Essential Oils from Seeds of Aframomum citratum (C. Pereira) K. Schum, Aframomum daniellii (Hook. F.) K. Schum, Piper capense (Lin. F) and Monodora myristica (Gaertn.) Dunal NL and…

Article *in* Journal of Essential Oil Bearing Plants · March 2019

DOI: 10.1080/0972060X.2019.1612282

CITATIONS
2

READS
383

5 authors, including:

Guy Sedar Singor Njateng
Université de Dschang
58 PUBLICATIONS **671** CITATIONS
SEE PROFILE

Jean De Dieu Tamokou
Université de Dschang
122 PUBLICATIONS **2,430** CITATIONS
SEE PROFILE

Pierre Tane
Université de Dschang
245 PUBLICATIONS **5,593** CITATIONS
SEE PROFILE

Jules-Roger Kuiate
Université de Dschang
263 PUBLICATIONS **5,341** CITATIONS
SEE PROFILE

Journal of Essential Oil Bearing Plants

ISSN: 0972-060X (Print) 0976-5026 (Online) Journal homepage: https://www.tandfonline.com/loi/teop20

Essential Oils from Seeds of *Aframomum citratum* (C. Pereira) K. Schum, *Aframomum daniellii* (Hook. F.) K. Schum, *Piper capense* (Lin. F) and *Monodora myristica* (Gaertn.) Dunal NL and their Antioxidant Capacity in a Cosmetic Cream

Sylvie C.D. Meffo, Guy S.S. Njateng, Jean-De-Dieu Tamokou, Pierre Tane & Jules-Roger Kuiate

To cite this article: Sylvie C.D. Meffo, Guy S.S. Njateng, Jean-De-Dieu Tamokou, Pierre Tane & Jules-Roger Kuiate (2019) Essential Oils from Seeds of *Aframomum citratum* (C. Pereira) K. Schum, *Aframomum daniellii* (Hook. F.) K. Schum, *Piper capense* (Lin. F) and *Monodora myristica* (Gaertn.) Dunal NL and their Antioxidant Capacity in a Cosmetic Cream, Journal of Essential Oil Bearing Plants, 22:2, 324-334, DOI: 10.1080/0972060X.2019.1612282

To link to this article: https://doi.org/10.1080/0972060X.2019.1612282

Published online: 10 Jun 2019.

Taylor & Francis
Taylor & Francis Group

ISSN Print: 0972-060X
ISSN Online: 0976-5026

Essential Oils from Seeds of *Aframomum citratum* (C. Pereira) K. Schum, *Aframomum daniellii* (Hook. F.) K. Schum, *Piper capense* (Lin. F) and *Monodora myristica* (Gaertn.) Dunal NL and their Antioxidant Capacity in a Cosmetic Cream

Sylvie C.D. Meffo [1], Guy S.S. Njateng [1], Jean-De-Dieu Tamokou [1], Pierre Tane [2] and Jules-Roger Kuiate [1]*

[1] Research Unit of Microbiology and Antimicrobial Substances, Faculty of Sciences, University of Dschang, Dschang-Cameroon, P. O Box 67, Cameroon
[2] Research Unit of Chemistry of Natural Substances, Faculty of Sciences, University of Dschang, Dschang-Cameroon, P.O Box 67, Cameroon

Received 22 November 2018; accepted in revised form 25 April 2019

Abstract: Preservative properties of essential oils from *Aframomum citratum, Aframomum daniellii, Piper capense* and *Monodora myristica* are well known in agri-food. In the current work, we study the possibility of using these oils in cosmetic creams as preservatives. Essential oils were obtained from powdered seed by hydrodistillation using a Clevenger-type apparatus. Their chemical compositions were determined using Gas Chromatography/Mass Spectrometry (GC/MS). Their cytotoxic activities were assayed against human intestinal (Caco-2) and epidermal (HaCaT). Briggs-Rauscher test and peroxide index were used to study the evolution of the antioxidant activity of essential oil-based cream submitted to accelerate aging process. Major component of the essential oil from the seeds of *A. citratum* was geraniol (97.6 %) while the essential oil of the seed of *A. daniellii* was rich in eucalyptol (51.5 %), α-terpineol (12.5 %) and β-pinene (8.5 %). Majors components of the essential oil from *P. capense* were β-pinene (38.1 %), germacrene D (12.3 %), *trans*-β-caryophyllene (11.3 %) and α-pinene (9.0 %) while the essential oil of seed of *M. myristica* was predominantly constituted of α-phellandrene (77.8 %). Essential oils of *A. citratum* and *P. capense* showed low cytotoxicity on the tested cells. *M. myristica* demonstrated a low cytotoxicity on epidermal cell lines HaCaT and no cytotoxicity on Caco-2 cell lines. No cytotoxicity was recorded with *A. daniellii*. The four essential oils in cosmetic cream preserved it from oxidation during accelerated aging process. This study provided evidence for possible utilization of *Aframomum citratum, Aframomum daniellii, Piper capense* and *Monodora myristica* essential oils in the prevention of oxidative damages in cosmetic creams.

Key words: Essentials oils, chemical analysis, cytotoxicity, Caco-2 cells, HaCaT cells, antioxidant activity.

