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Volatile Compounds in the Skin Essential Oil of Moroccan *Feijoa sellowiana*

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Authors' contributions

This work was carried out in collaboration between all authors. Author MB designed the study. Author JJ performed the statistical analysis. Author ME wrote the protocol and wrote the first draft of the manuscript. Authors AAAH and MA managed the analyses of the study and managed the literature search. All authors read and approved the final manuscript.

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ABSTRACT

The oil of Feijoa skin (*Feijoa sellowiana*, family Myrtaceae) was isolated by hydrodistillation in a Clevenger-type apparatus and analyzed by GC-MS analysis. As a result, 76 components were isolated. Among 19 peaks identified which three were reported for the first time in this plant (Elixene, Linalylanthranilate and Farnesol). The sesquiterpene group was predominant, accounting for 97.8% of the total oil. Of which Caryophyllene was the most abundant 17.7%, followed by Germacrene D14.4%, Humulene 10.5%, Ledene 14%, Spathulenol 8.5%, Cadina-3,9-diene 8.3%, Farnesol 8%, Linalylanthranite 5.6%, β-elemene 4.8%, α-Cubebene 2.7%. Other constituents were also present in oil such as Octanone 5.3%, D limoneme 0.17%, Ocimene 1.6%, Benzoicacidmethylester 1.1%.

Keywords: Feijoa sellowiana; Myrtaceae; fruit skin; essential oil.

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1. INTRODUCTION

The *Feijoa sellowiana* (*F. sellowiana*) Berg. (synonym *Acca sellowiana*) is a close relative of the guava (*Psidium guajava*.) [1], also known as guavasteen. It is a small evergreen shrub member of Myrtaceae family; the genus name is replaced by Acca instead Feijoa, but Feijoa name is still used [2]. The Feijoa plants native to the southern part of South America: extreme southern Brazil, northern Argentina, western Paraguay and Uruguay. *F. sellowiana* were introduced to Europe in 1890 by the French botanist, Dr. Edouard Andre, in North Africa at 1899 by Dr. Trabut, in New Zealand in 1908 and in Turkey in 1988 by Yalova Ataturk Horticultural Research Center [3–5]. They were not commonly distributed in the word but were planted commercially in Uruguay, New Zealand, United States of America (California), Caucasian region of southern Russia, Sicily and Portugal [6]. Feijoa plant has a preference to moderate winters and summers (26 to 32°C), and is in general adapted to areas where temperatures stay above – 9°C. It is used either as an ornamental or exploited commercially. Indeed *F. sellowiana* fruit is used as juice, jam, and ice-cream [1,7]. Several studies about Volatile compounds of *F. sellowiana* have been done by using GC-MS [1, 7–13]. The important characteristic aroma of *F. sellowiana* is associated to volatile constituents like terpenes and methyl- and ethylbenzoates (Sun-Waterhouse et al., 2013). 29 aroma components were identified by GC-MS, the abundant compounds were: esters 50.64%, aldehydes 26.04%, alcohols 5.84%, hydrocarbons 3.85%, ketones 3.14%, phenol 0.77% and the Methyl benzoate was of the highest product with a percentage of 36.56% [12]. Differences on the nature of the abundant compounds and a volatile fraction composition have been described and reported to be dependent to the part of the fruit from which it was extracted and also on the geographical origin of the fruit. The intensities of the aromas of the essential oils of *F. sellowiana* fruit showed clearly their great potential commercial value as a food flavors, however the yields of Feijoa oils remains low and the technology actually used in their isolation did not perform for producing oil with a best composition, a best yield and a best aroma [14]. It was reported that *F. sellowiana* fruit was an excellent source of vitamin C, minerals , fiber, iodine [15] and the linoleic acid is the main fatty acid shown in the oil of the *F. sellowiana* seed (84.44 g/100 g) [16]. Different biological activities of *F. sellowiana* fruits had been described as antioxidant; antibacterial; cytotoxic; anti-inflammatory and anti-cancer activities. Indeed *F. sellowiana* had shown high antimicrobial activity against gram-positive and gram-negative bacterial strains such as Pseudomonas, Enterobacter and Salmonella [15], especially active against *Helicobacter pylori*, due to the presence of flavones [17]. *F. sellowiana* extract also inhibited *Listeria monocytogenes* and *Bacillus cereus* [18]. Others studies were done in different cancer cell lines have revealed that *F. sellowiana* fruit extracts showed anti-tumoral activities without toxicity toward normal cells [19]. A clinical study performed with type two diabetic subjects has demonstrated that doses of 150 mg/daily of *F. sellowiana* during 12 weeks showed a decrease of blood pressure, compared to control group, and also a decrease of blood sugar, glycosylated hemoglobin, cholesterol and triglycerides [20]. These results place *F. sellowiana* as a promising food ingredient for the control of hyperglycemia and hypertriglyceridemia. Exploring essential oil appeared to be an interesting way to estimate the underlying economic values of *F. sellowiana* due to the special roles played in food, flavor and cosmetic industries. In this work we report on the characterization of the principal volatile flavour constituents associated with the skin oil of *F. sellowiana* cultivated in Morocco.

