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Evolution of carotenoids and volatile compounds in microwave-dried fruits of three different loquat cultivars (Eriobotrya japonica Lindl.)

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Dear Editors-in-Chief: **Octavio Paredes-López**

We submit the following original manuscript: "Evolution of carotenoids and volatile compounds in microwave-dried fruits of three different loquat cultivars (*Eriobotrya japonica* Lindl.)"

authors: Vittorio Farina , Luciano Cinquanta*, Francesco Vella, Serena Niro, Gianfranco Panfili, Antonio Metallo, Gennaro Cuccurullo, Onofrio Corona,

for publication in "PFHN – Plant Foods for Human Nutrition" as original research paper.

Loquat fruits are rich in bioactive compounds, but their consumption in fresh form is limited due to the low shelf-life. Till date, loquat microwave dried processing and its effect on fruit quality and bioactive compounds have not been investigated. In this research we evaluated the effects of microwave drying at 60°C, controlled by infrared thermography, on the quality of three cultivars of loquat fruit, by analyzing carotenoid compounds, antioxidants activity, sensorial characteristics and volatile compounds. We think the article is interesting for the journal because of its interdisciplinary character, including arboriculture, food technologies (microwaves, infrared), nutritional and sensory analysis.

The undesigned, prof. Luciano Cinquanta, attests that:

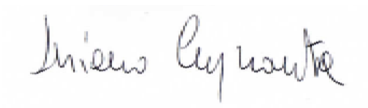
the corresponding author and all of the authors have read and approved the final submitted manuscript

no portion of the work has been or is currently under consideration for publication elsewhere

no portion of the manuscript, other than the abstract, has been previously published or posted in the Internet

The authors declare that they have no conflict of interest.

Yours sincerely



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Evolution of carotenoids and volatile compounds in microwave-dried fruits of three different loquat cultivars (*Eriobotrya japonica* Lindl.)

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Abstract

The consumption of loquat fruits is highly appreciated for their carotenoid content and valuable sensory notes, but it is limited due to the low shelf-life. An on-line temperature controlled microwave system based on infrared thermography was used to dry three different loquat cultivar at 60 °C. The time to reach the target value of 23% moisture content was about 105 min in *Claudia* fruits and 162 min in *Virticchiara* and *Peluche*. Seven carotenoids were identified in loquat fruits, among these the major were all-trans-β-carotene in *Virticchiara* and *Claudia*. *Virticchiara* had the major total carotenoid content (206 µg/g dry basis), followed by *Peluche* (158 µg/g d.b.) and *Claudia* (41 µg/g d.b.). The loss of carotenoids after drying ranged between 24% (*Peluche*) and 41% (*Claudia*). Carotenoids that showed a higher loss were on average: lutein (70%) and zeaxhantin (51%). Thirty-six volatile compounds were identified in fresh and dried loquats: the aldehydes were the most abundant class. After drying, aldehydes declined slightly, with

alcohols falling more sharply. From the sensory analysis, *Virticchiara* was the most appreciated cultivar. The shortened times by using temperature-controlled microwave heating with infrared thermography have guaranteed a fair quality of the dried loquats from the nutritional and sensory point of view, variable among the three cultivars.

Key-words: *Eriobotrya japonica*; carotenoids; drying; microwave; volatile compounds

1 Introduction

Loquat (*Eriobotrya japonica* Lindl.) is a subtropical evergreen tree belonging to the *Rosaceae* subfamily *Maloideae*. Currently, the main producers of loquat are China and Spain but the fruit is commercially grown in many countries. It is cultivated extensively in the Mediterranean basin especially in the citrus-growing regions, in Italy, its cultivation is done 90% in Sicily, mainly in the province of Palermo (1). Inappropriate harvesting can lead to unmarketable fruits; about 20–30% of fresh fruits produced in China are lost during post- harvest owing to decay and quality decline, producing a thoughtful economic loss (2). An operation to increase its availability to the consumer is drying, prolonging shelf-life. Pitted dried loquat can be a healthy snack appreciated by consumers (3), owing to their carotenoid and phenolic contents and valuable sensory notes, or ingredient in sweets (4). Since a long time is required to obtain dried products with hot air heating, microwave (MW) processing was proposed as an efficient technique for moisture removal. In fact, MW processing considerably reduces the time needed to reach the set point temperature and hence, the entire drying period. Till date, loquat microwave dried processing and its effect on fruit quality and bioactive compounds have not been investigated. The purpose of this research was to evaluate the effects of microwave drying at 60°C, controlled by infrared thermography, on the quality of three cultivars of loquat fruit, by analyzing carotenoids, antioxidants activity, sensorial characteristics and volatile compounds.

