

Nutritional Value of *Citrullus lanatus* (Cucurbitaceae) Seed Oil, Consumed in Côte D'ivoire

ROBET Emilie Jocelyne^{1,*}, NAGALO Ousmane¹, YEBOUE Kouamé Hermann²,
MEITE Alassane², AMOIKON Kouakou Ernest²

¹UFR Sciences et Technologies, Université Alassane Ouattara, Côte d'Ivoire

²UFR Biosciences, Université Félix Houphouët Boigny, Côte d'Ivoire

*Corresponding author: millierobet@gmail.com

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Abstract *Citrullus lanatus* (Cucurbitaceae) seed oil, pumpkin seeds reveal a richness in monounsaturated fatty acids and polyunsaturated fatty acids. This present work aims to promote dietary diversification through the consumption of local food products. The evaluation of the nutritional quality of the oil extracted from the seeds of *Citrullus lanatus* (Cucurbitaceae) was therefore carried out. The determination of the physicochemical composition and the fatty acid profile of *Citrullus lanatus* (Cucurbitaceae) oil. The study of the physicochemical composition reveals that *Citrullus lanatus* (Cucurbitaceae) oil is composed of 50.02 ± 0.6 % fat. The acid value is 8.2 ± 0.21 mg NaOH/g and the iodine value is 25.38 ± 3.02 mL/g, ($P \leq 0.05$). The peroxide and saponification values are 23 ± 0.13 and 203.3 ± 0.68 mg KOH/g of oil, respectively ($P \leq 0.05$). Fatty acid characterization reveals that *Citrullus lanatus* (Cucurbitaceae) oil is composed of 26.75% saturated fatty acids and 73.5 % unsaturated fatty acids ($P \leq 0.05$). Among the saturated fatty acids, lauric acid has a value of 17.27 %. Stearic acid accounts for 6.53 %, and arachidonic acid for 2.70 % ($P \leq 0.05$). Among the unsaturated fatty acids, linoleic acid is the most abundant (44.23 %), followed by linolenic acid (22.23 %), and finally oleic acid (4.76 %) ($P \leq 0.05$). Ultimately, *Citrullus Lanatus* (Cucurbitaceae) is a high-quality oil and could be recommended for use in the diets of populations in Côte d'Ivoire.

Keywords: *Citrullus Lanatus*, oil, linoleic, linolenic, Côte d'Ivoire

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1. Introduction

Vegetable oils have been an important food source for populations worldwide for centuries, with 57 % of this production intended for human consumption [1,2]. Their production in 2020 and 2021 was 241.1 million tonnes worldwide [3]. Vegetable oils are preferred vectors of diverse fatty acids, particularly the two major precursors of the omega-3 and omega-6 metabolic families, α -linolenic acid and linoleic acid, which are essential for human health [4]. They also represent a major source of energy during metabolism. Fatty acids allow living beings to store 9 kcal of energy per gram of lipids, compared to 4 kcal for carbohydrates [5].

Worldwide, the main vegetable oils consumed are, in million tonnes, palm oil (78.34), soybean oil (69.26), rapeseed oil (34.65), sunflower oil (20.45), palm nut oil (8.96), peanut oil (6.25), cottonseed oil (4.74), coconut oil (3.70) and finally olive oil (3.03) [6]. The diversity of oils and fats offered contributes to the balance in the intake of different fatty acids (omega 9, 6 and 3, saturated fatty

acids) to contribute to the 35 % - 40 % of total energy intake covered by lipids recommended for adults [1].

In Africa, the main vegetable oils consumed are palm oil, cottonseed oil, peanut oil, and shea oil [7]. And in Côte d'Ivoire, the main oil consumed is palm oil, with a production of 560,000 tonnes [8]. Since 2009, African oil needs have continued to increase due to the growing African population and rising living standards [1-9]. A diversity of oils is therefore necessary to maintain a balance in the intake of different fatty acids in populations.

Citrullus lunatus seed oil, pumpkin seeds, commonly called pistachios, are rich in monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs), which could contribute to the diversification of dietary fatty acid intake. The objective of this study is to promote dietary diversification through the consumption of local food products.

