International Journal of Food Science and Nutrition
ISSN: 2455-4898; Impact Factor: RJIF 5.14
Received: 25-04-2020; Accepted: 15-05-2020; Published: 26-05-2020
www.foodsciencejournal.com
Volume 5; Issue 3; 2020; Page No. 87-91

Influence of storage type on the quality parameters of industrial and artisanal red palm oils produced in Côte d'Ivoire

Niaba Koffi Pierre Valery[1*], Combo Agnan Marie-Michel[2], Ekissi Alice Christine[3], ESSE David[4], Beugre Grah Avit Maxwell[5]

[1-3, 5] Agro-valorization Laboratory, Agro forestry Department, Jean Lorougnon Guédé University, Daloa, Côte d'Ivoire
[4] Vagny LAB Laboratory, Abidjan, Côte d'Ivoire

Abstract

Plant products, especially oil from palm seeds, have remarkable nutritional and therapeutic properties due to their chemical composition. However, poor production and storage conditions can affect their quality. the aim of this study was to improve the impact of storage conditions on the quality of red palm oils produced traditionally and industrially in the presence and absence of sun. The storage of two oil types was followed up for eight weeks. The analysis of three quality parameters which are: water content, acidity and the peroxide index of two oils types was carried out according to standard methods. Analysis of results shows that the water contents of the oils during their storage decrease from 0.7 to 0.13%. The decrease from 0.42 to 0.13% is more significant with industrial red palm oil in the presence of sun. In addition, storage induced an increase in the acidity of oils from 2.35 to 3.28% in absence of sun and from 2.35 to 3.76% in presence of sun. As for oil peroxide indices, an increase from 0.74 to 1.67 meq O_2 / kg has been observed. In both types of storage, artisanal red palm oil had high acidity and peroxide index values. However, during their storage, the artisanal and industrial red palm oils pre sented acceptable water contents, acidity and peroxide index and in conformity with standards, exception of acidity of artisanal raw palm. Industrial red palm oil therefore has good chemical quality during storage, both in the absence and in presence of sun.

Keywords: red palm oil, storage, humidity, acidity, peroxide index

1. Introduction

Food is the first priority and the main concern of humans, where oils are essential nutrients for the good functioning of organism. Over the last century, vegetable oils have gradually replaced animal fats as main source of food fat (Benoit and Meyer, 2005; Barka, 2016) [7, 6]. In fact, vegetable oils represent more than 70% of world production (Balasundram *et al*., 2005; Almeck *et al*., 2008) [5, 2].

Palm oil is one of most consumed oils in human diet (Cheyns, 2001; Dubois *et al*., 2008) [8, 11]. In many countries, this oil is produced by industries and consumed largely in its refined form (Tan *et al*., 2007) [26]. However, traditional production exists in different localities, where it is consumed in its crude form, without special treatment after its extraction. Its production is ensured by small local producers. But, it lets appear organoleptic defects indicating an advanced deterioration only a few weeks after its sale on the local market. Indeed, these oils were exposed to sunlight (Asiédu, 1991; Monde, 2011) [19]. Healthy and good quality oil gives food a pleasant texture. It increases the satisfaction felt by consumers and can contribute to acceptance of a food (Ndéye, 2001; Lecerf, 2013; Lefèvre, 2015) [15, 16]. On the other hand, poor quality oil, rancid and / or acid, altered by oxidation and / or by hydrolysis is unfit for consumption and not credible on the international market (Ndzouli, 2011) [21].

Vegetable oils have remarkable nutritional and therapeutic properties due to their chemical composition. However, poor production, transport, storage and use conditions can alter their quality by increasing of the acidity and influencing of their stability to oxidation (Gornay, 2006; Kamla – raj, 2011) [14]. Thus, the attention of this study was drawn to the impact that production methods could have on the different quality parameters of red palm oil during its storage.

2. Materials Et Methods

2.1 Raw materials

The red palm oils used in this study come from two localities: Abidjan for industrial production oil (Figure 1) and Divo for production of artisanal oil (Figure 2).

Fig 1: Industrial red palm oil

Fig 2: Artisanal red palm oil

2.2. Methods

2.2.1. Oil storage methods

The oil samples were divided into two lots and each packed in cans at room temperature. The first lot consisted of red palm oils stored in absence sunlight. As for second lot, it consisted of red palm oils exposed to sunlight. The storage period lasted eight weeks. Oil samples were taken weekly to determine humidity, acidity and the peroxide index.

