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The impact of ecological and conventional technologies on strawberry fruit quality (*Fragaria × ananassa* Duch.)

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Abstract
Strawberry (*Fragaria* × *ananassa* Duch.), it is one of the most prized fruits grown due to its sweet and aromatic taste, and health-related compounds, including anthocyanins, antioxidants, fiber, and ellagic acid. The main reasons for eating organic strawberries are related to health benefits (i.e. fewer pesticide residues and more balanced nutrition), taste and environmentally friendly agricultural practices such as those that promote soil health. Comparing the quality of horticultural products obtained by ecological technologies with conventional ones are very complicated due to the interactive effects of technologies, soil quality, genotypes and harvest time, all with direct effects on nutritional quality. The objective of the research was to comparatively analyse the quality of fruits in two strawberry varieties grown on the farm, under identical pedoclimatic conditions, through ecological and conventional technologies, through psycho-sensory analyses, using the nine-point hedonic assessment scale. The sensorial quality of strawberries is a key factor in consumer preference. Although numerous methods have been used to assess taste, smell and aroma, it seems that the most widely used scale for measuring the acceptability of fruit is the nine-point hedonic scale. The verbal anchors of the scale were selected so that the psychological distance between successive points of the scale was approximately equal. This equal interval property helps justify the practice of analysing responses by assigning successive integer values (0, 1, 2, ... up to 8) at scale points and test differences in mean acceptability using parametric statistics. Using hedonic/taste assessments, panel sensory analyses of consumers found that organic "Clery" strawberries are sweeter and have preferable flavour, appearance and overall acceptance compared to conventional fruits. Organic and conventional fruits "Aprica" were valued similarly. The sensory results of sweeter-tasting organic strawberries "Aprica" were confirmed by the higher content of soluble solids determined by biochemical analysis in the laboratory.

Keywords: organic, conventional, taste, flavour, hedonic scale

Introduction

Organic farming involves many practices that emphasize optimizing ecosystem management, integrated plant cultivation and animal husbandry systems, diversification of production and disease control without conventional chemical treatments [24]. The main objective of organic farming is to produce healthy and sustainable food, relying exclusively on biological and ecological processes [2]. According to data from the Research Institute of Organic Agriculture FiBL and IFOAM – Organics International in 2021, more than 76.4 million hectares of organic agricultural land were recorded, including areas in conversion. The regions with the largest areas of organic agricultural land are Oceania (36.0 million hectares – almost half of the world's organic farmland, accounting for 47% of the total) and Europe (17.8 million hectares, up 23%). Latin America had 9.9 million hectares (13%), followed by Asia (6.5 million hectares, 8.5%), North America (3.5 million hectares, 4.6%) and Africa (2.7 million hectares, 3.5%) (1254-organic-world-2023.pdf (fibl.org)

Data concerning organic food production and consumption in the EU show an increasing trend in the decade 2010-2020. With 14.8 million ha in 2020, the area under organic farming accounted for 9.1% of total

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EU agricultural land and almost 20% of the world's organic area (df01a3c7-c0fb-48f1-8eca-ce452ea4b8c2_en (europa.eu).

In Romania, the dynamics of organic agricultural area decreased in 2015-2016, driven by various factors, such as the interval between CAP programming periods [26] and sanctions applied to farmers who did not comply with organic rules [13]. After 2016, the total area followed a constant upward trend, with 578,718 ha cultivated organically at the end of 2021 [5].

Qualitative comparison of fruits from organic and conventional systems is often complicated by interactive effects of agricultural practices, soil quality, plant varieties, and harvest time. Recent studies have shown that, in general, consumers have favourable expectations towards organic food and buy these foods because they avoid pesticides (and other chemicals used in food production) and genetically modified foods; In addition, they believe that they are more nutritious, environmentally friendly, natural, healthy, safe, tasty, clean and of high quality [1; 4; 6].

Strawberries (*Fragaria* × *ananassa* Duch.) are fruits of high economic value, normally eaten fresh or processed, appreciated by consumers in particular for their attractive sensory characteristics, including aroma, taste, shape and colour [17;18]. Strawberries are low in calories, rich in fiber, vitamin C, folic acid, and bioactive compounds such as anthocyanins and other flavonoids and antioxidants with biological activities essential for human health [9].

