

Fatty Acid Profile of Momordica Charantia Seeds Oil: a Focus on Conjugated Linoleic Acid (CLnA)

Samba Baldé^{1,2,*}, Papa Guedel Faye^{1,2}, Khadim Niane^{1,2}, Nicolas Cyrille Ayessou^{1,2}, Alioune Sow^{1,3}, Oumar Ibn Khatab Cisse^{1,4}, Codou Mar Diop^{1,2}, Yvan Larondelle^{1,5}

¹Laboratoire Eau, Energie, Environnement et Procédés Industriels (LE3PI)
Université Cheikh Anta Diop, BP 5080 Dakar Fann, Sénégal

²Centre d'Etudes sur la Sécurité Alimentaire et les Molécules Fonctionnelles (CESAM), Dakar, Sénégal

³Laboratoire des Sciences Biologiques, Agronomiques, Alimentaires et de Modélisation
des Systèmes Complexes (LaBAAM), Saint-Louis, Sénégal

⁴UFR des Sciences Agronomiques, de l'Aquaculture et des Technologies Alimentaires (S2ATA),
Université Gaston Berger de Saint-Louis, Saint-Louis, Sénégal

⁵Unité de biochimie de la nutrition, Université catholique de Louvain & Institut des Sciences de la Vie,
Croix du Sud, 2/8, 1348 Louvain-la-Neuve, Belgium

*Corresponding author: balsamb2013@yahoo.fr

Received June 19, 2025; Revised July 23, 2025; Accepted July 30, 2025

Abstract The vegetative part and the fruit of *M. charantia* are widely used in traditional medicine. But studies relating to the extraction, physico-chemical characterization and fatty acid profile of *M. charantia* seed oil are almost non-existent. In this context, methyl esters from *M. charantia* and *M. balsamina* oils were extracted and fatty acid profiles were explored. In these oils obtained after extraction, the analysis of fatty acid methyl esters allowed the identification and quantification of 07 fatty acids. The oils from the seeds of *M. charantia* are richer in CLnA, particularly in stearic acids and α -eleostearic acid, compared to the oil from the seeds of *M. balsamina* which is richer in punicic acid and oleic acid. These two species constitute a good source of CLnA isomers which play an essential rôle against cardiovascular diseases such as cancers. However, *M. balsamina* oil is higher in monounsaturated fatty acids compared to *M. charantia* oil. Ultimately, the valorization of this research work allows a good knowledge and a potential use of these two species of cucurbits for the benefit of the whole population.

Keywords: Chromatography, oil, fatty acid, CLnA, profile

Cite This Article: Samba Baldé, Papa Guedel Faye, Khadim Niane, Nicolas Cyrille Ayessou, Alioune Sow, Oumar Ibn Khatab Cisse, Codou Mar Diop, and Yvan Larondelle, "Fatty Acid Profile of Momordica Charantia Seeds Oil: a Focus on Conjugated Linoleic Acid (CLnA)." *American Journal of Food Science and Technology*, vol. 13, no. 3 (2025): 70-76. doi: 10.12691/ajfst-13-3-4.

1. Introduction

Momordica charantia, better known as bitter melon, Margose, karela, bitter cucumber or 'mbeurbeuf' in Wolof [1]. This climbing plant of the Cucurbitaceae family would be native to the tropical regions of the globe. It is widely cultivated in Asia, South America, India, and East Africa [2]. Their fruits are widely used around the world in combination with other foods to meet human protein and fat requirements [3]. Previous studies on the botanical characteristics [4] and fruit or seed yield [5] of species grown in West Africa have been widely published. Currently, the consumption of bitter melon has enormously increased not only for its nutritional value but also for its therapeutic interest. It has good sources of catechin, gallic acid, chlorogenic acid, folic acid, thiamin, [6] saponin, carotenoids [7], but also vitamin C, vitamin A, and minerals like calcium, potassium, magnesium and sodium [8]. In other words, the alcoholic extracts of the

seeds could also be used for the treatment of chronic leukemia [9]. There are several ethno-pharmacological indications, such as antidiabetics, immunomodulator, anti-dengue and antioxidant activities and hepatic fibrosis [10]. In addition, the fruits, seeds, and roots are used in traditional medicine in the treatment of certain pathologies [11]. This plant is a valuable resource for the majority of rural populations in Africa, where more than 80% of people use it for their health care [12]. Scientists have demonstrated the importance given to the plant by the populations living in the regions where *M. charantia* grows. Indeed, these are unconventional oilseed species [1]. Additionally, oil from *M. charantia* seeds can regenerate tissue without side effects in scarring rabbit skin [13]. Realizing the huge potential of the plant, researchers decided to conduct research on *Momordica charantia* seed oil and its components [14]. However, in Senegal, the exploitation and use of the seed oil by local populations remains unknown. Thus, the objective of this study is to quantify the fatty acid composition of *M. charantia* seed oil by different methods.

