Heliyon 10 (2024) e28294

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Determination of impregnation parameters and volatile components in vacuum impregnated apricots

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ARTICLE INFO

Keywords:
Vacuum impregnation
Malatya apricots
Volatiles
Fruit porosity
Vacuum infusion

ABSTRACT

An investigation was conducted to analyse the impact of vacuum impregnation (VI) on aroma profile of intermediate-moisture apricots. cv. Hacihaliloğlu and cv. Kabaaşı apricots were immersed in a variety of solutions, including citric acid and sucrose, as well as plant extracts like rosehip, roselle, and rhubarb. According to the results, solid loss and water gain were observed in all infused samples by VI, while osmotic dehydration occurred in the apricots after immersing in sucrose solution. After all process, a total of 71 volatile compounds were detected in the Hacihaliloglu variety and 66 in the Kabaasi variety. These components are aldehydes, ketones, esters, furan compounds, alcohols, terpenes, isoprenoids, and acids, collected in eight groups. Vacuum impregnation had positive effects on terpenes in both cultivars.

1. Introduction

Nowadays, increasing the added value of foods by enriching them with natural components has been a subject that has been highly emphasized. Moreover, extending the shelf life maintains its currency by applying minimal processing to fruits and vegetables. Many methods have been proposed for this purpose, and some are used industrially. One of these methods is the vacuum impregnation (VI) technique [1]. VI is a process where food items are immersed in a liquid solution while being exposed to a vacuum environment. This technique is particularly effective for porous foods such as fruits, vegetables, and baked goods, as it allows the liquid to penetrate the food matrix deeply. The vacuum created during the process helps in removing air from the food pores, creating space for the liquid to be absorbed efficiently [2]. VI is a technology developed to absorb some components into the cavities in food tissues. Thus, the properties such as antioxidant, browning prevention, and hardness in the infusion liquid can be penetrated the fruits [3,4]. In several studies, vacuum impregnation positively affects fruits' structure, durability, physical, chemical, and microbiological properties [5,6].

Assessing impregnation parameters and volatile components in vacuum-impregnated apricots is crucial for understanding the process and improving the quality of the final product. Proper evaluation of these factors can lead to significant improvements in apricots' sensory properties and marketability. Therefore, it is imperative to thoroughly analyse the impregnation parameters and volatile components in vacuum-impregnated apricots to ensure optimal results. Presenting perishable apricots with medium humidity is a different option for the consumer. This study aimed to impregnate apricots with other solutions and increase their diversity using the VI technique. In this way, new products have been developed that can be an alternative to traditional sulphurous apricots. In this study, apricots, which were applied VI by dipping apricots in their solutions prepared with certain concentrations of citric acid,

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https://doi.org/10.1016/j.heliyon.2024.e28294
Received 11 October 2023; Received in revised form 11 March 2024; Accepted 15 March 2024
Available online 18 March 2024

rosehip, roselle, rhubarb and sugar, were dried in the sun to investigate impregnation parameters and aroma profile of vacuum impregnated apricots [4,6,7].

2. Material and methods

2.1. Materials

Both the cv. Hacihaliloglu (HH) and cv. Kabaaşı (KA) varieties of apricots, which are the most common types grown in the Malatya (Eastern town of Türkiye, two summers in 2014-15), were used in this research. To determine the commercial maturity of apricots, the amount of water-soluble dry matter (20–25 °Brix) was taken as a basis, as well as color and sensory quality characteristics. Harvested apricots were brought to the research laboratory and kept at +4 °C for 24 h before VI application.

2.1.1. Vacuum impregnation solutions

In the VI application, five different water-based infusion media were prepared citric acid (1:10 w/v), rosehip extract (1:5 w/v), roselle extract (1:5 w/v), rhubarb extract (1:5 w/v), and sugar solution (1:2 w/v) containing 1% soy lecithin. The °Brix values of the prepared solutions at 20 °C were determined with a digital refractometer (model PTR-2A, Index), and VI was performed quickly to preserve color stability and prevent microbial growth. Abbreviations of samples used (HH–F) for fresh cv. Hacihaliloglu apricots; (KA-F) for fresh cv. Kabaasi apricots; (HH-CA & KA-CA) for citric acid; (HH-RH & KA-RH) for rosehip extract; (HH-RO & KA-RO) for roselle extract; (HH-RB & KA-RB) for rhubarb extract; (HH–S & KA-S) for sugar solution impregnation; and also (HH–C & KA-C) for control samples which were sun-dried without any process.

2.1.2. Vacuum impregnation process

A 5 kg of apricots were prepared for each application. After washing the apricots, they were cut in half with a knife, and the seeds were removed. Apricots placed in beakers were placed in a vacuum desiccator (model VDC 31, Jeiotech) after adding a solution of approximately 1:2 (fruit: solution) by weight. For the VI procedure, the method Jacob and Paliyath [6] used was modified and applied. After the vacuum pump was started, the desiccator was expected to drop to 100 mbars pressure. Afterward, the samples, which were vacuum applied for 15 min, were kept in the solution for 1 h at room temperature after removing the vacuum. At the end of the period, the filtered apricots were dried with blotting paper. The VI procedure was repeated in two replications. After the VI process, the apricots were left to dry in the sun in a clean area without wasting time, and drying time differed between VI apricots. All apricot samples were sun dried for equal periods of time for 4 days. Therefore, when the apricots decrease to approximately 30% humidity, drying is terminated by taking the form of apricots with medium moisture. Apricots without any treatment were dried as a control sample as sun-dried apricots. Apricots were kept in the refrigerator for one day, and after reaching equilibrium humidity, they were coded and packaged. As the packaging material, lockable polyethylene transparent bags with a volume of 0.95 L (water vapour permeability 2.5 g $m^{-2}d^{-1}$, O_2 permeability 4.0 $dm^3m^{-2}d^{-1}bar^{-1}$, CO_2 permeability 16.0 $dm^3m^{-2}d^{-1}bar^{-1}$) were used.

2.2. Methods

2.2.1. Determination of total porosity of apricots

Salvatori et al. [7] proposed method was used to determine the total porosity. For this, apparent density ($\rho_{apparent}$) and actual density (ρ_{actual}) were calculated using a Hubbard pycnometer. After removing the seeds of the apricots, they were placed in the pycnometer and filled with isotonic sugar solution. Equation (1) was used for density calculations.

$$\rho = \frac{B - A}{(D - A) \times (C - B)} \times G \quad (1)$$

A: Pycnometer tare.
B: Sample weight.
C: Sample and solution weight.
D: Solution weight.
G: Specific gravity of the isotonic solution.

In order to determine the real value of ρ, after the apricots were crushed, deaeration was carried out by keeping them in a vacuum of 260 mbars for 2 h. Weight changes were recorded by adding the isotonic solution to the apricot puree placed in the pycnometer [8]. Equation (2) was used to determine the total porosity of apricots.

$$\varepsilon = \frac{\rho apparent - \rho actuel}{\rho actuel} \quad (2)$$

2.2.2. Measuring weight change, a vacuum impregnation parameter

Using equation (3), Guillemin et al. [9] recommended that the percentage weight change be determined to determine VI activity.

$$\text{Weight Change } (\%) = \frac{M\dot{I} - M0}{M0} \times 100 \quad (3)$$

M_1:Weight after vacuum impregnation.
M_0: Initial weight of the fruit.
However, to compare the effect of vacuum on weight change, apricots were dipped in the same solutions at atmospheric pressure.

2.2.3. Change of water and solids content after vacuum impregnation

The fact that the impregnation solutions have different °Brix values causes water loss and solids loss and gain in apricots after VI [6]. Equations (4) and (5) were used to calculate these values.

$$\text{Water Loss } (\%) = \frac{(M0 - m0) - (M - m)}{M0} \times 100 \quad (4)$$

$$\text{Solids Recovery } (\%) = \frac{(m - m0)}{M0} \times 100 \quad (5)$$

M_0: Initial weight of fruit before impregnation (g)
M: Fruit weight after impregnation (g)
m_0: Amount of dry matter of fresh fruit (g)
m: Dry matter amount of vacuum infused fruit (g)

2.2.4. Determination of volatile components

Volatile components obtained from apricots by solid phase microextraction (SPME) technique were determined using GC-MS (Shimadzu GC-2010; QP-2010). 3 g of the material was weighed into 15 mL SPME vials after the apricots had been crushed. Before extraction, 10 μL of internal standard (2-methyl-3-heptanone and 2-methyl-pentanoic acid, 50 ppm) solution was added to the vials. The samples were kept on the heater for 30 min at 40 °C inside the vial. For the adsorption of volatile components, 2 cm long DVB/CAR/PDMS (Divinylbenzene/Carboxene/Polydimethylsiloxane) fiber (50/30 μm coating thickness; Supelco) was used. After the fibre was put in the vial, it remained in the vial for the next 30 min, and at the conclusion of that time period, the manual injection was performed into the injection port of the GC-MS. The desorption period was completed in 3 min. The volatile components were separated using a DB-WAX capillary column (60 m, 0.25 mm, 0.4 m; J&W Scientific). The injection temperature of the device was 250 °C, the MS ion source temperature was 200 °C, and the scanning range of the MS detector was 33–650 mass/charge (m/z) per second. Helium gas at a rate of 1 mL/min was used as the driving phase. The temperature program for the separation began with 2 min at 40 °C and reached 240 °C with an increase of 5 °C/min before remaining at this temperature for 6 min to end the analysis. The total analysis time was set to 48 min. The peaks were defined using the MS library's Wiley 7 and NIST 147 computer programs. The retention indices (RI) of the identified peaks were determined by the C_{10}–C_{26} n-alkane series and compared with the literature data have been compared [10].

2.2.5. Statistical analysis

For the statistical evaluation of the investigation's findings, the SPSS 16.0 (SPSS Inc.) software program was used. Following the application, the one-way analysis of variance (ANOVA) and Duncan's multiple comparison tests were carried out in order to discover the differences that existed between the samples. In addition, an analysis known as the "General Linear Model" was carried out in order to investigate the impact that storing the apricots with different varieties and applying them in different ways had on the VI score [11]. The results were evaluated at the $P < 0.05$ significance level.

