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## THE AROMA OF STRAWBERRIES GROWN IN THE RIGHT-BANK FOREST-STEPPE ZONE OF UKRAINE

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**Abstract.** The content and composition of volatile aroma compounds in strawberries of the Ducat, Honey and Polka varieties were studied using GCMS analysis. To identify volatile compounds, an Agilent Technologies 6890 chromatograph with a 5973 mass spectrometric detector and a DB-5 chromatographic capillary column (inside diameter 0.25 mm and length 30 m) was used. Esters (12.8–41.8%), aldehydes (5.9–15.9%), ketones (8.7–35.6%), furanones (22.7–24.4%), organic acids (2.47–21.85%), aroma compounds, lactones, terpenic compounds and alkanes were identified in the aroma. It was found that the aroma of strawberries of the Polka variety is presented by ethyl butanoate (30.7%), 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) (19.9%), trans-2-hexenal (15.6%), acetoin (8.7%) and 2,5-dimethyl-4-hydroxy-3(2H)-furanone (3.7%). Ducat berries contain – acetoin (35.7%), 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) (19.8%), trans-2-hexenal (11.3%), ethyl butanoate (10.1%) and 2,5-dimethyl-4-hydroxy-3(2H)-furanone (4.4%). The main aroma compounds of Honey berries are 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) (19.1%), ethyl butanoate (14.1%), hexanoic (caproic) acid (9.5%), acetoin (8.2%), trans-2-hexenal (5.3%), hexadecanoic acid (5.1%), 2,5-dimethyl-4-hydroxy-3(2H)-furanone (3.4%). In terms of aroma activity in berries, 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) and 2,5-dimethyl-4-hydroxy-3(2H)-furanone (furanol) prevail, with slightly lower activity of ethyl 2-methylbutanoate, ethyl butanoate and trans-2-hexenal. It has been proven that the aroma of strawberries grown in the Right-Bank Forest-Steppe of Ukraine is most characterised by sweet, caramel tones, while fruit and green tones are less pronounced.

**Keywords:** strawberries, volatiles, activity of volatile components

### Introduction. Formulation of the problem

Strawberries are a popular and valuable berry crop due to their adaptability, early maturity, high yield, versatility of use, antioxidant and dietary properties. According to FAOSTAT, global production of strawberries is growing annually, reaching more than 9.175 million tons in 2021. In 2023, China (3.336 million tons), the United States (1.055 million tons), Egypt (0.297 million tons) and Turkey (0.546 million tons) were the leaders in global production of wild strawberries. In 2023 Ukraine produced 55170 tons of strawberries [1].

Ukraine has significant agroclimatic and resource potential for strawberry cultivation with opportunities to sell the crop on the Ukrainian and EU markets. The assortment of strawberries grown in Ukraine is very diverse and is represented by varieties of domestic and foreign selection for various uses. The climate of the

Right-Bank Forest-Steppe zone of Ukraine is temperate continental with mild winters, which contributes to the concentration of commercial strawberry production in this zone and the accumulation of a significant amount of sugars, biologically active substances, phenolic compounds in the berries, the formation of a harmonious taste and aroma, which is highly appreciated by consumers.

The taste of strawberries is determined by the content of sugars, organic acids and volatile aromatic compounds. The formation of the qualitative and quantitative composition of the latter occurs during ripening under the influence of enzymes and depends on the species, pomological variety, soil and climatic conditions, agricultural technology, degree of maturity and post-harvest processing [2]. However, there is insufficient information about the content and composition of volatile aromatic compounds in

strawberries grown in certain soil and climatic zones of Ukraine.

### Analysis of recent research and publications

The organoleptic properties of strawberries combine appearance, texture, taste and aroma. Sweet taste and rich aroma are the main factors that influence consumer choice. Strawberries have one of the most complex flavors. Numerous studies show more than 350 volatile compounds as components of the berry flavor, among which scientists identify alcohols, aldehydes, esters, ketones, lactones and terpenes [4-7]. The main aromatic compounds are identified as esters, lactones, furanones, sulfur compounds, and terpenoids [8-10].