Aroma is the perceptual and hedonic reaction to the synthesis of constituent compounds of taste, smell and tactile sensations [20]. In the case of strawberries and other fruits, sensory arousal is the result of several direct interactions between fruits and humans: sugars and acids, pigments, turgidity and structure, volatile compounds, acting on the senses of taste, sight, tactile sensation and olfaction respectively in the perception of aroma [7, 22].

Fresh strawberries are valued for their characteristic red colour, juicy texture, distinct aroma and sweet taste.

The objective of the research was to evaluate sensory (with the help of consumers) and biochemical (through specific equipment) strawberry fruits different in genotypic origin (Aprica and Clery cultivars) and cultivation technologies (organic vs. conventional), but identical in terms of soil and climate conditions in which they were produced. The analyses carried out aimed to determine the main characteristics that have hedonic influence in the sensory perception of strawberry fruits. The intensity of sweetness and aroma of strawberries may be intensified or diminished by the technology and genotypes used, or the pressure of environmental conditions, by the impact on sucrose and volatile organic compounds.

Material and Method

Experimental location: Codrea farm - Draguseni locality (47°54′19"N 23°04′40"E), Satu-Mare county.

Biologic material

Cv. Aprica (figure 1) - is an Italian variety (C.I.V.) with an average ripening duration at the beginning of the season. The fruit ripens about four days after Clery. The fruits are bright red, large, cone-shaped, with beautiful gloss and large individual profile, which is also why it is often preferred by growers. Production is high, with a large percentage of fruits fall into the first grade, tolerant to handling, transportation and storage.

Cv. Clery (figure 1) - is an Italian variety (C.I.V.) with a maturing duration at the beginning of the season. The fruits have a regular, elongated-conical shape, very uniform in size, with firm pericarp, carmine-red colour, with characteristic shine. The pulp is light red, very juicy, firm, moderately fragrant. The core of the fruit is slightly whitish in the center.

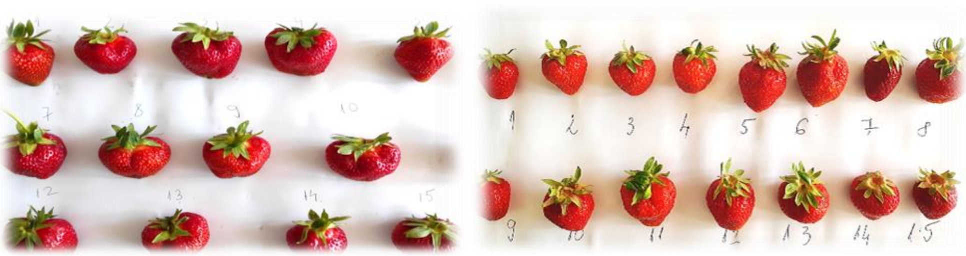

Figure 1. Cv. Aprica **Cv. Clery**

Soil characteristics

The analysis of soil samples was carried out within the Office for Pedological and Agrochemical Studies Satu-Mare, the methods used to be standardized, 5 soil samples were collected from the 0.89 ha of experimental field.

Parameter	**pH (H_2O-1:2,5)**	**P-mobile (ppm)**	**K-mobile (ppm)**	**Humus (%)**	**IN**	**Hydrolytic acidity (me/100)**	**Sum of exchangeable bases (me/100)**	**V (%)**
value	7.2	69.6	234	2.15	2.2	1.68	10.12	96.89
interpret	neutral	low	good	low	low	very low	low	eubasic

Analytical methods for determining certain quality parameters of strawberry.

Fruit firmness, expressed in kg force /cm^2 – determined using a portable digital penetrometer (model PCE – PTR 200, manufacturer PCE Instruments UK Ltd), using a sensor with nominal diameter of 6 mm, with an effective surface area of 0.28 cm2. The determinations were performed on 10 fruits of each experimental variant by pressing the sensor in 3-4 places on the pericarp, reading the maximum value recorded at each penetration and calculating the average / fruit.

