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Assessment of Crude Palm Oil Quality Marketed at Yaounde– Cameroon

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ABSTRACT: This study was aimed at the assessment of the food quality parameters of crude palm oil (CPO) sold on the major markets of Yaounde city. Information on the origin of the crude palm oil sold therein was gathered from 56 wholesalers, that is eight per market. Twenty one (21) samples were gathered for the purpose of this survey, which is 3 per market depending on the main sources for the analysis of food quality parameters, namely acidity, peroxide value, water content and the potential hydrogen (pH). The results show that the CPO sold in Yaounde markets comes mainly from smallholders sector in Bassa communities and also from SAFACAM of Dizangue industrial sector. As regards food quality, the peroxide value, which was below the maximum level of 10 meq O2/kg, showed no significant difference between the various sources. The pH varies between 4.00 and 4.50 while water content and acidity vary from 0.10 to 1.13% and from 2.56 to 12.16% respectively. Based on these results, the food quality of the CPO samples assessed were of low food quality. CPO from the Dizangue plant proved to be of low quality despite its mechanised production system. These results further show that inappropriate ways of transportation and storage are the cause of the deterioration of the palm oil from the Dizangue plants.

Keywords: Yaounde markets, Wholesalers, Crude Palm Oil, Oil Quality.

RESEARCH PAPER

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1. INTRODUCTION

The oil palm (*Elaeis*) comprises of two species namely *Elaeis guineensis* originated from West Africa and *Elaeis oleifera* originated from America. Like other cash crops such as cocoa and rubber, oil palm requires suitable climatic and soil conditions for optimum yield. It is cultivated mainly for its fruits which are very profitable due to the fact that it can produce more oil per land area than the other plants and that it produces two type of oil namely crude palm oil (CPO) and palm kernel oil (PKO) (Sundram *et al.,* 2003). The palm fruits take five to six months from pollination to maturity. CPO is the most utilized vegetable oil in most part of the world. CPO has dominated the global vegetable oil supply accounting for 33% of total edible oil in the world. Since 2006, palm oil is the most consumed oil in many in the world. It is used in various food products such as margarine and cosmetics such as soap. 70% of crude palm oil (CPO) is produced by the industrial sector constituted of major companies such as SOCAPALM, PAMOL, CDC, while the informal sector (smallholders) produces 30% CPO. It has also been reported that the smallholders cover about 80% of the Nigeria oil palm sector Ohimain *et al.* (2013). CPO quality such as levels of free Fatty Acids (FFA), often exceed the quality standards (Noviar *et al*., 2016).

Although the CPO consumed as food is hardly subjected to strict quality analysis in several markets over the world, the percentage of FFA % is the most commonly used criterion for determining the quality of CPO. An oil with more than 5% FFA content is not good in terms of quality. The FFA of oil comes from the hydrolysis of triacylglycerol of palm oil by lipase. Ngando *et al. (2006)* show that this lipase is present in palm fruit mesocarp. This enzyme is activated at maturity upon bruising and/or wounding of the fruit. Several studies documented that lipase activity in some extend, can also be due to the presence of some microorganism in CPO (Tagoe *et al. 2012*, Likeng *et al.,* 2017). The CPO produced by smallholders is considered as low quality according to the CPO

production process (Ngando *et al* 2008). The presence of that microorganism in CPO, may reflect a lack of care during fruit harvesting, transportation, sanitation and processing in the state of Bahia *(*De Almeida *et al., 2013).*

The quality of palm fruits, processing techniques, handling and storage are critical points to be considered in the production of quality palm oil *(*Gulla & Waghray (2011)**;** Izah & Ohimain, *2015).* For that raison, Noviar *et al. (2016)* concluded that, all activities conducted by humans in the informal palm oil production sector are liable to increase CPO acidity. Our previous work showed that, the acidity of palm oil is affected by several factors, the major ones being extraction procedures, presence of microorganisms and the genotype of the palm tree *(*Likeng *et al. 2016*, Likeng *et al. 2017).* After showing the difference in terms of quality between oil from smallholders sector and industrial sector, Ngando *et al. (2013)* demonstrated that 50% CPO of the major markets of Douala city was more than 5% of FFA content. However, no information on the quality of palm oil has been documented in Yaounde area, the political capital of Cameroon. For that propose, the current study was aimed at the assessment of the quality of CPO in its majors markets.