2. Material and Methods

2.1. Material

❖ Equipment

Chromatography is the best technique for separating and identifying the different constituents of complex mixtures. Gas chromatography (GC) (Figure 1) and Waters ACQUITY UPC2 chromatography (Figure 2) (Waters, Milford, MA, USA) were used. They are equipped with 3 Chromspher 5 lipids columns for silica HPLC mounted in series. The column used in both devices is a RESTEK brand capillary (Rt-2560, Belle fonte, USA). It has a length of 100 m, an internal diameter of 0.25 mm, with a film thickness of 0.20 μm . It is a highly polar phase column with unbound biscyanopropyl polysiloxane, whose stationary phase selectivity is optimized for the separation of isomers and to ensure precise quantitation of critical cis/trans fatty acid methyl esters. The chromatographs are equipped with an injector and a flame ionization detector. Chromatographic data were processed with Chromquest 5.0 software. The acronym UPC² stands for "Ultra Performance Convergence Chromatography". The advantages are respectively a better efficiency (separation power) and diffusion of the mobile phase, as well as a wide selectivity of compounds that can be analyzed. Its supercritical temperature and pressure are 31°C and 74 bar respectively. The separation is done by manipulating the density and composition of the basic supercritical fluid from the mobile phase. It is equipped with 3 Chromspher 5 Lipid columns for silica HPLC, mounted in series, 250 mm in length and 4.6 mm in internal diameter, and they are designed especially for the separation of triglycerides. It provides highly efficient separation of positional isomers and trans/cis geometric isomers of fatty acids.

❖ Plant sample

The analyzes were carried out on two (2) samples of seeds of *M. charantia* and one (1) samples of *M. balsamina* harvested in the Niaye area (Dakar) (ND), Fatick (F) and *Pal and Jamba*. Hulled seeds were powdered and stored in tightly closed tubes before lipid extraction. After preparation and extraction, the oils obtained were analyzed by gas chromatography, and by ultra-performance convergence chromatography (UPC2) (Figure 2).



Figure 1. Almond seeds of *Momordica charantia*



Figure 2. Samples seed oil

2.2. Analysis methodology

❖ Extraction of fatty acids

The extraction of fatty acids is done according to the method of Folch et al, [15]. One gram of almond powder is mixed with 7 g of an internal standard solution C13:0-chloroform, (C13:0 Sigma-Aldrich, Steinheim, Germany). The whole is first treated with 10 ml of methanol, in order to precipitate the proteins, then homogenized. To this mixture is added 20 ml of chloroform, the whole is homogenized and then filtered. The residue is recovered and dissolved in 30 ml of a chloroform-methanol solution in the proportions 2:1 (Folch's reagent), then homogenized, filtered, and the residue present on the filter paper is rinsed with 20 ml of chloroform and 10 ml of methanol. The two filtrates are combined, and to this mixture are added 22 ml of an aqueous solution of 0.88% KCl (Merck, Darmstadt, Germany) and a methanol-water solution (1:1) whose role is to eliminate non-lipid substances. The immiscible mixture obtained is placed in a separatory funnel and the lower phase (organic phase containing the purified lipids) is recovered in a flask, then evaporated in a rotavapor (Rotavapor R-3000 Buchi, Switzerland) at 30°C. The remaining lipids are recovered in diethyl ether (VWR, Leuven, Belgium) then transferred to methylation tubes.

❖ Fatty acid methylation

Gas chromatography and UPC2 analysis of fatty acids requires derivatization to increase their volatility [16]. For this, it is necessary to prepare fatty acid methyl esters. Thus, the diethyl ether used to collect the lipids in the methylation tubes is evaporated using nitrogen, and a mixture of KOH in 0.1M MeOH (KOH, Sigma Aldrich, Seelze, Germany) is added to the samples, which are then placed in a water bath at 70° C. for 1 hour. After cooling, a 1.2M HCl solution in MeOH is added, and the tubes are again placed in a water bath for 20 minutes, in order to allow the formation of fatty acid methyl esters. After adding water and hexane, the tubes are placed in a cold room for phase separation for 24 hours. The organic phase (hexane) is then recovered. It contains fatty acid methyl esters.

❖ Chromatographic analyze

Before doing a chromatographic analysis, the samples must first be diluted. For both types of chromatography, the dilutions are carried out according to the following protocol: Concerning gas phase chromatography (GC): In flasks, we successively introduced 81 μl of C11:0 (Sigma

Aldrich, Steinheim, Germany) as injection standard, 9 μ l of the fatty acid extract recovered in hexane, and 710 μ l of hexane. The vials thus prepared were placed in the apparatus for analysis. For UPC2 chromatography: The dilutions are made in successive stages. First, 1 ml of the extract is introduced into a 15 ml tube of fatty acids recovered in the hexane phase mixed with 9 ml of hexane. Then, we take 1 ml of this diluted sample which we put in a 15 ml tube. Finally, we put 1 ml of the diluted sample for the second time in another tube, to which we have already added 0.2 ml of sorbic acid as an injection standard. For the standard solution, we added 1 ml of fatty acid standard to 0.2 ml of sorbic acid. The standard consists of β -eleostearic, β -catalpic, α -catalpic, α -calendic, punicic and jcaric acids. This standard does not contain α -eleostearic acid, but this fatty acid is quantified in the samples on the basis of the surface area obtained for α -catalpic acid.