3. Results and discussion

3.1. Some characteristics of apricots

After the density values were measured with the Hubbard pycnometer, the porosity of the HH variety was calculated as 3.93 and the KA variety as 3.87 (Table 1). Salvatori et al. [7] found the $\mathcal{E}$ value to be 2.2 in Bulida apricots, while Fito et al. [12] determined the effective porosity values in Canino apricots between 5.2 and 6.4 depending on the vacuum time.

On the other hand, while the porosity of apricots was found to be quite low compared to apples (21.6–25.4%) in a previous study, it was found to be closer to the values of kiwi (2.3%), peach (2.6%) and strawberries (6.3%) [7]. Porosity values affect substance transfer during impregnation. It is known that the amount of infusion solution filled into the intercellular pores in fruits depends on the actual density and porosity values. From this point of view, the infusion efficiency of apricots that do not have high porosity, such as apples

Table 1
Density and porosity parameters of fresh apricots.

	Hacihaliloglu	Kabaasi
$\rho_{appearent}$ (g/cm^3)	1.090 ± 0.016	1.073 ± 0.005
ρ_{real} (g/cm^3)	1.134 ± 0.046	1.116 ± 0.000
Porosity ($\mathcal{E}$, %)	3.93 ± 1.44	3.87 ± 0.45

Averages; ± standard deviations.

and mushrooms, remains at low levels [7,12].

3.2. The effectiveness of VI in altering substance quantity

Depending on the concentration, two different substances are transferred from the infusion solutions to the fruit during the VI process. The first of these is the infusion of the substances in the solution into the fruit, while the other is the passage of some solid components into the solution [13]. The % weight changes of the VI applied samples are given in Fig. 1(a); solid content change in Fig. 1 (b) and solid content change in Fig. 1(c). In order to compare the effect of the applied vacuum on the infusion, normal immersion was performed under the same conditions. Weight gain was observed in apricots due to the hypotonic nature of the solutions other than the sugar solution. The lowest change was observed in the application of citric acid (5.96%) in HH apricots, while the highest increase was observed in vacuum impregnation of rhubarb (8.72%). In the KA variety, the lowest value (5.75%) was determined in the rosehip solution. When the VI process was compared with the normal dipping, it was observed that there was an increase of approximately two times in all applications except sugar infusion. The infusion solution is filled into the spaces formed after the air in the pores expands and leaves with the vacuum [7,12,14].

Apricots dipped in hypertonic sugar solution underwent osmotic dehydration and lost water. While the weight loss in the blood sugar sample is higher than the $HH_{regular}$ sugar application (2.53–2.73%), the effect of vacuum in both types was not found significant ($P > 0.05$). In VI studies, it was determined that the cell permeability of fruits in hypertonic sugar solutions increased with vacuum. Guillemin et al. [9], on the other hand, it was reported that the weight change in apples decreased as the solution concentration and viscosity were increased. On the other hand, it has been reported that some of its components pass into fruit texture with sugar [14–16]. However, in this study, the effect of vacuum on the weight change of samples immersed in sugar solution was not found significant. The interaction between the infusion solution and the fruit is not only limited to the spaces between the cells but can also affect the intracellular space. For example, by using a hypotonic infusion solution, penetration of the desired components into the denser cytoplasm can be achieved due to the osmotic pressure difference. The amount of substance that passes into the cell increases the efficiency. On the other hand, it has been reported that hypotonic VI treatment should be done under control in order to prevent negative consequences such as cell lysis as a result of swelling of the cells and increased turgor pressure in the parenchyma cells [17]. While an increase was observed in the amount of solids in apricots with sugar infusion, a decrease was observed in other applications.

For the HH variety, the highest water recovery was observed in the HH-RB sample, while the difference was not significant with the other applications except HH-CA. KA-RO and KA-RB samples gained more water than the other samples. Due to its low °Brix values, water gain is thought to increase after infusion with roselle and rhubarb solutions. There was no statistical difference between the samples except for sugar infusion regarding solids loss. After VI, some differences occurred in the changes in the amount of solids in the

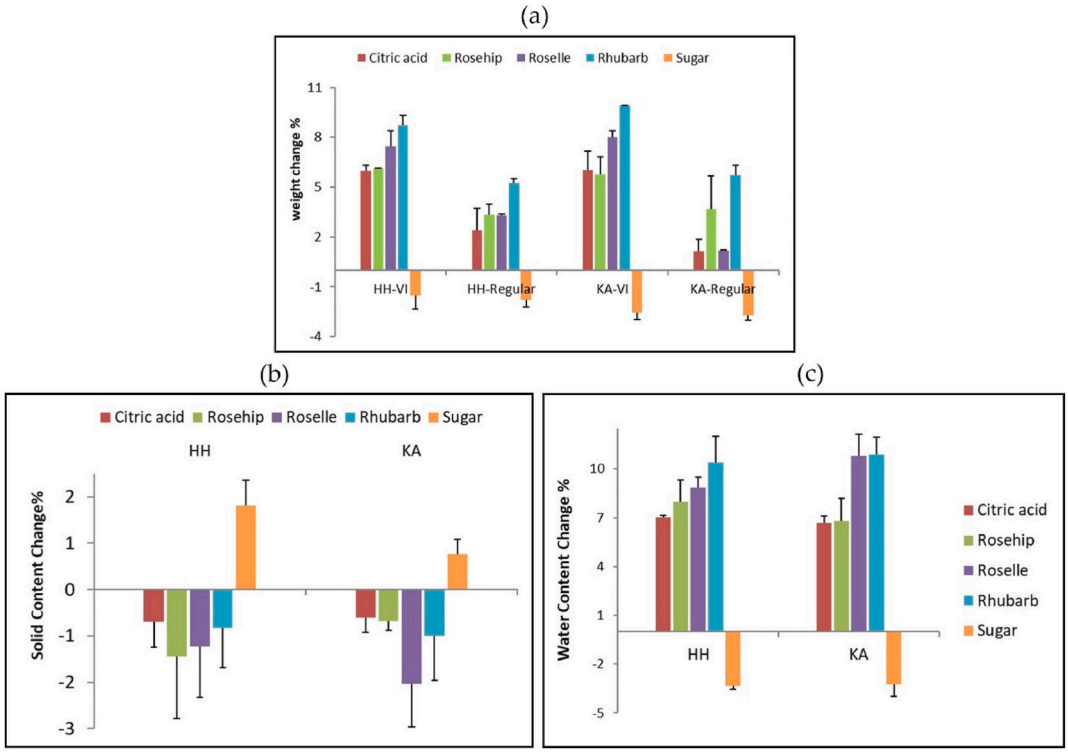

Fig. 1. % Weight change after vacuum imgregnation. a) weight change (%) b) solid content change (%) c) water content change (%); VI: vacuum impregnation; Regular: normal immersion without vacuum.

Table 2
Volatile components of plant extracts used in impregnation solution (μg/kg).

<!–Col Count:10–>	R.I.	Rosehip	Roselle	Rhubarb		R.I.	Rosehip	Roselle	Rhubarb
Aldehydes					Alcohols				
Acetaldehyde	738	–	–	1.22 ± 0.63	Ethanol	959	–	–	10.38 ± 0.40
2-Methylbutanal	929	1.96 ± 0.24	0.74 ± 0.22	0.78 ± 0.73	Tridecanol	111	14.14 ± 4.52	–	–
3-Methylbutanal	933	2.00 ± 0.16	0.82 ± 0.38	1.26 ± 0.54	1-Dodecanol	1131	–	16.86 ± 2.16	–
Pentanal	990		3.72 ± 1.59	3.26 ± 1.53	(*Z*)-3-Hexen-1-ol	1275	–	–	23.80 ± 2.59
Hexzanal	1070	3.22 ± 0.07	31.41 ± 4.14	14.48 ± 3.05	1-Hexanol	1340	2.02 ± 0.51	3.18 ± 0.39	14.56 ± 3.14
Octanal	1284	–	–	3.02 ± 1.85	1-Octen-3-ol	1432	–	51.66 ± 5.88	–
(*E*)-2-Heptenal	1322	–	8.80 ± 1.98	4.50 ± 1.66	1-Heptanol	1338	–	1.59 ± 0.22	2.20 ± 0.37
Nonanal	1390	2.43 ± 0.49	3.42 ± 1.25	6.95 ± 1.34	2-Hexen-1-ol	1393	–	–	1.68 ± 0.47
2,4-Hexadienal	1412	–	1.17 ± 0.46	–	2-Ethyl-1-hekzanol	1477	3.53 ± 3.53	14.51 ± 4.45	13.58 ± 5.82
(*E*)-2-Nonenal	1419		13.05 ± 2.63		1-Octanol	1526	1.43 ± 0.21	4.11 ± 1.03	2.22 ± 0.52
(*E,E*) 2,4- Heptadienal	1463	–	3.81 ± 0.89	–	(*Z*)-2-Octen-1-ol	1587	–	5.47 ± 1.18	–
Decanal	1492	–	–	2.74 ± 0.48	1-Pentadecanol	1599	–	3.25 ± 0.14	–
(*E,E*) 2,4- Octadienal	1510	–	1.04 ± 0.52	–					
(*E*)-2-Decanal	1517	–	2.90 ± 1.44	–	***Terpenes terpineols***				
(*E,E*) 2,4- Nonadienal	1577	–	4.88 ± 2.84	–	α-Pinene	909	3.51 ± 0.29	0.65 ± 0.11	21.99 ± 23.01
					α-Tugen	913	–	–	4.56 ± 5.70
Ketones					Sabine	1007	–	–	1.83 ± 2.20
2-Methyl 1-penten-3-one	961	–	1.19 ± 0.12	1.07 ± 0.56	β-myrcene	1117	1.19 ± 0.01	–	67.48 ± 74.79
3-Octanone	1231	–	2.32 ± 0.44	–	Limonene	1133	86.52 ± 2.28	47.88 ± 5.24	1.088.48 ± 850.07
6-Methyl-5-Hepten-2-one	1333	76.63 ± 5.06	5.82 ± 0.55	7.09 ± 2.93	δ-3-Karen	1028	–	–	1.41 ± 1.32
					β-fellandrene	1110	–	–	11.70 ± 13.46
					1,8-Cineole	1205	–	12.73 ± 7.12	15.09 ± 13.95
Esters					ρ-Cymene	1268	–	2.12 ± 0.07	–
Methyl acetate	840	6.91 ± 0.63	31.45 ± 17.65	1.34 ± 0.38	α-Terpinolene	1272	1.92 ± 0.05	–	5.88 ± 6.61
Ethyl Acetate	909	5.08 ± 0.33	4.87 ± 3.56	21.24 ± 7.30	(E)-Limonene oxide	1437	–	–	2.08 ± 0.32
Methyl butyrate	862	1.13 ± 0.07	0.96 ± 0.40	–	Camphor	1518		–	–
Methyl 2- methylbutyrate	894	0.92 ± 0.04	0.79 ± 0.15	1.42 ± 0.04	Linalool	1533	10.14 ± 0.43	–	2.32 ± 1.02
2-Methyl-ethyl butyrate	947	3.26 ± 0.22	3.40 ± 1.97	–	Caryophyllene	1566	5.50 ± 0.33	–	1.03 ± 0.47
2-Pentyl Acetate	969	3.06 ± 0.22	–	–	α-Terpineol	1533	10.14 ± 0.43	–	2.32 ± 1.02
2-Methylbutyl acetate	1016	10.90 ± 0.31	–	–	β-Selinene	1566	5.50 ± 0.33	–	1.03 ± 0.47
2-Methyl-propyl butyrate	1047	1.32 ± 0.02	–	–					
Butylbutyrate	1103	3.30 ± 0.03	–	–	**Volatile Acids**				
isoamyl butyrate	1148	6.96 ± 1.67	–	–	Acetic acid	1433	170.02 ± 66.41	15.65 ± 11.30	4.18 ± 4.25
Hexyl acetate	1157	8.68 ± 0.68	–	–	Isovaleric acid	1638	8.04 ± 0.40	2.17 ± 0.24	–
Propyl hexanoate	1200	3.10 ± 0.02	–	–	Hexanoic acid	1828	3.78 ± 0.15	4.11 ± 1.77	–
Ethyl hexanoate	1227	8.36 ± 0.54	–	–	Octanoic acid	2048	11.95 ± 2.72	–	–
Methyl octanoate	1268	4.00 ± 0.07	–	–					
Butyl hexanoate	1289	8.81 ± 0.47	–	–	***Furans***				
Hexyl 2- methylbutanoate	1303	2.51 ± 0.42	–	–	2-Methyl- Tetrahydrofuran-3-one	1169	–	3.46 ± 1.95	–
Citronellyl butyrate	1462	–	1.08 ± 0.13	–	Furfural	1364	5.27 ± 0.32	269.89 ± 71.18	–
					2-Acetyl Furan	1400	–	6.47 ± 0.94	–
Hydrocarbons					5-Methyl furfural	1466	–	15.19 ± 0.74	–
Decanal	878	4.46 ± 0.21	3.97 ± 1.37	3.27 ± 0.03	2-Furanmethanol	1536	1.40 ± 0.00	1.17 ± 0.43	–
2,3-Dimethyl-2-pentene	1037	1.20 ± 0.07	1.23 ± 0.38	–					