2.2.2. Determination of oils humidity

The oils water content was determined according to the AOAC method (1997) relating to the water content in fat. A quantity of 10g of oil was weighed and placed in a crucible, then brought to the oven for 3 hours at a temperature of 105°C. After the first weighing, this operation is repeated every 30 min until obtained constant mass. The determination of the water loss was calculated according to the following formula:

$$H\ (g/100\ g) = \frac{(P_e - m_2)}{(P_e - m_1)} \times 100 \qquad (1)$$

H: Humidity
P_e: Analyzed oil mass
m_1: Empty crucible mass
m_2: oil mass + crucible mass after steaming

2.2.3. Determination of oils acidity

The determination of oils acidity provides information on their degree of hydrolysis. Fats contain very little free fatty acids. This assay method is based on the AOAC method (1997). A quantity of 10 g of red palm oil was added a heated alcoholic solution and a colored indicator which is thymol blue (basic solution). This mixture was dosed with a sodium hydroxide solution (NaOH) prepared at 0.1 N. the acidity (A) was calculated according to the following formula:

$$A\ (g/100\ g\ of\ oil) = \frac{2{,}56 \times V}{P_e} \qquad (2)$$

A: Acidity
V: Volume in ml of the burette drop (NaOH)
P_e: Analyzed oil mass

2.2.4. Determination of oils peroxide index

The peroxide index of oil samples was determined according to method described by AOAC (1997). This method consists of treating a test sample of fat dissolved in a mixture of chloroform and acetic acid with a saturated solution of potassium iodide, then titrating the released iodine with a solution of sodium thiosulfate.

A quantity of 1 g of oil has been dissolved in 30mL a of chloroform-acetic acid mixture in proportions 3: 2 (v / v). To content was added 1 mL of saturated potassium iodide solution. The vial was then closed, shaken for 1 min and protected from light for 5 min. After this hold in dark, 30 mL of distilled water was added to mixture. The mixture thus formed is titrated with a 0.01 N sodium thiosulfate solution in presence of starch paste until completely discolored. A blank test is carried out under the same conditions. The peroxide index (IP) was calculated with the following formula:

$$IP\ (méq\ d'\frac{O2}{kg}\ of oil) = \frac{V - V_0}{P} \times 10 \qquad (3)$$

IP: Peroxide index (méq d'O_2/kg d'huile)
V_0: Sodium thiosulfate volume poured at equivalence for the blank test (mL)
V: sodium thiosulfate volume poured at equivalence for the oil mass (mL)
P_e: Analyzed oil mass
10: Number of millimolecules of peroxides / Kg

2.2.5. Data Statistical Analysis

The data statistical analysis was done using the STATISTICA 7.1 software. An analysis of variance (ANOVA) was performed to compare the analyzed parameters of different oils. The statistical differences between the oil samples were made using the Duncan test and the student T test at the confidence level p = 0.05.

3. Results and Discussion

3.1. Results

3.1.1. Humidities of analysed oils

Humidity results of two red palm oil types are shown in Figures 3 and 4. It appears that after production, the two oil types had water contents of 0.70 and 0.42%, respectively for artisanal red palm oil and industrial red palm oil.

The storage of two oil types in absence sunlight has lowered the humidity. Results showed that the water contents of industrial red palm oil vary from 0.42 to 0.21% and those of artisanal red palm oil from 0.70 to 0.43% at the end of the storage period (Figure 3). On the other hand, when the oils are exposed to sun, a decrease in water content of the two oil types is observed. Indeed, water contents of industrial red palm oil vary from 0.42 to 0.13% and those of artisanal red palm oil from 0.70 to 0.21% (Figure 4). There is a significant difference between the water contents of the two oil types regardless of the storage method. Humidity contents of two oil types show significant decreases of humidity when the oils are exposed to sun compared to those in absence of sun.