Introduction

Essential oils are used in natural cosmetics for their anti-inflammatory, antibacterial, antiviral and antioxidant properties [1,2,3]. They are also used as preservative agent in cosmetic products. One of the most sought-after effects in cosmetics is either their ability to rejuvenate the skin or slow down its aging. Indeed, reactive oxygen species, free radicals and lipid peroxides are important causative agents of skin aging [4]. This is because skin constantly is exposed to environmental oxidative agent such as ultraviolet radiation, air pollutants, chemical oxidants and aerobic microorganisms. Therefore, the use of antioxidants in

*Corresponding authors (Jules-Roger Kuiate)
E-mail: < jrkuiate@yahoo.com; jules.kuiate@univ-dschang.org >

cosmetic products thereby assumes great importance for health and traditional medicine [5,6]. Then, exogenous antioxidants such as essential oils in cosmetics are one approach to prevent or minimize ROS (reactive oxygen species) -induced photo aging and also minimize the cosmetic product degradation.

Cosmetics can themselves undergo oxidation of its components and thus degraded. It is therefore necessary to use preservatives in these products in order to limit oxidation reactions, so as not only to avoid the formation of toxic products for consumers but also to prolong their self-life. Apart of their capacity to prevent cosmetics damage caused by microorganisms they can also protect it against damage and degradation caused by exposure to oxygen [7]. Without preservatives, cosmetic products can become contaminated, leading to product spoilage and possibly irritation or infections.

Aframomum is widespread across tropical Africa. Antiprotozoal, antibacterial, anti-inflammatory and antioxidant activities of *Aframomum* species are documented [8-11]. *Aframomum daniellii* (Hook. F.) K. Schum., seeds have been used to flavor dishes and as food additives [12]. It possess laxative, anti-helmintic, antibacterial and anti-fungal properties [13]. According to Essien *et al.*[14], seed essential oil of *A. daniellii* showed a radical scavenging activity. *Aframomum citratum* is used traditionally to treat bacterial infections, malaria, cancers and as an aphrodisiac [15,16]. Extracts from *M. myristica* also possess very good antioxidant properties beneficial in the prevention of some off-flavor development, in snack foods and meat products [17]. According to Debebe *et al.*[18] essential oil of *P. capense* seed from Ethiopia showed a radical scavenging activity and inhibit lipid peroxidation. The present work was therefore focused on the study of the capacity of essential oils of *Aframo-mum citratum, A. danielli*, *Piper capense* and *Monodora myristica* to preserve a cosmetic cream from oxidations when submitted to accelarated aging process.

Materials and methods

Plant material

Dried seeds of *Aframomum citratum, A. daniellii, Piper capense* and *Monodora myristica* were purchased in February 2016 at market "B" in Bafoussam, West-Cameroon. Plants identifications were carried out at the National Herbarium of Cameroon where voucher specimens were kept under the reference numbers 37736/NHC, 43130/NHC, 6018/NHC and 2949/NHC respectively.

Essential oil extraction

Essential oils were obtained by hydrodistillation using a Clevenger-type apparatus. To 100 g of each powder, 500 mL of distilled water were added. The mixture was heated using a heating mantle associated with a magnetic stirrer. Hydrodistillation was carried out for 1 h and the obtained essential oils were dried over a column of anhydrous sodium sulphate and then stored in amber tubes at 4°C until analyses.

Determination of the chemical composition of essential oils

Chemical compositions of essential oils were determined using Gas Chromatography-Mass Spectrometry (GC-MS) on an Agilent apparatus (6890 N series), fitted with a HP-5MS fused silica capillary column (30 m × 0.25 mm, film thickness 0.25 µm) and coated with 5 % phenyl 95 % dimethylpolysilosane. The initial temperature was set at 50°C and the oven was heated up to 110°C at a rate of 3°C/min, then from 110 to 300°C at a rate of 10°C/min. The carrier gas was helium at a flow rate of 1.2 mL/min.

From the obtained chromatograms, retention indices (RI) of components were determined relatively to the retention times of a series of *n*-alkanes with linear interpolation. Compounds were identified by comparing their retention indices and their mass spectra with those of Wiley Library data 2009 [19].

Cytotoxicity assay of essential oil

Human keratinocytes (HaCaT) and intestinal (Caco-2) cell lines used in this study were purchased from the Cellular Biochemistry, Nutrition and Toxicology Laboratory of Catholic University of Louvain-Belgium. They were maintained in Dulbecco's Modified Eagle Medium (DMEM) supplemented with 10 % Foetal Bovine Serum (FBS) (Hyclone, UK), glutamine, phenol red and

50 µg/mL gentamycine, in humidified atmosphere at 37°C with 5 % CO_2.

Cytotoxicity tests of essential oils were carried out using MTT assay (20) against Human keratinocytes (HaCaT) and intestinal (Caco-2), two human epithelial cell lines. A stock solution (2 mg/mL) of each essential oils were prepared in 10 % absolute ethanol solution and serially diluted with culture medium to give concentrations ranging from 25 µg/mL to1600 µg/mL. Two hundred microliters of culture medium containing Caco-2 (20000 cells) and HaCaT (15000 cells) were separately seeded in wells of a 96 well-plates and incubated in humidified atmosphere with 5 % CO_2 at 37°C using a SANYO CO_2 incubator. After 24 h incubation, the medium was removed in each well and 200 µL of medium containing essential oils at appropriate concentrations were added into each well. The plates were covered and incubated under the same conditions. After 24 h incubation, the medium was removed and 100 µL of MTT reagent at 1mg/mL were added to each well and incubated for 1h. Then, MTT was removed and 100 µL of DMSO were added in each well to solubilize the formazan crystals formed. After 20 min of incubation under constant agitation, absorbance of each well was read at 530 nm using a microplate reader (Spectracount, Packard). The test repeated thrice and each concentration was tested in quadruplicate. The control was made of 10 % absolute ethanol without essential oils. Absorbance of the control wells was consider as corresponding to 100 % viability and used to calculate the percentage viability of cells test assay as follow:

$$\% \text{ Viability} = \frac{\text{OD treated cells} \times 100}{\text{OD untreated cells}}$$

Cell cytotoxicity fifty (CC_{50}) corresponding to the concentration of tested oil resulting in 50 % reduction of cell growth was determined using the curve of cell viability percentage with respect to essential oils concentration.