(*continued on next page*)

Table 2 (*continued*)

<!–Col Count:10–>	R.I.	Rosehip	Roselle	Rhubarb		R.I.	Rosehip	Roselle	Rhubarb
o-Xylene	1134	2.97 ± 0.09	1.44 ± 0.30	4.79 ± 4.22	**Miscellaneous components**				
1-Tridecene	1316	7.65 ± 1.74	17.10 ± 0.60	–	Eugenol	2147	–	10.40 ± 5.58	–

Averages; ± standard deviations. Values shown with different letters (a-d) on the same line show that the applications differ from each other at the $P < 0.05$ level.
aThe retention index (Retention Index, RI) was established on the DB-Wax (60 m, 0.25 mm, 0.4 μm) column with the C8–C20 alkane series.

Table 3
Volatile components of Hacihaliloglu apricots (μg/kg).

	R.I.*	HH-F	HH-C	HH-CA	HH-RH	HH-RO	HH-RB	HH-S
Aldehydes (16)								
Acetaldehyde	738	5.31 ± 0.48a	13.33 ± 2.59BCE	8.64 ± 1.11 ab	25.06 ± 7.16BCE	18.02 ± 4.81c	31.36 ± 0.49d	11.60 ± 1.85abc
2-Methylbutanal	929	0.94 ± 0.20a	2.96 ± 1.36b	–	1.73 ± 0.74a	1.48 ± 0.12a	1.23 ± 0.12a	3.83 ± 0.74b
3-Methylbutanal	933	1.28 ± 0.11 ab	6.79 ± 2.96cd	–	4.32 ± 1.73 ab	3.21 ± 0.86 ab	4.20 ± 1.73BCE	9.01 ± 1.36d
Pentanal	990	2.82 ± 0.42a	4.69 ± 1.48a	46.54 ± 5.68d	8.15 ± 2.22a	17.65 ± 1.48c	13.46 ± 1.98BCE	8.64 ± 2.59 ab
Hexanal	1070	145.60 ± 12.96c	55.31 ± 12.72a	233.94 ± 9.14d	98.76 ± 12.72 ab	128.76 ± 9.26c	109.99 ± 19.01c	104.69 ± 10.62BCE
(E)-2-Pentenal	1123	1.68 ± 0.44a	2.72 ± 2.35a	14.57 ± 5.31b	3.60 ± 2.13a	10.86 ± 7.53 ab	5.68 ± 2.47 ab	4.94 ± 0.62a
Heptanal	1180	8.30 ± 0.91a	10.37 ± 5.93a	27.53 ± 3.83b	14.44 ± 1.11a	15.43 ± 4.44a	15.80 ± 2.84a	9.63 ± 0.99a
(E)-2-Hexenal	1214	222.17 ± 19.88d	32.34 ± 19.38a	20.49 ± 8.27a	92.09 ± 9.26 ab	111.85 ± 24.20BCE	144.44 ± 19.63c	64.19 ± 2.35 ab
Octanal	1284	8.46 ± 0.43a	10.37 ± 3.21 ab	23.09 ± 1.60c	16.42 ± 0.37 ab	11.36 ± 1.60 ab	18.76 ± 4.32BCE	10.37 ± 4.32 ab
(E)-2-Heptenal	1322	3.26 ± 0.55 ab	1.97 ± 1.11 ab	–	9.01 ± 1.48b	22.71 ± 4.44d	–	14.07 ± 0.74c
Nonanal	1390	8.18 ± 0.43a	11.73 ± 7.04 ab	40.62 ± 0.62c	27.41 ± 5.43abc	33.21 ± 5.80abc	37.04 ± 21.36BCE	20.62 ± 10.12abc
(E,E)-2,4-Hexadienal	1412	2.52 ± 0.59 ab	–	14.81 ± 3.33c	2.80 ± 1.67 ab	5.43 ± 0.62 ab	9.88 ± 7.90BCE	3.46 ± 0.49 ab
(E)-2- Octenal	1429	3.84 ± 0.89 ab	2.72 ± 1.73a	31.48 ± 8.02d	12.84 ± 2.59abc	17.65 ± 4.32c	16.54 ± 10.00BCE	10.86 ± 0.12abc
(E,E) 2,4-Heptadienal	1463	8.57 ± 1.41a	19.95 ± 17.90 ab	17.22 ± 8.41 ab	60.09 ± 3.58abc	84.19 ± 18.39BCE	94.56 ± 63.95c	94.07 ± 3.21c
Decanal	1492	2.98 ± 0.92 ab	–	28.15 ± 5.18c	–	7.90 ± 0.49b	8.27 ± 2.35b	–
Benzaldehyde	1529	1.28 ± 0.25a	2.10 ± 1.60a	6.17 ± 2.35 ab	5.06 ± 0.12 ab	5.93 ± 0.37 ab	10.49 ± 6.91b	5.06 ± 1.11 ab
Total Aldehyde		427.19	177.35	513.25	381.78	495.64	521.7	375.04
Ketones (5)								
2-Pentanone	987	4.25 ± 0.69a	10.37 ± 2.72b	–	5.93 ± 0.62a	–	–	–
4-Octanone	1220	13.20 ± 0.43 ab	10.25 ± 1.73 ab	3.95 ± 0.62a	12.22 ± 0.12 ab	9.51 ± 3.21 ab	19.13 ± 11.60b	9.51 ± 1.11 ab
Acetoine	1280	–	69.26 ± 20.49c	–	29.75 ± 3.21 ab	16.30 ± 10.00 ab	26.91 ± 1.48b	5.80 ± 1.36 ab
6-Methyl-5-hepten-2-one	1333	9.11 ± 1.22a	7.41 ± 3.21a	10.99 ± 2.96a	22.47 ± 3.95a	11.23 ± 4.81a	14.07 ± 3.58a	10.25 ± 0.12a
γ-Butyrolacton	1639	0.79 ± 0.01a	11.85 ± 4.81b	21.60 ± 4.57c	5.31 ± 0.12 ab	3.09 ± 0.99a	6.67 ± 5.18 ab	4.32 ± 1.11 ab
Total Ketones		27.35	109.14	36.54	75.68	40.13	66.78	29.88
Esters (13)								
Methyl acetate	840	2.33 ± 0.22a	18.39 ± 9.14b	2.96 ± 0.49a	6.42 ± 0.49a	3.58 ± 0.62a	6.30 ± 2.10a	4.81 ± 0.37a
Ethyl acetate	909	4.39 ± 0.03a	22.34 ± 7.28BCE	59.63 ± 2.96d	35.06 ± 12.96c	20.37 ± 4.32BCE	18.89 ± 4.07b	34.07 ± 10.74c
2-Methylpropyl 2-methyl propanoate	1079	8.72 ± 0.37b	6.67 ± 0.25 ab	–	5.19 ± 2.63 ab	5.78 ± 2.22 ab	10.47 ± 7.16b	5.34 ± 0.41 ab
Methyl 2-methylpentanoate	1086	5.15 ± 0.32 ab	9.37 ± 5.26b	–	4.82 ± 3.95 ab	5.15 ± 2.92 ab	6.52 ± 0.43 ab	7.83 ± 0.50b
1-Methyl ethyl pentanoate	1124	7.95 ± 0.29 ab	–	–	5.60 ± 3.32b	–	6.20 ± 1.62BCE	9.67 ± 0.42c
Butyl isobutyrate	1138	5.79 ± 0.18 ab	4.64 ± 0.74 ab	–	3.71 ± 0.12a	4.20 ± 2.22a	7.41 ± 0.99b	3.83 ± 0.12a
2-Methylpropyl butanoate	1154	4.30 ± 1.68b	4.52 ± 0.93b	–	2.52 ± 1.51 ab	10.62 ± 2.22c	–	3.24 ± 0.12b
Butyl butanoate	1211	–	2.35 ± 0.62a	–	2.96 ± 0.12a	–	–	–
Ethyl hexanoate	1227	–	1.48 ± 0.74a		2.59 ± 0.86a	1.60 ± 0.62a	2.59 ± 0.49 ab	3.46 ± 0.74b
2-Methylpentyl pentanoate	1296	65.69 ± 3.36b	57.03 ± 10.25 ab	14.57 ± 0.49a	93.70 ± 5.43b	71.23 ± 22.84b	71.60 ± 11.48b	74.93 ± 1.73b
1,1-Dimethylpropyl hexanoate	1298	65.56 ± 9.32 ab	59.50 ± 12.22 ab	16.79 ± 0.25a	93.70 ± 5.93 ab	69.50 ± 28.52 ab	99.62 ± 38.39b	69.75 ± 8.15 ab