❖ Static analysis

Chromatographic data were processed with Chromquest 5.0 software. For the statistical analysis of the data, Microsoft EXCEL and STATISTICAT software were used. These two softwares allowed a better analysis and interpretation of the results in order to make a good comparison between the devices (CPG and UPC2).

3. Results and Discussion

3.1. Analysis of *M. charantia* Samples by GC

Table 1 presents both the mean concentrations and the percentages of the various fatty acids identified in the samples of *Momordica charantia* by means of analysis by gas chromatography. It can be seen from the table that for all the oil samples of *Momordica charantia* seeds analyzed, the highest fatty acid concentration is that of CLnA and the lowest is oleic acid. Data processing by analysis of variance shows that there is no significant difference at the 5% threshold between the fatty acids identified in the *M. charantia* oil samples.

Table 1. Concentrations of fatty acids identified in *M. charantia* oil by GC

Fatty Acids	E. Fatick (mg/g)	E. Dakar (Niayes) (mg/g)	Identified AG Percentages (%)	
C16:0	9.32 $\pm$ 0.15 ^a	8.43 $\pm$ 0.5 ^a	2.36 $\pm$ 0.04 ^a	2.33 $\pm$ 0.04 ^a
C18:0	136.29 $\pm$ 9.87 ^b	111.59 $\pm$ 7.08 ^b	34.41 $\pm$ 2.45 ^b	30.84 $\pm$ 6.37 ^b
C18:1cis9	5.38 $\pm$ 0.09 ^c	4.11 $\pm$ 0.07 ^c	1.36 $\pm$ 0.03 ^c	1.14 $\pm$ 0.04 ^c
C18:2c9c12	10.63 $\pm$ 0.49 ^d	9.42 $\pm$ 3.08 ^d	2.68 $\pm$ 2.13 ^d	2.60 $\pm$ 3.04 ^d
CLnA	226.17 $\pm$ 1.04 ^e	221.38 $\pm$ 5.87 ^e	57.10 $\pm$ 2.86 ^e	61.19 $\pm$ 1.47 ^e

Table 2. Mean concentrations of fatty acids in *M. balsamina* oil

Locality	Unités	C16 :0 (Acide palmitique)	C18 :0 (Acide stéarique)	C18 :1cis9 (Acide oléique)	C18 :2c9c12 (Acide linoléique)	CLnA
Pal de Jamba	(mg/g)	27.54	23.82	39.07	25.31	127.42
	(%)	11.01	9.55	15.63	10.13	50.98

3.2. Analysis of *M. balsamina* Samples by (GC)

Table 2 presents the average concentrations and the percentages of the different fatty acids identified by gas chromatography (GC) in the seed oil of *M. balsamina* collected in the Pal Jamba area. According to this table, in the oil of the seeds of *M. balsamina*, the CLnA represent half of the fatty acids identified (50.99%). It appears from this study that *M. balsamina* contains more polyunsaturated acid than monounsaturated fatty acid. These results are similar to those obtained by Armougom et al,[17] for palmitic acid: 13.6%; stearic acid: 7.5%; oleic acid: 5.1%; linoleic acid: 6.5%; α -eleostearic acid: 13.1%; β -eleostearic: 1.1%; catalpic acid: 2% and punicic acid: 50.6% (Table 2).

Figure 2 presents superimposed chromatograms of samples of *Momordica charantia* and *Momordica balsamina* analyzed by gas chromatography. This figure corresponds to a zoom carried out on the peaks obtained as a function of the CLnA retention times. The chromatogram shows peak areas and concentrations that differ for all fatty acids. The figure shows two CLnA peaks for *M. charantia* which do not separate sufficiently for the same retention time and a single CLnA peak for *M. balsamina*. We find that with gas chromatography (GC), it is possible to quantify the CLnA present in an oil sample, but it is not possible to separate the different isomers. Gas chromatography allows for sensitive and reproducible fatty acid analyses, as well as the characterization of complex mixtures of isomers when combined with other chromatographic separations [18]. Gas chromatography (GC) has been the method of choice for fatty acid analysis for half a century. However, more reliable analysis of fatty acid isomers only became possible with the introduction of open tubular (capillary) columns. Therefore, the device should still undergo further improvements to achieve higher sensitivity, accuracy and precision [19]. The area under each peak is proportional to the concentration of fatty acid in the sample (quantity in mg of fatty acids per ml of solution injected). The more the numbers of carbons and desaturations of the fatty acid increase, the more the fatty acid is retained in the gas chromatography column.