2. MATERIALS AND METHODS

2.1 Plant Materials

Fully ripened fresh fruits of Moroccan *F. sellowiana* were used. The skin of fruits were peeled carefully and used for oil separation while fresh.

2.2 Isolation of the Essential Oil

The samples of fresh *F. sellowiana* peels were subjected to hydro-distillation for 3 h using a Clevenger-type apparatus. Distillates of essential oils were dried over anhydrous sodium sulfate, filtered and stored at -20°C until analyzed.

2.3 Analysis of the Essential Oil

The GC-MS analyses were carried out with a gas chromatograph model GC-MS: TSQ8000 of thermo Scientific using a column GC: ZB-1MS (30 m, 0.25 mm x 0.25 um).

The injection port was set to 250°C and the oven was initially set at 70°C and held for 5 min. The temperature was then increased 3°C/ min up to a temperature of 250°C. The mass spectra interface was set to 250°C with the ion source set to 200°C. The scan range was 50 m/z – 500 m/z ionization voltage, 70eV.

The identification of the different constituents was carried out from their mass spectra in comparison with those of the standard compounds of the computerized data bank (mainlib and replib). Data processing for the identification of metabolites was conducted with the Thermo Scientific compound discover software.

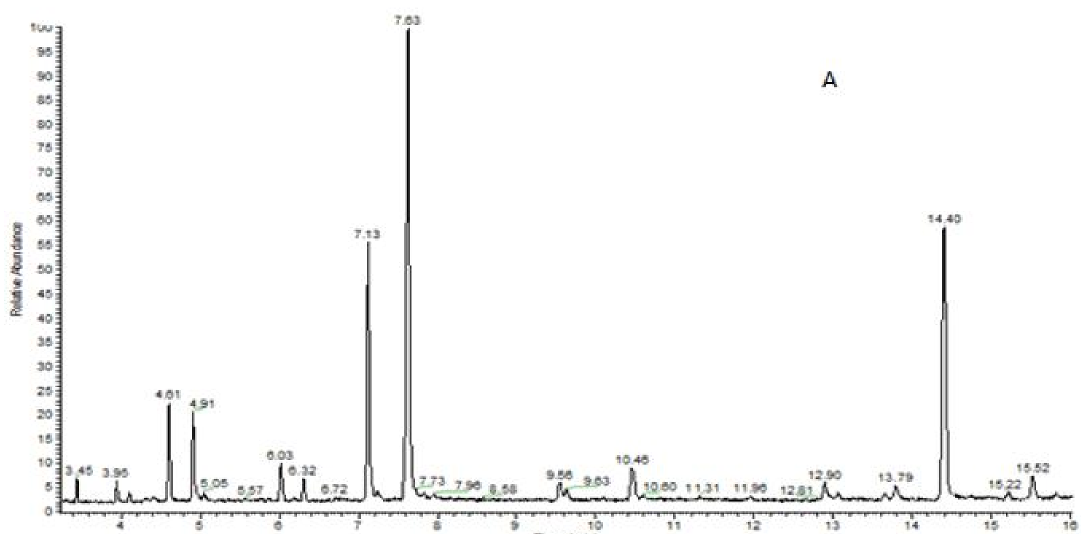
3. RESULTS AND DISCUSSION

Using the hydrodistillation in a Clevenger-type apparatus, the essential oil contents in *F. sellowiana* were reported. The extract was examined by GC-MS. The gas chromatographic profiles and compositions of the essential oil were presented in Fig. 1 and Table 1.