Thus, Wu L. et al. [11] found 147 volatile compounds in strawberries, among which esters dominated with a relative content of 49.95%. Instead, Abouelenein D. et al. [10] identified 181 compounds belonging to different classes in 20 strawberry varieties (Albion, Calinda, Camarosa, Candonga, Candonga Sebrosa, Crystal, E-22, Elide, Festival, FL 127, Florida Fortuna, Fortuna, Frontera, Monterey, Plared, Portola, Rubygem, Sabrina, Sahara, and Victory): esters (78 compounds), terpenes (21), acids (20), alcohols (19), hydrocarbons (13), aldehydes (9 compounds), ketones (5), furanones (5), lactones (7), aromatic compounds (4), of which 31 compounds were found simultaneously in 10 varieties.

According to Wang, J. et al. [12], the aroma of strawberries is formed under the influence of 46 compounds, including  $\gamma$ -decalactone, methyl butanoate, ethyl butanoate, methyl hexanoate, 2,5-dimethyl-4-methoxy-3(2H)-furanone, linalool and (E)-2-hexenal.

Parra-Palma et al. [13] identified 48 volatile compounds, including esters, acids, terpenes and lactones, in strawberries of Camarosa, Cristal, Monterey, and Portola varieties, while Nogai et al. [14] found 56 volatile compounds in three strawberry varieties: esters, aldehydes, furan derivatives, alcohols, terpenes, acids, and ketones.

Esters are considered the main components of the flavor, represented by more than 130 ester compounds with a share of 25 to 90% of their total. The most important among them are methyl butanoate, ethyl butanoate, ethyl hexanoate, and 2-methylbutanoate [15]. Esters give strawberries a fruity and floral flavor [10].

The most important volatile compounds in strawberries include 2,5-dimethyl-4-hydroxy-3(2H)-furanone (furanol) and its methoxy derivative (methoxyfuranol, mesifuran). The content of these flavor components increases sharply during ripening, reaching a maximum at the stage of overripening [16]. Furanones impart herbal, sweet or caramel notes to the strawberry flavor [17-19]. Furanones account for up to 50% of the total volatile compounds [20].

While esters are important aromatic compounds in ripe strawberries, aldehydes and alcohols are characteristic of unripe berries and give green, grassy notes to the flavor of the berries [21]. Compounds such as 1-penten-3-ol, pentanal, heptanal, hex-(2Z)-enal, hex-(2E)-enal, and pent-(2E)-enal can serve as indicators of unripe fruit [22].

According to D Ulrich, K Olbricht [23],  $\gamma$ -decalactone and  $\gamma$ -dodecalactone make a significant contribution to the strawberry flavor, which impart fresh peach notes. A.T. Oz et al. [24] indicate the presence of terpenoids in strawberry volatiles, including nerolidol (E-), nerolidol, L-terpinolene, linalol, L-terpineol, geraniol and trans-farnesene, which impart spicy notes.

Thus, the study of strawberry flavor is crucial to understanding consumer choice. However, despite the numerous results of determining the content and composition of volatile compounds in strawberries, there are not enough studies on the analysis of the aroma of berries grown in Ukraine.

Since the content and composition of strawberry volatile compounds is formed under the influence of the region of cultivation and depends on the variety, **the aim** of our research was to determine the characteristics of the aroma of different strawberry varieties grown in the Right-Bank Forest-Steppe of Ukraine.

#### Research objectives:

- determination of the quantitative and qualitative composition of volatile compounds of strawberry varieties Dukat, Honey and Polka;
- determination of the activity of volatile compounds of strawberries and determination of the characteristics of the aroma of strawberries of the studied varieties on their basis.

### Research materials and methods

#### Materials

The research was carried out on the strawberries of such cultivars as Ducat, Honey, Polka in the laboratory conditions of the department of food technology of Uman national university of horticulture.

#### Main Instruments and Equipment

Agilent Technologies 6890 chromatograph with mass-spectrometric detector 5973 and chromatographic capillary column DB-5 – internal diameter 0.25 mm and length 30 m – was used to identify volatiles of strawberries.

#### GCMS analysis on volatile components

The content and composition of volatile compounds were determined using an Agilent Technologies 6890 chromatograph with a 5973 mass spectrometric detector and a DB-5 chromatographic capillary column, dia. 0.25 mm and 30 m long.