The nutritional quality of oil extracted from the seeds of *Citrullus lanatus* (Cucurbitaceae) was therefore assessed. To achieve this objective, this study aims to determine the physicochemical composition and fatty acid profile of *Citrullus lanatus* (Cucurbitaceae) oil.

2. Materials and Methods

2.1. Materials

The materials used included plant material and technical equipment.

2.1.1. Plant Material

Whole and hulled *Citrullus lanatus* seeds were purchased from the Gouro market in Adjamé (Abidjan District, Côte d'Ivoire). This market is known to be the major supply area for *Citrullus lanatus* in Côte d'Ivoire.

2.1.2. Technical Equipment

The technical equipment consisted of laboratory glassware for performing the various physicochemical assays. An incubator (MEMMERT, 854 Schwabach, Germany) was used for food dehydration. A NASCO blender (BL1008AK-CB) was used for seed grinding. A Soxhlet (DÜSSELDORF, Germany) was used for fat extraction. A Büchi ROTAVAPOR R-3 (Switzerland) was used for hexane removal. An extraction flask containing hexane was used to collect the fat. A WATERS ALLIANCE HPLC was used to determine the fatty acid composition of the extracted oil.

2.2. Methods

2.2.1. Preparation of Plant Material and Oil Extraction

The seeds were cleaned and then ground in a blender at the Animal Physiology Laboratory. Then the paste obtained is introduced into the Whatman cartridge and a quantity of 10 g of the sample and placed a piece of cotton on top of the cartridge to prevent rising during heating. To this assembly is added a volume of 150 mL of hexane and the whole connected to the flask to the extractor for 6 hours. The hexane-oil mixture is collected and the solvent is removed by rotary evaporation. The oil is extracted and stored in a cold room. The oil content is given by the following formula:

$$\% \text{ Oil} = 100 \times \frac{m}{m_1} \quad (1)$$

m_1 : 10 g of sample

m : mass of extracted oil

2.2.3. Fat Content

The lipids were extracted at boiling point using pure hexane [10]. The latter was then removed by evaporation. The residue was dried and weighed. 10 g of the sample (M) was placed in a Whatmann cartridge. The cartridge was plugged with cotton. The SOXHLET apparatus was set up with a tared extraction flask (M_1) then filled with 300 mL of hexane. The heating block, set at 175 °C, was turned on. After 5 hours of extraction, the hexane was removed using a ROTAVAPOR rotary evaporator (RV05-ST, Germany). The flask with its oil deposit is dried in an oven at 50°C for 2 h and cooled in a desiccator for 45 min and finally weighed (M_2). The lipid content is determined by the following formula:

$$\text{Lipid content (\%)} = \frac{M_2 - M_1}{M} \times 100 \quad (2)$$

M_2 : Mass of the flask + oil deposit

M_1 : Mass of the empty flask

M : Mass of the sample

2.2.4. Iodine Value

The iodine value, also called the Hübl value, is the mass in grams of iodine bound to the double bonds present in 100 g of fatty substance [7]. The method used is that proposed by Wijs [11]. A sample of 0.13 g of oil, representing the test sample, is placed in a 500 mL flask. 20 mL of hexane is added to dissolve the oil. 25 mL of Wijs's reagent is added to the mixture.

The flask is closed, shaken, and placed in a dark place for 1 hour. A blank test is prepared with the same solvent (hexane) and the same reagent (Wijs) but without the test sample. At the end of the hour (1 h), a volume of 20 mL of potassium iodide solution and a volume of 150 mL of water are added to each of these two flasks.

The flasks are each titrated with 0.1N sodium thiosulfate solution, in the presence of starch paste until the yellow color due to iodine has practically disappeared. Finally, a few drops of the starch solution are added and the titration continues until the blue color disappears after vigorously shaking the contents. The iodine value is given by the following formula:

$$\text{Indice d'iodure} = \frac{(12,62 \times N) \times (V_0 - V)}{m} \quad (3)$$

V_0 : initial volume

V : final volume

m : Mass of the test portion (g) of the sample.