(*continued on next page*)

Table 3 (*continued*)

	R.I.*	HH-F	HH-C	HH-CA	HH-RH	HH-RO	HH-RB	HH-S
(E)-2-Hexenyl acetate	1326	1.14 ± 0.21	–	–	–	–	–	–
Butyl 2-ethylhexanoate	1437	34.53 ± 4.48 ab	34.44 ± 11.85 ab	–	77.44 ± 69.90 ab	90.98 ± 42.59b	–	35.39 ± 4.81 ab
Total Esters		205.55	220.73	93.95	333.71	283.01	229.60	252.32
Furans (4)								
2-Ethyl furan	988	–	–	–	–	1.60 ± 0.37	–	–
2,5-Diethyl furan	1057	–	–	5.56 ± 2.35	–	–	–	–
2-Pentyl furan	1204	–	–	11.36 ± 1.73b	1.98 ± 0.49a	2.72 ± 1.48a	2.47 ± 0.99a	–
3,4-Dimethyl-2,5-furandione	1735	–	–	2.84 ± 0.86	–	–	–	–
Total Furans		–	–	19.76	1.98	2.16	2.47	–
Alcohols (12)								
Ethanol	959	38.53 ± 5.45a	180.48 ± 26.17 ab	449.60 ± 38.89cd	228.67 ± 112.93b	327.51 ± 61.60BCE	227.02 ± 47.28b	488.24 ± 72.71d
1-Butanol	1130	–	30.86 ± 4.20a	–	–	–	–	–
1-Pentanol	1219	–	–	10.74 ± 4.07a	–	–	–	–
2-Methyl-1-pentanol	1256	4.87 ± 0.29BCE	4.00 ± 1.03BCE	–	–	–	2.96 ± 2.96 ab	6.17 ± 0.99c
2-Propyl-1-heptanol	1291	13.18 ± 0.67a	13.58 ± 3.21a	3.70 ± 0.49a	20.74 ± 0.25a	14.07 ± 6.91a	15.68 ± 5.43a	14.44 ± 1.98a
(E)-2-Penten-1-ol	1307	0.94 ± 0.88a	3.21 ± 2.22a	6.17 ± 0.99a	5.06 ± 0.62a	4.07 ± 1.11a	12.22 ± 11.60a	3.33 ± 0.37a
1-Hexanol	1340	22.51 ± 3.24c	9.14 ± 5.68 ab	6.54 ± 0.62a	11.36 ± 3.95a	16.79 ± 2.96BCE	19.26 ± 4.81c	10.12 ± 0.99 ab
(Z)-3-Hexene-1-ol	1368	2.21 ± 0.43a	–	–	–	–	1.98 ± 0.62a	–
(E)-2-Hexene-1-ol	1393	36.42 ± 4.49b	–	–	–	–	19.01 ± 16.42a	–
1-Octen-3-ol	1432	–	–	138.02 ± 22.34	–	–	–	–
2-Ethyl-1-hexanol	1477	10.48 ± 3.33 ab	9.75 ± 6.91 ab	14.94 ± 7.28 ab	13.33 ± 5.43 ab	13.58 ± 6.79 ab	22.84 ± 9.63b	4.20 ± 2.84a
(E)-2-Octen-1-ol	1601	–	–	11.48 ± 9.14b	1.73 ± 0.37a	4.20 ± 0.25 ab	1.98 ± 1.11a	3.21 ± 0.12 ab
Total Alcohol		124.61	250.97	641.19	280.89	380.22	322.95	529.71
Terpenes and terpineols (14)								
β-Pinene	1100	1.36 ± 0.03 ab	0.96 ± 0.37 ab	–	0.86 ± 0.12 ab	–	3.11 ± 2.96b	0.92 ± 0.25 ab
β-Fellandrene	1110	2.98 ± 0.00b	4.29 ± 0.12c	–	2.10 ± 1.19b	2.82 ± 0.12b	2.35 ± 0.17b	4.14 ± 0.14c
β-Miricen	1125	2.67 ± 0.13BCE	–	4.07 ± 1.85c	2.22 ± 0.49 ab	–	–	–
Limonene	1194	42.94 ± 0.35a	36.91 ± 7.41a	162.21 ± 53.82b	51.23 ± 0.74a	49.75 ± 1.48a	42.96 ± 0.74a	45.68 ± 16.91a
1,8-Cineole	1205	1.50 ± 0.09 ab	3.21 ± 1.11b	–	1.48 ± 0.25 ab	–	2.72 ± 2.10b	–
γ-Terpinene	1240	0.75 ± 0.10 ab	–	–	1.11 ± 0.25b	1.36 ± 0.49b	–	–
ρ-Cymene	1268	2.55 ± 0.35a	2.35 ± 0.62a	–	3.46 ± 0.37a	2.72 ± 1.23a	4.20 ± 0.99a	2.35 ± 0.49a
Teaspiran A	1511	1.62 ± 1.43a	2.22 ± 1.85a	10.49 ± 0.99c	5.80 ± 1.60 ab	7.41 ± 1.11BCE	5.56 ± 3.95 ab	4.32 ± 1.60 ab
Linalool	1533	8.46 ± 2.51a	23.70 ± 15.18 ab	249.37 ± 32.84c	74.44 ± 18.64 ab	46.05 ± 6.54 ab	44.69 ± 18.76 ab	62.34 ± 8.52b
Teaspiran B	1548	2.11 ± 0.74a	3.31 ± 2.84 ab	17.78 ± 3.33d	11.60 ± 3.46BCE	12.14 ± 2.84bcd	13.49 ± 7.53cd	8.02 ± 2.96abc
β-Cyclocitral	1629	6.64 ± 2.08 ab	2.72 ± 1.98a	5.18 ± 1.73 ab	–	–	13.21 ± 8.76b	–
α-Terpineol	1691	0.83 ± 0.12a	4.69 ± 4.07a	47.40 ± 12.35b	8.76 ± 0.62a	5.93 ± 1.36a	6.17 ± 3.95a	7.04 ± 0.86a
Nerol	1788	–	–	7.65 ± 1.85c	–	–	2.59 ± 1.85b	0.99 ± 0.25a
Geraniol	1831	–	–	21.36 ± 7.41c	–	–	9.38 ± 5.18b	1.48 ± 0.37 ab
Total terpenes and terpineols		74.41	84.44	525.51	163.06	128.16	150.38	137.41
Norisoprenoids (3)								

(*continued on next page*)

Table 3 (*continued*)

	R.I.*	HH-F	HH-C	HH-CA	HH-RH	HH-RO	HH-RB	HH-S
Dihydro-β-ionone	1838	6.41 ± 0.95b	2.35 ± 2.35 ab	–	6.54 ± 0.25b	3.09 ± 0.25 ab	4.20 ± 2.59 ab	3.21 ± 0.37 ab
β-Ionone	1942	7.37 ± 1.55b	5.93 ± 5.56 ab	3.95 ± 1.60 ab	3.54 ± 2.14 ab	19.51 ± 0.99c	5.18 ± 3.58 ab	–
Dihydro-β-ionol	1959	–	8.39 ± 9.01a	–	2.10 ± 0.12a	–	10.12 ± 8.89a	4.07 ± 0.86a
Total Norisoprenoids		13.28	16.67	3.95	13.70	22.60	19.50	7.28
Volatile acids (4)								
Acetic acid	1433	–	540.10 ± 177.75BCE	–	471.60 ± 287.65b	–	818.35 ± 330.25c	100.05 ± 0.17 ab
Butanoic acid	1611	–	188.90 ± 85.20b	–	–	9.25 ± 1.25a	–	–
2-Methylbutanoic acid	1655	–	28.51 ± 16.67a	–	–	–	22.34 ± 12.48a	
Hexanoic acid	1828	41.96 ± 2.27a	62.95 ± 40.75a	53.10 ± 11.10a	42.60 ± 3.10a	25.90 ± 3.70a	58.00 ± 24.05a	28.40 ± 1.85a
Total Acid		41.96	791.95	53.10	514.20	35.15	876.45	128.45
TOTAL		914.35	1651.25	1887.25	1765.00	1387.07	2189.83	1460.09

verages; ± standard deviations. Values shown with different letters (a-d) on the same line show that the applications differ from each other at the $P < 0.05$ level.
aThe retention index (Retention Index, RI) was established on the DB-Wax (60 m, 0.25 mm, 0.4 μm) column with the C8–C20 alkane series.