Formulation of cosmetic cream and characterization

Formulation of cosmetic cream

Cosmetic cream was made using the modifying formula of Flick [21]. Two mixtures were prepared separately: mixture A made up of water (97.4 %), glycerol (1.7 %) and xanthan (0.9 %) and mixture B made up of wax (15.1 %), apricot oil (82.9 %) and shea butter (2.0 %). These two mixtures were mixed at 70°C in a water bath for 4 min and then cooled on ice bath for 2 min, followed by addition of sorbate/benzoate solution (1:1) (1 %) as cream preservative. Lactic acid was then added to adjust the pH of the cream at 4.5. Finally, 1 g of essential oil per 100 g of cream was added giving a final concentration of oil in cream of 1 %. Control cream was made up of cream without any antioxidant and without essential oil.

Study of antioxidant capacity of cosmetic cream submitted to accelerate aging

Preparation of tested cream solutions

Each cream was distributed in 5 pots (55 g/pot). To induce accelerated aging, each pot was stored in an oven (Damuzeaux) at 50°C for one month. Every 7 days, a sample of cream was tested for it's antioxidant capacity using the Briggs-Rauscher reaction (7) and peroxide index [22]. For this purpose, an emulsion of each cosmetic cream sample was prepared by dissolving 12 g of cream in 10 mL of isopropyl alcohol for a final concentration of 1.2 g/mL. The mixture was homogenized using a vortex and then centrifuged at 3230 rpm for 15 min. The resulting supernatant was used for the Briggs-Rauscher test. For this purpose, different volumes of supernatant varying from 500 to 2500 µL with and increment of 500 µL were used in the method of Briggs-Rauscher to determine the antioxidant capacity of the cream. Gallic acid at 1 mg/mL was used as a standard.

Measurement of antioxidant capacity of supernatants

Briggs-Rauscher reaction [23] was done by mixing appropriate volumes of supernatant (varying from 500 to 2500 µL with an increment of 500 µL) with the reagent in a 100 mL beaker. The reagent consisted of a mixture of three solutions:

Solution A made up of 43 g of potassium iodate (KIO_3) and 4.5 mL of sulfuric acid (H_2SO_4, 96 %) dissolved in distilled water for a final volume

of 1 L;

Solution B made up of 15.6 g of malonic acid, 3.4 g of manganese sulfate monohydrate ($MnSO_4$, H_2O) and 4 g of starch dissolved in distilled water and diluted to 1 L;

Solution C made up of 400 mL of 30 % hydrogen peroxide (H_2O_2, 30 %) diluted with distilled water to 1 L.

The three solutions were prepared extemporarily. For each measurement, 10 mL of solution A and B were poured into a beaker. After 5 s of agitation on a magnetic stirrer, 10 mL of solution C was added to initiate the oscillation of the titrator. After the third oscillation, increasing volumes of sample solutions (supernatant or gallic acid) were added to the mixture. The inhibition time was measured via a potentiometer (Metrohm Titrino 785) equipped with a combined platinum redox electrode (Metrohm 6.0431.100 Titrode Pt). To mark the beginning of the inhibition time, the last minimum potential before the flat region was considered; the first minimum potential after the flat region was considered to mark the end of the inhibition time. The inhibition time was calculated using the following formula:

$$Ti = Te - Ta$$

Ti: inhibition time, *Te*: Time at the end of the oscillation, *Ta*: Time of addition of sample or standard.

Isopropyl alcohol (200 µL) was used as a blank to demonstrate that the Briggs-Rauscher oscillations were not perturbed by the addition of the solvent. For each sample, five concentrations were tested. All measurements were performed in triplicate, and the mean value was considered. Inhibition time was proportional to the quantity of antioxidant added. Regression line of gallic acid (inhibition time/mass of gallic acid, s mg^{-1}) was plotted to obtain the equation of the line: $y_1 = a_1x_1 + b_1$. The regression lines of creams (inhibition time/mass of added creams, s mg^{-1}) were also plotted to obtain the equation $y_2 = a_2x_2 + b_2$. The value of the BRAI (mg of gallic acid per 100 g of cosmetic cream) was calculated by making the ratio of the slopes [7,24].

$$BRAI = \frac{a_2 \times 10000}{a_1}$$

Determination of peroxide index

Extraction of fats

Extraction of fats in cosmetic creams was done following Folch principle [25]. A sample cream (40 g) was dissolved in 170 mL of chloroform/methanol (2:1) for 1 h under constant agitation. Then, the mixture was filtered using a separatory funnel. Calcium chloride, 10 mM (70 mL) were added to the mixture. After agitation, the mixture was let for decantation for 24 h. Lower phase was taken and the solvent evaporated at 45°C rotary evaporator. The oil obtained was used to determinate the peroxide index.