Quantity of invert sugar in the vacuolar fruit juice, expressed in ^{0}Brix, with the digital refractometer (model DR 201-95, manufacturer Kruss Optronic GmbH Germany). Juice was extracted by pressing each fruit and left overnight to clarify, and then the clear sample was taken and the temperature compensated refractometer reading.

Methods of psycho-sensory assessment of strawberry fruit quality

The consumer panels were conducted in the laboratory of Plant Physiology, Department of Genetic Engineering of the "King Mihai I" University of Life Sciences in Timisoara. The tasting coordination team approved the protocol that the sensory panel participants had to complete. The members of the group (11 women, 12 men) were recruited from students and teachers of the Faculty of Engineering and Applied Technologies in Timisoara, having prior training and knowledge of descriptive analysis techniques for fresh products. The participants were volunteers aged between 21 and 59 and generally liked strawberries before tasting. Before the sensory sessions, they received additional information to explain the descriptive and scaling characteristics specific to this study. Basic taste and aroma information was provided to panellists to clearly define differences in colour intensity, texture, aroma and visual perception through smell, juiciness, succulence and taste.

During the session, the 23 panellists used individual booths to evaluate the samples. Two whole strawberries and two half-sectioned strawberries of each of the four randomly coded and ordered experimental variants were offered to each panellist. The samples were served at room temperature (25 °C) in 100 ml plastic cups, with strawberries from each variety and technological variant being coded with three-digit numbers.

Consumers were asked to rate hedonic attributes (taste preference, flavour, and texture) on the global scale of hedonic intensity, which was associated with the most intense pleasure ever experienced at the bottom (0) and the most intense antipathy ever experienced at the top (8) [3].

9-point hedonic scale for taste rating. 0- extremely pleasant; 1-very pleasant; 2-moderately pleasant; 3-slightly pleasant; 4-dislike; 5-slightly unpleasant; 6-moderately unpleasant; 7-very unpleasant; 8-extremely unpleasant.

The order of presentation of samples for tasting was randomized for each consumer and the nine-point hedonic scale was used to assess acceptance. Participants' purchase intent relative to strawberries was assessed using a three-point scale, where: 1 = yes; 2 = no and 3 = don´t know. Mineral water at room temperature was available for consumers to clean their mouths between samples.

Results and Discussion

The fruits quality intended for fresh consumption depends on a series of attributes related to external attributes (appearance, texture, smell) and internal attributes (firmness, aroma, sweetness, flavour, etc.), most of them being polygenic traits influenced by genotype, environment, technologies used, but also by the degree of ripeness [10; 11; 23].

Common quality characteristics of strawberries intended for consumer acceptance are appearance (colour, shape and dimensions), firmness and aroma perceived by combining the senses of taste and smell. Sugars (fructose, glucose and sucrose), organic acids (predominantly citric acid) and phenolic compounds (anthocyanins and flavonoids) give strawberry its characteristic taste, while more than 360 volatile compounds distinguish its aroma [12; 14]

Average fruit weight is a trait expressing fruit size and is a commercially important characteristic, especially when fruit is intended for fresh consumption [25]. Sensory assessment of fruit size can provide valuable information on consumer perception of these parameters, as well as the acceptability of fruit for consumption.

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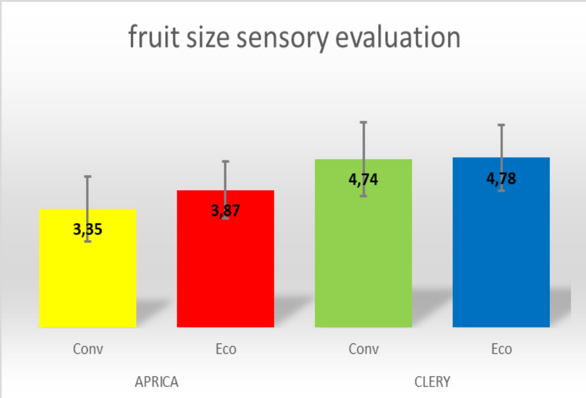
The obtained data (fig. 2) show that the evaluators awarded a better score for the Aprica, compared to Clery, and the conditions of conventional technology ensured a slight superiority in the case of the Aprica variety. For Clery, sensory evaluation of fruit size determined that both those obtained by conventional and ecological technologies are relatively equal. However, according to the 9-point hedonic scale, the average fruit size scores ranged from 3 to 4 for Aprica, which means slightly pleasant to unpleasant, and between around 5 for Clery, which means slightly unpleasant.