MATERIALS AND METHODS

Plant material

Loquat fruits were harvested in a commercial farm located near Palermo, Italy (38°04' N, 13°22' E, 150 m a.s.l.) in 2018. The orchard was managed according to the organic farming protocol. Three cultivars were studied: two yellow-fleshed cultivars (*Peluche* and *Virticchiara*) and one white-fleshed (*Claudia*). *Peluche* is a commercial cultivar diffused in many Mediterranean areas, whereas, *Virticchiara* and *Claudia* are local ecotypes. Three uniform trees grafted on loquat seedling rootstock were selected for each cultivar, planted in single rows (north–south oriented), spaced at 5 × 5 m and trained to full globe branched at about 1.2 m from the ground, while reaching 3 to 3.5 m in height. Fruits were hand-picked at the ripe stage suitable for the fresh fruit market using peel color as a maturity index. A sample of 45 fruits per cv (15 fruits x 3 tree x cv.) were used the for physicochemical and sensory analysis on fresh, while other 15 fruits were dried.

Microwave prototype and drying test

Drying trials were carried out by means of a lab scale microwave (MW) plant (1 m^3), equipped with a magnetron operating at 2.45 GHz with a power output of 2 kW (5). A rotary stirrer has been installed inside the oven, a teflon grid turning table (550 mm diameter) allowed MW drying, while the turntable rotated at 7 rpm (Fig. 1). The destoned and peeled halved fruits (about 300 g) were placed in one layer of the rotating grid for heating, combined with a balance (Gibertini EU-C 1200 RS, Novate Milanese, Italy) located in the upper part of the oven for the online measurement of moisture loss. Temperature control during the complete drying process were detected by IR thermography system (ThermaCAM Flir P65, Canada) located on the upper surface. Based on previous researches (6-7-8), it was decided to dry fruits by MW at 60 °C, because the best results were obtained under similar conditions (*i.e*. on apricots and apples). Just before commencement of the drying process at 60°C, loquat samples were MW blanched at 90°C x 1 min to inactivate enzymes and reduce microorganisms. The end of MW drying point (about 23% moisture content, corresponding to water activity = 0.69) was chosen after several preliminary tests, in order to guarantee at the same time: microbial stability and even appreciable sensory characteristics in dried fruits. After drying, the samples were vacuum packed in high barrier plastic films and stored in the dark at 4 °C before being analyzed.

Physico-chemical analyses

The weight of the different parts of the fruits (Fig. 2) were determined by an analytical balance. The water activity measurement on dried loquats was done by a water activity meter (Testo 650, Testo Inc., USA) at 25 °C. Total Soluble Solids Content (TSSC) was measured on juice (Brix°) using digital refractometer Atago Palette PR–32 (Atago Co., Ltd, Tokyo, Japan) and total acidity (TA) (g/L of citric acid) was measured using a CrisonS compact titrator (Crison Instruments, SA, Barcelona, Spain). Total reducing compounds, mainly phenolic (TPC), were analysed according to the Folin-Ciocalteu procedure (9). Color was measured using a CR-300 Chroma Meter Minolta. All determinations were obtained from different samples in triplicate.

Sensory analysis

A panel of 10 judges (4 male and 6 female, aged between 25 and 37 years) defined the sensory profile. All panelists had a broad expertise in sensory evaluation of fruits and were trained using different samples of loquat to enable them recognize the qualitative characteristics to be assessed and to generate the attributes (1-10). The fresh and dried samples were evaluated using twenty attributes, the intensity of each descriptor was assessed by categorical scores from 1 (absence of sensation), to 9 (extremely intense).

DPPH radical scavenging method

Antioxidant activity (AA) has been evaluated by the DPPH method. Loquat samples were homogenised in 25 mL of distilled water and subjected to centrifugation at 4000 g for 10 min, after the supernatant was filtered by a 0.45 lm filter (Millipore). The AA analysis was carried out according to reports by (7).

Volatile organic compounds (VOCs)

Loquat fruits were subjected to GC/MS analysis to identify the volatile organic compounds (VOCs). The GC/MS equipment, column, conditions used for analysis and the identification of the compounds were described elsewhere (11-12).

Carotenoid analysis

The carotenoid analysis, performed by HPLC, was carried out as reported in a previous paper (13).

Statistical analysis

All data were tested for differences between the cvs using the one way analysis of variance (ANOVA; general linear model) followed by Tukey's multiple range test for $P \leq 0.05$ using XlStat® software version 9.0 (Addinsoft, Paris, France). Data of the total phenols, DPPH and groups of volatile compounds were tested for differences between fresh and dried loquats using Student's t-test for mean comparison ($P \leq 0.05$).