2. METHODS

2.1. Study areas

Seven markets were chosen in other to provide equal representation of all the geographical areas of the city of Yaounde. These markets namely Mokolo (M1), Mfoundi (M2), Atangana Mballa (M3), Acaccia (M4), Mvog-betsi (M5), Ekounou (M6), and Mbankolo (M7) represent the major markets of Yaounde subdivision (Figure 1).

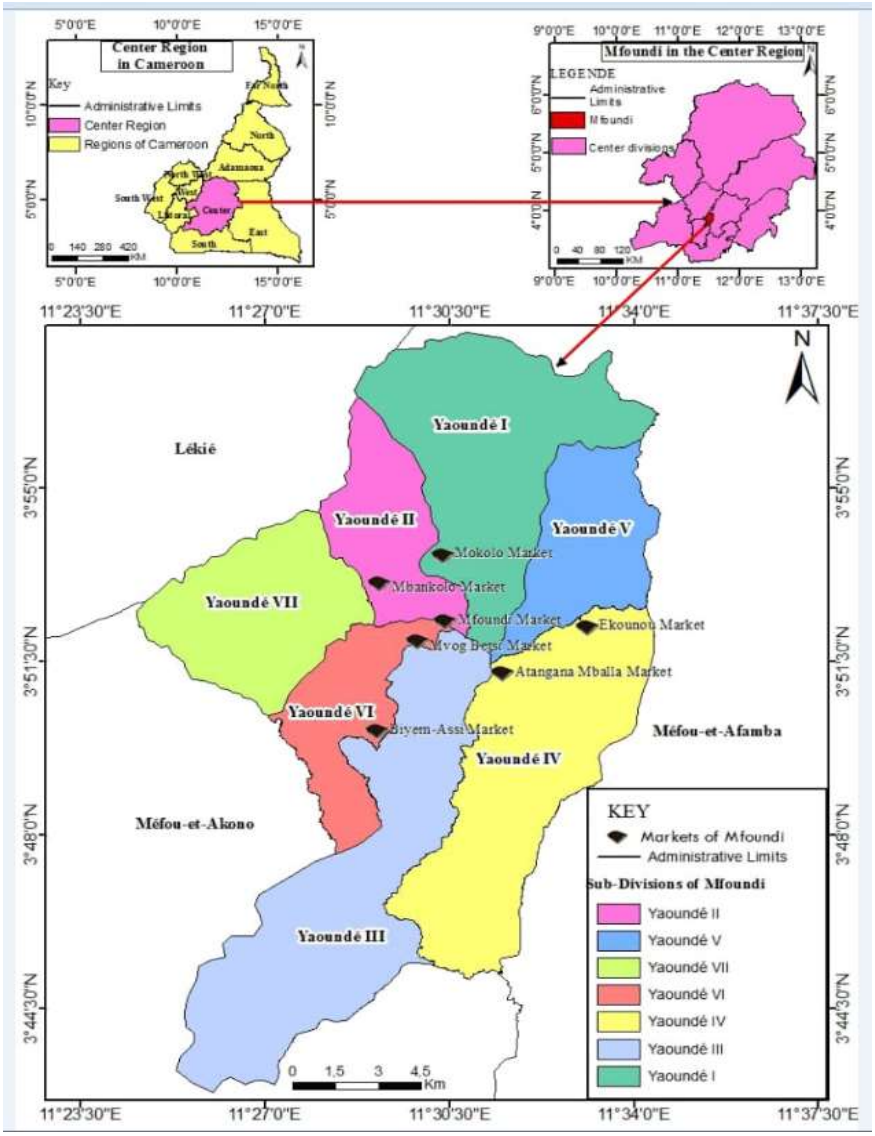

Fig-1: Main major markets of Yaounde area

2.2. Origins, sample collection and quality assessment of CPO of major markets of Yaounde

The origins of palm oil sold in the major markets were determined by a structured interview. This structured interview schedule used for data collection was divided into seven areas (markets) based on the objectives of our study as used in Ajani *et al. (2012)* and Nkongho *et al.* (2014) studies. For each market, eight wholesalers filled the interview, giving a total of fifty six (56) respondents. Only data of wholesalers with more than one year of experience were considered. For each interview, eight parameters namely : sex of the seller, the length of service, origin of palm oil, materials used for selling, mixing of oil before selling, duration of oil storage and selling place, were evaluated.

Three samples of palm oil from the three main origins were analyzed with four replicates per sample with each marking for acidity, pH, humidity and peroxide within 24 hours before collection as in Ngando *et al. (2013)* in the city of Douala. To have the same results in all markets, sample with similar colors were chosen (Figure 2). Precautions were taken to avoid the contamination of the bottles before and during collection of samples for the analysis within 24 hours.