HH and KA varieties. For example, while the substance loss of the HH variety was higher in rosehip infusion, the HH-RO specimen was lower than KA-RO. The reason for this is thought to be due to the differences in fruit texture among cultivars that affect substance transfer. Forni et al. [18] reported that after VI was applied to apricots cut into cubes, water loss in the samples was 22.1%, and sugar gain was approximately 3.0%. Due to peeling and size reduction affecting material transfer, Forni et al. [18] are thought to have higher values than the results found in this study.

3.3. Effect of vacuum impregnation on volatile compounds

Fruit aroma is formed by the presence of volatile components in different proportions. In addition, aroma components, the most obvious factors that show the sensory difference between fruits, significantly affect fruit quality. In fruits, volatile components such as aliphatic esters, alcohols, acids, and carbonyl groups are generally known to be oxidative degradation derivatives of linoleic and linolenic acids [19]. The aroma profile of apricots is very important to consumer proference [20]. Especially benzaldehyde, linalool and esters are volatile components that make up the characteristic aroma of apricots [21]. Changes in aroma profile after VI treatment depends on temperature, pressure, solution/fruit ratio, solution type, and concentration [22]. With the VI method, after the pores in the fruits are filled with the solution, aroma loss occurs, probably due to either dilution of the volatile components with the infusion solution or reducing the aromatic perception [23]. In addition, when the fruits are heat treated, the original volatile components often decrease. In contrast, new components are formed due to autoxidation of unsaturated fatty acids, thermal degradation, browning reactions, or caramelization. For example, more than 3500 aroma compounds with low detection thresholds were detected with the Maillard reaction. While these substances negatively affect the aroma of dried products, they are desirable because of the formation of some natural components, such as ionone, decalactone, and butyl acetate, that enrich the flavour [19,24]. The volatile components of HH variety apricots are given in Table 3, and the KA variety is given in Table 4. After all applications, a total of 71 volatile compounds were detected in the HH variety and 66 in the KA variety. These components are aldehydes, ketones, esters, furan compounds, alcohols, terpenes, isoprenoids, and acids, collected in 8 groups. VI had positive effects on terpenes in both cultivars. Compared to the control samples, the infusion process, which increased the aldehydes in the HH variety and the ketones in the KA variety, showed different behaviour in other volatile component groups. Both cultivars showed a rise in volatile components, attributed to fermentation that produced ethanol and acetic acid. On the other hand, no direct contribution to the aroma profile of the infusion solutions was observed. During the drying process, it was noted that the release of bound flavoring substances or the Maillard reaction resulted in the formation of different components in comparison to the fresh sample. However, VI is thought to prevent the formation of excessive amounts of furan compounds, except for the HH-CA sample. The efficiency of vacuum infusion is hindered when dealing with apricots due to their low porosity, significantly limiting substance transfer.

3.3.1. Aldehydes

Aldehydes are generally compounds formed by the Strecker degradation of amino acids in plant cells or the conversion of alcohols catalysed by the alcohol dehydrogenase enzyme. In addition, lipids released by cell membrane damage are used as substrates in the formation of aldehydes and alcohols. High-concentration aldehydes have a pungent odor, while in low amounts, they can evoke a strong aroma perception. Aldehydes are the most predominant components of volatile fractions resembling fruit and grass odor. Aldehydes are essential apricot components [25,26].

VI has been shown to have positive effects on aldehydes. A total of 16 aldehydes were determined in the HH variety and 15 aldehydes in the KA variety, with the most hexanal and (*E*)-2-hexenal. Lipoxygenase forms these components in metabolism [27]. While

Table 4
Volatile components of Kabaasi apricots (μg/kg).

	R.I.*	KA-F	KA-C	KA-CA	KA-RH	KA-RO	KA-RB	KA-S
Aldehydes (15)								
Acetaldehyde	738	4.68 ± 0.10a	18.64 ± 7.78b	10.86 ± 2.96 ab	30.86 ± 5.18c	15.31 ± 0.74b	35.92 ± 0.25c	16.17 ± 2.72b
2-Methylbutanal	929	0.30 ± 0.06a	1.38 ± 0.74 ab	1.31 ± 0.49 ab	3.41 ± 0.12BCE	3.80 ± 0.12c	2.90 ± 1.60BCE	4.14 ± 1.48c
3-Methylbutanal	933	0.62 ± 0.21a	61.97 ± 13.33b	3.43 ± 1.36a	8.70 ± 0.25a	9.50 ± 0.49a	6.93 ± 2.84a	10.37 ± 4.07a
Pentanal	990	1.68 ± 1.01 ab	2.10 ± 0.86 ab	6.59 ± 1.11d	4.59 ± 0.99bcd	3.27 ± 0.49abc	–	5.43 ± 2.84cd
Hexanal	1070	93.42 ± 23.58BCE	49.63 ± 11.73 ab	38.89 ± 16.79a	115.67 ± 16.17c	46.66 ± 0.62 ab	69.75 ± 24.69abc	104.69 ± 25.31c
(E)-2-Pentenal	1123	–	–	3.36 ± 0.74b	2.55 ± 0.74b	1.60 ± 0.25 ab	2.26 ± 1.11b	2.81 ± 1.48b
Heptanal	1180	7.69 ± 5.62a	6.05 ± 2.35a	8.00 ± 2.22a	9.70 ± 2.22a	6.25 ± 0.74a	8.85 ± 0.99a	10.54 ± 5.31a
(E)-2-Hexenal	1214	210.16 ± 40.62c	52.10 ± 3.58a	22.34 ± 5.18a	126.41 ± 22.96b	37.78 ± 3.33a	72.47 ± 10.99a	58.89 ± 23.33a
Octanal	1284	9.77 ± 3.38b	7.04 ± 3.09b	–	11.85 ± 4.20 ab	10.74 ± 2.72 ab	12.75 ± 0.49 ab	16.77 ± 0.74b
(E)-2-Heptenal	1322	–	–	12.17 ± 3.58cd	7.16 ± 3.21BCE	3.18 ± 1.11 ab	–	13.97 ± 4.20d
nonanal	1390	6.43 ± 2.73a	9.14 ± 5.93 ab	18.15 ± 14.32 ab	12.47 ± 4.81 ab	16.67 ± 2.10 ab	15.06 ± 2.72 ab	26.05 ± 6.79b
(E)-2-Octenal	1429	2.11 ± 1.35a	4.20 ± 1.48abc	9.94 ± 2.22cd	9.51 ± 4.32bcd	3.58 ± 1.11 ab	7.76 ± 3.58abc	14.44 ± 0.12d
(E,E) 2,4-Heptadienal	1463	5.23 ± 1.23a	64.69 ± 5.80b	49.87 ± 8.52 ab	80.61 ± 18.76BCE	37.28 ± 26.17 ab	86.69 ± 35.92BCE	131.84 ± 38.15c
Decanal	1492	3.78 ± 2.27	–	–	–	–	–	–
Benzaldehyde	1529	0.70 ± 0.29a	3.63 ± 1.36 ab	3.31 ± 1.85 ab	3.79 ± 1.11b	3.15 ± 0.86 ab	3.58 ± 0.86 ab	5.37 ± 1.11b
Total Aldehydes		346.57	280.57	188.22	427.28	198.77	324.92	421.48
Ketones (5)								
2-Pentanone	987	3.69 ± 0.48a	–	–	3.70 ± 0.25a	–	6.05 ± 1.73b	3.21 ± 0.74a
4-Octanone	1220	11.87 ± 2.73a	5.85 ± 1.48a	9.26 ± 1.11a	10.00 ± 1.85a	7.65 ± 3.09a	9.26 ± 0.62a	7.65 ± 3.83a
Acetoin	1280	–	13.00 ± 3.21 ab	18.27 ± 12.72 ab	10.86 ± 2.84a	24.15 ± 8.76 ab	50.70 ± 0.49c	37.04 ± 21.85BCE
6-Methyl-5-hepten-2-one	1333	7.33 ± 1.98bc	4.44 ± 1.98 ab	11.97 ± 2.59cd	14.63 ± 5.43d	–	9.81 ± 1.11abc	11.66 ± 0.37cd
γ-Butyrolactone	1639	0.78 ± 0.40a	3.48 ± 0.74 ab	6.88 ± 1.60b	4.34 ± 1.60 ab	7.08 ± 1.73b	3.93 ± 0.49 ab	8.89 ± 5.56b
Total Ketones		23.67	26.77	46.38	43.53	38.88	79.75	68.45
Esters (13)								
Methyl acetate	840	4.09 ± 0.54a	5.43 ± 1.98abc	–	4.32 ± 0.25 ab	7.78 ± 0.01cd	10.25 ± 1.48d	7.16 ± 1.60BCE
Ethyl acetate	909	2.64 ± 0.52a	5.13 ± 2.88a	9.22 ± 2.00a	55.87 ± 5.62c	35.33 ± 5.53b	31.13 ± 0.27b	61.23 ± 0.74c
2-Methyl propanoate	1079	6.74 ± 2.30b	2.84 ± 1.60a	3.70 ± 0.86 ab	6.23 ± 1.85 ab	4.20 ± 1.23 ab	5.26 ± 0.68 ab	5.68 ± 0.53 ab
Methyl 2-methylpentanoate	1086	2.54 ± 1.01 ab	3.23 ± 0.95abc	–	6.49 ± 1.13c	3.17 ± 1.18abc	5.93 ± 2.10c	4.28 ± 1.81BCE
1-Methyl ethyl pentanoate	1124	6.39 ± 1.63a	4.48 ± 3.33a	8.15 ± 6.05a	9.75 ± 1.36a	6.42 ± 1.98a	4.69 ± 0.25a	8.76 ± 5.80a
Butyl isobutyrate	1138	5.32 ± 1.34c	2.10 ± 1.36 ab	3.09 ± 0.99BCE	4.32 ± 1.36BCE	3.33 ± 0.99BCE	–	3.64 ± 0.49BCE
2-methylpropyl butanoate	1154	4.80 ± 2.40b	1.52 ± 1.48 ab	–	3.21 ± 0.25 ab	2.84 ± 0.62 ab	4.20 ± 1.85b	2.92 ± 0.86 ab
Butyl butanoate	1211	–	–	2.47 ± 0.49	–	1.48 ± 1.48	1.85 ± 0.12	–
Ethyl hexanoate	1227	–	–	–	2.10 ± 0.99a	–	0.67 ± 0.02a	2.64 ± 2.72a
2-Methylpentyl pentanoate	1296	70.79 ± 6.43a	68.21 ± 32.84a	83.71 ± 8.39a	86.29 ± 24.69a	62.39 ± 19.26a	76.54 ± 3.83a	94.19 ± 4.81a
1,1-Dimethylpropyl hexanoate	1298	75.64 ± 8.58a	69.13 ± 20.99a	83.33 ± 1.85a	87.40 ± 26.91a	60.09 ± 22.71a	75.00 ± 2.84a	88.73 ± 2.59a
(E)-2-Hexenyl acetate	1326	5.08 ± 1.57	–	–	–	–	–	–
Butyl 2-ethylhexanoate	1437	36.03 ± 4.14 ab	69.75 ± 30.74b	–	63.18 ± 27.65 ab	44.30 ± 11.85 ab	66.17 ± 5.43b	87.81 ± 50.86b
Total Ester		220.06	231.82	193.70	329.16	231.33	281.69	367.08
Furans (1)								
2-Pentyl furan	1204	–	–	–	1.48 ± 1.11	–	0.73 ± 0.03	–
Total Furans		–	–	–	1.48	–	0.73	–