N : Normality of the sodium thiosulfate solution at (0.01N)

12.62: Iodine constant for oils

2.2.5. Peroxide Value

Peroxides characterize the oxidation of unsaturated fatty acids. They are determined based on their ability to release iodine from potassium iodide in acidic environments. The peroxide value is measured by the reaction with thiosulfate [11]. The procedure consists of dissolving, in a flask, 2 g of oil in 10 mL of chloroform, 15 mL of acetic acid, and 1 mL of potassium iodide. The flask is then immediately stoppered, shaken vigorously for 1 min and left in the dark for 5 min at room temperature. A quantity of distilled water is added to the mixture. The liberated iodine is titrated after the addition of a few drops of starch paste with a 0.01N sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$) solution. A blank test is carried out under the same conditions. The peroxide index is given by the following formula:

$$\text{Peroxide Value} = \frac{(V - V_0)}{m} \times 10 \quad (4)$$

V_0 : Volume (mL) of $\text{Na}_2\text{S}_2\text{O}_3$ (0.01N) required to titrate the blank.

V : Volume (mL) of $\text{Na}_2\text{S}_2\text{O}_3$ (0.01N) required to titrate the sample.

m : Mass of the test portion (g) of the sample.

N: Normalité of the sodium thiosulfate solution at (0.01N)

10: Peroxide constant for oils

2.2.6. Acid Number and Acidity of Oil

The acid number is the number of mg of potassium hydroxide (KOH) required to neutralize the free fatty acids contained in 1 g of fat. The acidity of a fat is the percentage of free fatty acids conventionally expressed as acid. Acidity is deduced from the acid number and is a conventional expression of the percentage of free fatty acids. A control test is carried out under the same conditions as those carried out for the peroxide index. And the acidity is expressed as a percentage of oleic acid according to the following formula:

$$\text{Acidity} = (V - V_0) \times \frac{N \times M}{10} \quad (5)$$

M: Molar mass of oleic acid, which is 282 g/mL.

N: Normality of the KOH solution (0.1N).

V: Volume (ml) of KOH required to neutralize the sample.

m: Mass (g) of the test sample

10 = Acidity constant for oils

2.2.7. Statistical Analysis

The results presented in this document are in the form of tables and graphs. Graph Pad Prism 8 software was used for statistical analyses and the calculation of means and standard deviations. Analysis of variance (ANOVA) followed by the Newman-Keuls multiple comparison test of means was used to rank and compare means. Means are always followed by their standard deviations. Two means are significantly different if the probability resulting from the statistical tests is less than or equal to 0.05 ($P \leq 0.05$).

3. Results and Discussion

3.1. Results

3.1.1. Physicochemical Characteristics

The study of the physicochemical composition was evaluated using lipid characteristic indices. It revealed that *Citrus lanatus* seeds had an oil extraction rate of 50.02 ± 0.6 %. *Citrus lanatus* (Cucurbitaceae) oil had an acid value of 8.2 ± 0.21 mg NaOH/g. It also contained 25.38 ± 3.02 ml/g of iodine value, and fat content of 50.02 ± 0.6 % ($P \leq 0.05$). The peroxide and saponification values are 23 ± 0.13 and 203.3 ± 0.68 mg KOH/g oil, respectively ($P \leq 0.05$). The oil yield is 0.5 (Table 1).

Table 1. Physicochemical characteristics of the oil *Citrus lanatus* (Cucurbitaceae)

Parameter	Content (%)
Fat	50.02 ± 0.6
Peroxide Value	23 ± 0.13
Acid Value	8.20 ± 0.21
Iodine Value	25.38 ± 3.02
Saponification Value	203.3 ± 0.68

3.1.2. Fatty Acid Profile

Fatty acid characterization reveals that *Citrus lanatus* oil is composed of 26.75 % saturated fatty acids and 73.5% unsaturated fatty acids ($P \leq 0.05$). Among the saturated fatty acids, lauric acid has a value of 17.27 %. That of stearic acid is 6.53 % and arachidonic acid represents 2.70 % ($P \leq 0.05$). Among the unsaturated fatty acids, the value of linoleic acid is more abundant (44.23 %), followed by linolenic acid (22.23 %) and finally oleic acid (4.76 %) ($P \leq 0.05$) (Table 2).