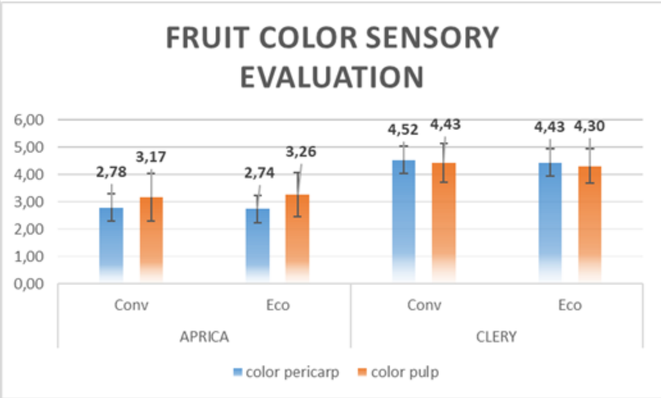


Figure 2. The sensory evaluation on strawberry fruit size Figure 3. The sensory fruit colour evaluation (Conv- conventional; Eco-Ecologic technology)

Hedonic assessments were performed in the panel regarding the colour of the pericarp and strawberry fruit pulp (fig.3). And for these parameters, the best scores were obtained in the case of the Aprica variety, which achieved an average of 2.74 ± 0.85 points for pericarp colour in organic and 2.78 ± 0.93 points in conventional, compared to 4.43 ± 0.77 points in Clery in organic and 4.52 ± 0.71 in conventional for the same character. Otherwise, interpretation of the hedonic scale shows that the colour of the pericarp and its brightness is moderate to slightly pleasant for Aprica and unpleasant to slightly unpleasant for Clery. Although there are some differences between the colour of fruits obtained by conventional versus ecological technologies, they do not have a major impact in the scores given by panellists.

Sensory analyses of the colour of fruit pulp also show better acceptance of the strawberry variety Aprica, with a more attractive colouring for this character. The Clery variety has as a genetic characteristic a light red to whitish colour of the fruit core, which does not seem to please panellists.

The evaluation of fruit colour by sensory analysis highlights the importance of the colour intensity of the pericarp and core. Thus, the cv. Aprica, of intense red colour, was more appreciated by panellists compared to the cv. Clery. These results are consistent with other studies [15; 27] which showed that fruit colour intensity is an important element of attractiveness for consumers.

Strawberries are soft fruits characterized by a very short shelf life, which makes fruit firmness a commercially important trait [21]. The results regarding the comparative evaluation of strawberry fruit firmness by instrumental determinations and sensory analysis showed that there is a direct correlation between the two techniques (fig.4). Fruit firmness was higher in the Aprica compared to Clery. By comparing fruits from organic and conventional technologies, eco-fruits are less firm in both cultivars. In fact, other studies have also shown that strawberry fruit firmness is influenced by cultivation technology and the type of fertilizers used (ecological/chemical) and it seems that the application of chemical fertilizers ends up obtaining firmer fruits [16].

The panel evaluation using the nine-point hedonic scale of smell, taste, and juiciness of commercially mature strawberry fruit of two varieties grown in conventional and organic technology (fig. 5) showed that there are important differences between cultivars and technologies. Thus, in terms of smell, the Clery offered the most pleasant smell to consumers in fruits obtained by ecological technology, with an average score of 4.17 ± 0.76, followed by fruits from the conventional version with 4.52 ± 0.77 points.