(*continued on next page*)

Table 4 (*continued*)

	R.I.*	KA-F	KA-C	KA-CA	KA-RH	KA-RO	KA-RB	KA-S
Alcohols (11)								
Ethanol	959	7.76 ± 1.88a	2.81 ± 0.86a	256.33 ± 43.33 ab	544.17 ± 7.28BCE	461.09 ± 25.92b	266.41 ± 31.36 ab	869.46 ± 375.66c
1-Butanol	1130	–	–	–	–	4.94 ± 5.56a	10.25 ± 1.23b	–
1-Pentanol	1219	–	–	–	9.63 ± 3.33a	–	6.91 ± 3.83a	–
2-Methyl-1-pentanol	1256	–	4.15 ± 2.84 ab	5.80 ± 0.74b	7.12 ± 2.35b	5.21 ± 2.22b	–	7.16 ± 0.62b
2-Propyl-1-heptanol	1291	14.96 ± 4.36a	12.02 ± 5.93a	15.43 ± 3.95a	17.61 ± 6.54a	12.43 ± 5.43a	14.64 ± 1.85a	18.45 ± 0.49a
(E)-2-Penten-1-ol	1307	–	–	–	1.36 ± 1.11a	–	2.92 ± 0.25 ab	4.69 ± 3.09b
1-Hexanol	1340	68.42 ± 13.67b	4.14 ± 2.10a	4.69 ± 0.86a	8.20 ± 2.35a	7.04 ± 2.35a	13.95 ± 2.10a	6.05 ± 0.74a
(Z)-3-Hexene-1-ol	1368	15.55 ± 2.97b	–	–	–		2.38 ± 0.49a	–
(E)-2-Hexene-1-ol	1393	133.62 ± 20.36b	–	–	4.54 ± 0.74a	–	5.01 ± 0.86a	–
2-Ethyl-1-hexanol	1477	4.78 ± 2.56a	10.12 ± 8.15a	16.42 ± 11.97a	8.76 ± 1.60a	14.32 ± 0.74a	12.91 ± 0.99a	13.11 ± 3.83a
(E)-2-Octen-1-ol	1601	–	–	8.02 ± 0.86a	–	–	–	5.88 ± 3.46a
Total Alcohol		245.09	33.33	306.64	601.39	505.04	335.54	924.90
Terpenes and terpineols (14)								
β-Pinene	1100	1.04 ± 0.03 ab	–	0.92 ± 0.45 ab	1.10 ± 0.30b	0.99 ± 0.49 ab	1.23 ± 0.03b	0.99 ± 0.86 ab
β-Phellandrene	1110	2.17 ± 0.39a	1.93 ± 1.48a	2.90 ± 1.71a	3.77 ± 0.07a	3.26 ± 1.31a	1.95 ± 0.12a	2.88 ± 2.22a
β-Miricen	1125	–	–	–	1.67 ± 1.67a	1.12 ± 0.74a	–	1.36 ± 0.49a
Limonene	1194	39.38 ± 0.64 ab	23.00 ± 0.86a	47.58 ± 8.02 ab	55.31 ± 20.00b	46.42 ± 0.86 ab	41.93 ± 5.18 ab	60.16 ± 22.96b
1,8-Cineole	1205	1.11 ± 0.60a	–	–	0.92 ± 0.49a	1.29 ± 1.11a	1.10 ± 0.01a	–
γ-Terpinene	1240	1.06 ± 0.22a	–	1.60 ± 0.25a	1.08 ± 0.49a	1.14 ± 0.62a	1.18 ± 0.25a	–
ρ-Cymene	1268	4.08 ± 1.61b	0.66 ± 0.12a	–	3.38 ± 1.36b	2.14 ± 1.48 ab	3.29 ± 1.11a	–
Teaspiran A	1511	–	–	5.83 ± 0.49c	1.94 ± 1.48b	1.48 ± 0.74 ab	–	2.33 ± 0.49b
Linalool	1533	4.51 ± 2.33a	28.60 ± 16.91a	153.32 ± 25.43c	51.60 ± 18.89 ab	50.00 ± 8.15 ab	33.00 ± 15.43a	96.73 ± 42.34b
Teaspiran B	1548	–	–	10.57 ± 0.86c	1.98 ± 1.48 ab	1.64 ± 0.74 ab	–	4.32 ± 2.22b
β-Cyclocitral	1629	–	1.64 ± 0.25a	12.15 ± 0.86b	2.22 ± 1.11a	2.31 ± 0.74a	–	–
α-Terpineol	1691	0.41 ± 0.03a	3.03 ± 2.72a	29.32 ± 11.36b	4.16 ± 1.85a	6.93 ± 1.11a	–	12.52 ± 8.15a
Nerol	1788	–	–	3.54 ± 1.85b	–	–	1.68 ± 0.86 ab	1.30 ± 1.11a
Geraniol	1831	–	–	8.06 ± 2.59a	–	–	9.44 ± 3.58a	–
Total terpenes and terpineols		53.76	58.89	275.90	129.13	118.57	94.92	182.59
Norisoprenoids (3)								
Dihydro-β-ionone	1838	–	–	1.85 ± 0.49a	–	–	4.46 ± 2.35b	–
β-Ionone	1942	4.33 ± 0.50a	8.57 ± 6.54a	57.90 ± 24.81b	3.98 ± 1.48a	11.21 ± 2.84a	22.10 ± 15.55a	16.39 ± 12.84a
Dihydro-β-ionol	1959	–	8.56 ± 6.54a	–	1.93 ± 0.62a	4.94 ± 1.85a	7.28 ± 3.33a	9.70 ± 7.28a
Total Norisoprenoid		4.33	17.04	59.75	5.93	16.19	33.82	26.17
Volatile Acids (4)								
Acetic acid	1433	–	–	–	–	274.79 ± 144.64a	530.85 ± 64.20b	504.30 ± 161.70b
Butanoic acid	1611	–	9.04 ± 4.30a	23.27 ± 4.30b	–	16.85 ± 1.25b	24.50 ± 5.55b	–
2-Methylbutanoic acid	1655	–	–	–	–	21.81 ± 6.76	–	
Hexanoic acid	1828	23.97 ± 10.95	–	–	–	–	–	–
Total Acids		23.97	9.04	23.27		313.45	555.55	504.30
TOTAL		917.45	657.46	1093.86	1537.90	1422.23	1706.92	2494.97

Averages; ± standard deviations. Values shown with different letters (a-d) on the same line show that the applications differ from each other at the $P < 0.05$ level.

aThe retention index (Retention Index, RI) was established on the DB-Wax (60 m, 0.25 mm, 0.4 μm) column with the C8–C20 alkane series.

145.60 μg/kg hexanal and 222.17 μg/kg (*E*)-2-hexanal were determined in the HH-F sample, and they were found to be 93.42 μg/kg and 210.16 μg/kg in the KA-F sample, respectively. Other aldehydes were determined at lower rates compared to these components. These components, which are quite abundant in apricots, give the characteristic fresh grass smell. In previous studies, aroma components of Hacihaliloglu and Kabaasicultivars were determined using liquid extraction [28] and the HS-SPME technique [20]. Studies showed similar levels of hexanal and (*E*)-2-hexanal, with some variations due to seasonal factors or extraction conditions. While the

HH-CA sample had the highest hexanal content, the application also caused the most (*E*)-2-hexanal loss. While the lowest hexanal content was observed in HH-C and HH-RH samples, other applications were not statistically different from each other.

(*E*)-2-Hexenal was most conserved in the HH-RB sample, followed by the HH-RO sample. In the KA variety, the highest loss for both components was observed in the KA-CA sample, while the KA-RH sample had the highest values. The volatile components of impregnation solutions prepared with plant extracts are given in Table 2. While the hexanal contents of the solutions decreased from roselle (31.41 μg/kg) to rosehip herb (3.22 μg/kg), (*E*)-2-hexenal was not detected in any solution. Therefore, no relationship was found between the VI apricots, which had higher values than the control samples, and the infusion solutions. It is known that all sugars, mainly sucrose, affect aroma. It has been reported that a high concentration of sugar solution (>40%) increases the perception of aroma by creating a salting effect [19]. After sugar infusion, the hexanal content of both cultivars was high, while the amount of (*E*)-2-hexenal was not statistically different from the control sample. On the other hand, in a study conducted on kiwis, it was observed that after VI application with 45 °Brix and 65 °Brix sugar solution, the amount of (*E*)-2-hexenal decreased while esters increased.

