Scientific Papers. Series B, Horticulture. Vol. LXVI, No. 2, 2022
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

MINIMUM QUALITY CHANGES AND WEIGHT LOSS OF TABLE GRAPES PROCESSED DURING STORAGE

STROE Marinela[1], CĂTUNEANU Ioana[2]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania
[2]Research Center for Studies of Food Quality and Agricultural Products, University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1,Bucharest, Romania

Corresponding author email: marinelastroe@yahoo.com

Abstract

To carry out this study, we started from the scientific argument that, after harvest, table grapes undergo a series of physico-chemical changes influenced mainly by the method of storage and its duration. During the cooling and the storage of the fruits, all the physiological processes continue to take place, but with reduced intensities compared to the previous stages of fruit growth and maturation, and the phytosanitary conditions of the grapes directly influence the shelf life of the fruits. The obtained results show that the samples from the variant with 5 % CO_2 registered lower weight losses during storage, and in terms of taste, more balanced. The practical outcomes of these results can be transferred to the grape vine - growing companies cultivating table varieties, but also to economic operators in the capitalization and retail chain who will be able to use the combination of different parameters (temperature, relative humidity and different fractions of CO_2, N_2, O_2) in order to increase the shelf life and ensure quality products for consumers.

Key words*: varieties, quality, postharvest, storage, table grapes.*

INTRODUCTION

Today, more than ever, food safety, product quality, guarantees of authenticity and originality in the range of healthy agri-food products offered by the consumer market are four of the main concerns of producers and consumers in the wine sector (O.I.V., 2020). For these reasons, traceability has become a useful tool, and also necessary to ensure the proper functioning and knowledge of the process of production, development and marketing of grapes, addressing the issue of food and nutrition security. Table grapes are part of the delicatessen fruit categort, they are the requested and consumed fruit-food, due to rich and varied chemical composition necessary for the health and vitality of the human body, and their consumption in fresh state has always been an object of need in human society. Regular and correct consumption in the fresh state also proved the therapeutic action, given by the concentration of phenolic compounds (over 500 compounds) accumulated in the skin, pulp and seeds of a series of microelements that promote metabolism, the presence of resveratrol - a powerful antioxidant, a true inhibitor of cancer cell growth (Mahanna et al., 2019; Tahereh et al., 2020; Benbouguerra et al., 2021), and last but not least, the presence of substances that promote the process of weight loss, with all of which also contain glucose (Haitao et al., 2021).
Over the last decade, world production of table grapes (27 million tons) and their consumption in fresh state (3 million tons exported between countries) has increased significantly (O.I.V., 2019). Moreover, the consumer market both globally and nationally has grown significantly from year to year (FAO, 2020), drawing attention to the need to ensure competitive products in terms of sensory and visual characteristics.
However, a number of factors are involved in achieving a quality production, factors that are mainly related to the environment and climate change, but also to the genetics of varieties, applied technology, storage life, etc. (Crupi et al., 2012; Stroe & Bejan, 2014; Rolle et al., 2015; Stroe et al., 2016; Martins et al., 2021; Huwei et al., 2021; Ehtesham et al., 2021).
In this context, producers and researchers focus more on the quality of the product that can be described by specific and measurable indicators and characteristics of the fruit (size, shape,

compactness, berry color, consistency, taste and aroma of the pulp, skin thickness and coverage) and coverage with plum odor, general, general appearance, discoloration and accelerated softening and degradarion of the berries, dehydration of the rachis, freshness, degree of ripeness or any other qualitative attribute specific to the fruit (Tyagi et al., 2020; Lingling et al., 2021) and which to be stored even after a storage period of more than 2-3 months. All these are in a close correlation, each influencing the response reaction of the vine and the product obtained. It is difficult to say which of the listed factors has a greater influence (Biniari et al., 2020), but the biological and technological barriers encountered on the flow of traceability in wine production must be removed.