Peroxide index

Peroxide index was measured using the AOCS Official method Cd 8b-90 [22]. This method determines all substances, in terms of milli equivalents of peroxide per 1000 g of sample that oxidize potassium iodine under the test conditions. Three grams of sample were dissolved in 50 mL of the acetic acid/chloroform (3:2) solution. Five hundred microliter of saturated potassium iodate solution (10 g of KI per 6 mL of distilled water) was added. Then, the solution was allowed to stand for 1 min during what it was shaken 3 times. Thereafter, 30 mL of distilled water and 500 µL of starch (0.5 g/100 mL) were added and the solution was titrated with 0.002 N sodium thiosulfate.

$$\text{Peroxide index} = \frac{(S - B) \times N \times 1000}{\text{Mass of sample}}$$

Where B= volume of titrant, mL of the blank,
S= volume of titrant, mL of the sample
N= normality of sodium thiosulfate solution;
Mass of sample, g.

Each sample was tested in triplicate. Blank determination of the reagents was conducted daily.

Statistical analysis

Data were submitted to one-way analyses of variance (ANOVA) and when differences were noted, mean in different groups were compared using Waller-Duncan test at 5 % significant level. This was done using SPSS 16.0.

Results

Chemical composition and cytotoxicity of essential oils

The four essential oils were obtained with 1.5 ±

0.1 %, 2.0 ± 0.2 %, 3.9 ± 1.3 % and 5.3 ± 0.3 % yields respectively for *A. citratum, A. daniellii, P. capense* and *M. myristica*. Five components were identified in the essential oil of *A. citratum* with geraniol (97.6 ± 0.1 %) as the main component (Table 1). In contrast, 23 constituents were identified in the oil of *A. daniellii*, with eucalyptol (51.5 ± 8.1 %), α-terpineol (12.5 ± 0.9 %) and β-pinene (8.5 ± 0.3 %) as major components. No sesquiterpene was identified in *A. citratum* oil while some were present in *A. daniellii* although in a lesser amount compared to monoterpenes. Twenty four (24) components were identified in the essential oil of *P. capense* with β-pinene (38.1 ± 1.3 %), germacrene (12.3 ± 4.6 %), *trans*-β-caryophyllene (11.3 ± 4.6 %) and α-pinene (9.0 ± 0.7 %) as major components. Fourteen constituents were identified in the essential oil of *M. myristica* with α-phellandrene (77.8 ± 5.9 %) as major components (Table 1). Monoterpenes and sesquiterpenes were slightly the same in *P. capense* oil while monoterpenes in *M. myristica* oil were higher than sesquiterpenes.

Essential oil from *A. citratum* (IC_{50}: 336 and 330 µg/mL) showed higher cytotoxic effects on Caco-2 and HacaT cell lines respectively, followed by the essential oils of *P. capense* (IC_{50}: 950 µg/mL and IC_{50}: 540 µg/mL), *M. myristica* (IC_{50}: 1280 µg/mL and IC_{50}: 636 µg/mL) and *A. daniellii* (IC_{50}= 1100 and 1280 µg/mL) on Caco-2 and HaCaT cell lines respectively. Globally, their cytotoxic effects were low.

Table 1. Qualitative and quantitative composition of essential oils from spices powdered seeds

Components	RI	*A. citratum*	*A. daniellii*	*P. capense*	*M. myristica*
Monoterpenes		98.8±0.3	91.5±2.8	56.1±5.5	90.3±1.3
Monoterpene hydrocarbons		0.3	15.7±3.6	54.3±5.1	89.1±1.5
α-Thujene	921	-	-	-	1.3±0.1
α-Pinene	927	-	1.9 ± 0.1	9.0 ±0.7	4.4±0.4
Sabinene	968	-	2.7±1.3	4.8±1.3	-
β-Pinene	971	-	8.5±0.3	38.1±1.3	-
Myrcene	990	-	-	-	1.1±0.3
β-Myrcene	995	0.3	0.5	0.7±0.05	2.6±0.2
α-Phellandrene	1002	-	-	-	77.8±5.9
δ-3-Carene	1006	-	-	1.6±0.1	-
p-Cymene	1020	-	-	-	0.9
Limonene	1024	-	3.0±0.7	-	2.8±0.5
1.8-Cineole	1027	-	-	1.2±0.05	2.4±0.2
β-Ocimene	1047	-	0.5	-	-
γ-Terpenene	1056	-	0.3	-	-
Oxygen-containing monoterpènes		98.7±0.2	75.8±6.4	1.8±0.9	1.2±0.3
Eucalyptol	1026	-	51.5±8.1	-	-
Linalool	1100	0.2	1.7±0.7	1.6	1.2±0.3
Linalyl propionate	1164	-	0.4	-	-
4-Terpineol	1174	-	1.1	0.6	-
α-Terpineol	1188	-	12.5±0.9	-	-
Geraniol	1257	97.6±0.05	4.9±2.9	-	-
Geranial	1274	0.3	-	-	-
Bornylacetate	1288	-	-	1.0±0.3	-
Geranyl acetate	1388	0.9±0.1	5.2±1.1	-	-
Sesquiterpenes		-	6.7±2.7	41.6±5.5	7.8±1.6

table 1. (continued).