The fruits of the Aprica were perceived by consumers in the panel as less smelly, both organic and conventional. Taste evaluations showed that the organic Aprica fruits had the best taste (3.95 ± 0.75), followed by the organic fruits of the Clery (4.52 ± 0.92). Therefore, the results of the evaluations showed that eco-friendly technologies give extra taste to strawberries compared to conventional ones, regardless of genotype. On the other hand, the perception of succulence was favourable to strawberries obtained by conventional technologies for both varieties, but the differences between genotypes and variants were very small, so that the major influence of either of the analysed factors cannot be clearly distinguished.

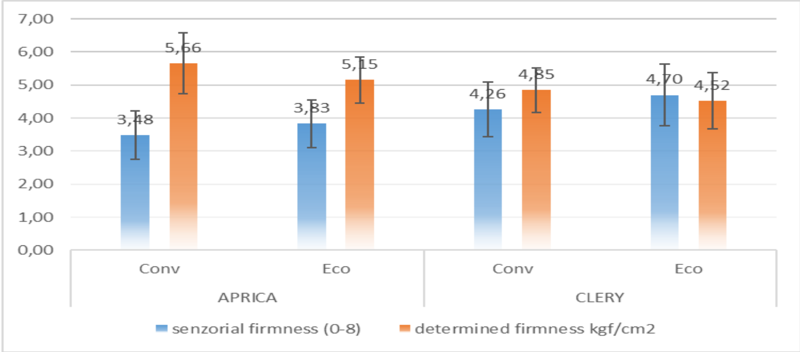
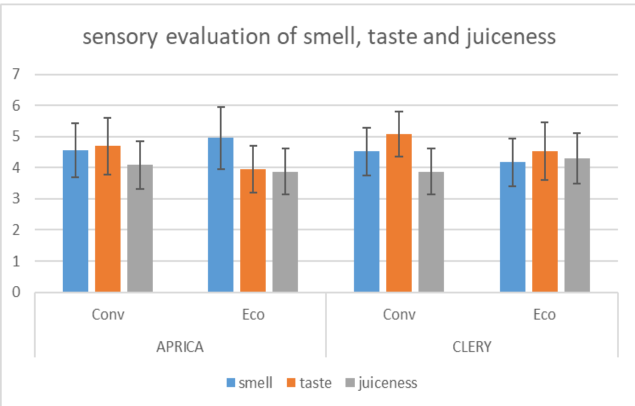


Figure 4. Comparative analysis of fruit firmness (sensorial and determined)

Sweetness is an attribute of the flavour determined in tastings as being extremely important for consumer preferences. This is consistent with consumer panels showing sweetness as the main element of consumer pleasure. Surprisingly, the same panels showed that the sweetness of even the most aromatic cultivars does not yet live up to the ideal expected by consumers [8]. Given the importance of sweetness, fruit sugars need to be a focal point of the improvement process. Because TSS is strongly correlated with total sugars in strawberries and can be easily measured using refractometers, this character can be compared to consumer panel assessments [19].

Data on sensory evaluation compared to instrumental determination of soluble sugar content demonstrated that the two methods are closely correlated (fig.6.). Strawberries obtained by ecological technologies registered values superior to those of classical technologies. Although the instrumental analyses determined a higher content of soluble sugars in the Clery in eco, the perception of the analyses in the panel gave victory to the Aprica, but the differences were minor (4.22 ± 1.06 points / 8.11 ± 0.11 ^{0}Brix in Aprica eco, compared to 4.39 ± 0.71 points / 8.73 ± 0.16 ^{0}Brix la Clery eco).



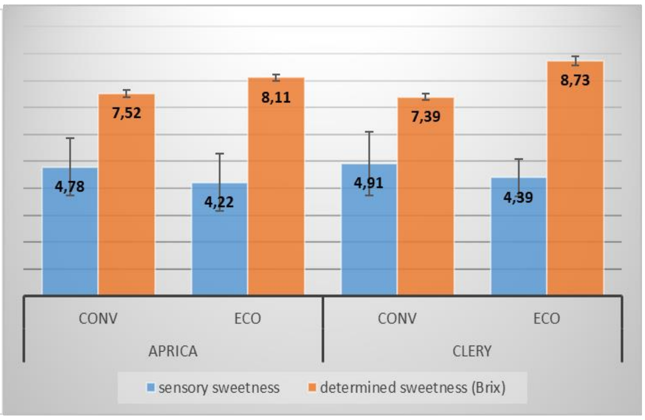


Figure 5. The sensory evaluation of smell, taste, and juiciness Figure 6. Comparative analysis of fruit sweetness (sensory and determined)