The strawberry samples were crushed, homogenized, and 0.75 g of puree was placed in a 2-ml vial with the addition of an internal standard

(tridecane) at the rate of 50 mkg per sample. The volatile substances were extracted in the presence of 0.5 ml of chloride methylene overnight by gently shaking several times. The extract was taken with a microsyringe, placed in a 2 ml vial and evaporated in a stream of very pure nitrogen to a volume of 50 mkl. The resulting extract was chromatographed.

The sample was injected into the chromatographic column in splitless mode, without flow separation, which increases the sensitivity of the chromatographic method, at an injection rate of 1.2 ml/min for 0.2 minutes.

The volatile components were identified using the NIST05 and WILEY 2007 mass spectra library with a total number of spectra of more than 470000 using the AMDIS and NIST identification software.

Volatile compounds were quantified using the internal standard method according to the formula:

$$C = K_1 + K_2$$

C – volatile component content, mg/kg,

$$K_1 = \frac{P_1}{P_2}$$

P<sub>1</sub> – peak area of the substance studied, P<sub>2</sub> – peak area of the standard;

$$K_2 = \frac{50}{M}$$

50 – mass of the internal standard (mkg), introduced into a sample, M – a sample (g) [20].

The contribution of each volatile compound to the aroma of strawberries is determined by odor activity values (OAV) by the ratio of the concentration of the substance to its threshold concentration (OAV = concentration (ppbv)/threshold value (ppbv) [25,26].

Statistic analysis was made using StatSoft STATISTICA 10.0.1011.6 EnterpriseSingleUser (2011).

## Results of the research and their discussion

### Content of volatile components in strawberries

The studies have established (Table 1) that 49 components were identified in the composition of volatile compounds of strawberries of the studied varieties: 23 in Polka strawberries, 30 in Dukat, and 38 components in Honey.

Among the volatile compounds, esters, aldehydes, acids, lactones, ketones, furan derivatives, terpenes and alkanes were found.

The proportion of esters was 12.8–41.8%, aldehydes – 5.9–15.9%, ketones – 8.7–35.6%, furan derivatives – 22.7–24.4%, acids – 2.47–21.85% (Figure 1). The proportion of terpenes was 0.47–1.68%, and alkanes – 0.8–1.06%.

Esters give the strawberry flavor floral and fruity notes, and their content in berries depends on the degree of maturity of the berries. Among the esters detected in

all strawberry varieties were ethyl butanoate, butyl acetate, ethyl capronate, ethyl 3-hydroxycapronate. The most common was ethyl butanoate, less common were butyl acetate and ethyl capronate.

In the class of aldehydes that give fresh grassy notes to berries in all studied varieties, trans-2-hexenal was identified in almost equal amounts in Polka and Dukat varieties, with significantly lower values in Honey variety. Pentanal was detected in Polka and Dukat berries, while benzaldehyde was identified in Honey berries.

Acid-rich strawberries of the Honey variety were rich in acids, where 10 compounds were identified with a share of 21.85 % of the total content. On the other hand, 3 compounds were found in Polka berries and 6 in Dukat berries, with a share not exceeding 3.55 % of the total volatile compounds. Among the acids present in all the studied strawberry varieties, cinnamic acid, tetradecanoic acid and hexadecanoic acid were found. In the class of lactones, carvone was detected in all studied varieties, while  $\gamma$ -decalactone and  $\gamma$ -dodecalactone were identified in Ducat berries, and  $\delta$ -hexalactone and  $\delta$ -decalactone were identified in Honey. Acetoin was a typical representative of the ketone class for all varieties, except for it, hexahydrofarnesil acetone was found in Dukat, and menthyl isopropenyl ketone and methyl propyl ketone were found in Honey.

Furan derivatives are responsible for the sweet caramel tones in strawberries. Among the furan derivatives, 2,4-dioxy-2,5-dimethyl-3(2H)-furan-3-one, 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) and 2,5-dimethyl-4-hydroxy-3(2H)-furanone (furanol) have been identified.

Together with esters and furan derivatives, terpenes are the most representative chemical class of the aroma profile of strawberries, imparting spicy aromatic notes [27-29]. Nerolidol and linalool were found to be the main volatile terpenoids of ripe strawberries, with nerolidol being characteristic of all varieties.

Tetradecane was identified in the alkane class.