Results and Discussion

Physicochemical composition of fresh fruits

The cv with the highest TSSC content in fresh fruit was *Virticchiara* (14.3 °brix), followed by *Peluche* (10.4 °brix) and *Claudia* (10.3 °brix). As far as titratable acidity is concerned, the cv that recorded the highest value was *Peluche* (13.1 g l^{-1}), followed by *Claudia* (11.3 g l^{-1}) and *Virticchiara* (7.5 g l^{-1}). TSSC/TA is the true index of the fruit's gustative balance: the cv that has shown this highest value was *Virticchiara* (1.91), followed by *Claudia* (0.89) and *Peluche* (0.80).

Microwave heating

Drying time at 60 °C, including the blanching, to reach the target value of 23% moisture content, was about 105 minutes in *Claudia* fruits (Fig. 3), while both in *Virticchiara* and *Peluche*, was equal to about 162 min (Fig. 3). These data are certainly interesting, considering that a convective vacuum drying test at 60 °C took about 800 minutes to reach around the same moisture content (14). Microwave (MW) drying significantly reduces the time to reach the selected temperature and therefore the heating period, due to volumetric MW heating. In these trials, the increasing rate of the initial heating period to reach 90 °C (for blanching) was just below 3 min and after about one minute, the temperature was reduced to 60 °C.

Phenols and DPPH

The concentration in total hydrophilic reducing compounds, mainly phenols (TPC), was highest in *Claudia*, while no significant variations between the other two cultivars were ascertained. A significant decrease was found ($P < 0.05$) in the TPC after drying: the loss of TPC in dried samples was 40% in *Virticchiara* and about 25% in the other fruits. Accordingly, the antioxidant activity measured as inhibition of DPPH scavenger activity showed that *Claudia* had the highest inhibition value (21.5%) and *Peluche* had the lowest (17.1%). A significant ($P < 0.05$) increase in antioxidant activities (AA) after drying was observed in all samples: AA had almost tripled in *Claudia* and *Peluche* and slightly less than doubled in *Virticchiara* fruits (Table 2). This behavior could be explained by oxidation of polyphenols that leads to the formation of stable intermediates with great antioxidant capacity and the formation of Maillard Reaction Products (MRPs) known to exhibit various antioxidant properties (15).

Carotenoids

HPLC analysis identified seven carotenoids in loquat fruits. *Virticchiara* showed the major total carotenoids (TC) content: 206.1 μg/g dry basis (d.b.), followed by cultivar *Peluche* (158.1 μg/g d.b.) and *Claudia* (41.7 μg/g d.b.). In two cultivars, the major carotenoids were all-trans-β-carotene; while β-cryptoxanthin was predominant in *Peluche* (85.1 μg/g d.b.). Similar results were already observed for different loquat cultivars (16-17) and are comparable with those found in apricots (18). Taking into account the Recommended Daily Allowance (RDA) for vitamin A, which is 800 μg/day (19), 100 g of loquats contribute 33 % of the RDA in *Peluche*, 30% in *Virticchiara* and only 6% in *Claudia*. Significant losses of carotenoids were found after drying (Table 3), ranging between 24% (*Peluche*) and 41.5% (*Claudia*).

Carotenoids that showed a higher loss were: lutein with an average of 70% and zeaxhantin with an average of 51%, both being xanthophyll. The high susceptibility at thermal treatment of xanthophyll was also observed in previous papers (20-21). Regarding *cis* isomers, several studies reported that different results after thermal treatment could be due to degradation and concomitant increase in *cis*-isomers 24, in our case, 9-*cis*-β-carotene and 13-*cis*-β-carotene showed a loss of about 43 % and 71%, respectively.

Color

The color of peeled fruits did not differ significantly among the three cvs for L and b* values (Fig. 4a). *Claudia* showed, as expected based on the lowest carotenoid content, a lower a* value, corresponding to a color typical of white fleshed cv. Comparing values of fresh fruit with dried fruit, a reduction of all the parameters in the three cvs was observed (Fig. 4b). Significant differences between cvs remained only for the lowest value of the red index (a*) in *Claudia* samples. The development of browning of samples after drying may be related to carotenoids destruction, as well as enzymatic and non-enzymatic browning (22).

Volatile compounds

Thirty-six volatile compounds (VOCs) were identified in fresh and dried loquats (data not reporte). These included nine aldehydes, eight organic acids, seven alcohols, five furans, four ketones, two esters and one hydrocarbon. The aldehydes were the most abundant class (Fig. 5), varying between almost 60% of the total VOCs in *Virticchiara* to about 40% in *Peluche*, while the amount of aldehydes were greatest in *Claudia* fruits (about 1402 μg/g d.b.). The other classes of VOCs in order of importance were alcohols, represented mainly in *Claudia* samples by C6-compounds: cis-3-hexeno-1-ol, trans-2-hexenol and 1-hexanol, which have been reported to contribute to the green aromas of loquat (23). Esters, mainly represented by γ-butyrolactone, prevailed in *Claudia*, as well as organic acids, responsible for floral and fruity notes (24). MW drying led to an evolution in VOCs: alcohols decreased in all samples, esters diminished in *Claudia* and *Peluche,* while they were constant in *Virticchiara* dried fruits. The aldehydes have undergone less variation in the dried products, with a decrease of about 20% only in *Claudia*.