The obvious defects of the quality of the grapes after storage can lead to the rejection of the product by the consumer, followed by the decrease of sales, the loss of markets and income, etc., and then it is no longer just a unique feature, recognizable is a dynamic concept, anchored in reality in which more and more emphasis is placed on product traceability and food safety.

Because of the growing interest and consumer demands, economic operators need to supply horticultural products of outstanding quality, respecting European quality stadards. For our country, however, the sale of fresh horticultural production has an uncontrolled, conjugal, disersed and very fluctuating aspect, which is aggressively completed by imports, through the attractiveness of the presentation (packaging), which are sold at a much higher price than similar domestic products. In our contry today, table grapes have a share of only 6.9% of Romania's wine production (O.I.V., 2020), and worldwide, table grapes represent 15% of total wine production.

This context causes a clear imbalance, which implicitly affects the shortening of the period of consumption in the fresh state. In addition to all of this, the storage of grapes in storage facilities is done at a very modest volume, although there is the potential for Romania to provide fresh table grapes on the market until February-March. Basically, we need a strategy that starts from the cultivation and capitalization of transportable varieties (promotion of Romanian creations), prone to storage, and also the collaboration between the research sector and producer assossciations through information and technology transfer, by upporting access to markets (supermarkets) in Romania of manufactures.

Fruit storage procedures are a topic of current research and are expanding more and more, testing and using different methodologies (Adamane Naouel et al., 2018) to extend this period. After harvest, table grapes undergo a series of physico-chemical changes influenced by the preservation method and its duration, because, during storage, physiological processes continue to take place, but with reduced intensities compared to previous periods of the fruit growth and maturation. The speed of biochemical reactions that take place in the fruit is influenced by microclimate conditions (Nicolosi et al., 2018).

Table grapes are non-climacteric fruits, perishable at room temperature, the perishability process evolving rapidly, especially if these were harvested after reaching the optimal time of harvest. Long-term storage causes problems, with weight loss, discoloration, dehydration of the rachis, loss of skin turgidity, all affecting fruit quality. Basically, in refrigeraton conditions with normal atmosphere, the losses are quite high: 10.1% after 3 months, 13.9% after 4 months, 18.1% after 5 months, 23.2% after 6 months (Rotaru et al., 2011; www.eurepgap.org). Based on these records, the present study aims to evaluate the weight loss and biochemical parameters recorded under conditions of storage in a controlled atmosphere for as long as possible.

MATERIALS AND METHODS

Sample preparation

The main objective is to keep table grapes in fruit storages with a controlled atmosphere by correlating different parameters (temperature, relative humidity and different fractions of CO_2, N_2 and O_2) with a dual purpose: to extend the storage period and ensure quality products for consumers. Although shelf life can be extended at a low temperature of about 0°C, this is not enough to control the senescence of the rachis, berry abscission or fungal attack mainly caused by *Botrytis cinerea*, which is able to grow at low temperatures. For this study, three table grapes varieties were selected: 'Coarnă Neagră Selecționată', 'Muscat Hamburg' and 'Muscat d'Adda'. The varieties are located in the experimental field of the ampelography collection from the Research and Development Station for Viticulture and Oenology Pietroasa - University of Agronomic Sciences and Veterinary Medicine of Bucharest, with the code "ROM 13" in www.vivc.de.