Among the identified volatile compounds, the typical compounds for the aroma of the berries of the studied strawberry varieties were ethylbutanoate with a proportion of 10.1–30.65%, trans-2-hexenal – 5.31–15.55%, acetoin – 8.20–35.67, 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) – 19.08-19.92% and 2,5-dimethyl-4-hydroxy-3(2H)-furanone – 3.43–4.40%.

A high content of hexanoic (caproic) acid was found in the berries of Honey strawberries – 9.54% of the total content of volatile compounds in the berries, hexadecanoic acid – 5.08% and  $\gamma$ -decalactone – 13.1%. The flavor of Polka strawberries is determined with help of ethylbutanoate (30.7%), 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) (19.9%), trans-2-hexenal (15.6%), acetoin( 8.7%) and 2,5-dimethyl-4- hydroxy - 3(2H)-furanone (3,7%).

Table 1 – Content and composition of volatile components of strawberries, n=9, p≤0,05

Volatiles	Variety		
	Polka0	Ducat	Honey
	mg/kg	mg/kg	mg/kg
<b>Esters</b>			
Methyl butanoate	1.20	–	–
Ethyl isobutanoate	0.47	0.16	–
Methyl 2-methylbutanoate	0.29	–	–
Ethyl butanoate	16.95	8.12	8.15
Butyl acetate	0.35	0.31	1.08
Ethyl crotonate	0.38	0.21	–
Ethyl 2-methylbutanoate	1.03	0.43	–
Hexyl formate	1.19	–	–
Hexyl acetate	–	–	0.12
Methyl 2- hydroxypropinoate	–	–	0.92
Methyl 3- hydroxybutanoate	–	–	0.27
Isoamyl acetate	–	–	0.09
Ethyl 3- hydroxybutanoate	–	0.37	0.08
Ethyl capronate	0.32	0.25	0.59
Ethyl 3- hydroxycapronate	0.18	0.09	0.10
Ethyl nicotinate	0.44	0.41	–
Benzyl acetate	–	–	0.18
Ethyl cinnamate	–	0.12	0.15
<b>Total esters % in total volatiles</b>	<b>41.77</b>	<b>12.80</b>	<b>20.35</b>
<b>Aldehydes</b>			
Benzaldehyde	–	–	0.36
Trans-2-hexenal	8.60	9.05	3.06
Pentanal	0.19	0.09	–
<b>Total aldehydes % in total volatiles</b>	<b>15.85</b>	<b>11.37</b>	<b>5.93</b>
<b>Aromatic compounds</b>			
Benzyl alcohol	–	0.21	–
<b>Total aromatic compounds % in total volatiles</b>	<b>–</b>	<b>0.26</b>	<b>–</b>
<b>Acids</b>			
2-Methylbutanoic acid	–	0.71	–
3-methylbutanoic acid	–	–	0.59
Isovaleric acid	–	–	2.12
Cinnamic acid	0.46	0.49	0.18
Octanoic acid	–	0.43	0.27
Nonanoic acid	–	0.32	0.21
Hexanoic acid	–	–	5.50
Dodecanoic acid	–	–	0.09
Tetradecanoic acid	0.14	0.19	0.46
Palmitoleic acid	–	–	0.25
Hexadecanoic acid	0.77	0.71	2.93
<b>Total acids % in total volatiles</b>	<b>2.47</b>	<b>3.55</b>	<b>21.85</b>
<b>Lactones</b>			
δ-Hexalactone	–	–	0.20
γ-Decalactone	–	0.18	6.92
δ-Decalactone	–	–	0.12
γ-Dodecalatone	–	0.10	0.24
Carvone	0.17	0.16	0.25
<b>Total lactones % in total volatiles</b>	<b>0.31</b>	<b>0.54</b>	<b>13.41</b>
<b>Ketones</b>			
Hexahydrofarnezil acetone	–	0.17	–
Menthyl isopropenil ketone	–	–	0.44
Methyl propyl ketone	–	–	0.42
Acetoin	4.82	28.67	4.73
<b>Total ketones % in total volatiles</b>	<b>8.71</b>	<b>35.88</b>	<b>9.65</b>
<b>Furan derivatives</b>			
2,4-dioxy-2,5-dimethyl-3(2H)-furan-3-	0.09	0.18	0.11