While the effect of VI application on aldehydes in the HH cultivar was seen, the same results were not seen in the KA cultivar. When the total aldehyde amounts were evaluated, all applications were found to be higher in the HH variety than the control sample. In contrast, HH-CA and HH-RB samples had the highest values. KA-CA and KA-RO prefixes were found to be lower than KA-C samples. Pentanal, (*E*)-2-pentenal, nonanal, 2,4-hexadienal (*E*)-2-octenal, decanal, and total aldehyde amounts in HH-CA sample were found to be statistically higher than other components. Fruits with glycosidic-linked flavorings undergo enzymatic or chemical hydrolysis during the ripening or industrial processes, resulting in free flavoring substances [29]. While acid hydrolysis liberates many bound flavoring substances, especially terpene, terpene oxides, aldehydes, and lactones, enzymatic hydrolysis is more effective on alcohols and ketones [30].

Solis-Solis et al. [29] using simultaneous distillation method on eight varieties of apricot grown in France, it was reported that approximately six times more flavoring substance was obtained thanks to acidic (pH 3) hydrolysis compared to neutral (pH 7) medium. Therefore, it is thought that citric acid infusion may affect some bound flavor components. However, there were differences between the cultivars in terms of aldehydes.

After the rosehip and rhubarb impregnation, the total aldehyde amount of the samples was higher than the control samples. However, the inability to detect (*E*)-2-nonenal, (*E*)-2 decanal, and (*E,E*)-2,4-nonadienal in the roselle extract in apricots showed that there was no component passing through this solution.

On the other hand, it is known that many aroma substances are formed by the Maillard reaction that occurs during drying in the sun. In addition, since the aldehydes in sugar application are high in both varieties, it is thought that the VI treatment has an increasing effect on the amount of aldehyde.

3.3.2. Ketones

Ketones are compounds formed by fatty acid metabolism and contribute to apricot flavor [29]. A total of 5 ketones were found in apricot samples. While 2-pentanone was found in close amounts in fresh samples, it could only be detected in HH-C and HH-RH samples after drying. The KA-RB sample was higher than the KA-RH and KA-S samples in the KA cultivar. While 4-octanone detected in all samples was higher in the HH-RB sample, the differences between other apricots were insignificant. In the impregnation solutions used in this study, 4-octane was not found. Acetoin, more common in dairy products than fruits, is an aroma component that gives butter and cream flavor together with diacetyl. Acetoin is a component formed by the Strecker degradation of pyrazines due to the Maillard reaction. Therefore, acetoin is thought to be formed during drying [19].

Acetoin determined in all samples except the HH-CA sample was detected mostly in the HH-C sample, while the values in VI samples were not statistically different. In the KA variety, acetoin was determined mostly in KA-RB and KA-S samples and less in other samples. Similarly, Inserra et al. [28] reported that while acetoin could not be detected in fresh samples of Hacihaliloglu and Kabaasi cultivars, they found a high amount (362.9 μg/kg) in dried apricots. 6-methyl-5-hepten-2-one, which has an important place in the aroma of apricot, is known to have a particularly floral odor [30,31]. The values of fresh samples of both cultivars were close to the results determined in previous studies [20,28]. In addition, 6-methyl–5-hepten-2-one determined in sun-dried apricots by Göğüş et al. [24] was detected in all samples except KA-RO in this study. Although this component was found to be high in the HH-RH sample after drying, the difference between the samples was insignificant. On the other hand, in the KA variety, other applications except KA-RO and KA-RB were higher than the control sample.

Lactones, which provide a peach and coconut-like odor, are essential components for the typical apricot flavor, and many lactone derivatives have been identified in previous apricot studies [21,29]. However, only γ-butyrolactone was determined in this study. γ-butyrolactone, which was very low in fresh samples, increased in the HH-CA sample. HH-C and KA-RB samples had the highest total ketone content, while HH-CA and KA-C had the lowest values.

The differences between the control samples were due to the amount of acetoin. Contrary to the KA-CA sample, after the citric acid application, acetoin could not be detected in the HH-CA sample. While the HH-RH sample was higher than the KA-KB sample, all ketones were determined in both. In addition, the amount of 6-methyl-5-hepten-2-one was higher in both samples than in other applications. It is thought that this component may be infused into apricots due to its high (76.63 μg/kg) amount in rosehip pulp.

On the other hand, 2-methyl-1-penten-3-one and 3-octanone determined in the pulp could not be detected in apricots. Although the total ketone amounts were found to be close to each other with the Roselle infusion, 6-methyl-5-hepten-2 had a moderate value in the ten HH-RO samples but could not be detected in the KA-RO sample. In addition, the amount of γ-butyrolactone was less in the HH-RO sample than in the control sample. The acetoin content of the KA-RB sample was approximately two times higher than the HH-RB sample. While 6-methyl-5-hepten-2-one was preserved at a similar rate with sugar infusion, the amount of acetoin in the KA-S sample was approximately six times higher. This situation is thought to be caused by the Maillard reaction [19].

3.3.3. Esters

Esters, which give a distinctive fruity odor in fruits, are synthesized after amino acids are converted into some branched aliphatic compounds during catabolic reactions [32]. However, it has been reported that it is not as effective as lactones in apricot flavour [26]. In the apricot studies, many ester and acetate forms have different names. Butyl butanoate, butyl hexanoate, hexyl butanoate, ethyl hexanoate, ethyl butanoate, ethyl 2-methyl butanoate, 2-phenethyl acetate, butyl acetate, and hexyl acetate have been reported to contribute to apricot flavor [26,30]. A total of 13 esters were determined in apricot samples, and the most 2-methylpentyl pentanoate and 1,1-dimethylpropyl hexanoate were found in fresh samples. While some esters decreased after drying, new compounds were also formed, unlike the fresh samples. Komes et al. [33] reported that some esters fell with the drying of apricot puree. Methyl acetate, determined in all samples except KA-CA, took values close to previous studies in fresh samples [20,34]. While the increase in HH-C and KA-RB samples after drying was significant, the other samples were found to be close to each other. Although ethyl acetate formed by Fischer esterification of ethanol and acetic acid was found in small amounts in fresh samples, it increased with drying. RiuAumatell et al. [34] found the amount of ethyl acetate (29.0 mg/L) in apricot juices to be higher than methyl acetate (4.36 mg/L), while Gokbulut and Karabulut [20] could not detect this component in Hacihaliloglu and Kabaasi cultivars. Göğüş et al. [24] determined ethyl acetate only in apricots dried in a desiccator, but it was found in all samples in this study. The HH variety found the highest number of HH-CA samples, followed by HH-RH and HH-S samples. Other VI samples had values close to the HH-C sample. On the other hand, while the amount of ethyl acetate in the KA cultivar increased the most in KA-S and KA-RH samples, KA-C and KA-CA samples remained at lower levels. Guillot et al. [30] reported that a correlation was established between fruity aroma characterization and ethyl and hexyl acetate in R. Roussillon apricots.

3.3.4. Furan compounds

As a result of the Maillard reaction during drying, undesirable compounds such as furan, furfuran, and imidazole are formed [33]. Furan compounds were detected in vacuum-infused apricots in HH-CA, HH-RH, HH-RO, and HH-RB samples and in KA-RH and KA-RB samples. While these components were most abundant in the HH-CA sample (19.76 μg/kg), only 2-pentyl furan was detected in the KA-RB sample. In the study by Göğüş et al. [24], in which apricots were dried in the sun, in a hot air stream and a microwave oven, 5-HMF (38–43%), 2,3-dihydro-3,5-dihydroxy-6-methyl 4H-pyran-4-one (12–17%) and furfural (3–4%) have been reported to be present in very high amounts. In addition, after VI was made on strawberries, the amount of furaneol increased in the samples immersed in 65° Brix solution, while a decrease was observed in 45° Brix. Researchers have reported that this is due to the solution viscosity difference. However, it has been reported that the formation of furan compounds is inhibited in apricot purees with trehalose and sucrose added [33]. In this study, no furan compounds were found after sugar infusion. While it was determined that 2-furancarboxaldehyde was formed in the process of processing into apricot juice [34], in another study, the sum of 5 different furan compounds in Hacihaliloglu and Kabaasi dried apricots was found to be 118.4 μg/kg and 176.1 μg/kg, respectively [28]. Furan compounds were not detected in the control samples in this study. It is thought that these components are limited by drying the apricots to medium moisture levels. It has been reported that non-enzymatic browning is maximized at low pH (4.5) values with the addition of citric acid [35]. Although three different components, mainly 2-pentyl furan, were formed in the HH-CA sample after citric acid infusion, no component was found in the KA-CA sample. Although there were two different furan compounds in rosehip pulp and five different furan compounds in roselle extract, these components were not found in VI apricots.

3.3.5. Alcohols

Alcohol production in fruits occurs by decarboxylation or reduction of amino acids after a series of reactions. On the other hand, aldehydes can be reduced to alcohols in the cell by aldehyde reductases or alcohol dehydrogenases. However, in the drying process, alcohols are generally formed by the metabolic activity of microorganisms or by reducing carbonyl compounds. Alcohols that do not have a high concentration of unsaturated structure (1-octen-3-ol, etc.) in fruit contribute very little to the flavor profile [19]. A total of 12 alcohols were determined in the apricot samples, and the increase in ethanol after drying is remarkable. Ethanol is an anaerobic metabolite produced by the alcohol dehydrogenase enzyme in fruit and yeast fermentation and is the precursor of many aroma compounds with acetaldehyde. It has been reported that ethanol increases with acetaldehyde in the ripening period of oranges and pears before harvest [36]. However, during ripening, the plants show resistance to the accumulation of high concentrations of ethanol. However, ethanol production increases due to the storage of fruits in low-oxygen environments after harvest. The ethanol content of fresh samples was found to be compatible with the values of Hacihaliloglu and Kabaasi cultivars in the study of Gokbulut and Karabulut [20]. Although there was an increase in the HH-C sample and a decrease in the KA-C sample after drying, both cases were not statistically significant. While HH-CA and HH-S samples were higher than the control sample, the changes in other samples were insignificant. Although the control sample was low in the KA variety, the ethanol content of the KA-S sample was the highest among all components, with 869.46 μg/kg.