For the proposed objective, the standard technology was applied throughout the technological flow (pre-harvest and post-harvest), in terms of obtaining and handling the grapes to be stored under controlled atmosphere conditions. Harvesting was done manually with the peduncle and wax layer intact and with rigorous control, ensuring sorting and calibration directly from the field, according to the quality standard. Their transport took place on the harvest day. In parallel – the storage space preparation (sanitation) and the intermediate temperature of 8-10°C regulation were established. Storage and analysis were done in the Postharvest Technology Laboratory of the Research Cener for Studies of Food Quality and Agricultural Products. In this experiment, two conditions with different CO_2 levels were chosen - 2.5% CO_2 and 5% CO_2 and the analyses were performed after 4-5 months, in terms of the parameters that interest those who intend to keep them in a controlled atmosphere (weight loss mainly) and parameters that make them attractive to consumers: commercial appearance, fermity and consistency of berries, taste (acidometric index), etc. Experimental variants are: **variant 1** (2.5% CO_2, 3% O_2 (oxygen content), RH (relative humidity) = 90%, T (temperature) = 0.5°C and **variant 2** - 5% CO_2, 3% O_2 (oxygen content), RH (relative humidity) = 90%, T (temperature) = 0.5°C.

Biochemical analysis

Because the main objective is to track weight loss (in the event of a technology transfer) after the introduction in the storage rooms, the samples were weighted every two weeks, and after 4.5 months were removed from the storage. Prior to storage, as well as after the storage period, sensory analysis of grapes was performed according to the tasting sheet (O.I.V. 2008b), as following: commercial appearance, size, uniformity and compactness (Notes: 1-3), appearance of berries to correspond to the variet, detachement of the pedicel (notes: 1-3), skin thickness, color, amber spots, itching (notes: 1-5), taste/ aroma of the stalks (notes: 1-5), core consistency (notes: 1-3), succulence (notes: 1-3). The maximum and total score on the set of assessed grades is 22 points. The tasting event was attended by 52 people, as follows: 44.23% students, 38.46% active in work, 17.30% pensionary. In order to assess the descriptive parameters of the quality, determinations of biochemical parameters of the grapes was made, as follows: to determine the dry matter and water content from samples, approximately 1 g of the average sample in the crucibles was introduced at 105°C until constant weight (Bezdadea-Cătuneanu, 2017; Moura, 2005; Skupień, 2006; Delian, 2011; Corollaro, 2014; Mureşan, 2014; Ticha, 2015, Iliescu, 2019). For the determination of fruit firmness, the electronic penetrometer TR was used, with a piston of 3 mm diameter, the results being expressed in N/cm^2. The contents of total soluble solids, glucose and fructose were determined from 5 grape berries for each sample: with refractive device Kruss DR301-95 (% Brix) for total soluble solids (TSS) (Mureşan, 2014; Oltenacu, 2015; Saei, 2011; Tolić, 2015; Yoon, 2005), with refractive device Milwaukee MA873 (%) for glucose and with refractive device Milwaukee MA872 (%) for fructose (Enciu (Bunicelu) et al., 2021). The total titratable acidity (TA) was determined by titration with 0.1N NaOH to pH 8.1, and the results were expressed in g tartaric acid/100 g. Titratable acidity calculation was done using the formula: Titratable acidity (%) = (V x N x C x 100)/m where V = volume of NaOH consumed; N = NaOH normality; C = tartaric acid equivalent; m = sample mass, C has values: 0.0075 to express acidity in tartaric acid (grapes, shoots, bananas). The maturity index, known also like acidometric equilibrium index, was calculated using the formula: TSS/TA.

All determinations were performed in triplicate. Statistical analyses were performed using Excel, including: average, standard deviation, ANOVA single factor, T Test and correlations (Pomohaci, 2017).

RESULTS AND DISCUSSIONS

Analyzing the data entered in Tables 1 and 2, for the evaluation of weight loss in case of storage, it is observed that the losses for both experimental variants are very similar, but higher for variant 1 (2.5% CO_2, 3% O_2, RH = 90%, T = 0.5°C), regardless of the time of observations.

It is observed that the 'Coarnă Neagră Selecționată' variety has the lowest weight loss, which proves that it has an increased storage capacity on a genetic basis (it is a selection of the local variety 'Coarnă Neagră'), followed by the 'Muscat d'Adda' variety and then 'Muscat de Hamburg' variety, which has proven to be the most sensitive, even in storage, not only in field conditions (Stroe, 2012).