Volatiles	Variety		
	Polka0 mg/kg	Ducat mg/kg	Honey mg/kg
one			
2.5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane)	7.70	15.88	11.00
2.5-dimethyl-4-hydroxy-3(2H)-furanone	2.07	3.54	1.98
<b>Total furan derivatives % in total volatiles</b>	<b>23.82</b>	<b>24.38</b>	<b>22.70</b>
<b>Terpenes</b>			
Nerolidol	0.26	0.27	0.08
Linalool	–	0.27	0.60
$\alpha$ -Terpineol	–	–	0.29
<b>Total terpenes % in total volatiles</b>	<b>0.47</b>	<b>0.68</b>	<b>1.68</b>
<b>Alcanes</b>			
Tetradecane	0.44	0.59	0.61
<b>Total Alcanes % in total volatiles</b>	<b>0.80</b>	<b>0.73</b>	<b>1.06</b>
<b>LSD<sub>05</sub></b>		<b>0.06</b>	

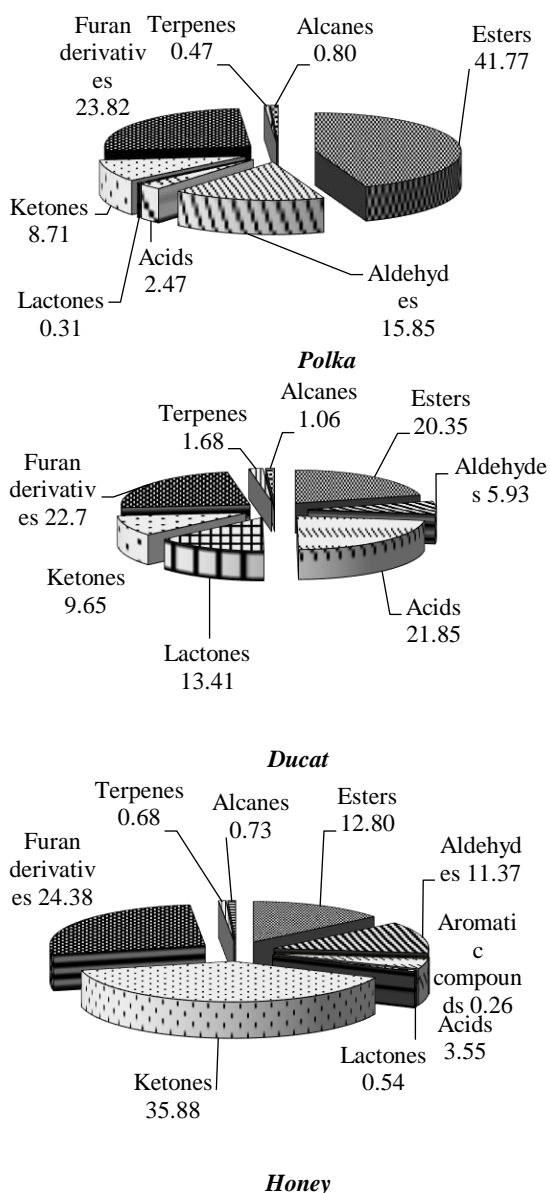


Fig. 1. Share of volatiles in strawberries, %

It is to be stated that the largest share of ethers – 41.77% is recorded in Polka strawberries, which exceeds a similar indicator for Honey strawberries by two times and for Ducat cultivar – by 3.2 times, also the share of aldehydes is 15.85% which exceeds a corresponding indicator for Honey strawberries by three times, and as to the indicator of Ducat cultivar it is higher by 4.47%.

The main flavor compounds of Ducat strawberries are acetoin (35.7%), 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) (19.8%), trans-2-hexenal (11.3%), ethylbutanoate (10.1%) and 2,5-dimethyl-4-hydroxy-3(2H)-furanone (4.4%). A peculiar feature of the volatiles of the strawberries of Ducat cultivar is the largest share of ketones which add some buttery, creamy tones to a strawberry aroma; it exceeds a similar indicator for Honey cultivar by 3.7 times and for Polka cultivar – by 4.1 times.