Table 2. Fatty acid composition of *Citrus lanatus* (Cucurbitaceae) oil

Fatty Acid (%)			
Saturated Fatty Acids 26.75		Saturated Fatty Acids 73.5	
Monosaturated	Polysaturated	Monosaturated	Polysaturated
Lauric Acid 17.27	Arachidonic Acid 2.70	Oleic Acid 4.76	Linolénic Acid 22.23 Linoléic Acid 44.23

3.1. Discussion

The physicochemical characteristics of oils, as well as their fatty acid profile, allow us to assess their quality [12]. Regarding physicochemical characteristics, first, the acid number of a fatty substance allows us to test whether the oils have been altered or not. It allows us to test the purity and stability of an oil at room temperature [13]. Next, the iodine number highlights the degree of unsaturation of the oils [7]. The peroxide number provides an assessment of the quantity of peroxides present in a substance. It indicates the quantity of fatty acids that have already gone rancid [14]. Finally, the saponification number of oils indicates the length of the carbon chain of the fatty acids. As for fatty acids, they are considered the genetic code of oils. They are the major constituents of the latter [15]. The study reveals that *Citrus lanatus* (Cucurbitaceae) kernels have an oil extraction rate of 50.02 ± 0.6 %. This value is comparable to that obtained (52.63 %) for *Citrus lanatus* (Cucurbitaceae) oil from Togo. This value indicates that the yield of fat extraction from the kernels is high [16].

Citrus lanatus oil has an acid number of 8.20 ± 0.21 mg KOH/g oil. This value is comparable to those obtained for Cucurbitaceae cultivated in the Katiola and Korhogo regions of Côte d'Ivoire (7.57 ± 0.19 ; 8.39 ± 0.23 mg NaOH/g oil) [7]. Such acidity values of oils are considered to be lower than the safety limit for consumption [7-17]. The low acidity of oils is explained by the lower presence of free fatty acids such as organic acids (citric acid, malic acid, malonic acid, oxalic acid) [18]. This low acidity characterizes the purity and stability of the oil at room temperature [13-19].

The iodine value obtained in this study is around 25.38 ± 3.02 g I₂/100 g oil. This value is lower than that of rapeseed (97 I₂/100 g oil -107 I₂/100 g oil) and olive (75 I₂/100 g oil - 94 I₂/100 g oil g I₂/100 g oil) [17]. This indicates that *Citrus lanatus* oil contains less unsaturated fatty acid than olive and rapeseed oils. However, it can be classified as a non-drying oil. This criterion is very useful for assessing the early stages of oxidative deterioration of an oil. The more unsaturations an oil contains, the more sensitive it is to oxygen [12].

The peroxide value found in this study is of the order of 23 ± 0.13 g O₂/g or 2.3 ± 0.01 meq O₂/kg of oil. This value is lower than 10 meq O₂/kg of oil which characterizes most conventional edible oils such as soybean, corn and sunflower [17]. Our results are close to those obtained for oils produced in Nigeria (3.82 meq of O₂/kg) [20]. According to the International Olive Council, such values demonstrate the effectiveness of the cucurbit oil extraction method, which does not cause major oxidation [14-21].

The average saponification index values of *Citrus lanatus* oil (203.3 ± 0.68 mg KOH/g of oil) are close to those of sunflower oil (188-194) and olive oil (ranging between 184 and 196 mg KOH/g of oil) usually used in food [11]. They are included in the standards (190 to 209 mg KOH/g) set by the Codex Alimentarius [17]. The saponification index value obtained in this study indicates that *Citrus lanatus* oil contains a significant amount of KOH that can be transformed into soap [12]. However, the majority of fatty acids contained in the oil studied are short chains or chains of low molecular weight. This low molecular weight is explained by the loss of certain macromolecules such as carotenoids [22].

Analysis of the fatty acid profile showed that *Citrus lanatus* oil is composed of 73.5% unsaturated fatty acids and 26.75 % saturated fatty acids. Regarding unsaturated fatty acids, the study showed that linoleic acid is predominant with an average content of 44.2 %. This is followed by linolenic acid (22.23 %) and oleic acid (4.76 %). This composition is corroborated by those found for *Citrus lanatus* seed oils from the Katiola and Korhogo regions [23]. According to his work, there is a predominance of linoleic acid (44.12 %) and linolenic acid (22.05 %) in the fatty acid composition of *Citrus lanatus* oil. However, this value is lower than that found for *Citrus lanatus* from Togo (62.70 %) [16]. Those of linolenic acid and oleic acid are higher than their values (0.39 % and 19.30 % respectively). The value of saturated fatty acids is low (26.75 %), and is represented mainly by lauric acid (17.27 %) and stearic acid (6.53 %).