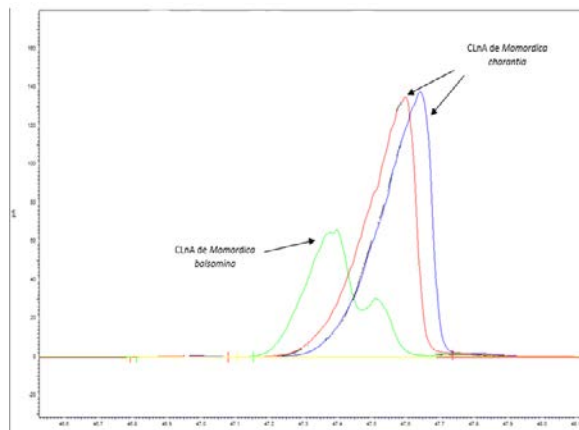


Figure 3. Zoom of CLnA peaks in *M. charantia* and *M. balsamina* seed oil

3.3. Analysis of *M. charantia* and *balsamina* Samples by UPC2

Figure 3 and Figure 5 show the chromatograms of *M. charantia* and *M. balsamina* oil samples obtained by ultra-performance convergence chromatography (UPC2). This device only allows the identification of CLnA isomers which are all eluted between 16 and 18 min. The profile obtained is quite clear, the peaks are well separated, and therefore easily identifiable thanks to their retention times. For Figure 5, which corresponds to *M. charantia* oil, the peak at 17.79 min is identified as being α -eleostearic acid. The other peaks identified are β -eleostearic acid (16.72 min) and punicic acid (18.20 min). At 16.87 min, β calendic acid is identified in trace amounts. Retention times of less than 20 min are optimal, because from 20 min onwards acetonitrile begins to be associated with CO₂ as a co-solvent, in order to remove any impurities from the column. This indicates that the scan is indeed complete. The different CLnA isomers found in the oil samples analyzed by UPC2 are the same as those found by Armougom in samples of *Momordica charantia* from Réunion [20].

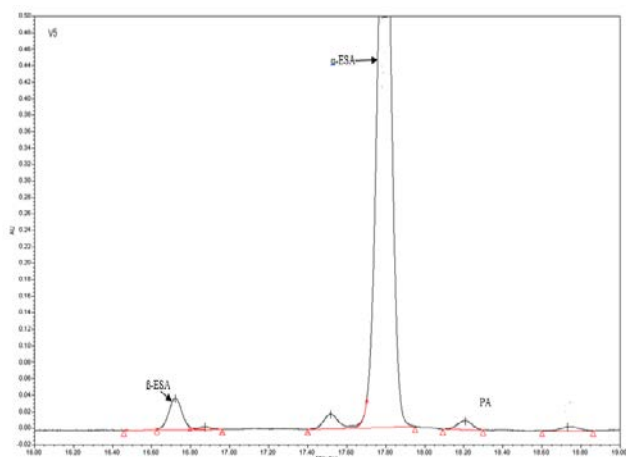


Figure 4. Chromatogram of CLnA isomers from *M. charantia* obtained by UPC2

Figure 4 corresponds to the oil sample from *M. balsamina* seeds obtained by UPC2, with three different peaks. The largest peak corresponds to punicic acid, which is eluted at 18.17 minutes. Then it is followed by

α -eleostearic acid which elutes at 17.71 minutes and β -eleostearic acid which elutes at 16.68 minutes comes last. This figure of *M. balsamina* seed oil shows three main isomer peaks unlike *M. charantia* where there are four peaks.

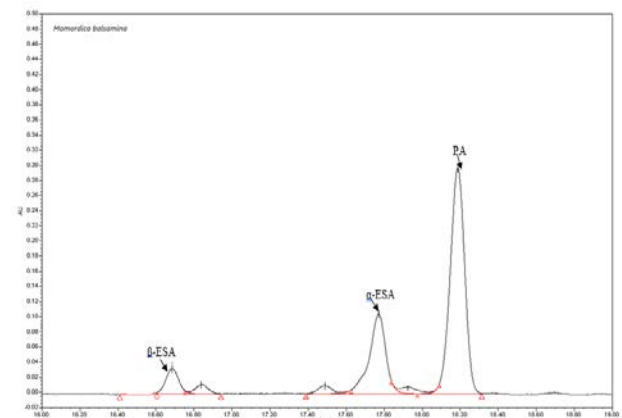


Figure 5. CLnA isomers identified in *M. balsamina* oil by UPC2

β -ESA: β -eleostearic acid; **α -ESA:** α -eleostearic acid; **PA:** punicic acid

Table 3 presents the CLnA contents identified in the oil samples of *M. charantia* and *balsamina* seeds analyzed by UPC2. According to the results, for the two *M. charantia* oil samples, the highest fatty acid percentage is that of α -eleostearic acid (88.36%) and the lowest is punicic acid (3.98%). Concerning *M. balsamina*, the main fatty acid is punicic acid (82.72%), and the weakest is that of β -eleostearic acid (3.28%). β -Eleostearic acid has very low concentrations in both varieties analyzed, so neither of them can be considered a good source of β -Eleostearic acid.