Those for the strawberry of Honey variety are 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) (19.1%), ethylbutanoate (14.1%), Hexanoic (caproic) acid (9.5%), acetoin (8.2%), trans-2-hexenal (5.3%), Hexadecanoic acid (5.1%), 2,5-dimethyl-4-hydroxy-3(2H)-furanone (3.4%). The aroma peculiarity of this cultivar is a considerable share of  $\gamma$ -decalactone in the amount of 6.92 mg/kg, which is 12.4% from the total number of volatiles; this adds fruit, sweet or peach tones to the aroma [19,30]. The share of acids, which add sour-sweet tones, from the sum of volatiles in Honey strawberries is higher by 6.1 times as compared with a similar indicator of Ducat cultivar and by 8.8 times – that of Polka strawberries.

#### Activity of volatile components of flavor/aroma

Despite the large number of volatile compounds in strawberries, only a small amount of them form a characteristic flavor. The contribution of each volatile compound to the aroma of strawberries is determined by odor activity values. The resulting calculated OAV value of > 1 indicates the contribution of the component to the flavor. The higher the calculated OAV values, the more

significant the contribution of the component to the fragrance (Table 2).

The calculation of flavor activity for the identified volatile components of the studied strawberry varieties indicates the dominance of furan derivatives: 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) and 2,5-dimethyl-4-hydroxy-3(2H)-furanone (furaneol).

Ethyl 2-methylbutanoate, ethyl butanoate and trans-2-hexenal also had high activity. In Polka berries, methyl 2-methyl butanoate and methyl isobutanoate showed the highest activity, while in Honey – hexyl acetate, which is consistent with the data of Forney C.F., Jordan M.A. [31].

Among the volatile compounds in Polka berries, ethyl 2-methylbutanoate, ethyl butanoate, trans-2-hexenal, 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) had high activity, indicating a more intense flavor of berries of this variety compared to others.

Pérez, A.G. et al [8, 33]; Rajesh R. Jetti [34]; Kim Y. H. et al. [25] distinguish characteristic fruity and floral

notes, green and sweet or caramel, in the complex aroma of strawberries. Ethyl acetate, butyl acetate, methyl butanoate, ethyl butanoate, ethylisovalerate, methyl hexanoate and ethyl hexanoate give the fruit and floral tones to the aroma. Fresh herbaceous notes are hexanal, trans-2-hexenal, 2-hexenal, hexanol, cis-3-hexen-1-ol, hexyl acetate, sweet, caramel – furaneols. The results obtained indicate that the aroma of strawberries of the studied varieties grown in the Right-Bank Forest-Steppe of Ukraine is most characterized by sweet, caramel tones due to the high activity of furaneols, with less characteristic fruit and green notes.

The aroma of Polka berries is characterized by caramel tones with fruity, floral notes and weakly expressed herbal ones. The characteristic tones of Ducat berries are sweet and caramel with a hint of fruit. The aroma of Honey berries is represented by sweet caramel tones, with almost no fruit and green notes.

**Table 2 –Activity of volatile components of flavor/aroma (OAV)**

Volatiles	Threshold, mg/kg	Activity of volatile components (OAV)		
		Polka	Ducat	Honey
Methyl butanoate	0.06	45.2	–	–
Methyl isobutanoate	0.007	121.4	28.6	–
Methyl 2-methyl butanoate	0.002	260	–	–
Ethyl butanoate	0.018	1702	561	785
Butyl acetate	0.066	9.5	5.9	28.3
Ethyl 2-methylbutanoate	0.0001	18600	5400	–
Hexyl acetate	0.002	–	–	105
Isoamyl acetate	0.02	–	–	8
Benzyl acetate	0.75	–	–	0.41
Benzaldehyde	0.35	–	–	1.8
Trans-2-hexenal	0.017	914	662.3	312.3
Pentanal	0.012	25	9.2	–
Benzyl alcohol	10	–	0.03	–
2-Methylbutanoic acid	0.25	–	3.5	–
Isovaleric acid	0.120	–	–	30.7
Octanoic acid	0.910	–	0.59	0.51
Hexanoic (caproic) acid	1.0	–	–	9.5
Dodecanoic acid	10	–	–	0.02
$\gamma$ -Decalactone	0.01	–	22	1200
$\delta$ -Decalactone	0.1	–	–	2.1
$\gamma$ -dodecalatone	0.007	–	17.1	60
Carvone	0.05	6.2	4	8.6
Hexahydrofarnesil acetone	0.54	–	0.4	–
Methyl propyl ketone	44.1	–	–	0.01
Acetoin	0.8	10.9	44.6	10.25
2,4-dioxy-2,5-dimethyl-3(2H)-furan-3-one	0.00004 <sup>2</sup>	4000	5500	4750
2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane)	0.00003 <sup>2</sup>	664000	658666	636000
2,5-dimethyl-4-hydroxy-3(2H)-furanone (furaneol)	0.00004 <sup>2</sup>	93500	110000	85750
Linalool	0.006	–	56.6	17.3
$\alpha$ -Terpineol	0.330	–	–	1.5