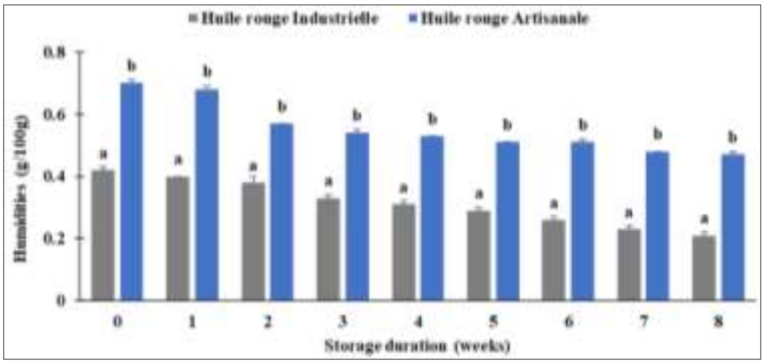

Fig 3: Evolution of industrial red palm oil and artisanal red palm oil humidities in absence of sun

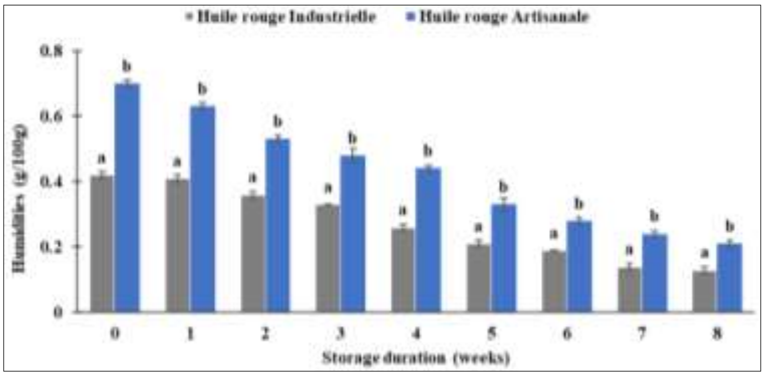

Fig 4: Evolution of industrial red palm oil and artisanal red palm oil humidities exposed to sun

3.1.2. Acidity of analysed oils

Acidities of two red palm oil types are showed in Figures 5 and 6. It appears that before storage, the two oil types register acidity contents of 3.11 % for red artisanal palm oil and 2.35% for red industrial palm oil.

Industrial red palm oil has an acidity that increases during the storage period. In fact, the content varies from 2.35 to 2.62% in absence of sun (Figure 5). On the other hand, the increase of acidity value of exposed oils to sun did not vary significantly ($p > 0.05$) (2.35 to 2.82%) (Figure 6). On the other hand, artisanal red palm oil has higher acidity values than those obtained with industrial red palm oil and increases with storage duration. The values are between 3.11 and 3.28% for stored oils in absence of sun (Figure 5) and between 3.11 and 3.76% for exposedoils to sun (Figure 6).

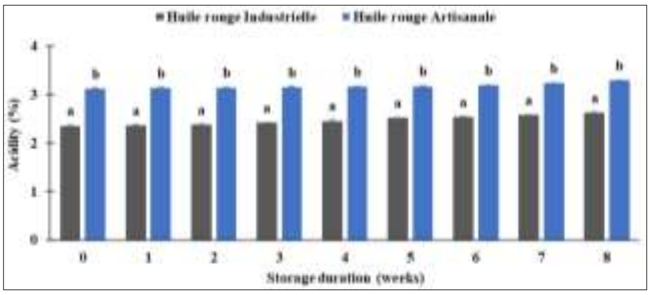

Fig 5: Evolution of industrial red palm oil and artisanal red palm oil acidities in absence of sun

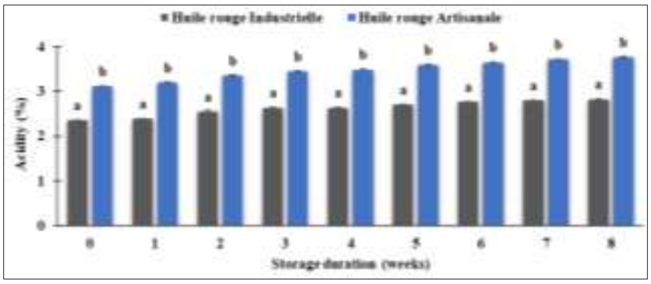

Fig 6: Evolution of industrial red palm oil and artisanal red palm oil acidities exposed to sun

3.1.3. Peroxide index of analysed oils

Figures 7 and 8 show the peroxide index of two red palm oil types. Results show that the oil types have peroxide index of 0.97 meq O2 / kg for artisanal red palm oil and 0.74 meq O2 / kg for red industrial palm oil.