Table 3. Percentages of CLnA in *M. charantia* and *balsamina* oil by UPC2

Acides gras	α -ESA (%)	β -ESA (%)	PA (%)
Ech. Fatick	87.28±0.04 ^a	8.38±0.09 ^b	4.34±0.08 ^d
Ech. Dakar (Niayes)	88.36±0.06 ^b	7.67±0.08 ^c	3.98±0.07 ^e
Ech. Pal jamba	6.21±0.04 ^c	3.2±0.03 ^d	82.72±0.05 ^f

3.4. Comparison of the Fatty Acid Profiles of *M. Momordica* and *M. Balsamina* with Chromatographies (CPG and UPC2)

Table 4 summarizes the fatty acid profiles of *M. charantia* and *M. balsamina* analyzed by GPC and UPC2. Thus, these two species contain more than half of the CLnA with respectively 56.09% and 50.99% for *M. charantia* and *M. balsamina*. However, *M. balsamina* contains a high percentage of monounsaturated acid, punicic acid (82.72%), with a low percentage of stearic acid (9.55%). This species displays a CLnA content of 50.99% lower than that of its cousin *M. charantia*. The latter displays a higher percentage of α -eleostearic acid (87.64%) and a low palmitic acid (2.15%). This same species has a very high percentage of CLnA (56.09%). The results of this study showed that on average, in the seeds of *M. charantia* and *M. balsamina*, there are 5 fatty acids, with two saturated fatty acids (palmitic acid and stearic acid), an acid monounsaturated fatty acids (oleic acid) and finally two polyunsaturated fatty acids (linoleic

acid and CLnA isomers).

Table 4. Comparison of fatty acid profiles of *M. charantia* and *M. balsamina* oils

fatty acids	<i>M. charantia</i>	<i>M. balsamina</i>
C16: 0	2.15%	11.02%
C18: 0	32.88%	9.55%
C18:1c9	2.23%	15.63%
C18:2c9c12	4.76%	10.13%
CLnA	56.09%	50.99%
• α -ESA	87.64%	12.98%
• β -ESA	8.11%	3.28%
• PA	4.24%	82.72%

Table 5 presents the CLnA concentrations (mg/g of oil) of *M. charantia* and *M. balsamina* oil samples analyzed by gas chromatography (GC) and by UPC2. It emerges from this table that the gas phase and UPC2 chromatographies give different concentrations of CLnA. A very high concentration of CLnA is observed with UPC2 chromatography. The latter, unlike the CPG, makes it possible to identify all the CLnA isomers present in the oil. According to the results, *M. charantia* contains a very high concentration of α -eleostearic acid (303.2 mg/g) with a low content of punicic acid (13.65 mg/g). However, *M. balsamina* contains more punicic acid (333.52) and less β -eleostearic acid in its seed oil.

Table 5. CLnA concentrations of *M. charantia* oil by GPC and UPC2

Methods	CPG (mg/g oil)	UPC2 (mg/g oil)			
Profil	CLnA	α -ESA	β -ESA	PA	Total CLnA
Dakar	221.38	303.2	26.31	13.65	343.16
Fatick	218.36	280.1	27.26	13.59	320.95

Fatty acids play several roles in humans and other organisms. Indeed, they constitute the main components of biological matter, in particular cell membranes. These fatty acids are classified into several groups with different functions depending on the structure. Thus, we have the group of saturated fatty acids such as palmitic and stearic acid, monounsaturated fatty acids (oleic acid) and polyunsaturated fatty acids (linoleic and alpha linolenic acid) [21]. These results are consistent with those found on *M. charantia* in Bangladesh with respectively (5.29%) and (20.21–24.20%) for palmitic acid and stearic acid [14]. Researchers [22] have reported that regular consumption of saturated fatty acids increases blood cholesterol levels leading to an increase in heart rate. Similarly, previous studies have shown that monounsaturated acids can prevent cardiovascular diseases [10]. The incidence of specific diseases is lower in the Mediterranean region than in other parts of the world due to the high consumption of oils rich in monounsaturated fatty acids [23]. Our results confirm those obtained on two samples of *M. charantia* grown in Pakistan [24]. This author found respectively for stearic acid (29%), oleic acid (16%), linoleic acid (6.9%) and α -eleostearic acid (48%) which turns out to be the acid most abundant fat in oils. According to some authors, the importance of α -eleostearic acid lies in its potential preventive properties against several non-communicable diseases, such as cardiovascular diseases, cancer and diabetes [25]. On the other hand, an increase in the quantity of α -eleostearic (62%) and stearic (32%) acids