Fig-2: CPO samples of the main origins of the major markets

2.3. Analysis of physicochemical parameters of CPO

Palm oil acidity (POA) was analyzed by titration according to AFNOR procedure as used in our previous research (*Likeng et al*., 2016), and many others *(Tagoe et al. 2012, Ngando et al. 2013).* Moisture content was analyzed by gravimetric method. pH of CPO was evaluated using a pH-meter. The peroxide value was determined by titrating chloroform/glacial acetic acid/potassium iodide solution of the oil with an aqueous solution of sodium thiosulphate using starch as indicator *(Aletor et al., 1990)*.

3. RESULTS

3.1. Distribution of respondents according to socio-economic characteristics of wholesalers and parameters susceptible to modify CPO quality

Results show that 62.5% of wholesalers are male and 37.5% are female. Regarding the selling experience, the average in this trade is 4-6 years (Table I) confirming the reliability of the data obtained from our interview. Results also show that CPO sold in Yaounde markets, comes from two principal sectors that is the smallholder sector from Nyong *et al.* Kelle and Sanaga Maritime subdivision from SAFACAM of Dizangue at 80% and 15% respectively (Table II). Meanwhile, others come from several locations such as CDC from South-west region (2%) and other localities (2%). These results are in line with those of Ngando *et al. (2013)* which showed that, more that 50% of CPO of the major markets of Douala region is from smallholder sectors. Similar results were obtained by Elijah *et al. (2013)* in Nigeria. Concerning the duration of storage, results shows that, CPO is stored at 80% from 5-15 days (Table II). This period correspond to the duration between the arrivals of CPO on the market and the distribution to the sellers. CPO mostly distributed with tankers and tins is at 61% blend before selling. The blending of CPO can be justified for homogenizing CPO purposes before selling given that CPO comes from different origins and on the other hand because the quality of CPO from industrial sector is different from those of the smallholders.

Table-I: Distribution of respondents according to socio-economic characteristics of wholesalers (n=56).

Variables	Number	Percentages (in %)
Distribution of respondents according to wholesalers sex characteristics (n=56).		
Male	35	62.5
Female	21	37.5
Distribution of respondents according to selling experience characteristics (n=56).		
1-3 years	15	26.8
4-6 years	16	28.6
7-9 years	9	16.07
10-13 years	10	17.9
14- 17 years	4	7.14
More than 17	2	3.6
Total	**56**	**100**

Table-II: Distribution of respondents according parameters susceptible to modify CPO quality (n=56).

Variable	Numbers	Percentage in %
Distribution of respondents according to the main origins of CPO characteristics (n=56).		
Bassa	45	80
Dizangue	8	15
North-West	2	3
South- West	1	2
Distribution of respondents according to the duration (days) of storage characteristics n=56).		
0-5	3	5.36
5-10	22	39.28
10-15	28	50
>15	3	5.36
Distribution of respondents according to a provisional materials (n=56).		
Drum	2	3.57
Tin	12	21.42
Tanker and drum	9	16.07
Tanker, drum and Tin	33	58,92
Distribution of respondents according to the blend of CPO before selling (n=56).		
Blend	35	61
Not blend	21	39
Total	**56**	**100**

3.2. Quality assessment of CPO according to the main origin

The physicochemical quality of CPO of the main origins of the major markets of Yaounde city is given in figure 3.

The result of moisture contains between the main origins showed that Dizangue CPO moisture was significantly lower than (0.2%) those of Bassa 1 and Bassa 2 (0.69%). In all origin, these values were lower than the recommended limit.

The potential of hydrogen (pH) ranges from 4.30 ± 0.26 to 4.18 ± 0.20, respectively for Bassa 1 and Bassa 2 origins, with no significant differences among origins.

As acidity as concern, our results ranged from 4.02 to 10.51%, respectively for the Dizangue and Bassa 2 origins. The comparison of these values shows once more a significant difference between the origins. However, the Dizangue oil which is significantly different from the other two origins has a value below the norm of 5% (Figure 3). These two groups (Dizangue on one hand and Bassa 1 and 2 on the other hand are also the same for the peroxide index where the Dizangue oil has the highest value (2.12).