Components	RI	*A. citratum*	*A. daniellii*	*P. capense*	*M. myristica*
Sesquiterpene hydrocarbons	-	6.2±2.6	40.5±6.8	4.9±0.8	
α-Cubebene	1357	-	-	0.7±0.1	-
α-Copaene	1380	-	-	1±0.4	-
β-Cubebene	1393	-	-	3.2±0.8	-
(Z.E)-α-Farnesene	1418	-	-	-	0.5
trans-β-Caryophyllene	1424	-	2.1±0.4	11.3±4.2	-
Santalen	1425	-	-	-	2.3±0.3
(Z.E)-α-Farnesene	1441	-	0.4	-	-
α-Cubebene	1455	-	0.5	-	-
Germacrene D	1460	-	0.7	1.6±0.5	-
α-Amorphene	1482	-	-	1.1±0.2	-
Germacrene D	1488	-	-	12.3±4.6	-
α-Amorphene	1500	-	-	1.1±0.3	-
δ-Cadinene	1514	-	0.3	-	-
γ-Cadinene	1522	-	3.1±0.7	-	1 ± 0.1
Naphthalene	1524	-	-	6.0±3.8	-
δ-Cadinene	1532	-	0.4	1.0±0.2	1.4 ±0.1
Germacrene B	1570	-	0.5	1.3±0.3	-
Oxygen-containing sesquiterpenes		-	0.8±0.1	3.1	2.9±0.8
Germacradienol	1588	-	-	-	2.9±0.8
Caryophyllene oxide	1598	-	0. ±0.1	0.9	-
Guaicol	1609	-	-	1.6	-
Azulene methanol	1684	-	-	0.6	-

RI: Retention Indices

Antioxidant effects of cosmetic cream containing essential oils and submitted to accelerated aging process

It is noteworthy that, cream without essential oil possess no radical scavenging activity. Submitted to accelerate aging process, the creams containing essential oil of *M. myristica* present the highest radical scavenging capacity and this activity decrease during the first week and became stable for the rest of the time (Figure 1). The three other oils showed radical scavenging activities 7 to 14 time lower compared to that of *M. myristica*. Activities of the creams containing these oils decrease during the two first week of accelerated aging process and became stable during the last week.

Essential oil of *M. myristica*, significantly inhibit the peroxidation in the cream during accelerate aging process, maintaining the peroxide index almost at the same level during the time. In contrast, in cream containing essential oils of *P. capense*, *A. daniellii* and *A. citratum*, the peroxidation increases continuously over the time. The peroxidation level was significantly high in cream containing *A. citratum* and *A. daniellii* as compare to *P. capense* (Figure 2). Globally, the essential oils of *A. daniellii*, *A. citratum* and *P. capense* had little protection effect against oxidative degradation in cosmetic cream produced. This protection did not exceed two weeks during the accelerated aging process. In contrast, the oils in cosmetic cream showed different antioxidant capacities with *M. myrisitica* having higher antioxidant effect.

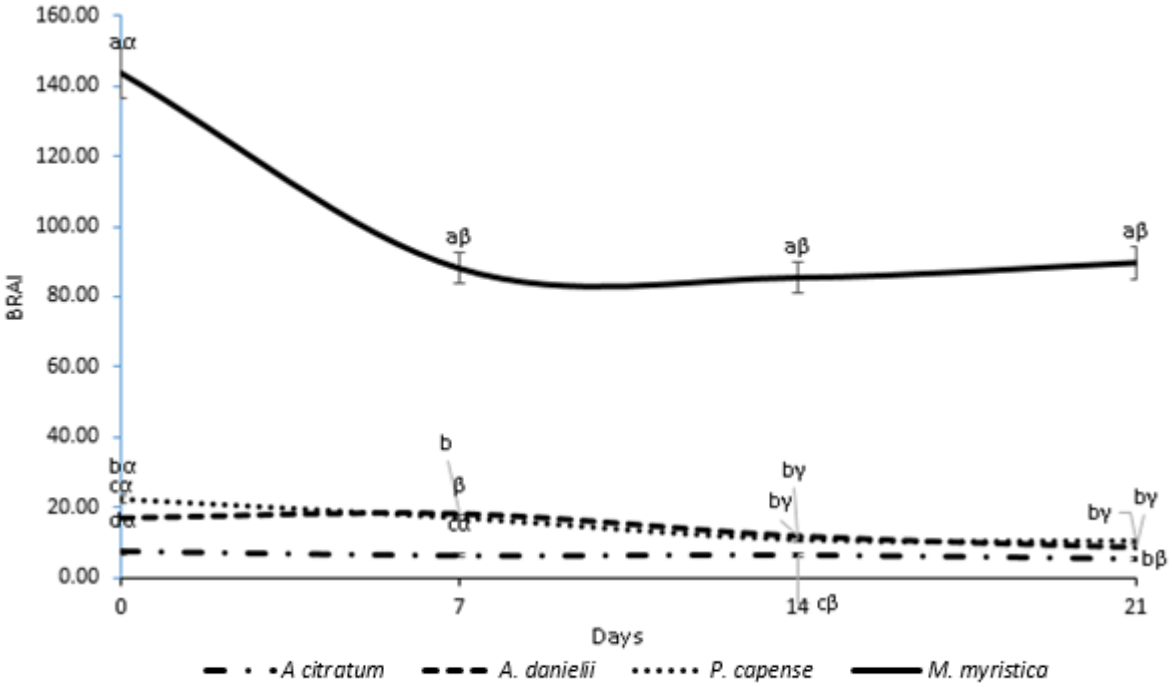

Figure 1. Evolution of the antioxidant capacity (BRAI) of cosmetic cream containing 1% essential oil and submitted to accelarate aging for 21 days. a, b, c and d: comparison of cream for the same day, BRAI carrying the same letter are not significatly different (P> 0.05), Duncan test. α, β and γ: comparison of each cream at different days, BRAI carrying the same letter are not significatly different.