From the data analysis on the purchase intention of the panellist (fig. 7) it can be seen that there is a direct link between the analysed quality parameters and the desire to purchase. However, the tightest links of desire to buy seem to be determined by the taste, sweetness and intensity of the colour red. Purchase intent data showed that 56.52% of people in the panel would buy fruit from Aprica eco, with others undecided. At the other end of the spectrum, only 26.09% of people in the panel would buy conventional Clery strawberries, 47.83% being undecided and 26.09% would not.

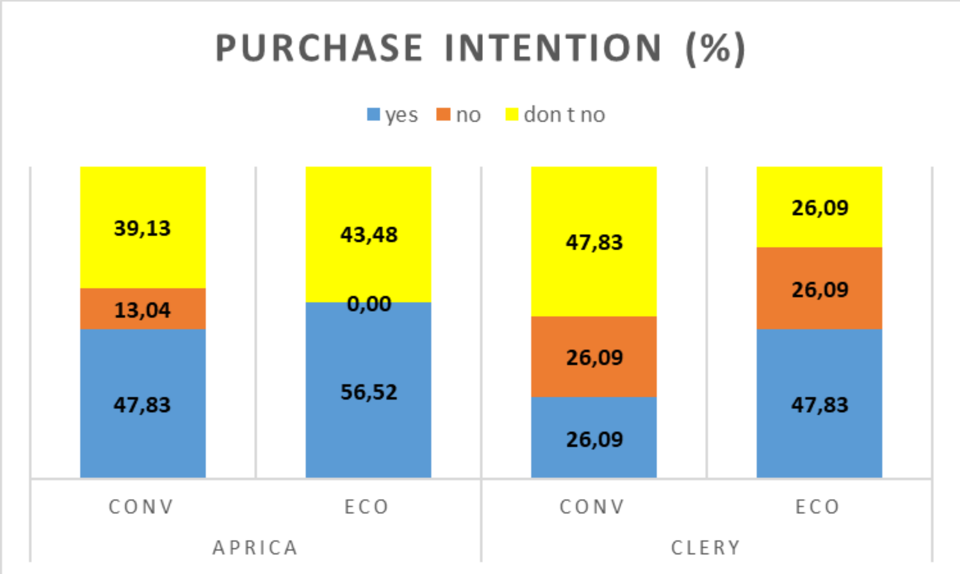


Figure 7. The purchase intention of consumers

Conclusions

Sensory evaluation of strawberry quality is a valuable method in determining the commercial value and preference of buyers to guide the breeding processes of this species. The influence of cultivation technologies is, along with genetic baggage, the main factor influencing the taste qualities of strawberries.

Organic growing conditions have a favourable impact on the taste, aroma and sweetness of strawberry fruits, essential features of attractiveness and purchase customer intention. The firmness of organic fruits is lower, hence their greater sensitivity to handling, transport and storage. Comparisons of sensory and analytical estimation methods are largely correlated, especially for characters defining taste, aroma, and sweetness.

References

[1]. Aschemann-Witzel, J., Ares, G., Thøgersen, J., Monteleone, E. (2019), *A sense of sustainability? How sensory consumer science can contribute to sustainable development of the food sector.* Trends Food Sci. Technol., *90*, 180–186.

[2]. Azadi, H., Schoonbeek, S., Mahmoudi, H., Derudder, B., De Maeyer, P., Witlox, F. (2011), *Organic agriculture and sustainable food production system: Main potentials*, Agriculture, Ecosystems & Environment, 144, 92-94.

[3]. Bartoshuk, L. M. et al. (2004), *Valid across-group comparisons with labeled scales: the g LMS versus magnitude matching*. Physiol. Behavior. 82, 109–114.