with lower levels of oleic (1.5%) and linoleic (2.6%) acids for a sample of *M. charantia* grown in Malaysia has been reported [26]. The fatty acid composition varies according to the variety, the type of soil and the climatic conditions of the growing medium [14]. The linolenic acid content of *M. charantia* seed oil is comparable to that of flaxseed oil (61.93%) [27]. In this oil, linolenic acid is mainly represented by α -linolenic acid, which is known to have certain health benefits, such as cardioprotective effects, modulation of inflammatory responses and positive influence on system functions. Central nervous [27]. Therefore, *M. charantia* oil could be used to increase linolenic acid intake in our daily life. Numerous studies have shown that bitter melon is a species very rich in conjugated α -linolenic acids (CLnA). It is for this reason that it has been frequently used in traditional medicine (mainly in Asia) for the treatment of many diseases, such as diabetes and atherosclerosis [28]. This is because polyunsaturated fatty acids contain two or more double bonds in the molecule. Linoleic acid (C18:2) and α -linolenic acid (C18:3n-3) are essential fatty acids that cannot be synthesized by humans and therefore are essential [29]. These fatty acids have been revealed to possess anti-atherogenic and anti-thrombotic properties and affect lipoprotein concentration, membrane fluidity, membrane enzyme function and modulation of other compounds [30]. These CLnA are isomers of α -linolenic acid containing three conjugated double bonds and are named conjugated linolenic acid (CLnA) [31]. Indeed, punicic acid (c9t11c13 CLnA) constitutes up to 83% of the total fatty acids of pomegranate (*Punica granatum*) and α -eleostearic acid (c9t11t13 CLnA) up to 67.7% of the seed oils of squash. Bitter (*M. charantia*) [32]. It has been reported in the literature that these two CLnAs, closely similar to conjugated linoleic acid (c9t11 CLA) can be converted to c9t11 CLA in rats, mice and even in humans [33]. Consistent with these in vivo data, we very recently observed the same conversions in Caco-2 cells used as an in vitro model of human intestinal epithelium [34]. The consumption of CLnA therefore provides an alternative route to the dietary intake of dairy products to produce CLA in mammals. This is a third possible source of supply of this fatty acid in humans. Other studies have proven that conjugated fatty acids are commonly adipose tissue reducers while increasing body mass [176; 380] and, therefore, several studies have been conducted with the aim of modifying the body weight of animals that have consumed CLnA. However, studies have reported conflicting results regarding the role of CLnAs in weight gain and body composition. Some authors attempted to show how CLnAs affected body fat in rats and they found that feeding CLnAs resulted in reduced adipose tissue weight [37]. In contrast, supplementation with 1% CLnA (punicic acid (PA) and/or α -eleostearic acid) for six weeks did not significantly affect weight. Mouse body or tissues [38]. Others [39] reported that body weight and tissues were unaffected in mice fed experimental diets containing 0.12 and 1.2% punicic acid for three weeks. Consumption of a diet supplemented with 9% safflower oil for two weeks did not affect the abdominal weight of white adipose tissue in hyperglycemic rats with long-term diabetic complications [40]. However, some CLnA isomers decreased perirenal adipose tissue weight to a

greater extent than linoleic acid (LA) and conjugated alpha linoleic acid (CLA) in rats [37]. The same team showed that supplementation with all the CLnA isomers reduced the weight of perirenal adipose tissue in mice in a dose-dependent manner after four weeks of feeding. In contrast, mice fed 2% punicic acid (PA) showed higher body weight gain with improved feed efficiency coefficient compared to animals fed 1% punicic acid (PA) and the control diet for 16 weeks [41]. Additionally, animals fed 1% and 2% punicic acid had reduced muscle weight (quadriceps) compared to the control group, but no difference was observed in epididymal adipose tissue weight [42].