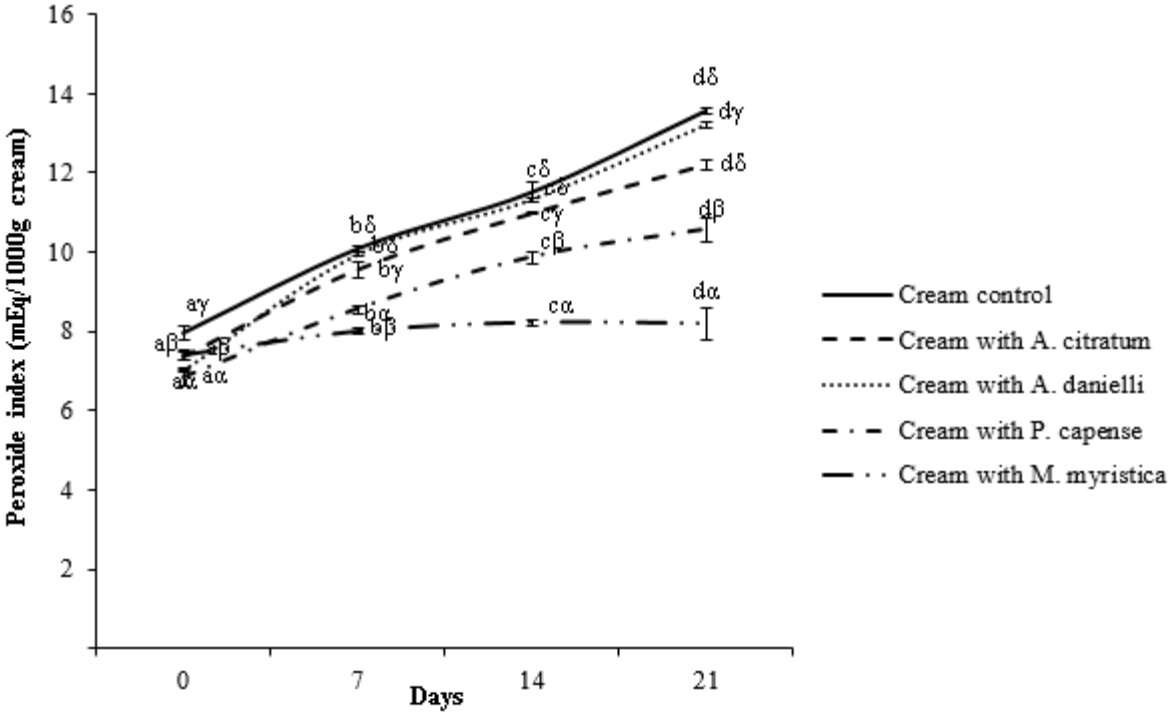

Figure 2. Evolution of the Peroxide Index (PI) of cosmetic cream containing 1% essential oil and submitted to accelarate aging for 21 days. a, b, c and d: comparison of cream for the same day, PI carrying the same letter are not significatly different (P>0.05), Duncan test. α, β and γ: comparison of each cream at different days, PI carrying the same letter are not significatly different

Discussion

The main component of the essential oils of *A. citratum*, geraniol, was the same as described by Amvam Zollo *et al.*[26] although its relative concentration in our sample seem higher. In this study, the chemical composition of essential oil of *A. daniellii* was almost the same as describe by Essien *et al* [14], Menut *et al*.[27] and Adegoke *et al*.[28]. Chemical composition of essential oil of *P. capense* corroborates the one reported by Woguem *et al*.[29]; Tchounbougnang *et al*.[30] and Amvam Zollo *et al*.[31]. It was also the case with *M. myristica* whose chemical composition as compared to the results reported by Bakarngavia *et al.* [20] and Lamaty *et al.*[32].

The four essential oils analyzed in this study showed low cytotoxicity on HaCaT and Caco-2, normal human cell lines with reference to scale proposed by Kuete and Efferth [33] for natural products. According to Bakarnga-Via et *al*.[20], the essential oil of *M. myristica* possess low toxicity on normal epithelial cell line ARPE-19. These results contrast with it cytotoxic effects on MCF-7 cancer cell line on which it was highly toxic. This was also the case with the essential oil of *P. capense* that showed high inhibitory effects on human tumor cells MDA-MB 231 (breast adenocarcinoma), A375 (malignant melanoma) and HCT116 (colon carcinoma), showing IC_{50} values of 26.3, 76.0 and 22.7 µg/mL, respectively [29]. These results reveal that the essential oils analyzed can distinguish between normal cells and cancer cells. This selectivity is a good thing because by using them in cosmetic creams, they will protect the cream against oxidative degradation but also can prevent skin cancer.

Essential oils were added in cream in this study as preservative particularly to prevent its oxidation. Preservatives are also added into cosmetics to prevent microbial spoilage and secondly to protect the consumers from potential infections [34]. Oxidation of unsaturated substances in the cream can influence the odor and color of the cream. This oxidation can leads to the formation of compounds harmful to health in addition to denaturing the quality of the product. By limiting this oxidation process, the studied essential oils, particularly the essential oils of *M. myristica* can be used to increase the lifespan of cosmetic creams provided they do not alter their odor. The decrease in antioxidant capacity of cream with time during accelerated aging process can be explained by the fact that as essential oils participate in oxidation reactions, their concentration in the formulation decrease gradually [34]. In addition to protecting cream against oxidation, the essential oils studied can have an antioxidant role on the skin and limit early aging. Wangcharoen and Morasuk [35] reported that heat treatment caused the degradation of antioxidants constituents in the essential oils. The antioxidant activity of essential oil of *A. daniellii* is known in mayonnaises subjected to a constant temperature increased during storage [36].