These values are different from those obtained for the species of Togo which are represented by palmitic acid and stearic acid (10.00 % and 10.20 % respectively). Indeed, cucurbit oils are linoleic and linolenic oils with, in total, more than 70 % unsaturated fatty acids [24,25]. However, the variabilities obtained could be due to the eco-climatic conditions and the genetic specificity of the species [16-24]. In addition, the presence of linoleic and oleic acids is particularly important for human nutrition. They contribute to the maintenance of membrane fluidity at the level of the water barrier of the epidermis and can be enzymatically oxidized into various derivatives involved in cell signaling [25]. Linoleic acid plays a role in the prevention of cancer and arteriosclerosis. Finally, linolenic and oleic acids play a role in regulating cholesterol. This fatty acid plays a role in the prevention of certain pathologies, particularly metabolic syndromes such as type 2 diabetes [16].

4. Conclusion and Outlook

The evaluation of the nutritional quality of the oil extracted from the seeds of *Citrullus Lanatus* (Cucurbitaceae) showed that *Citrullus Lanatus* (Cucurbitaceae) oil contains a low acid content, reflecting its purity and stability at room temperature. It also contains less unsaturated fatty acids than olive and rapeseed oils. However, it can be classified as a non-drying oil. Furthermore, it contains a significant amount of KOH, which can be transformed into soap. Finally, it is classified as a linoleic and linolenic oil due to its high content of these fatty acids. Ultimately, *Citrullus Lanatus* (Cucurbitaceae) is a high-quality oil and could be recommended in the diet of populations in Côte d'Ivoire. However, it would be interesting to expand this study by evaluating the effect of its consumption on a living organism.

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Statement of Competing Interests

The authors declare that there was no conflict of interest in the writing of this article.

References

- [1] Boujemaa, I., El Bernoussi, S., Harhar, H., and Tabyaoui, M, "The influence of the species on the quality, chemical composition and antioxidant activity of pumpkin seed oil", *Research article*. 27(40). 2-7. Jul. 2020.
- [2] OCDE/FAO, "Oléagineux et produits oléagineux", *perspectives agricoles de l'OCDE et de la FAO 2023-2032*, 177-191. 2023.
- [3] FAO, "Oléagineux et produits dérivés: vue d'ensemble du marché", in *Trente et unième session du groupe intergouvernemental sur les graines oléagineuses et les matières grasses*, 1-20.
- [4] Bourlieu-Lacanal, C, " Les huiles végétales alimentaires", in *Journée scientifique 2022 «Perception sensorielle des lipides et comportements alimentaires*, 1-18.
- [5] Nonnotte A. C, *Diabète de type 2. Des pannes multiples*, 2022.
- [6] USDA, United States Department of Agriculture Foreign Agricultural Service Oilseeds: World Markets and Trade, Jul. 2025. 1- 40.
- [7] Ouattara, H., Atsamo D. A., Ouattara B., Kone V. and Kati-Coulibaly, S, "Consumption of Cucurbitaceae Seeds Oils is Better in Risk of Cardiovascular Disease Prevention on Rats Than The Consumption of Red Palm Oil", *Research Square*, 1-15. Apr. 2021.
- [8] Bessou, C. and Dubos B, Filière Palmier à Huile en Côte d'Ivoire Analyse fonctionnelle et diagnostic agronomique, Rapport d'expertise, *La Recherche Agronomique pour le Développement*, (29)12. Août. 2020.