Conclusion and Perspectives

The objective of this research work was to determine the fatty acid chemical profile of the seed oil of *M. charantia* and *M. balsamina* in Senegal by gas chromatography CPG and ultra-efficient convergence chromatography UPC2. In these oils, the analysis of fatty acid methyl esters allowed the identification and quantification of 07 fatty acids. *M. charantia* oils are richer in stearic acid, α -eleostearic acid and CLnA than that of *M. balsamina*. These two species constitute a good source of CLnA with more than half of all the fatty acids identified in the seed oil. It would also be very important to carry out an exhaustive characterization of the oil of the seeds of *M. charantia* and particularly of its unsaponifiable fraction. Further studies will be needed to establish the full profile of fatty acids and the bioactive compound responsible for the antioxidant activity of the oil. The study of the biological effects of *M. charantia* oil will make it possible to evaluate its therapeutic and pharmaceutical properties for the benefit of populations. Ultimately, the promotion of this research work will allow a good knowledge and useful use of these species for the benefit of the entire population.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] S. Balde *et al.*, «Investigations ethnobotaniques de *Momordica charantia* Linn (Cucurbitaceae) au Sénégal», *Int. J. Biol. Chem. Sci.*, vol. 13, n° 1, p. 466-474, 2019.
- [2] A. M. Sorifa, «Nutritional compositions, health promoting phytochemicals and value added products of bitter gourd: a review.», *Int. Food Res. J.*, vol. 25, n° 5, 2018.
- [3] S. Balde *et al.*, «Effects of Seed Pretreatment on Germination, Growth and Yield of *Momordica charantia* L.», *Agric. Sci.*, vol. 12, n° 1, p. 39-57, 2021.
- [4] A. Salifou, C. Alidou, F. P. Tchobo, et M. M. Soumanou, «Connaissances endogènes et importance des courges (Cucurbitacées) pour les populations autochtones productrices des graines au Bénin», *J. Appl. Biosci.*, vol. 92, p. 8639-8650, 2015.
- [5] A. Keteve, E. Osseyi, I. Bilabina, A. Creppy-Togodoe, Y. Batalia, et C. Lamboni, «Caractéristiques chimiques et physicochimiques des graines de cucurbitacées du Togo: concombre amer (*Cucumeropsis edulis* Hook. f.) et melon à pistache (*Citrullus lanatus* Var)/Some chemical characteristics of the seeds of two cucurbitaceae species grown in Togo: the bitter cucumber, *Cucumeropsis edulis* Hook. F. and the pistachio melon, *Citrullus lanatus* Var.», *J. Société Ouest-Afr. Chim.*, vol. 40, p. 1, 2015.
- [6] P. Budrat et A. Shotipruk, «Enhanced recovery of phenolic compounds from bitter melon (*Momordica charantia*) by subcritical water extraction», *Sep. Purif. Technol.*, vol. 66, n° 1, p. 125-129, 2009.
- [7] M. S. Maria, a. Păucean, m. S. Chiş, e. Purice, I. R. Şerban, et i. E. Mureşan, «The Effects Of Bitter Melon (*Momordica charantia* L.) Powder On The Quality Characteristics Of Dark Bread».
- [8] R. Sharifi-Rad, S. Esmailzadeh Bahabadi, A. Samzadeh-Kermani, et M. Gholami, «The Effect of Non-biological Elicitors on Physiological and Biochemical Properties of Medicinal Plant *Momordica charantia* L.», *Iran. J. Sci. Technol. Trans. Sci.*, vol. 44, n° 5, p. 1315-1326, 2020.
- [9] R. Soundararajan, P. Prabha, U. Rai, et A. Dixit, «Antileukemic potential of *Momordica charantia* seed extracts on human myeloid leukemic HL60 cells», *Evid. Based Complement. Alternat. Med.*, vol. 2012, 2012.
- [10] R. Yang *et al.*, «A review of chemical composition and nutritional properties of minor vegetable oils in China», *Trends Food Sci. Technol.*, vol. 74, p. 26-32, 2018.
- [11] M. Gupta, S. Sharma, A. K. Gautam, et R. Bhadauria, «*Momordica charantia* Linn.(Karela): Nature's silent healer », *Int. J. Pharm. Sci. Rev. Res.*, vol. 11, n° 1, p. 32-37, 2011.
- [12] T. Jiofack *et al.*, «Ethnobotanical uses of medicinal plants of two ethnoecological regions of Cameroon», *Int. J. Med. Med. Sci.*, vol. 2, n° 3, p. 60-79, 2010.
- [13] Ö. G. Kisacik, Ü. Güneş, M. V. Yaprakci, et K. Altunbaş, «Effectiveness of bitter melon extract in the treatment of ischemic wounds in rats», *Turk. J. Biol.*, vol. 42, n° 6, p. 506-516, 2018.
- [14] M. A. Ali, M. A. Sayeed, M. S. Reza, M. S. Yeasmin, et A. M. Khan, «Characteristics of seed oils and nutritional compositions of seeds from different varieties of *Momordica charantia* Linn. cultivated in Bangladesh», *Czech J Food Sci*, vol. 26, n° 4, p. 275-83, 2008.
- [15] C. Uribe, H. Folch, R. Enríquez, et G. Moran, «Innate and adaptive immunity in teleost fish: a review», *Vet. Med. (Praha)*, vol. 56, n° 10, p. 486, 2011.
- [16] R.-K. Park et K.-T. Lee, «Synthesis and characterization of mono- and diacylglycerol enriched functional oil by enzymatic glycerolysis of corn oil », *Korean J. Food Sci. Technol.*, vol. 36, n° 2, p. 211-216, 2004.
- [17] A. E. Kaoutari, F. Armougom, J. I. Gordon, D. Raoult, et B. Henrissat, «The abundance and variety of carbohydrate-active enzymes in the human gut microbiota», *Nat. Rev. Microbiol.*, vol. 11, n° 7, p. 497-504, 2013.
- [18] T. Seppänen-Laakso, I. Laakso, et R. Hiltunen, «Analysis of fatty acids by gas chromatography, and its relevance to research on health and nutrition», *Anal. Chim. Acta*, vol. 1, n° 465, p. 39-62, 2002.
- [19] D. W. Reische, D. A. Lillard, et R. R. Eitenmiller, «Chemistry, nutrition and biotechnology», *N. Y.*, p. 423-448, 1998.
- [20] P. R. Armougom, «Etude de la fraction lipidique des graines de Cucurbitacées tropicales des genres *Lagenaria*, *Luffa*, *Momordica*», PhD Thesis, Université de la Réunion, 1998.
- [21] E. Tvrzicka, L.-S. Kremmyda, B. Stankova, et A. Zak, «Fatty acids as biocompounds: their role in human metabolism, health and disease-a review. part 1: classification, dietary sources and biological functions.», *Biomed. Pap. Med. Fac. Palacky Univ. Olomouc*, vol. 155, n° 2, 2011.
- [22] A. Astrup *et al.*, «The role of reducing intakes of saturated fat in the prevention of cardiovascular disease: where does the evidence stand in 2010?», *Am. J. Clin. Nutr.*, vol. 93, n° 4, p. 684-688, 2011.
- [23] J. H. Weisburger, «Eat to live, not live to eat», *Nutrition*, vol. 16, n° 9, p. 767-773, 2000.
- [24] F. Anjum, M. Shahid, S. A. Bukhari, S. Anwar, et S. Latif, «Study of quality characteristics and efficacy of extraction solvent/technique on the antioxidant activity of bitter gourd seed», *J Food Process Technol*, vol. 4, n° 2, 2013.
- [25] G.-F. Yuan, X.-E. Chen, et D. Li, «Conjugated linolenic acids and their bioactivities: a review», *Food Funct.*, vol. 5, n° 7, p. 1360-1368, 2014.
- [26] K. L. Nyam, C. P. Tan, O. M. Lai, K. Long, et Y. C. Man,