Table 1. Volatile flavour constituents identified in the skin oil from *F. sellowiana*

Retention time (min)	SI*	RSI**	Constituent name	Relative abundance (%)
4.58	876	876	3-Octanone	5,3
4.86	939	970	3-Octanol	0.88
6	923	923	Ocimene)	1.6
5.86	881	906	Sylvestrene	0.17
7.10	931	935	Benzoic acid,Methyl ester	1.1
7.61	863	868	Linalyl anthranilate	5.9
9.52	858	863	Ethyl benzene Carboxylate	0.17
16.56	856	922	Elixene	0.17
17.74	920	933	α-Cubebene	2.7
18.67	911	921	Belemene	4.8
19.69	943	943	Caryophyllene	15
20.95	898	906	Humulene	10.5
21.99	889	892	Germacrene D	14
22.61	889	895	Ledene	14
23.63	887	890	Cadina-3,9-diene)	8.3
25.26	927	928	Spathulenol	8.5
30.76	918	919	Farnesol	6.9

** Similarity Index. ** Reverse Similarity Index*



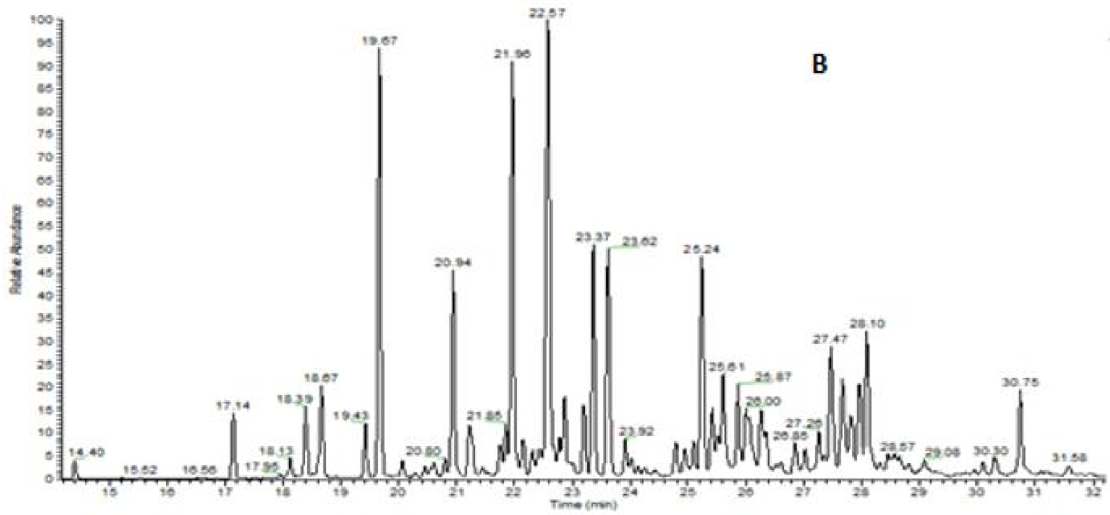


Fig. 1. Chromatogram presenting results of GC-MS analysis of essential oil skin (A: 0 to 16 min, B: 16 to 32 min)