- [9] Kapseu, C, "Production, analyse et applications des huiles végétales en Afrique", *Oléagineux, Corps Gras, Lipides*, 16 (4), 215-229. Jul. 2009.
- [10] AOAC, *Official methods of analysis*. 12th ed. Association of Official Analytical Chemists. Washington DC. 1975.
- [11] Diakite, K., Diagouraga, S., Diawara, M. and Fane, M. "Etude des paramètres physico-chimiques des huiles de graine de coton produites en zone CMDT au Mali", *International Journal of Biological and Chemical Sciences*, 16 (3). 1320-1330. Aug. 2022.
- [12] Liyansan, S.M., Fatunsin, O.T., Olayinka, K.O, "Evaluation of Physicochemical Parameters of Unbranded Palm Oil Samples Purchased from Important Markets in Lagos, Nigeria" *Journal of Science and Technology*, 3 (1-2).101-112. Jun. 2022.
- [13] Eze, S.O., Orji, J.N., Okechukwu, V.U., Omokpariola, D.O., Umeh, T. C. and Oze, N.R, Effect of processing method on carotenoid profiles of oils from three varieties of Nigerian palm oil (elaeis guinensis). *Journal of Biophysical Chemistry*, 12 (03), 23-31. Aug. 2021.
- [14] Novidzro, K.M., Wokpor, K., Fagla, B.A., Koudouvo, K., Dotse, K., Osseyi, E. and Koumaglo, K.H, "Etude de quelques paramètres physicochimiques et analyse des éléments minéraux, des pigments chlorophylliens et caroténoïdes de l'huile de graines de Griffonia simplicifolia" *International Journal of Biological and Chemical Sciences*.13 (4). 2360-2373, Aug. 2019.
- [15] Ollivier, D, "Recherche d'adultération dans les huiles végétales: application à la qualité des huiles vierges et notamment de l'huile d'olive" *Oilseeds and fats, Crops and Lipids*, 10 (4), 315-320. Jul. 2003.
- [16] Keteve, A., Osseyi, E., Bilabina, I., Creppy-Togodoe A., Batalia Y, and Lamboni, C, " Caractéristiques chimiques et physicochimiques des graines de cucurbitacées du Togo: concombre amer (*Cucumeropsis edulis* Hook. f.) et melon à pistache (*Citrullus lanatus* Var) ", *Journal de la Société Ouest-Africaine de Chimie*, 1-7. Dec. 2015.
- [17] Codex Alimentarius, Norme sur les huiles végétales portant un nom spécifique, CXS 210-1999. 2023. 21p.
- [18] M'Baye, B.K., Alouemine, S.O., Lô, B.B, and Bassene, E, "Etude physico-chimique des huiles consommées en Mauritanie", *Science Lib Editions Mersenne*, 4(120101). 1-9. Dec. 2011.
- [19] Tay, B.Y.P., Anishas, C.I, and Zulina, A.M, "Oxidative Stability of Refined Red Palm Olein under two Malaysian Storage Conditions", *Journal of Oleo Science*, 69 (10). 1209-1218. Jun. 2020.
- [20] Adamu, M, "Liquid-liquid extraction of carotenoids from palm oil (*Elaeis guineensis*)", *Universidade Federal de Viçosa*, 88p.
- [21] Ouagouch A. and Chimi H, Guide de producteur de l'huile d'olive, Organisation des Nations Unies pour le développement industriel, Vienne, 2007, 35p.
- [22] Budju, R, "Analyse comparative des caractéristiques physico-chimiques de l'huile de palme brute et de l'huile raffinée, Rina, consommées à Bunia", *UJUVI*, 1(19). Dec. 2012.
- [23] Ouattara, H., Atsamo D. A., Ouattara B., Kone V. and Kati-Coulibaly, S, "Comparison of the Effects of Cucurbitaceae Seeds Oils and Refined Palm Oil in the Prevention of Cardiovascular Disease Risk". *Journal of Nutritional Health & Food Science*, 1-13. May. 2022.
- [24] Silou, T., Kissototokéné-Ntinou, O., Tsieri M.M., Ouamba J.M. and Kiakouama S. Contribution à l'étude des corps gras de quatre espèces de curcubitaceae cultivées au Congo, *Journal de la Société Chimique de Tunisie*, 11(11). Jun. 1990.
- [25] Ouassor I., Aqil Y., Belmaghraoui, W. and El Hajjaji, S, Characterization of two Moroccan watermelon seeds oil varieties by three different extraction methods, *Oilseeds & fats Crops and Lipids*, 27 (13), 1-8. Mar. 2020.