Sensory analysis

The results of the sensory analysis on fresh fruits showed significant differences for the descriptors; sweet, sour, loquat flavor and overall evaluation. The panel's preferences were for the cv *Virticchiara* (Fig. 6). The greater intensity of the bitter taste perceived in *Claudia* was correlated with the higher content in phenolic substances, while *Peluche* fruits were characterized by a lower "loquat flavor", as well as a weak intensity of sweet. *Claudia* was judged by panelists to be more yellow and less brown in contrast to the *Virticchiara*, which was the most appreciated cultivar. Although, the differences between the different dried fruits were much smaller than for the fresh loquats (Fig. 7).

Conclusions

The use of temperature-controlled microwaves with infrared thermography (60 °C) has shown good results, using short period of time (from 105 to 162 min) and ensuring a fair quality of dried loquats, from a nutritional and sensory point of view. Carotenoids reduction after drying was comprise between 24 and 41%, depending on the cultivar. The study also demonstrated the different behavior of the loquat cultivars tested using microwave drying. In particular, all the dried cvs showed a good level of appreciation by the panel test, while the cv *Peluche* was poorly evaluated as a fresh product.

References

1. Gentile C, Reig C, Corona O, Todaro A, Mazzaglia A, Perrone A, Gianguzzi G, Agusti M, Farina V (2016) Pomological traits, sensory profile and nutraceutical properties of nine cultivars of loquat (*Eriobotrya japonica* Lindl.) fruits grown in Mediterranean area. Plant Foods Hum Nutr 71*:* 330-338.
2. Tian S, Li B, Ding Z (2007) Physiological Properties and Storage Technologies of Loquat Fruit. Fresh Produce 1: 76-81.

3. Siddiq M, Uebersax MA. Jujube and Loquat (2012) In: Tropical and Subtropical Fruits: Postharvest Physiology, Processing and Packaging. Editor: Muhammad Siddiq PhD, John Wiley & Sons, Inc.

4. Kamiloglu S, Toydemir G, Boyacioglu D, Beekwilder J, Hall RD, Capanoglu E (2016) A review on the effect of drying on antioxidant potential of fruits and vegetables. Crit Rev Food Sci 56: S110-S129.

5. Cuccurullo G, Sorrentino G, Cinquanta L (2007) A procedure to achieve fine control in MW processing of foods. Infrared Phys Technol 49: 292-296.

6. Cuccurullo G, Giordano L, Metallo A, Cinquanta L (2017) Influence of mode stirrer and air renewal on controlled microwave drying of sliced zucchini. Biosyst Eng 158: 95-101.

7. Albanese D, Cinquanta L, Cuccurullo G, Di Matteo M (2013) Effects of microwave and hot-air drying methods on colour, beta-carotene and radical scavenging activity of apricots. J Food Sci Technol 48: 1327-1333.

8. Cuccurullo G, L Metallo A, Corona O, Cinquanta L (2019) Comparing different processing methods in apple slices drying. Part 1. Performances of microwave, hot air and hybrid methods at constant temperatures. Biosyst Eng. In press

9. Slinkard K, Singleton VL (1977) Total phenol analyses: automation and comparison with manual methods. Am J Enol Vitic 2: 49-55.

10. Farina V, Barone F, Mazzaglia A, Lanza CM (2011) Evaluation of fruit quality in loquat using both chemical and sensory analyses. Acta Hortic 887: 345-349.

11. Corona O (2010) Wine-making with protection of must against oxidation in a warm, semi-arid terroir. S Afr J Enol Vitic 31: 58–63.

12. Martorana A, Alfonzo A, Settanni L, Corona O, La Croce F, Caruso T, Moschetti G, Francesca N (2016) Effect of the mechanical harvest of drupes on the quality characteristics of green fermented table olives. J Sci Food Agric 96: 2004-2017.

13. Fratianni A, Albanese D, Mignogna R, Cinquanta L, Panfili G, Di Matteo M (2013) Degradation of carotenoids in apricot (*Prunus armeniaca* L.) during drying process. Plant Foods Hum Nutr 68: 241-246.

14. Saberian H, Amooi M, Hamidi-Esfahani Z (2014) Modeling of vacuum drying of loquat fruit. Nutr Food Sci 44: 24-31.

15. Morales FJ, Perez SJ (2001) Free radical scavenging capacity of Maillard reaction products as related to colour and fluoresence. Food Chem 72: 119–125.

