections meet the grade 1 cocoa standards (ISO 2451, 2017). Grades 1 recorded at bandiahi, luenoufla, blaisikro, kamblesso, bonoufla, sikaboutou, uruta and mossikro sections are similar to grades obtained by Koffi, *et al.* [28] and this will reveal the good quality of the bean samples, which would be attributable to fermentations in the box and banana leaf compared to fermentations on plastic sheeting.

5. Conclusion

At the end of our study on the quality control of cocoa beans received by the cooperative. It can be seen that the majority of sections (60%) obtained a compliant pH and only 40% had pH values above the standard. The total acidity and volatile acidity of all sections are consistent. In terms of humidity, only the bandiahi, bonoufla, sikaboutou and mossilro sections have humidities that meet the standard (humidity level 8%). All sections have an acceptable graining with the Best Bandiahi, Luenoufla, Blaisikro, Bowali and Kamblesso sections. As for the broken rice, foreign matter, garbage and jaw contents, all the sections comply with the standards and are of grade 1, only the Bowali and Balea sections have the grade 2. Similarly, the planters of the Baléa and Bowali sections have beans. which have a lower physicochemical quality compared to the Bandiahi, Bonoufla, Kamblesso, Sicaboutou, Luenoufla, Mossikro, Blaisikro and Ourouta sections on the basis of grade. In the end, it is the planters of the Bandiahi, Sicaboutou, Bonoufla and Mossikro sections who have the best beans.

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