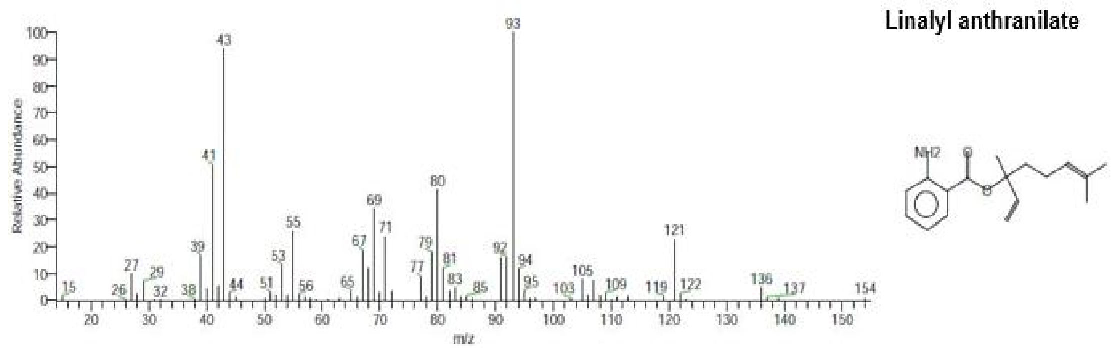


Fig. 2. Mass spectrometry of Linalyl anthranilate

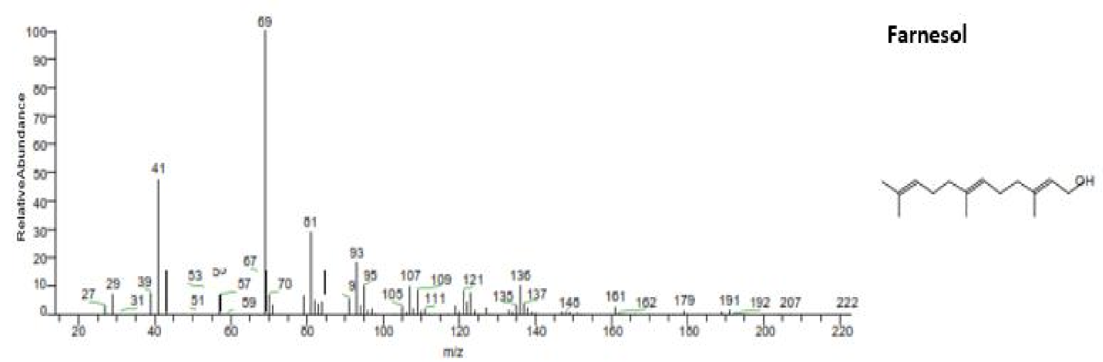


Fig. 3. Mass spectrometry of Farnesol

A total of 76 different compounds were isolated by hydrodistillation and among them, 25 compounds were identified using both chromatographic and spectroscopic (mass spectra). Of the 19 constituents identified in this study, 3 have not been previously identified in

F. sellowiana (Elixene, Linalyl anthranilate and Farnesol). As revealed in Table 1, the principal components of the oil were sesquiterpen (C15H24) and sesquiterpen alcohol, including Caryophyllene 15%, Germacrene D14%, Ledene 14%, Humulene 10.5%, Spathulenol 8.5%, Cadina-3,9-diene 8.3%, Farnesol 6,9%, Linalyl anthranite 5.6%, β-elemene 4.8%, α-Cubebene 2.7%. Other constituents were also present in oil such as Octanone 5.3%, sylvestrene 0.17%, Ocimene 1.6%, Benzoicacid,methylester 1.1%., which represented 97.8% of the total oil.

The chemical compositions of essential oils were various from Feijoa species and varies according to the part of the fruit from which it was extracted and also on the geographical origin of the fruit. Shaw isolated the peel oil from New Zealand fruit in low yield (<0.1%) and the major components were found to be (Z)-hex-3-en-1-ol (20%), linalool (18%), methyl benzoate(14.5%), germacrene D (6%) and octan-3-one (6%) [7,9, 10,21]. While in the Other studies on the peel from fruit in France by Fernandez et al (2004), showed that the yield was also low 0.1% but the major constituents belong sesquiterpen group, β-caryophyllene (12%), ledene (9.5%), α-humulene (6.5%), β-elemene (5%), d-cadinene (5%) and bicyclogermacrene (4.5%). This composition were significantly similar to the composition determined in this study whose the sesquiterpen was dominant. Probably the same species introduced in France has been introduced in North Africa in 1899 by Dr. Trabut. The volatile components of ripe Feijoa fruit grown in Georgia (Russia) were similar to those of New Zealand fruit [22] and to those from fruit grown in Japan [23]. It should be pointed that, however, essential oil content could differ greatly even in the same genus, as well as in different ripening stage and different organs [24–28]. In comparison with other studies, [7,9], we found in the present study a low concentration of Linanol 5,9%, octan-3-one 5,3%, methylbenzoate 1,1% and also ethylbenzene carboxylate 0;17%, another major and organoleptically important constituent. Probably this difference was that the fruit used in the studies being at different stages of ripeness. The high amounts of ethyl benzoate in the volatile flavour fraction were closely associated with over-ripe fruit and methyl benzoate was the most compound closely associated with the characteristic ‘sweet’ of fresh *F. sellowiana*. The fruit has strongly sweet aromatic flavor and the taste resembled to combination of strawberry, guava and pineapple or limon or quince. Feijoas were aromatic when ripe and like other guava varieties, they too emit a musky, sweet, strong unique fragrance. This scent growed stronger as it neared peak ripeness. In the essential oil of *F. sellowiana* the flavor was dependent to ripeness and to composition of oil contents. For example the Caryophyllene exhibit a weet, woody, spicy clove dry, Germacrene possess a warm spicy-woody flavor, Humulene’s aroma was robust on the senses and carries woody, earthy, and herbal character and Spathulenol showed earthy herbal fruity medium. Farnesol was used in perfumery to emphasis the odors of floral perfumes and in cosmetic for production of deodorant.

4. CONCLUSION

The essential oil of *F. sellowiana* forms may be valuable for the flavouring of foods, where floral-fresh-fruity aromas were essential, such as chewing gums and sweets. In cosmetics, *F. sellowiana* sample with distinctive floral-fresh-fruity odor may be explored in shampoos, soaps, shower gels, and others, whereas an application in perfumees and deodorants of the oils may to be interesting. It could also be used in the food preservation due to high percentage of well-known antimicrobial compounds with the β-caryophyllene, α-pinene, β-pinene and limonene.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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