16. Zhou CH, Xu CJ, Sun CD, Li X, Chen KSJ (2007) Carotenoids in White- and Red-Fleshed Loquat Fruits. J Agric Food Chem 55: 7822–7830.

17. de Faria AF, Hasegawa PN, Chagas EA, Pio R, Purgatto E, Mercadante AZ (2009) Cultivar influence on carotenoid composition of loquats from Brazil. J Food Comp Anal 22: 196–203.

18. Fratianni A, Niro S, Messia MC, Cinquanta L, Panfili G, Albanese D, Di Matteo M (2017) Kinetics of carotenoids degradation and furosine formation in dried apricots (*Prunus armeniaca* L.). Food Res Int 99: 862–867.

19. Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers.

20. Fratianni A, Niro S, Alam MDR, Cinquanta L, Di Matteo M, Adiletta G, Panfili G (2018) Effect of a physical pre-treatment and drying on carotenoids of goji berries (*Lycium barbarum* L.). LWT - Food Sci Technol 9: 318-323.

21. Melèndez-Martínez AJ, Paulino M, Stinco CM, Mapelli-Brahm P, Wang XD (2014) Study of the time-course of cis/trans (Z/E) isomerization of lycopene, phytoene, and phytofluene from tomato. J Agric Food Chem 62: 12399–12406.

22. Ibarz A, Pagan J, Garza S (1999) Kinetic models for colour changes in pear puree during heating at relatively high temperatures. J Food Eng 39: 415–422.

23. Chen FX, Lui XH, Chen LS, Zheng SX (2011) The determination of volatile constituents of loquat fruit and leaf by gas chromatography–mass spectrometry coupled with solid phase micro extraction. Acta Hortic 887: 369–72.

24. Sultan MZ (2018) Loquat (*Eriobotrya japonica* Lindl.). In: Fruit and Vegetable Phytochemicals: Chemistry and Human Health, 2 edition, Volume I Editors: Elhadi M., Yahia Wiley 1118-1119.

Figure Legends

Figure 1. Pilot microwave plant.

Figure 2. Whole fruit fresh weight (FrW), flesh weight (FlW), skin weight (SkW), seed weight (SdW) in different loquat cultivars: *Peluche, Claudia* and *Virticchiara*. Values represented as mean ± SD.

(footnote) For each column, within the same series, different lowercase letters indicate significantly different at P ≤0.05 as measured by Tukey's multiple range test. Letter "a" denotes the highest value.

Figure 3. Drying curve of pitted halved *Claudia* and *Peluche* loquat fruits.

Figure 4. Color CIE L a*b* coordinates in fresh (A) and dried (B) loquat fruits of the three observed cv. Values represented as mean ± SD.

(footnote) For each column, within the same series, different lowercase letters indicate significantly different at *P* ≤0.05 as measured by Tukey's multiple range test. Letter "a" denotes the highest value, ns means no significant differences.

Fig. 5. Amount of volatile compounds (µg/g d.b.) united by chemical groups, in fresh (F) and dried (D) by microwave at 60 °C in different loquats fruits

For each column, within the same series, different lowercase letters indicate significantly different at *P* ≤0.05 as measured by Tukey's multiple range test. Letter "a" denotes the highest value; ns means no significant differences.

Figure 6. Fresh fruit sensory profile of the three observed loquat cultivars. For each descriptor * indicate significantly different at $P \leq 0.05$.

Figure 7. Fresh fruit sensory profile of the three observed loquat cultivars. For each descriptor * indicate significantly different at $P \leq 0.05$.