Osmotic applications cause CO_2 accumulation by reducing oxygen consumption in the cell; after this situation, which causes the development of fermentative metabolites, volatile components such as ethanol and acetaldehyde increase, depending on the process conditions. After VI process, the amount of ethanol and acetaldehyde in strawberries was higher than in fresh samples [37]. While a similar situation was observed during the storage of vacuum-infused pears, less ethanol and acetaldehyde increased in the solutions using anti-browning agents compared to the control sample and isotonic solution [38]. According to reports, the inability of oxygen to diffuse into the intercellular gaps filled with the infusion solution is the root cause of both disorders. 2 Methyl pentanol is a component characterized by the smell of fresh grass [28] and was not detected in fresh samples, but was determined in HH-C, HH-RB, and HH-S samples. In the KA variety, 2-methyl pentanol, which was not found only in the KA-RB sample, had values close to each other in the other samples. 2-Propyl-1-heptanol was detected in all samples. Although the (*E*)-2-penten-1-ol component was determined in all

samples of the HH cultivar and KA-RH, KA-RB, and KA-S samples in the KA cultivar, there was no statistical difference between them. 1-Hexanol is a necessary alcohol found in apricots and is characterized by the smell of freshly cut grass. The 1-hexanol content of fresh samples was found to be lower than in the previous study [20], while values close to other apricot varieties in the literature were found [33,39]. While it was observed that this component in the HH variety apricots was lost with drying, only the HH-RB sample was found to be statistically different from the control sample. The loss rate in the KA-F variety was higher than in the HH variety, and the difference between samples was insignificant. (*Z*)-3 hexen-1-ol, which were close to each other in fresh samples, could only be detected in the rhubarb infusion after drying. (*Z*)-3-hexen-1-ol, known as green leaf alcohol, was also detected in previous apricot studies with the SPME technique, and it was found in close values with the results in this study [29,31,33].

3.3.6. Terpenes and terpineols

Terpenes and terpineols, consisting of isopropene units, are produced by carbohydrate and lipid metabolism in fruits and are the compounds responsible for fruity and floral odors in apricots [19,40]. A total of 14 terpene components were determined in apricot samples, and the highest amount of limonene and linool was found. Limonene and β-cyclocitral impart citrus flavor to apricots [30]. Limonene had values close to each other in fresh samples, and similar results were observed in previous studies with the SPME technique [20,29,30,39]. Gomez and Ledbetter [41] reported that the amount of limonene in apricots decreased during ripening. After VI, the amount of limonene in the HH-CA sample increased, while the other samples had similar results with HH-C. Although the control sample was lower than the VI apricots in the KA variety, the increase in only KA-RH and KA-S samples was significant. However, it has been reported that drying techniques do not make a big difference in limonene content [24]. β-cyclocitral, formed from thermal or enzymatic degradation of β-carotene in fruits, was determined in the HH-F sample but not in the HH-RH, HH-RO, and HH-S samples after processing. While β-cyclocitral could not be determined in the KA-F sample, KA-C in the KA-CA sample was found to be higher than KA-RH and KA-RO samples. Inserra et al. [28] reported no difference between fresh and sun-dried samples of both cultivars.

1,8-cineol is a component determined only in a limited number of apricot studies [34,42,43]. Although it was detected in fresh and VI samples in this study, its amounts remained at low levels. While 1,8-cineole was not found after citric acid and sugar infusion, there were differences between cultivars in other treatments. β-pinene, β-phellandrene, and *p*-cymene in fresh samples as in previous studies [20,29,30,34,44] were determined in low amounts, and there was no statistical difference in the samples determined after the process. The β-myricene KA type determined in HH-F, HH-CA, and HH-RH samples was detected in KA-RH, KA-RO, and KA-S samples, while all samples were found to be close to each other. Similar amounts (1–6 μg/kg) of β-myricene were determined in Malatya apricots by Gokbulut and Karabulut [20]. Teaspiran A and teaspiran B were previously described by Riu-Aumatell et al. [34] and Inserra et al. [28]. While the increase in HH-CA and HH-RO samples was significant for Teaspiran A, the amount in the KA-CA sample differed from other samples in the KA variety. Teaspiran B had higher values in HH-CA and HH-RB samples compared to the control sample. More γ-terpinene was determined in KA variety samples than in the HH variety. Linalool, which adds a floral character to the apricot scent, is defined as a special flavoring agent for apricot together with lactones [26]. While linalool in fresh samples was found in low amounts as in previous studies [30,34], higher values were determined in some studies [28,41,42,45].

3.3.7. Norisoprenoids

Carotenoids are unstable compounds due to the conjugated double bonds they contain, and they undergo chemical and enzymatic reactions to form new compounds with strong aroma properties. While norisoprenoids, which are formed by the direct degradation of carotenoids such as β-carotene, can be stored as glycoconjugate in plants, they can be converted to aglycon form after enzyme or acid hydrolysis. Three norisoprenoids were detected in apricot samples: dihydro-β-ionone, β-ionone, and dihydro-β-ionol. Although dihydro-β-ionone was detected in other HH apricots except for HH-CA, their differences were insignificant. This component was detected only in the KA variety in KA-CA and KA-RB samples. This component was determined by Gokbulut and Karabulut [20] as 16.8 μg/kg and 19.0 μg/kg in fresh apricots of Hacihaliloglu and Kabaasi cultivars, respectively. β-ionone, which has a low odor perception threshold of 0.09 μg/L, gives apricots a floral (violet) character [29,30]. After drying, control samples of both cultivars were found close to fresh apricots. In a study, it was reported that drying techniques did not affect the amount of β-ionone in Şekerpare apricots [24]. In this study, β-ionone loss in the HH-S sample was higher in the HH-RO sample than in the others. This component, determined in all KA samples, was higher in the KA-CA sample than in the KA-C. Differences in other samples were not statistically significant. It has been reported that β-ionone is one of the major components converted to free form in apricots due to enzymatic and chemical hydrolysis [44]. In a previous study, β-ionone glycosides were higher in apricots than in their free form [28]. Therefore, this increase is thought to be due to the transition of the glycoside structure to the free form after the process. On the other hand, it is known that norisoprenoids are formed as a result of β-carotene degradation. However, when the relationship between the β-carotene content of VI apricots and the amount of β-ionone was examined, a very weak correlation ($r = -0.246$) was found.

While dihydro-β-ionol could not be detected in fresh samples, it was detected in other samples except citric acid. Similarly, Inserra et al. [28] found this component only in sun-dried and sulphurous apricots. Accordingly, in this study, it is thought that dihydro-β-ionol is formed with drying. While the citric acid infusion was ineffective in the HH variety, it increased the total norisoprenoid amount in the KA variety. While all the components in this group were determined in the HH-RH sample after rosehip infusion, it was not different from the control samples in terms of the total amount. The amount of β-ionone increased in the HH-RO sample and differed from the KA-RO sample in terms of the detected components and the total amount. While the rhubarb infusion was the only treatment containing all norisoprenoids in both cultivars, the difference between the control samples in total amounts was not significant. After the sugar infusion, dihydro-β-ionone was detected in the HH-S sample, while β-ionone was detected in the KA-S sample. No norisoprenoid was found in infusion solutions. Therefore, increases in these components are thought to be due to β-carotene degradation

or chemical hydrolysis [44].

3.3.8. Volatile acids

Aliphatic or aromatic acids are formed in fruits by fatty acid metabolism and deamination of amino acids [19]. Essential acids in apricots, including acetic, butanoic, 2-methylbutanoic, and hexanoic acids, have been reported [26]. In this study, only hexanoic acid was detected in fresh samples of both cultivars, while other components were determined only in medium-moisture apricots. Acetic acid can be formed during acetaldehyde oxidation or heterofermentative lactic acid fermentation, as well as by the direct conversion of sugars by acetic acid bacteria. A study reported that acetic acid was the component with the highest concentration among the 31 most important aroma substances in apricots [26]. However, in this study, the increase in acetic acid, which could not be detected in fresh samples after drying, draws attention. Similarly, acetic acid, which could not be detected in fresh Hacihaliloglu and Kabaasi apricots by Inserra et al. [28], could be determined (91.6–155.4 μg/kg) in dried apricots.

It has been determined that many of the aldehydes, ketones, terpenes, and acids change with the process. Researchers reported that β-ionone, linalool, γ-decalactone, hexanal, (*E*)-2-hexanal, and geraniol are key apricot components [26]. While the effect of the cultivar on linalool, (*E*)-2-hexanal, and geraniol was not significant, it was observed that the other components were affected by both cultivar and treatment. However, a relationship could not be established between the total amount of volatile compounds and the sensory evaluation results ($r = -0.180$, $r = -512$). Due to the low amount of volatile components found and the high sugar content of apricots, it is thought that it does not affect the sensory properties much.

4. Conclusion

The variations in the volatile compounds indicate that the VI process, carried out using different solutions, has a beneficial impact on the aroma profile of inter-mediate moisture apricots. There are noticeable variations in both the composition and amount of components. This demonstrates the efficacy of the work performed. While the sucrose solution created an osmotic dehydration effect on apricots, the other solutions showed hypotonic solutions. In order to determine the efficiency of vacuum impregnation, weight changes in samples compared with regular immersion were examined, and the vacuum effect was seen in all samples except sugar infusion. In addition, in the samples where water gain and loss and solid gain/loss were evaluated, the highest solid loss was seen in the HH-RH and KA-RO samples, while the most water gain was achieved with the rhubarb and roselle infusions. While the apricots lost water with the sugar infusion, the HH-S sample's solids gain was higher than the KA-S. In terms of volatiles, the levels of aldehydes, ketones and terpenes of apricots were increased by vacuum impregnation.

Statement of originality

The submitted manuscript is ORIGINAL and the author's exclusive property (s). It has not been published, nor have substantial portions of the work been published, nor is it under consideration for publication in another journal.

Data availability statement

This study is derived from Nurullah Demir's PhD thesis []. The document is registered in the National Thesis Scanning System of the "Turkish Higher Education Institution" and is exclusively processed within its individual database.

CRediT authorship contribution statement

Nurullah Demir: Writing – original draft, Methodology, Funding acquisition, Formal analysis. **Mehmet Alpaslan:** Writing – review & editing, Validation, Supervision.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interestsNurullah Demir reports financial support was provided by Scientific and Technological Research Council of Turkey.

Acknowledgements

We thank to Turkey's Scientific and Technological Research Council (TUBITAK- 114 O 814) for their financial support in this study.

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