The storage of oils in absence of sun led to a significant increase ($p < 0.05$) in their peroxide index. Indeed, increases of index of industrial red palm oil from 0.74 to 1.21 meq O2 / kg and of artisanal red palm oil from 0.7 to 1.34 meq O2 / kg were observed (Figure 5). In addition, figure 6 illustrates the increase of oils peroxide index during storage. The peroxide index values of industrial red palm oil increase from 0.74 to 1.38 meq O2 / kg and those of artisanal red palm oil, from 0.97 to 1.67 meq O2 / kg. The exposure of oils to sun induced a significant difference ($p < 0.05$) of peroxide index. Results revealed that the peroxide index of two oil types have high values compared to those stored in sun.

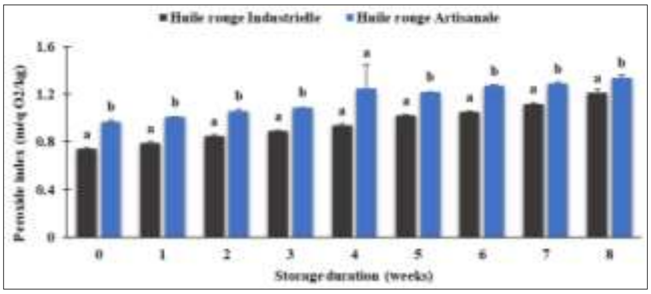

Fig 7: Evolution of industrial red palm oil and artisanal red palm oil peroxyde index in absence of sun

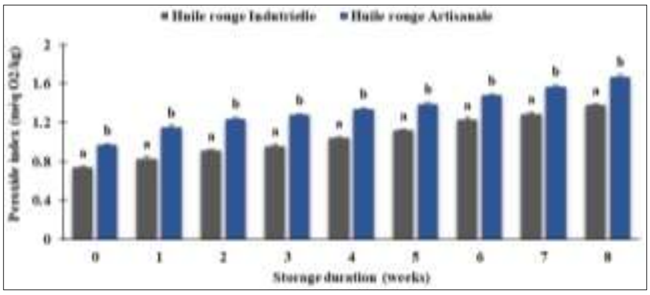

Fig 8: Evolution of industrial red palm oil and artisanal red palm oil peroxide index exposed to sun

3.2. Discussion

The influence of conservation on the quality parameters of industrial red palm oil and artisanal red palm oil was studied in this work. The quality parameters concerned humidity, acidity and the peroxide index.

Variations of humidity were observed between the different oils analyzed. These differences of observed humidity are due to production methods of these oils. In fact, during industrial production, extraction is followed by refining of oil (Cissé, 2010). This refining produces an edible oil with characteristics that meet the wishes of consumer. These characteristics of neutral flavor, neutral odor, clarity, light color, stability to oxidation, the possibility of frying and refining allow the elimination of free fatty acids (Ndeye, 2001) [20]. Water loss is higher for exposed oils to sun.

However, the humidity of oils decreases both in absence of sunlight and in presence of sunlight. This decrease is due to the reaction using food water as a catalyst. The decrease water content in oil during storage does not indicate that the oil is becoming more and more stable. On the contrary, it reveals that when the humidity is very high, this represents an alteration factor favoring certain chemical reactions of oil. It is this reaction which would be at the origin of the increase in fatty acids during the conservation of oils, because the more water there is in the oil, the more active the hydrolysis reaction. The work of Asiedu (1991) [4] indicates that a low content of fatty acids in oil during storage is correlated with the reduction of water content to less than 0.1%.

During their storage for eight weeks, the water contents of oils were lower than the maximum content of 0.2% set by (Codex Alimentarus, 2009). Storage could be a factor in improving the quality of oils. In fact, the low water content is essential for the stability of an oil (Aïssi *et al*., 2009) [1] and therefore for its conservation, because water promotes the alteration reactions of oils (Wolf, 1991) [29].

Acidity is a quality factor of oils. It provides information on the alteration there of by hydrolysis of certain compounds. During storage, an increase of acidity of oils was observed. This increase could be related to temperature as a factor allowing a rapid growth of oils acidity. This increase in acidity could be explained by a reaction of hydrolysis of triglycerides which evolves more quickly under the effect of heat (Edem, 2002; Leger, 2006; Soumanou, 2011) [12, 17, 1]. Similarly, the results of this study are consistent with those of Asiedu, (1991) [4]. According to this author, a good quality palm oil must contain less than 3% of free fatty acids for it to be easily declarable.