Losses after one month of storage range from 3.07% ('Coarnă Neagră Selecționată' in variant 2, with 5% CO_2, to 5.32% ('Muscat Hamburg' - in variant 1, with 2.5% CO_2. The percentage for weight loss after 2 months is between 10.20% ('Coarnă Neagră Selecționată' in variant 2, with 5% CO_2 and 15.96% ('Muscat Hamburg' variant 1, with 2.5% CO_2.

When removed from storage (4.5 months - 145 days), the sum of the losses shows values between 17.11% ('Coarnă Neagră Selecționată' variant 1) and the highest loss in storage was recorded by 'Muscat Hamburg' - 25.90% in variant 1 and 20.64% in variant 2.

Immediately after removal from the storage, the descriptive quality parameters were assessed and the data in Tables 3 and 4 show a greater balance between samples in terms of dry matter content (DM%), the data being statistically verified.

For dry matter content (DM %) significant differences ($p<0.05$) has registered between all varieties, in both conditions.

For 'Coarnă Neagră Selecționată' has registered insignificant differences ($p>0.05$) between conditions, while for 'Muscat Hamburg' and 'Muscat d´Adda' varieties, were registered significant differences ($p<0.05$), between both conditions.

The total soluble solids (Brix) values show that they remain within the normal limits of the varieties for both experimental variants, but on the background of an accentuated dehydration in variant 1, they seem significantly higher - 23.8 Brix% (soluble solids content) - 'Muscat d' Adda'.

The same trend is observed in terms of glucose (%) and fructose (%) values - confirming a visible dehydration in the variant CO_2 - 2.5%, O_2 - 3%, RH 90%, T - 0.5°C, observed also by the values berry firmness.

The total soluble solids content (TSS), glucose and fructose content (Table 3 and Table 4) have registered significant differences ($p<0.05$) between 'Coarnă Neagră Selecționată' and 'Muscat Hamburg' and 'Muscat d´Adda' varieties, for variant 1 (2.5% CO_2), and also for variant 2 (5% CO_2). For TSS, total glusose and fructose contents, between 'Muscat Hamburg' and 'Muscat d´Adda' varieties, for both conditions, were registered insignificant differences ($p>0.05$).

For TSS and glucose content, between both conditions, for all varieties, were registered insignificant differences ($p>0.05$), while for fructose content significant differences ($p<0.05$) has registered for 'Muscat d´Adda' variety, between variant 1 (2.5% CO_2), and variant 2 (5% CO_2). For fructose content, 'Coarnă Neagră Selecționată' and 'Muscat Hamburg' were registered insignificant differences ($p>0.05$) between conditions.

Between TSS and glucose of the fruit, for 'Coarnă Neagră Selecționată' cv. it was observed a very strong significant positive correlation $R^2 = 0.9815$, with linear regression equation $y = 0.9035x + 2.5383$, for variant 1 (2.5% CO_2) and a very strong significant positive correlation $R^2 = 0.8581$, with linear regression equation $y = 1.2046x - 3.1955$, for variant 2 (5% CO_2).

Between TSS and glucose of the fruit, for 'Muscat Hamburg' variety it was observed a very strong significant positive correlation $R^2 = 0.847$, with linear regression equation $y = 0.7863x + 6.3777$, and for 'Muscat d´Adda' variety it was observed a very strong significant positive correlation $R^2 = 0.9704$, with linear regression equation $y = 1.2432x - 4.6534$, for variant 1 (2.5% CO_2)