[4]. Brantsæter, A.L., Ydersbond, T.A., Hoppin, J.A., Haugen, M., Meltzer, H.M. (2017), *Organic food in the diet: Exposure and health implications*. Annu. Rev. Public Health, *38*, 295–313.

[5]. Brumă, I. S., Chițea, M. A., Jelea, A. R., Chițea, L. F., Rațu, R. N., Popa, M. (2024), *The Evolution of the Romanian Organic Agriculture in a Global Context*. Romanian Agricultural Research, 41,doi.org/10.59665/rar4107.

[6]. Çakmakçı, S., Çakmakçı, R. (2023), *Quality and Nutritional Parameters of Food in Agri-Food Production Systems*. Foods, *12*, 351. https://doi.org/10.3390/foods12020351.

[7]. Causse, M., Saliba-Colombani, V., Lesschaeve, I., Buret, M. (2001), *Genetic analysis of organoleptic quality in fresh market tomato. 2. Mapping QTLs for sensory attributes*. Theoretical and Applied Genetics 102: 273–283.

[8]. Fan, Z., Hasing, T., Johnson, T. S., Garner, D. M., Schwieterman, M.L., Barbey, C. R., Colquhoun, T. A., Sims, C. A., Resende, M. F.R., Whitaker, V. M. (2021), *Strawberry sweetness and consumer preference are enhanced by specific volatile compounds. Horticulture Research*, 8(1), 66. https://doi.org/10.1038/s41438-021-00502-1.

[9]. Fernandes, V.C., Domingues, V.F., Freitas, V., Delerue-Matos, C., and Matheus, N. (2012), *Strawberries from integrated pest management and organic farming: phenolic composition and antioxidant properties.* Food Chem. 134, 1926–1931. https://doi.org/10.1016/j. foodchem.2012.03.130.

[10]. Figàs, M.R., Prohens, J., Raigón, M.D., Fita, A., García-Martínez, M.D., Casanova, C., Borràs, D., Plazas, M., Andújar, I., Soler, S. (2015), *Characterization of composition traits related to organoleptic and functional*