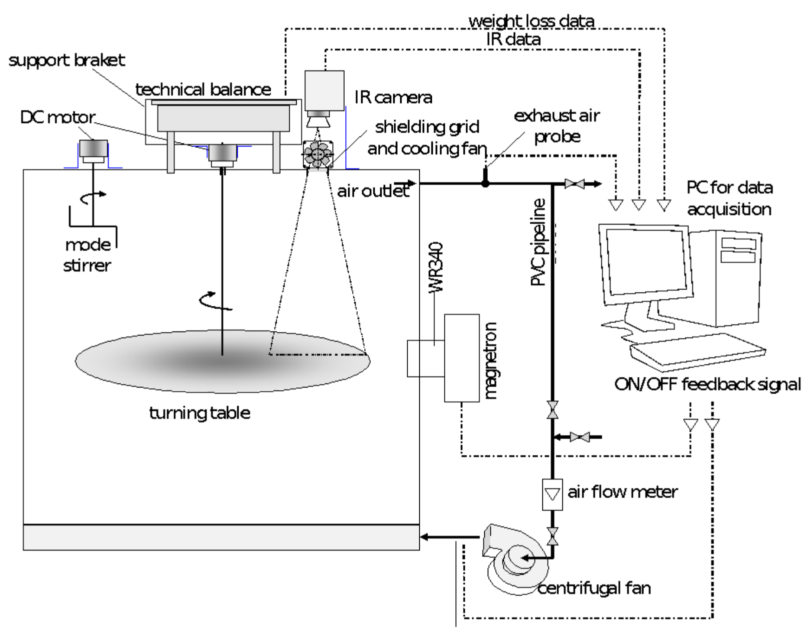
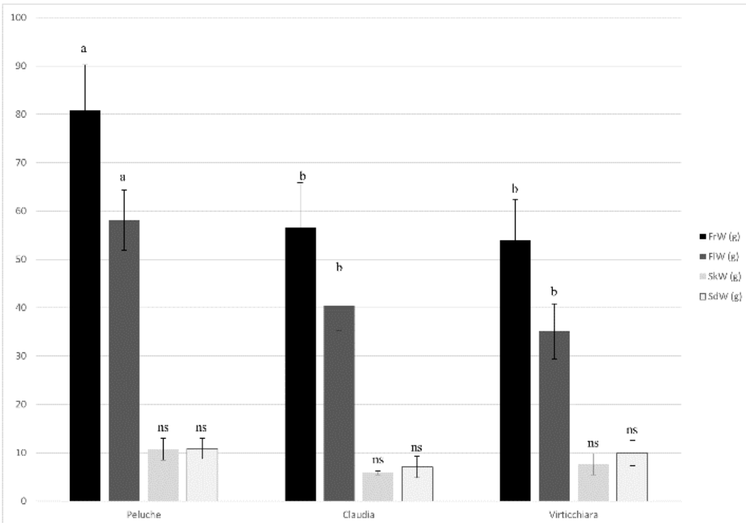


Fig.1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FlW (g)
SkW (g)
SdW (g)
Peluche
Claudia
Virticchiara

Fig.2

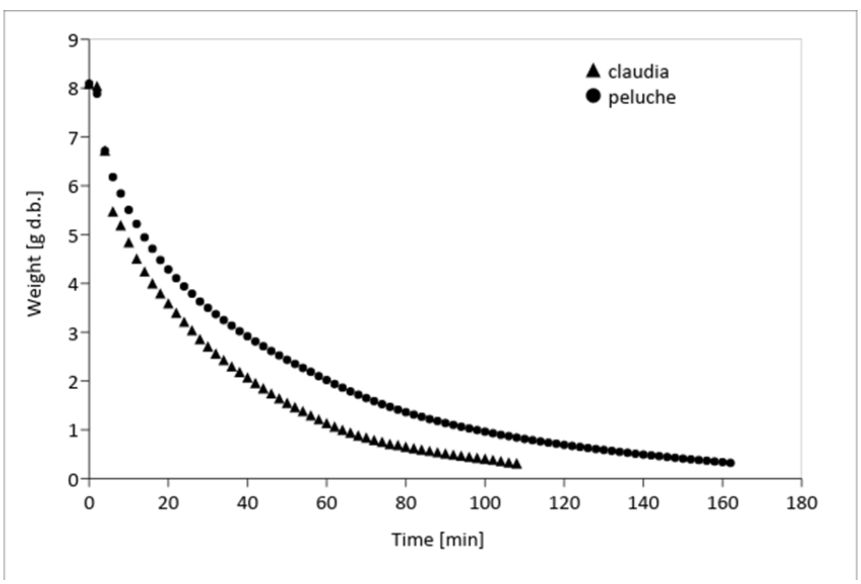
claudia
peluche
Weight [g d.b.]
Time [min]