Between TSS and fructose content of the fruit, for 'Coarnă Neagră Selecționată' cv. it was observed a very strong significant positive correlation $R^2 = 0.9479$, with linear regression equation $y = 0.9098x + 2.8251$, for 'Muscat Hamburg' variety it was observed a very strong significant positive correlation $R^2 = 0.9316$, with linear regression equation $y = 0.8189x + 6.1492$, and for ‘Muscat d´Adda’ variety it was observed a very strong significant positive correlation $R^2 = 0.9668$, with linear regression equation $y = 0.9706x + 2.3809$, for variant 1 (2.5% CO_2). Between glucose and fructose of the fruit, for ‘Muscat Hamburg’ variety it was observed a very strong significant positive correlation $R^2 = 0.978$, with linear regression equation $y = 0.9821x + 0.8994$, for variant 1 (2.5% CO_2) and a very strong significant positive correlation $R^2 = 0.9323$, with linear regression equation $y = 0.9569x + 1.4624$, for variant 2 (5% CO_2).

Table 1. Variation of weight losses during storage in 2.5% CO_2

Samples/ Date	04.X.	18.X.	1.XI	15.XI	6.XII	1 month	2 months	4.5 months
Coarnă Neagră Selecționată	-1.42	-2.71	-4.01	-4.45	-4.45	-4.13	-12.65	-17.11
Muscat Hamburg	-2.11	-3.21	-4.54	-6.10	-9.94	-5.32	-15.96	-25.90
Muscat d´Adda	-1.71	-3.10	-4.36	-6.06	-9.41	-4.80	-15.22	-24.64

Table 2. Variation of weight losses during storage in 5% CO_2

Samples/ Date	04.X.	18.X.	1.XI	15.XI	6.XII	1 month	2 months	4.5 months
Coarnă Neagră Selecționată	-1.13	-1.94	-2.88	-4.26	-7.82	-3.07	-10.20	-18.02
Muscat Hamburg	-1.46	-2.63	-3.43	-4.81	-8.32	-4.08	-12.33	-20.64
Muscat d´Adda	-1.12	-2.11	-3.02	-4.21	-7.37	-3.23	-10.46	-17.84

[1]RH % = relative umidity

Table 3. Variation of: DM (%), TSS (%), glucose (%), fructose (%), TA and fermity during storage in 2.5% CO_2

	DM[1] (%)		TSS [2](%)		Glucose (%)		Fructose (%)		TA[3](mg/100g fw)		Fermity (N/cm^2)	
Samples	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.
Coarnă Neagră Selecționată	19.28	±0.6	17.8	±2.1	18.6	±1,9	19.0	±1.9	0.82	±0.02	6.0	±0.4
Muscat Hamburg	23.93	±0.3	21.7	±2.8	23.4	±2.4	23.9	±2.3	0.45	±0.00	5.1	±1.7
Muscat d´Adda	24.82	±0.2	23.8	±1.6	25.0	±2.0	25.5	±1.6	0.46	±0.01	7.0	±1.5

Table 4. Variation of: DM (%), TSS (%), glucose (%), fructose (%), TA and fermity during storage in 5% CO_2

	DM[1] (%)		TSS [2](%)		Glucose (%)		Fructose (%)		TA[3](mg/100g fw)		Fermity (N/cm^2)	
Samples	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.
Coarnă Neagră Selecționată	20.36	±1.0	18.9	±0.8	19.6	±1.0	19.9	±0.7	0.51	±0.0	4.1	±1.4
Muscat Hamburg	22.8	±0.2	21.0	±1.0	22.3	±1.3	22.8	±1.3	0.45	±0.0	4.2	±0.4
Muscat d´Adda	23.26	±0.1	21.1	±1.1	22.6	±0.7	23.1	±0.8	0.46	±0.0	5.3	±1.1

[1]DM% = dry matter content
[2]TSS% = total soluble solids (Brix)
[3]TA% Titrable acidity