<sup>1</sup>NA – not available. Threshold levels of compounds (in water) were obtained from the flavor base of Leffingwell & Associates [32].

<sup>2</sup>Siegmund B., Bagdonaite K., Leitner E. [18].

## Conclusion

The aroma of fresh strawberries of the Polka, Dukat and Honey varieties grown in the Right-Bank Forest-Steppe of Ukraine is represented by a complex mixture of volatile compounds of 49 components, with high activity of 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) and 2,5-dimethyl-4-hydroxy-

3(2H)-furanone (furanol). Ethyl 2-methyl butanoate, ethylbutanoate, trans-2-hexenal, methyl 2-methylbutanoate, methylisobutanoate, hexyl acetate make a serious contribution to the flavor. Sweet, caramel scents are typical for all the studied strawberry cultivars. Polka strawberries have the most pronounced characteristic aroma.

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## АРОМАТ ЯГІД СУНИЦІ САДОВОЇ, ВИРОЩЕНИХ В УМОВАХ ПРАВОБЕРЕЖНОГО ЛІСОСТЕПУ УКРАЇНИ

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**Анотація.** Вміст і склад летких ароматичних сполук у ягодах суниці сортів Дукат, Хоней та Полка досліджували за допомогою GCMS-аналізу. Для ідентифікації летких сполук використовували хроматограф Agilent Technologies 6890 з мас-спектрометричним детектором 5973 та хроматографічну капілярну колонку DB-5 (внутрішній діаметр 0,25 мм, довжина 30 м). В ароматі ідентифіковано складні ефіри (12,8–41,8%), альдегіди (5,9–15,9%), кетони (8,7–35,6%), фуранони (22,7–24,4%), органічні кислоти (2,47–21,85%), ароматичні сполуки, лактони, терпенові сполуки та алкани. Встановлено, що аромат суниці сорту Полка представлений етилбутаноатом (30,7%), 2,5-диметил-4-метокси-3(2Н)-фураноном (мезифураном) (19,9%), транс-2-гексеналом (15,6%), ацетоїном (8,7%) та 2,5-диметил-4-гідрокси-3(2Н)-фураноном (3,7%). Ягоди сорту Дукат містять ацетоїн (35,7%), 2,5-диметил-4-метокси-3(2Н)-фуранон (мезифуран) (19,8%), транс-2-гексенал (11,3%), етилбутаноат (10,1%) та 2,5-диметил-4-гідрокси-3(2Н)-фуранон (4,4%). Основними ароматичними сполуками ягід сорту Хоней є 2,5-диметил-4-метокси-3(2Н)-фуранон (мезифуран) (19,1%), етилбутаноат (14,1%), капронова кислота (9,5%), ацетоїн (8,2%), транс-2-гексенал (5,3%), пальмітинова кислота (5,1%), 2,5-диметил-4-гідрокси-3(2Н)-фуранон (3,4%). За активністю аромату в ягодах переважають 2,5-диметил-4-метокси-3(2Н)-фуранон (мезифуран) і 2,5-диметил-4-гідрокси-3(2Н)-фуранон (фуранеол), дещо меншу активність мають етил-2-метилбутаноат, етилбутаноат і транс-2-гексенал. Доведено, що для аромату суниці, вирощеної в Правобережному Лісоствепу України, найбільш характерні солодкі, карамельні тони, тоді як фруктові та зелені тони виражені слабше.

**Ключові слова:** суниця, леткі сполуки, активність летких компонентів.