One of parameters used to characterize the oxidative rancidity of an oil is the peroxide index. This parameter is a measure of the peroxides and hydroxy-peroxides concentration formed in the initial stages of lipid oxidation. The values of peroxide index found in this study before the storages types is of order of 0.74 meq O2 / kg for industrial red palm oil and of 0.97 meq O2 / kg for artisanal red palm oil. These contents are lower than those of Tchouar *et al*. (2014) [28]; Novidzro *et al*. (2019) [22] which respectively obtained contents of the order of 7.5 to 12.5 meq O2 / kg on olive oils of artisanal and industrial production and 44.00 ± 0.26 meq O2 / kg on Griffonia simplicifolia seed oil. These values are also lower than 10 meq O2 / kg which characterizes most conventional edible oils such as those of soya, corn and sunflower (Codex Alimentarius, 2009) [10].

The peroxide index of studied oils increased during their storage. However, exposed oils to sun have higher peroxide indices than stored oils in absence of sun. This result could be explained by the light presence and the oxygen availability. Indeed, exposed olive oil to light has been found to have a higher peroxide index than stored oil in absence of ligh (Okogeri and Tasioula – Margari, 2002) [23]. According to Tanouti (2011), fatty substances can oxidize in oxygen presence. This high oxidation in stored oils in presence of sun could also be due to effect of environment temperature. According to Sess (2008) [24], the increase temperature exerts an important influence on the speed of oils oxidation. However, peroxide contents of artisanal red palm oils are higher than those of industrial red palm oils regardless of storage method. This result could indicate that the fat of artisanal red palm oils is more oxidized than that industrial red palm oils. According to M'Baye *et al*. (2011) [18], more the peroxide index, more the fat is oxidized. However, the two oil types after storage showed acceptable peroxide indices.

Conclusion

The objective of this study was to determine the influence of storage type on the quality parameters of industrial red palm oil and artisanal palm oil. Obtained results revealed that increasing of the temperature influences the quality of oils by increasing of acidity and peroxide index. The storage conditions of stored oils in absence of sun allow them to maintain their qualities. The shelf life reduces the water content. Industrial red palm oil has good quality after eight weeks of storage.

References

1. Aïssi VM, Soumanou MM, Tchobo FP, Kiki D. Etude comparative de la qualité des huiles végétales alimentaires raffinées en usage au Bénin. Bulletin d'Informations de la Société Ouest Africaine de Chimie. 2009; (06):25-37.
2. Almeck KAD, Tchiegang C, Parmentier M. Evolution de quelques paramètres de qualité physico–chimique de