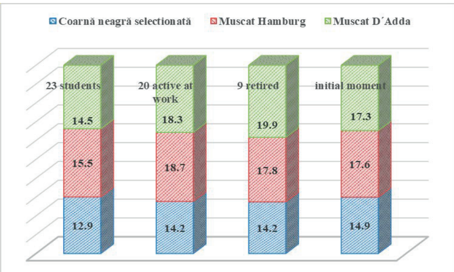

Figure 1. Qualitative scores before storage

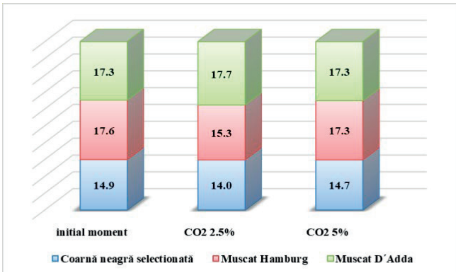

Figure 2. Qualitative scores for the stored fruits

Between glucose and fructose of the fruit, for ‘Coarnă Neagră Selecționată’ variety it was observed a very strong significant positive correlation $R^2 = 0.9857$, with linear regression equation $y = 1.0174x + 0.0765$, and for ‘Muscat d´Adda’ variety it was observed a very strong significant positive correlation $R^2 = 0.9771$, with linear regression equation $y = 0.7732x + 6.2021$, for variant 1 (2.5% CO_2).

In essence, the grapes of experimental variant 1 seem firmer due to the elasticity of the skin, and for variant 2, with 5% CO_2, the varieties have firm berries, being a particular variety, on a turgid background. This indicator of organoleptic appreciation also included the acidity expressed in tartaric acid, which together with the accumulated sugars give the The maturity index, recorded the following values: for 'Coarnă Neagră Selecționată' variety in 2.5%, CO_2, 2.18 g tartric acid/L for an acidity of 0.84 tartaric acid g/100 g FW and 3.73 g tartric acid/L at 5% CO_2, on the background of an acidity of 0.51 tartaric acid g/ 100 g FW. For 'Muscat d'Adda' variety, in 2.5% CO_2, the maturity index registered a value of 5.18 g tartric acid/L for an acidity of 0.46 tartaric acid g/100 g FW and 4.56 g tartric acid/L in 5% CO_2, against a background of an acidity of 0.46 tartaric acid g/100 g FW. For 'Muscat Hamburg' variety, the data are very similar, regardless of the CO_2 content, respectively 4.86 g tartric acid/L for variant 1 (0.45 tartaric acid g/100 g FW) and 4.69 g tartric acid /L for variant 2 (0.45 tartaric acid g/100 g FW)

The titrable acidity (TA) (Tables 3 and 4) has registered significant differences ($p<0.05$) between 'Coarnă Neagră Selecționată' and 'Muscat Hamburg' and 'Muscat d´Adda' varieties, for variant 1 (2.5% CO_2), and significant differences ($p<0.05$) between all varieties for variant 2 (5% CO_2). For 'Coarnă Neagră Selecționată' has registered significant differences ($p<0.05$) between conditions, while for 'Muscat Hamburg' and 'Muscat d´Adda' varieties, were registered insignificant differences ($p>0.05$), between conditions.

The firmness (Tables 3 and 4) has registered insignificant differences ($p>0.05$) between all varieties, for variant 1 (2.5% CO_2), and also for variant 2 (5% CO_2). For 'Coarnă Neagră Selecționată' and 'Muscat d´Adda' varieties, were registered significant differences ($p<0.05$) between conditions, while for 'Muscat Hamburg' variety, were registered insignificant differences ($p>0.05$), between conditions. Regarding the tasting of the samples (Figure 1), before storage - it is observed that the values are very close, and the most appreciated by the three categories of people participating in the tasting is the 'Muscat Hamburg' variety with a total score of 17.6 out of 22. The organoleptic assessment of the grapes after storage, it seems that, in general, consumers (active people at work) appreciated more the varieties stored in the conditions of variant 2, giving a significantly higher score, with small exceptions. The most appreciated was the 'Muscat d'Adda' variety (notes: 17.3 out of a maximum of 22), followed by the 'Muscat Hamburg' variety (17.3 out of a maximum of 22).