Fig. 3

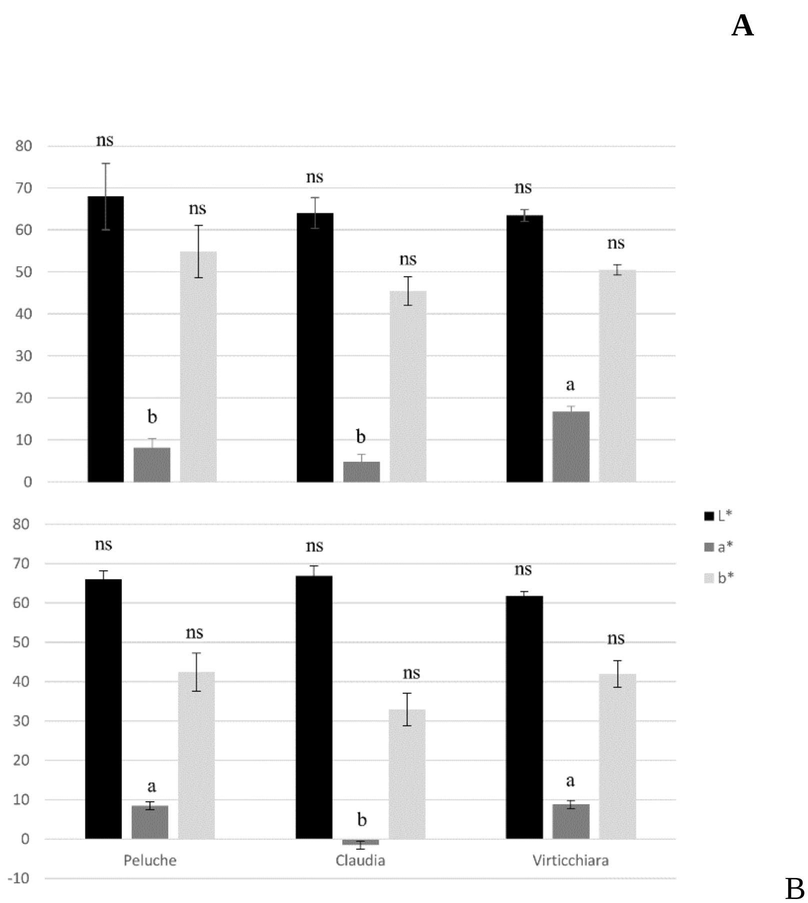
A
B
L*
a*
b*
Peluche
Claudia
Virticchiara
ns
a
b

Fig. 4

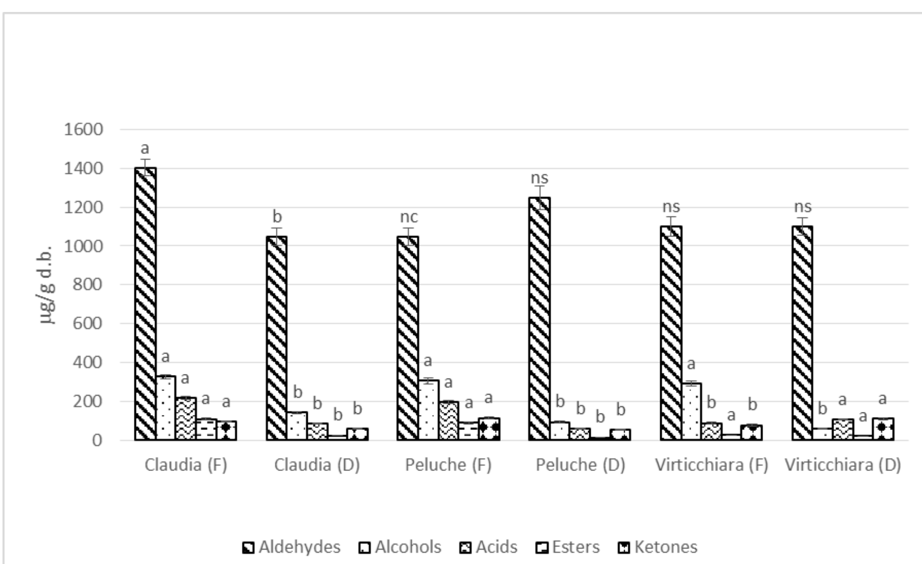
µg/g d.b.
Claudia (F)
Claudia (D)
Peluche (F)
Peluche (D)
Virticchiara (F)
Virticchiara (D)
Aldehydes
Alcohols
Acids
Esters
Ketones
ns
nc
a
b