quality for the differentiation, selection, and enhancement of local varieties of tomato from different cultivar groups. *Food Chem.* 2015, *187*, 517–524.
[11]. Grandillo, S., Cammareri, M. Molecular Mapping of Quantitative Trait Loci in Tomato. In *The Tomato Genome. Compendium of Plant Genomes*; Causse, M., Giovannoni, J., Bouzayen, M., Zouine, M., Eds.; Springer: Berlin/Heidelberg, Germany, 2016; pp. 39–73.
[12]. Gunness, P., Kravchuk, O., Nottingham, S.M., D'Arcy, B.R., Gidley, M.J, (2009*), Sensory analysis of individual strawberry fruit and comparison with instrumental analysis*. Postharvest Biol. Technol. 52 (2), 164–172. https://doi.org/10.1016/j. postharvbio.2008.11.006.
[13]. Jurjescu, A.L., Brînzan, O., Mateoc-Sîrb, T., Țigan, E., Orboi, D., Vass, H., Mateoc-Sîrb, N. (2020), *Susținerea agriculturii ecologice prin PNDR 2014-2020, Măsura 11.* Revista de Management și Inginerie Economică, 19(3): 380-388.
[14]. Kader, A.A. (1991), *Quality and its maintenance in relation to the postharvest physiology of strawberry*. In: Dale, A., Luby, J.J. (Eds.), The strawberry into the 21st century. Proceedings of the Third North American Strawberry Conference. Houston, Texas, 14–16 February, 1990, pp. 145–152.
[15]. Kim, S.L., Michael, J.N, Eunhee, P., Yaguang, L. (2020), *Consumer preference and physiochemical analyses of fresh strawberries from ten cultivars*, International Journal of Fruit Science, 20:sup2, 733-756, DOI: 10.1080/15538362.2020.1768617.
[16]. Kilic, N., Burgut, A., Gündesli, M.A., Nogay, G., Ercisli, S., Kafkas, N.E., Ekiert, H., Elansary, H.O., Szopa, A. (2021), *The Effect of Organic, Inorganic Fertilizers and Their Combinations on Fruit Quality Parameters in Strawberry*. Horticulturae, 7, 354. https:// doi.org/10.3390/horticulturae7100354
[17]. Kobi, H.B., Martins, M.C., Silva, P.I., Souza, J.L., Carneiro, J.C.S., Heleno, F., Queiroz, M.E.L.R., Costa, N.M.B. (2018), *Organic and conventional strawberries: Nutritional quality, antioxidant characteristics and pesticide residues*. Fruits, *73*, 39–47.
[18]. Kovačević, D.B., Putnik, P., Uzelac, V.D., Vahčić, N., Babojelić, S.M., Levaj, B. (2015), *Influences of organically and conventionally grown strawberry cultivars on anthocyanins content and color in purees and low-sugar jams*. Food Chem. 181, 94–100. https://doi. org/10.1016/j.foodchem.2015.02.063.
[19]. Mangandi, J., Verma, S., Osorio, L., Peres, N. A., van de Weg, E., &Whitaker, V. M. (2017), *Pedigree-based analysis in a multiparental population of octoploid strawberry reveals qtl alleles conferring resistance to Phytophthora cactorum*. G3 (Bethesda), 7(6), 1707–1719.https://doi.org/10.1534/g3.117.042119.
[20]. Prescott, J. (2015), *Multisensory processes in flavor perception and their influence on food choice*, Current Opinion in Food Science, 3, 47-52, https://doi.org/10.1016/j.cofs.2015.02.007.
[21]. Rey-Serra, P., Mnejja, M., Monfort, A. (2022), *Inheritance of esters and other volatile compounds responsible for the fruity aroma in strawberry*. Frontiers in Plant Science, **13**, 959155.
[22]. Schwieterman, M.L., Colquhoun, T.A., Jaworski, E.A., Bartoshuk, L.M., Gilbert J.L, et al. (2014), *Strawberry Flavor: Diverse Chemical Compositions, a Seasonal Influence, and Effects on Sensory Perception*. PLoS ONE 9(2): e88446. doi:10.1371/journal.pone.0088446.
[23]. Sinesio, F., Cammareri, M., Cottet, V., Fontanet, L., Jost, M., Moneta, E., Palombieri, S., Peparaio, M., Romero del Castillo, R., Saggia Civitelli, E. et al. (2021), *Sensory Traits and Consumer's Perceived Quality of Traditional and Modern Fresh Market Tomato Varieties: A Study in Three European Countries*. Foods, *10*, 2521. https://doi.org/10.3390/foods10112521.
[24]. Suciu, N., A., Ferrari, F., Trevisan, M. (2019), *Organic and conventional food: Comparison and future research, Trends in Food Science & Technology*, 84, 49-51, https://doi.org/10.1016/j.tifs.2018.12.008.
[25]. Temocico, G., Sturzeanu, M., Ion, V., Cristea, S. (2019), *Evaluation of strawberry fruit quality for new selections and cultivars*. Rom Biotechnol. Lett. 24(4): 742-748. DOI: 10.25083/rbl/24.4/742.748.
[26]. Ursu, A., Petre, I.L. (2022), *Forecasting the Optimal Sustainable Development of the Romanian Organic Agriculture*. Sustainability, 14: 14192. https://doi.org/10.3390/su142114192.
[27]. Zeliou, K., Papasotiropoulos, V., Manoussopoulos, Y., Lamari, F.N. (2018), *Physical and chemical quality characteristics and antioxidant properties of strawberry cultivars (Fragaria × ananassa Duch.) in Greece: Assessment of their sensory impact.* J. Sci. Food Agric., 98, 4065–4073.
https://www.researchgate.net/publication/260171014_Strawberry_Flavor_Diverse_Chemical_Compositions_a_Seasonal_Influence_and_Effects_on_Sensory_Perception [accessed May 15, 2024].
1254-organic-world-2023.pdf (fibl.org) [accessed May 15, 2024]
df01a3c7-c0fb-48f1-8eca-ce452ea4b8c2_en (europa.eu) [accessed May 15, 2024]