CONCLUSIONS

The 'Coarnă Neagră Selecționată' variety has registered the lowest weight losses, which shows that has an increased genetic storage capacity, followed by the 'Muscat d'Adda' variety and then the 'Muscat Hamburg' variety, regardless of the experimental variant.

The values of total soluble solids (Brix %) show that they remain within the limits of the varieties for both experimental variants, on the background of a more accentuated dehydration in variant 1, they seem significantly higher for 'Muscat d'Adda'.

Tasting of samples, before storage, shows a very close score, the most appreciated being the variety 'Muscat Hamburg'. For TSS and glucose content, between both conditions, for all varieties, were registered insignificant differences. After storage, it is observed that the samples stored in the conditions of variant 2 have a score closer to the initial moment, with small exceptions. It turns out that the samples stored in controlled atmosphere variant 2 - 5% CO_2, 3% O_2 (oxygen content), RH (relative humidity) = 90%, T (temperature) = 0.5°C, show lower weight loss (regardless of variety) and, in terms of taste, they are much more balanced.

The firmness has registered insignificant differences between all varieties, for both variants.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Research and Development Station for Viticulture and Oenology Pietroasa and Research Center for Studies of Food Quality and

Agricultural Products - University of Agronomic Sciences and Veterinary Medicine of Bucharest.

REFERENCES

Benbouguerra, N., Hornedo-Ortega, R., Garcia, F., El Khawand, T., Saucier, C. & Richard, T. (2021). Stilbenes in grape berries and wine and their potential role as anti-obesity agents: A review, Trends in Food Science & Technology, Volume 112, 2021, Pages 362-381, ISSN 0924-2244, https://doi.org/10.1016/j.tifs.2021.03.060.

Bezdadea-Cătuneanu, I., Bădulescu. L., Dobrin, A., Stan, A., Hoza, D. (2017). The influence of storage in controlled atmosphere on biochemical parameters of three blueberries varieties. *Scientific Papers. Series B, Horticulture.* Vol. LXI: 91-100, Romania.

Biniari, K, Xenaki, M., Daskalakis, I., Rusjan, D., Bouza, D. & Stavrakaki, M. (2020). Polyphenolic compounds and antioxidants of skin and berry grapes of Greek Vitis vinifera cultivars in relation to climate conditions, *Food Chemistry*, Volume 307, 2020, 125518, ISSN 0308-8146, https://doi.org/10.1016/j.foodchem.2019.125518.

Corollaro, M. L., Aprea E., Endrizzi I., Betta E., Demattè M. L., Charles M., Bergamaschi M., Costa F., Biasioli F., Grappadelli L. C., Gasperi F. (2014). A combined sensory-instrumental tool for apple quality evaluation. *Postharvest Biology and Technology*, 96: 135-144

Crupi, P., Coletta, A., Milella, R. A., Perniola, R., Gasparro, M. & Genghi R. (2012). HPLC-DAD-ESI-MS analysis of flavonoid compounds in 5 seedless table grapes grown in Apulian region. *Journal of Food Science*, 77, 174–181.

Delian, E., Petre V., Burzo I., Bădulescu L., Hoza D. (2011). Total phenols and nutrients composition aspects of some apple cultivars and new studied breeding creations lines grown in Voineşti area - Romania. *Romanian Biotechnological Letters*, vol. 16, no. 6: 6722-6729

Ehtesham, N.A., Taghipour, S., & Siahmansour, S. (2021). Pre-harvest application of chitosan and postharvest Aloe vera gel coating enhances quality of table grape (*Vitis vinifera* L. cv. 'Yaghouti') during postharvest period, *Food Chemistry*, Volume 347,2021, 129012, ISSN 0308-8146https://doi.org/10.1016/j.foodchem.2021.129012

Enciu (Bunicelu), D., Cătuneanu, I., Bădulescu L., Toma F., (2021) - Physiological parameters changes in hyacinth bulbs during cold storage. Scientific Papers. Series B, Horticulture. Vol. LXV, No. 2: 209-214, Romania.