- «Physicochemical properties and bioactive compounds of selected seed oils», *LWT-Food Sci. Technol.*, vol. 42, n° 8, p. 1396-1403, 2009.
- [27] S. Islam, M. Jalaluddin, et N. S. Hettiarachchy, «Bio-active compounds of bitter melon genotypes (*Momordica charantia* L.) in relation to their physiological functions», p. 14.
- [28] A. Bialek, M. Jelinska, M. Bamburowicz-Klimkowska, et A. Tokarz, «Effect of bitter melon aqueous extract and pomegranate oil on glucose concentration and lipid profile in blood of rats—preliminary study», *Int J Cardiol Lipidol Res*, vol. 1, p. 1-7, 2014.
- [29] G. C. Burdge, «Polyunsaturated fatty acid intakes and α -linolenic acid metabolism.», *Am. J. Clin. Nutr.*, vol. 93, n° 3, p. 665-6, 2011.
- [30] A. P. Simopoulos, «Essential fatty acids in health and chronic disease», *Am. J. Clin. Nutr.*, vol. 70, n° 3, p. 560s-569s, 1999.
- [31] A. A. Hennessy, R. P. Ross, R. Devery, et C. Stanton, «The health promoting properties of the conjugated isomers of α -linolenic acid», *Lipids*, vol. 46, n° 2, p. 105-119, 2011.
- [32] T. Takagi et Y. Itabashi, «Occurrence of mixtures of geometrical isomers of conjugated octadecatrienoic acids in some seed oils: analysis by open-tubular gas liquid chromatography and high performance liquid chromatography», *Lipids*, vol. 16, n° 7, p. 546-551, 1981.
- [33] G. Yuan, A. J. Sinclair, C. Xu, et D. Li, «Incorporation and metabolism of punicic acid in healthy young humans», *Mol. Nutr. Food Res.*, vol. 53, n° 10, p. 1336-1342, 2009.
- [34] A.-C. Schneider, P. Beguin, S. Bourez, et J. W. Perfield, «Conversion of t11t13 CLA into c9t11 CLA in Caco-2 cells and inhibition by sterculic oil», *PLoS One*, vol. 7, n° 3, 2012.
- [35] J. Miranda, N. Arias, A. Fernández-Quintela, et M. del Puy Portillo, «Are conjugated linolenic acid isomers an alternative to conjugated linoleic acid isomers in obesity prevention?», *Endocrinol. Nutr. Engl. Ed.*, vol. 61, n° 4, p. 209-219, 2014.
- [36] G.-F. Yuan, M. L. Wahlqvist, J.-Q. Yuan, Q.-M. Wang, et D. Li, «Effect of punicic acid naturally occurring in food on lipid peroxidation in healthy young humans », *J. Sci. Food Agric.*, vol. 89, n° 13, p. 2331-2335, 2009.
- [37] K. Koba *et al.*, «Dietary conjugated linolenic acid in relation to CLA differently modifies body fat mass and serum and liver lipid levels in rats», *Lipids*, vol. 37, n° 4, p. 343-350, 2002.
- [38] G.-F. Yuan, J.-Q. Yuan, et D. Li, Punicic acid from *Trichosanthes kirilowii* seed oil is rapidly metabolized to conjugated linoleic acid in rats», *J. Med. Food*, vol. 12, n° 2, p. 416-422, 2009.
- [39] M. Yamasaki *et al.*, «Dietary effect of pomegranate seed oil on immune function and lipid metabolism in mice», *Nutrition*, vol. 22, n° 1, p. 54-59, 2006.
- [40] K. Arao, H. Yotsumoto, S.-Y. Han, K. NAGAO, et T. YANAGITA, «The 9 cis, 11 trans, 13 cis isomer of conjugated linolenic acid reduces apolipoprotein B100 secretion and triacylglycerol synthesis in HepG2 cell», *Biosci. Biotechnol. Biochem.*, vol. 68, n° 12, p. 2643-2645, 2004.
- [41] K. Nemer, «The role of punicic acid (c9t11c13-CLNA) in lipid and energy metabolism of mice», PhD Thesis, The Ohio State University, 2009.
- [42] I. L. P. de Melo, A. M. de O. e Silva, E. B. T. de Carvalho, L. T. Yoshime, J. A. G. Sattler, et J. Mancini-Filho, «ncorporation and effects of punicic acid on muscle and adipose tissues of rats», *Lipids Health Dis.*, vol. 15, n° 1, p. 40, 2016.



© The Author(s) 2025. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).