Fig.5

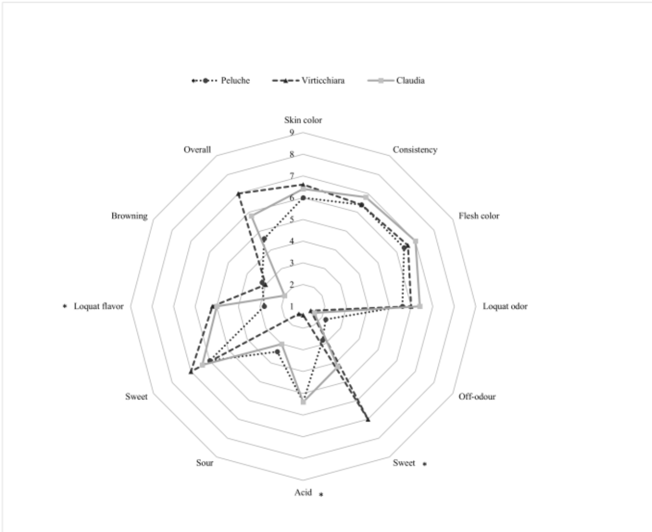

Fig. 6

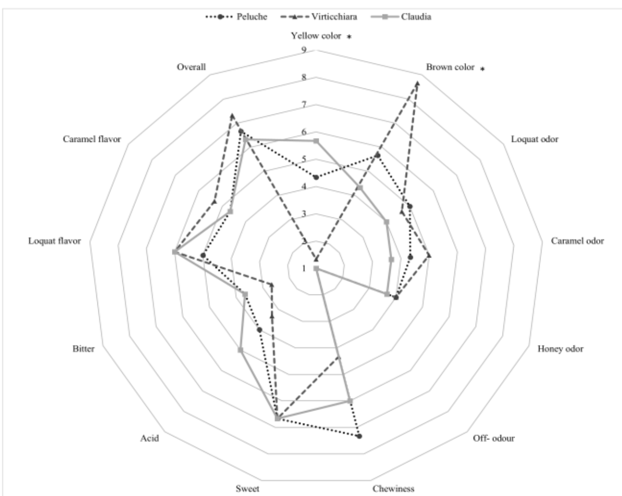

Fig. 7

Table 1

Total Phenols and DPPH in fresh and dried loquats fruit

Fruits	Total Phenols ((+) catechin) (mg/kg d.b)			DPPH %			Total Phenols ((+) catechin) (mg/kg d.b.)			DPPH %		
Fresh							**Dried**					
Claudia	2252.77	±	80.74 [a]	21.47	±	1.63 [b]	1706.68	±	22.21 [b]	58.62	±	0.97 [a]
Peluche	1720.10	±	24.44 [a]	17.08	±	1.38 [b]	1277.87	±	57.59 [b]	45.34	±	1.00 [a]
Virticchiara	1688.45	±	72.25 [a]	20.20	±	0.79 [b]	1011.86	±	66.17 [b]	35.94	±	0.97 [a]

For each column, within the same series, different lowercase letters indicate significantly different at $P \leq 0.05$ as measured by Tukey's multiple range test. Letter "a" denotes the highest value

Table 2

Carotenoid composition and content (µg/g d.b.) in fresh and dried loquats.

	Claudia (Fresh)	*Claudia* MW (60°C)	loss %
lutein	5.9 ± 0.26 [a]	1.2 ± 0.07 [b]	80.3
zeaxanthin	2.3 ± 0.30 [a]	1.3 ± 0.17 [b]	42.7
β -criptoxanthin	13.1 ± 0.21 [a]	10.4 ± 1.82 [b]	20.5
α -carotene	2.5 ± 0.07 [a]	1.60 ± 0.17 [b]	34.0
13cis β -carotene	0.8 ± 0.11 [a]	0.47 ± 0.04 [b]	41.4
all trans β-carotene	15.2 ± 0.26 [a]	8.7 ± 2.30 [b]	42.8
9cis β-carotene	1.9 ± 0.20 [a]	0.7 ± 0.14 [b]	62.2
total carotenoids	41.7 ± 0.26 [a]	24.4 ± 4.58 [b]	41.5
	Virticchiara (Fresh)	*Virticchiara* MW (60°C)	loss %
lutein	6.9 ± 0.15 [a]	3.04 ± 0.38 [b]	56.1
zeaxanthin	23.5 ± 2.49 [a]	12.2 ± 3.84 [b]	48.1
β -criptoxanthin	69.3 ± 9.83 [a]	68.1 ± 4.02 [a]	1.7
α -carotene	11.3 ± 0.77 [a]	6.7 ± 0.32 [b]	40.4
13cis β -carotene	4.7 ± 0.21 [a]	2.7 ± 0.17 [b]	42.4
all trans β-carotene	77.6 ± 3.86 [a]	47.5 ±0.48 [b]	38.8
9cis β -carotene	12.8 ± 0.20 [a]	2.6 ± 0.03 [b]	79.4
total carotenoids	206.1 ± 16.79 [a]	142.9 ± 15.35 [b]	30.7
	Peluche (Fresh)	*Peluche* MW **(**60°C)	loss %
lutein	3.0 ± 0.38 [a]	0.7 ±0.02 [b]	74.4
zeaxanthin	7.3 ± 0.58 [a]	2.8 ±0.08 [b]	61.6
β -criptoxanthin	85.1 ± 13.38 [a]	69.9 ± 0.12 [b]	17.9
α-carotene	7.2 ± 0.87 [a]	6.3 ± 0.18 [b]	12.3
13cis β -carotene	3.2 ± 0.22 [a]	1.8 ± 0.09 [b]	45.1
all trans β-carotene	45.7 ± 7.23 [a]	36.3 ± 1.47 [b]	20.6
9cis β -carotene	6.6 ± 1.11 [a]	2.5 ± 0.28 [b]	61.4
total carotenoids	158.2 ± 23.77 [a]	120.4 ± 3.15 [b]	23.9

For each line, within the same series, different lowercase letters indicate significantly different at $P \leq 0.05$ as measured by Tukey's multiple range test.