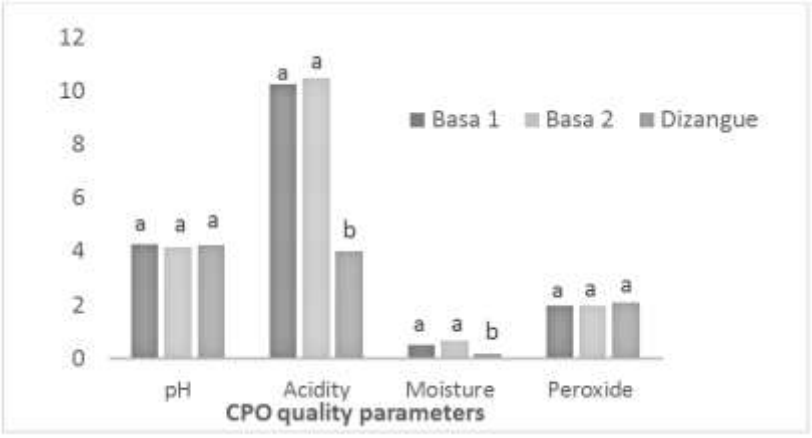

Fig-3: CPO quality of the main Origins

3.3. Quality assessment of CPO according to market

CPO of all the markets except M6 have a moisture content greater than 0.2% which is the maximum limit according to Anonymous (2011). The different values ranged between 0.2 and 1 respectively for M7 and M6. No significant difference have been observed for humidity, although their means (Table III).

The peroxide index results of CPO of the different markets showed a range of 1.11 ± 0.47 meq.

O2 / kg and 2.36 ± 0.52 meq. O2 / kg respectively for M3 and M2. ANOVA showed significant differences between the markets. Three groups were obtained. M1 and M2 for the first group; M3 and M6 for the second and M4, M5 and M7 for the third.

pH evaluation revealed values extended 4.12 to 4.63 respectively for the CPO of M2 and M4 markets. ANOVA showed a significant difference between markets. However, regarding the pH, all the palm oil samples were acidic, confirming the result of the acidity in the different markets, where the acidities of the samples varied from 6.29 ± 4.42% to 10.88 ± 2.86% respectively for the markets M2 and M1. The comparison of CPO acidity among markets, indicated significant differences (Table III).

Table-III: CPO quality according to the seven markets. M1: Mokolo,, M2: Mfoundi, M3: Atangana Mballa, M4: Acaccia, M5: Mvog-betsi,, M6: Ekounou and M7: Mbankolo. Means in each row followed by different letters are significantly different (p<0.05).

Markets	pH	Acidity	Moisture content	Peroxide
M1	4.19 ± 0.13^{c}	10.88 ± 2.86^{a}	0.3± 0.35a	2.36 ± 0.51^{a}
M2	4.12 ± 0.17^{d}	6.29 ± 4.42^{b}	0.43 ± 0.1 ^{a}	2.36± 0.52^{a}
M3	4.18 ± 0.15^{c}	8.39 ± 3.59^{c}	0.23 ± 0.15^{a}	1.70 ± 0.11^{c}
M4	4.63±0.12^{a}	7.25 ± 3.18^{c}	0.23 ± 0.15^{a}	2.03 ± 0.51^{b}
M5	4.19 ± 0.04^{c}	6.29 ± 3.49^{d}	0.93 ± 1.26^{a}	2.03± 0.51^{b}
M6	4.12 ±0.14^{d}	8.96 ± 4.42^{e}	1,00 ± 1,3 ^{a}	1.70 ± 0.12^{c}
M7	4.27 ± 0.20^{b}	9.81 ± 5.16^{e}	0.2 ± 0.10^{a}	2.03 ± 0.51^{b}

4. DISCUSSION

The difference in moisture observed between the main origins of CPO could be due to the extraction process, where CPO from Dizangue as earlier mentioned comes from industrial sectors. This difference could also be due to the manner of conservation. This observation is consistent with the findings of Okonkwo *et al.* (2012), which showed that oil quality, varies with the duration of storage. Fatin *et al.* (2014) found a correlation between storage and moisture content of CPO. However results of moisture content of the smallholders sectors of this study are different from those of Ohimain *et al.* (2013) and Ngando *et al.* (2011), which shows that moisture contain of smallholders CPO sector varies from 5.48 to 12.52% and from 0.22 to 0.32% respectively.