l'huile de la pulpe des fruits de Canarium schweinfurthii Engl. au cours du stockage. Int. J. Biol. Chem. Sci. 2008; 2(3):249-257.
3. AOAC. Official Methods of Analysis.Washington D.C. 15th edn, 1997, 375-379.
4. Asiedu JJ. La transformation des produits agricoles en zone tropicale: Approche technologique, KARTHALA, Editions, 1991, 335 p.
5. Balasundram N, Ty A, Sambanthamurthi R. Antioxidant properties of palm fruit extracts. Asia Pac J Clin Nutr. 2005; 14:319-324.
6. Barka A. Evaluation des indices de nature physico-chimiques de quelques huiles alimentaires de friture et impact sur la santé du consommateur. Mémoire de Master, 2016, 86 p.
7. Benoit L, Meyer S. Détermination du coefficient d'émission de GES de l'huile de palme. Convention IBGE E04-070, 2005, p. 14-15.
8. Cheyns E. La consommation urbaine de l'huile de palme rouge en Côte d'Ivoire : quels marchés ? in "Oléagineux, Corps Gras, Lipides. Dossier : L'avenir des cultures pérennes'' Volume 8, Numéro 6, 641 pages, 2001.
9. Cisse L. Caractérisation d'huile végétale brute issue d'oléagineux d'Afrique de l'ouest comme carburant. Mémoire pour l'obtention d'un Master spécialisé en énergétique, génie électrique et énergies renouvelables option: énergies renouvelables et énergies dans l'industrie. Institut d'ingénierie de l'eau et de l'environnement; 72 pages, 2010.
10. Codex Alimentarius. Normes alimentaires Internationales pour les huiles végétales portant un nom spécifique CODEX STAN 210-1999. Adoptée en 1999. Amendement: 2005, 2011, 2013, 2015. Révision: 2001, 2003, 2009, 2009.
11. Dubois V, Breton S, Linder M. Proposition de classement des sources végétales d'acides gras en fonction de leur profil nutritionnel. Oléagineux Corps gras Lipides, 2008, p. 56-75.
12. Edem D. Palm oil: Biochemical, physiological, nutritional, hematological, and toxicological aspects: A review. Plant Food Hum Nutr, 2002; 57:319-341.
13. Gornay J. Transformation par voie thermique de triglycérides et d'acides gras. Application à la valorisation chimique des déchets lipidiques. Thèse de Doctorat, 2006, 333 pages.
14. Kamla – raj. Effect of storage on physico chemical characteristics and fatty acid composition of selected oil blends, 2011.
15. Lecerf JM. L'huile de palme : aspects nutritionnels et métaboliques. Rôle sur le risque cardiovasculaire, Article OCL, 2013, p. 147-159.
16. Lefèvre C. L'huile de palme : ses effets sur la santé et l'environnement. Enquête auprès de la population française, 2015, p. 39-45.
17. Leger CL. Anti-oxydants d'origine alimentaire: diversité, modes d'action antioxydante, interactions. Oléagineux Corps Gras Lipides. 2006; 13(1):59-69.
18. M'Baye BK, Alo H. et Lô BB. Etude physico-chimique des huiles consommées en Mauritanie, 2011; 4:10 p.
19. Monde A. Caractérisation des différentes formes variétales d'huile de palme de Côte d'Ivoire : propriétés antioxydantes. Thèse de Doctorat, 2011, p. 133-134.
20. Ndeye AK. Etude de la composition chimique et De la qualité d'huiles végétales Artisanales consommées au Sénégal. Thèse pour l'obtention du grade de docteur en pharmacie (diplôme d'état). Université Cheikh Anta Diop de Dakar, faculté de médecine, de pharmacie et d'odontostomatologie, 2001, 99pages.
21. Ndzouli N. Sécurité alimentaire: évaluation du taux de rancissement des huiles alimentaires. Mémoire en vue de l'obtention du DIPES II, 2011.
22. Novidzro KM, Wokpor K, Fagla BA, Koudouvo K, Dotse K, Osseyi E, *et al*. Etude de quelques paramètres physicochimiques et analyse des éléments minéraux, des pigments chlorophylliens et caroténoïdes de l'huile de graines de Griffonia simplicifolia. Int. J. Biol. Chem. Sci. 2019; 13(4):2360-2373.
23. Okogeri O, Tasioula–Margari M. Changes occuring in phenolic compounds and –tocopherol of virgin olive oil during storage. J Agric. Food Chem. 2002; 50(5):1077-1080.
24. Sess D. Teneur en acides gras et en antioxydants de l'huile de palme en Côte d'Ivoire. Pharmacopée et Médecine Traditionnelle Africaines, 2008, p. 11-17.
25. Soumanou MM, Aissi MV, Tchobo FP, Natta AK, Piombo G, Villeneuve P, *et al*. Effet des prétraitements post-récolte des amandes de Pentadesma butyracea (Sabine) sur la technologie d'extraction en milieu réel et la qualité du beurre. Oléagineux Corps Gras Lipides. 2011; 18(6):384-392.
26. Tan Y, Sambanthamurthi R, Sundram K. Valorization of palm by products as functional components. Eur J Lipid Sci Technol. 2007; 109:380-393.
27. Tanouti K, Serghini-Caid H, Chaieb E, Benali A, Harkous M, Elamrani A, *et al*. Les technologies de laboratoire. 2011 ; l6(22):1-12 p.
28. Tchouar AK, Selka S. Contribution à l'étude physico-chimique et organoleptique de deux huiles d'olive d'extraction traditionnelle et industrielle de la wilaya de Tlemcen, mémoire de Master, 2014, 122 pages.
29. Wolf JP. Analyse et dosage des lipides dans Analyse des constituants alimentaires (J. L. Multon eds). Techniques d'analyse et de contrôle dans les industries Agroalimentaires, 2ème Edition., Lavoisier-Tec & Doc, 1991, 157-199.