Conclusion

All the essential oils showed preservatives capacities on the cream oxidation. The essential oil from *Monodora myristica*, with α-phellandrene as main constituent has emerged as the best candidate for the preservation of a cosmetic cream against accelerated oxidative degradation. It can therefore increase the self-life of the product. It is also possible to consider, as for the majority of essential oils, that these essences possess antimicrobial activities that could be beneficial to the consumers by preserving the cream against microbial contaminations.

Data availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of interest

The authors have declared that there are no conflicts of interest.

Acknowledgements

The authors are grateful for the support received to carry out this project. This work received support from the ARES-CCD (Académie de Recherche et d'Enseignement Superieur-Commission de la Coopération au Développement).

References

1. **Sawamura, M. (2000).** Aroma and functional properties of Japanese zuzu (*Citrus junos* Tanaka) essential oil. Arom. Res. 1(1): 14-19.
2. **Ormancey, X., Sisalli, S. and Coutiere, P. (2001)**. Formulation of essential oils in functional perfumery. Parf. Cosm. Act. 157: 30-40.
3. **Sacchetti, G., Maietti, S., Muzzoli, M., Scaglianti, M., Manfredini, S. and Radice, M. (2005).** Comparative evaluation of 11 essential oils of different origin as functional antioxidants, antiradicals and antimicrobials in foods.Food Chem. 91: 621-632.
4. **Liu, J. and Mori, A. (2005).** Oxidative damage hypothesis of stress associated aging acceleration: neuroprotective effects of natural and nutritional antioxidants. Res. Commun. Biol. Psychol. Psychiatr. Neurosci. 30: 103-119.
5. **Pinnell, S.R. (2003).** Cutaneous photodamage, oxidative stress, and topical antioxidant protection. J. Am. Acad. Dermatol. 48(1): 1-19.
6. **Scartezzini, P. and Speroni, E. (2000).** Review of some plants of Indian traditional medicine with antioxidant activity. J. Ethnopharmacol. 71(1-2): 23-43.
7. **Cecchi, T., Cecchi, P. and Passamonti, P. (2011).** The first quantitative rating system of the antioxidant capacity of beauty creams via the Briggs-Rauscher reaction: a crucial step towards evidence-based cosmetics. Roy. Societ. Chem. 136: 613-618.
8. **Lawal, O., Kasali, A.A., Opoku, A.R., Ojekale, A.B., Oladimeji, O.S. and Bakare, S. (2015).** Chemical composition and antibacterial activity of essential oil from the leaves of *Aframomum melegueta* (Roscoe) K. Schum from Nigeria. J. Essent. Oil Bearing Plants. 18(1): 222-229.
9. **Adjalian, E., Bothon, F., Yehouenou, B., Noudogbessi, J., Figueredo, G., Avlessi1, F. and Sohounhloue, C.K. (2014).** GC/MS and GC/FID analysis and evaluation of antimicrobial performance of *Aframomum sceptrum* essential oils of Benin.World J. Pharm. Sci. 2(8): 787-792.
10. **Cheikh-Alia, Z., Adikoa, M., Bouttierc, S., Boriesa, C., Okpekon, T., Poupon, E. and Champy, P. (2011).** Composition and antimicrobial and remarkable antiprotozoal activities of the essential oil of rhizomes of *Aframomum sceptrum* K. Schum. (Zingiberaceae). Chem. Biodivers. 8(4): 658-667.
11. **Dongmo, J., Boyom, F.F., Sameza, M.L., Ndongson, B., Kwazou, N.L., Amvam Zollo, P. and Menut, C. (2008).** Investigations of the essential oils of some *Aframomum* species (Zingiberaceae) from Cameroon as potential antioxidant and anti-inflammatory agents. Int. J. Essent. Oil Ther. 2(4): 149-155.
12. **Adegoke, O.A., Makinde, O., Falade, K.O. and Uzo Peters P.I. (2003).** Extraction and characterization of antioxidants from *Aframomum melegueta* and *Xylopia aethiopica*. Europ. Food Res. Techn. 216(6): 526-528.
13. **Tane, P., Tatsimo, S.D., Ayimele, G.A. and Connolly, J.D. (2005).** Bioactive metabolites from *Aframomum* species. In Proceedings of the 11th NAPRECA Symposium, Antananarivo, Madagascar. 9(12): 214-223.
14. **Essien, E.E., Thomas, P.S., Oriakhi, K. and Choudhary, M.I. (2017).** Characterization and antioxidant activity of volatile constituents from different parts of *Aframomum danielli* (Hook) K. Schum. Med. 4(29): 29.
15. **Titanji, V.P.K., Zofou, D. and Ngemenya, M.N.T. (2008).** The antimalarial potential of medicinal plants used for the treatment of malaria in Cameroonian folk medicine.Afr. J. Trad. Compl. Altern. Med. 5(3) : 302-321.
16. **Kuete, V., Krusche, B., Youns, M., Voukeng, I., Fankam, A.G., Tankeo, S., Lacmata, S. and Efferth, T. (2011).** Cytotoxicity of some Cameroonian spices and selected medicinal plant