The results obtained as moisture contain were different from those of Olorunfemi *et al.* (2014), who find that the moisture contain of CPO in major markets of Ibadan, Nigeria ranges from 1.3 to 2%. Morever, Oji *et al.* (2015) concluded that, a high level of moisture content and FFA in CPO is undesirable as it leads to rancid taste, lower price and increases the costs of refining. This clearly explains the bleed of CPO before selling, as a result of the parameters susceptible to modify CPO quality found in our research.

The results of peroxide index of our work were much better compared to the maximum standard for cold-pressed oil that must be less than 10 meq. O2 / kg (Anonymous, 2011). Similar results have been obtained by De Almeida *et al.* (2013) and Goudoum *et al.* (2015). However, our results were better than those obtained by other authors (Agbaire, 2012; Ngando *et al.,* 2013). So, Ngando *et al.*, 2013 who conducted the same studies on the markets of the city of Douala-Cameroon found a range of 1, 97 ± 1 meq. O2 / kg and 7.13 ± 4.19 meq. O2 / kg respectively. Our results are also different from those obtained at Bayelsa State in Nigeria (Elidja *et al.*, 2013). They observed peroxide value of 43.90 meq. O2 / kg. The comparison of these results shows that the CPO marketed in the city of Yaounde is of good quality, despite that Bassa and Dizangue origins are significantly different. Our results corroborate with the results of the Douala-Cameroon of Ngando *et al., (2013)*. Moreover, for the couples of the markets (M1 and M2), (M2, M5 and M7) and (M3 and M6), the ANOVA tests did not show any significant difference, which corroborates with the works of Ngando *et al., (2013*). However, the results of the peroxide index are higher for Dizangue CPO sector. This is in accordance with the findings of Ngando *et al. (2013)* in the major markets of Douala. This difference is due to the parameters involved during transportation, commercialization and storage. This result goes in line with the findings of Dongho *et al.* (2017) who showed seasonal influence on the physicochemical characterization of CPO of Douala markets. Enyoh *et al.* (2016) clearly demonstrated the increase of CPO acidity before 10 days of storage.

The absence of the correlation between pH and acidity found here is due to the fact that, oil acidity is evaluated in the percentage of the most represented free fatty acid (FFA) and not with pH meter. This is in accordance with Guedes *et al. (2014)*, who showed pH values different from testable acidity of *Jabuticaba* fruits. The same values of pH have been obtained with different levels of acidity by Ezediokpu *et al.* (2015). However, CPO of smallholder sectors of Bassa1 and Bassa 2 present values lower than Dizangue CPO values. This can be explained by the extraction methods as in Elijah *et al. (2013)* in Bayelsa state (Nigeria). However, the findings of Amata & Ozuor (2013), which

shown no significant differences between extraction methods are different with the present results.

CPO of SAFACAM which comes from industrial sector and which is well known as good quality, shows that more parameters are below the desirable. CPO from Dizangue plants proved to be of low quality despite its mechanized production system. These results further show that inappropriate means of transportation and storage are the cause of the deterioration of the palm oil from the Dizangue plants. Several researches showed that CPO degradation could be due to transportation, containers and selling process (Ngando *et al*., 2013). On that line, Noviar *et al*. (2016) concluded in their research on the quality control system of CPO on palm oil processing industry (Case Study Bah Jambi Palm Oil Mill, PTPN IV, Medan, North Sumatra) that all activities conducted by humans in the informal palm oil production sector are liable to increase CPO acidity and quality. This could be also due to the fermentation process of fresh fruit bunches in the smallholder sector of CPO processing. On that way, Izah and Ohimain (2015) showed that**,** the fermentation of fresh fruit bunces promotes proliferation of lipolytic microorganisms that have invaded the fruit due to bruises and subsequently increases the FFA. Main other studies indicated the impact of lipolytic microorganisms on the deterioration of CPO quality (Okechalu *et al.*, 2015; Chuks *et al*. 2016, Likeng *et al*., 2017)

5. CONCLUSION

At the end of this work, which consist in the evaluation of food quality parameters of CPO sold on the major markets of Yaounde city, we can conclude that, CPO sold in Yaounde markets comes at 85% from smallholders sector in Bassa communities and also from SAFACAM of Dizangue industrial sector. As regards food quality, the peroxide value, which was below the maximum level of 10 meq O2/kg, showed no significant difference between the various sources. The pH varies between 4.00 and 4.50 while moisture content and acidity vary from 0.1 to 1.13% and from 2.56 to 12.16% respectively. Based on these results, the food quality of the CPO samples assessed was rather low. We can recommend traders to store their oil in well closed containers to avoid contamination during the selling period.

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