extracts. J. Ethnopharmacol. 134(3): 803-812.
17. **Giese, J. (1994).** Spices and seasoning blends: A taste for all seasons.Food Technol. 48(4) : 87-98.
18. **Debebe, E., Dessalegn, T. and Melaky, Y. (2018).** Chemicals constituents and antioxidants activities of the fruits extracts of *Piper capense*. Bull. Chem. Societ. Ethiop. 32(1): 167-174.
19. **Adams, R.P. (2007).** Identification of essential oil by gas chromatography/mass Spectrometry," 4thed, Allured Publishing Corporation: Carol Stream, IL, USA.
20. **Bakarnga-via, I., Hzounda, J.B., Fokou, P.V.T., Tchokouaha, L.R.Y., Gary-Bobo, M., Gallud, A., Garcia, M., Walbadet, L., Secka, Y., Dongmo, P.M.J., Boyom, F.F., and Menut, C. (2014).** Composition and cytotoxic activity of essential oils from *Xylopiaaethiopica* (Dunal) A. Rich, *Xylopiaparviflora* (A. Rich) Benth.) and *Monodoramyristica* (Gaertn) growing in chad and Cameroon."BMC Compl. Alter. Med. 14(125) : 1-8.
21. **Flick, E.W. (1992).** Cosmetics and toiletry formulations.Noyes Publications, Second Edition, Park Ridge, New Jersey, USA. 2: 202-353.
22. **AOCS. (2001).** "Peroxide Value Acetic Acid-Isooctane Method. Sampling and analysis of commercial fats and oils." AOCS Official method Cd 8b-90. pp. 1-3.
23. **Briggs, T. and Rauscher, W. (1973).** An oscillating iodine clock. J. Chem Educ. 50, 496.
24. **Cervellati, R., Renzulli, C., Guerra, M.C. and Speroni, E. (2002).** Evaluation of antioxidant activity of some natural polyphenolic compounds using the Briggs-Rauscher reaction Method. J. Agri. Food Chem. 50(26): 7504-7509.
25. **Folch, J., Lees, M. and Sloane-Stanley, G.A. (1957).** A simple method for isolation and purification of total lipids from animal tissues. J.Biol. Chem. 226(1) : 497-509.
26. **AmvamZollo, P., Abondo, R., Biyiti, L., Menut, C. and Bessière, J. (2002).** Aromatic plants of Tropical Central Africa XXXVIII: Chemical composition of the essential oils from four *Aframomum* species collected in Cameroon (1). J. Ess. Oil Res. 14 : 95-98.
27. **Menut, C., Lamaty, G., Amvan Zollo, P.H., Atoho, B.M., Abondo, R. and Bessiere, J.M. (1991).** Aromatic plants of tropicalcentral Africa. V. volatile components of three Zingiberaceae from Cameroon: *Aframomum melegueta* (roscoe) K. Schum., *A. daniellii* (Hook. f.) K. Schum. and *A. sulcatum* (Oliv. and Hanb.) K. *schum.* Flavour. Fragr. J. 6(3) : 183-186.
28. **Adegoke, G.O., Rao, J.M. and Shankaracharya, N.B. (1998).** A comparison of the essential oils of *Aframomum daniellii* (Hook. F.) K. schum. And *Amomum subulatum* Roxb. Flavour. Fragr. J. 13(5): 349-352.
29. **Woguem, V., Maggi, F., Fogang, H.P.D., Tapondjou, L.A., Womeni, H.M., Quassinti, L., Bramucci, M., Vitali, L.A., Petrelli, D., Lupidi, G., Vittori, S. and Barboni, L. (2013).** Antioxidant, antiproliferative and antimicrobial activities of the volatile oil from the wild pepper *Piper capense* used in cameroon as a culinary spice. Nat. Prod. Commun. 8(12): 1791-1796.
30. **Tchoumbougnang, F., Jazet, D.P.M., Sameza, M.L., Fombotioh, N., Wouatsa, N.A.V., Amvam, Z.P.H. and Menut, C. (2009).** Comparative essential oils composition and insecticidal effect of different tissues of *Piper capense* L., *Piper guinense* Schum. And Thonn., *Piper nigrum* L., and *Piper umbellatum* L., grown in Cameroon."Afric J Biotechnol.8(3) : 424-431.
31. **AmvamZollo, P.H., Biyiti, L., Tchoumbougnang, F., Menut, C., Lamaty, G. and Bouchet, P. (1998).** Aromatic plants of tropical central Africa. Part XXXII. Chemical composition and antifungal activity of thirteen essential oils from aromatic plants of Cameroon. Flavour. Fragr. J. 13(2) : 107-114.
32. **Lamaty, G., Menut, C., Bessiere, J. M., Amvam Zollo, P.H. and Fekam, B.F. (1987).** Aromatic plants of tropical central Africa. I. Volatile components of two annonaceae from cameroon: *Xylopia aethiopica* (dunal) A. Richard and *Monodora myristica* (Gaertn.) Dunal. Flavour. Fragr. J. 2(3) : 91-94

33. **Kuete, V. and Efferth, T. (2015).** African Flora Has the Potential to Fight Multidrug Resistance of Cancer." BioMed. Res. Inter. ID 914813, pp 1-24.
34. **Varvaresou, A., Papageorgiou, S., Tsirivas, E., Protopapa, E., Kintziou, H., Kefala, V. and Demetzoset, C. (2009).** Self-preserving cosmetics.Inter J CosmetSci. 31(3) : 163-175.
35. **Wangcharoen, W. and Morasuk, W. (2009).** Effect of heat treatment on the antioxidant capacity of Garlic.Maejo Inter. J. Sci. Technol. 3(1) : 60-70.
36. **Etti, C.J., Adegoke, G.O. and Etti, I.C. (2012).** Lipid oxidation of *Afamomumdanielli* Antioxidant extracts in prevention. IOSR J. Engineer. 2(11) : 46-50.