FAO, 2020 - http://www.fao.org/faostat/en/#data/FBS

Haitao, J., Zhang, W., Li, X., Xu, Y., Cao, J., & Jiang W. (2021). The anti-obesogenic effects of dietary berry fruits: A review, *Food Research International*, Volume 147, 2021, 110539, ISSN 0963-9969, https://doi.org/10.1016/j.foodres.2021.110539.

Huwei, S., Asghari, M., Zahedipour-Sheshglani, P., & Alizadeh, M. (2021). Modeling and optimizing the changes in physical and biochemical properties of table grapes in response to natural zeolite treatment, *LWT,* Volume 141, 2021, 110854, ISSN 0023-6438, https://doi.org/10.1016/j.lwt.2021.110854.

Iliescu, L.M., Stănică F., Stan A., Bezdadea-Cătuneanu I.L., Mihai C.A. (2019). Fruits physico-chemical parameters of some romanian kiwifruit hybrids influenced by different cold storage technologies. *Fruit Growing Research*, Vol. XXXV: 104-115.

Lingling Zhang, Xingyan Li, Yaxing Pang, Xinyu Cai, Jun Lu, Xueyan Ren, Qingjun Kong (2021). Phenolics composition and contents, as the key quality parameters of table grapes, may be influenced obviously and differently in response to short-term high temperature, *LWT*, Volume 149, 111791, ISSN 0023-6438, https://doi.org/10.1016/j.lwt.2021.111791.

Mahanna, M., Millan-Linares, M.C., Grao-Cruces, E., Claro, C., Toscano, R., Rodriguez-Martin, N.M., Naranjo, M.C., & Montserrat-de la Paz, S. (2019). Resveratrol-enriched grape seed oil (*Vitis vinifera* L.) protects from white fat dysfunction in obese mice, *Journal of Functional Foods*, Volume 62, 2019, 103546, ISSN 1756-4646, https://doi.org/10.1016/j.jff.2019.103546.

Martins, V., Soares, C., Spormann, S., Fidalgo, F., & Gerós, H. (2021). Vineyard calcium sprays reduce the damage of postharvest grape berries by stimulating enzymatic antioxidant activity and pathogen defense genes, despite inhibiting phenolic synthesis, *Plant Physiology and Biochemistry*, Volume 162, 2021, Pages 48-55, ISSN 0981-9428, https://doi.org/10.1016/j.plaphy.2021.02.025.

Moura C., Masson M., Yamamoto C., (2005). Effect of osmotic dehydration in the apple (*Pyrus malus*) varieties Gala, Gold and Fuji. *Thermal Engineering*, vol 4: 46-49

Mureşan, E.A., Muste S., Borşa A., Vlaic R.A., Mureşan V., (2014). Evalution of physical-chemical indexes, sugars, pigments and phenolic compounds of fruits from three apple varieties at the end of storage period. *Bulletin UASVM Food Science and Technology*, 71(1): 45-50

Naouel, A., Genovese, F., Altieri, G., Tauriello, A., Trani, A., Gambacorta, G., Verrastro, V., & Carlo Di Renzo, G.C. (2018). Effect of ozone or carbon dioxide pre-treatment during long-term storage of organic table grapes with modified atmosphere packaging. *LWT,* Volume 98, 2018, Pages 170-178, ISSN 0023-6438.

Nicolosi, E., Ferlito, F., Amenta, M., Russo, T., & Rapisarda, P. (2018). Changes in the quality and antioxidant components of minimally processed table grapes during storage. *Scientia Horticulturae* (232), 175-183.https://doi.org/10.1016/j.scienta.2017.12.050

O.I.V. (2008b) - Resolution VITI 1/(2008). Organisation Internationale de la Vigne et du Vin: OIV Standard on Minimum Maturity Requirements for Table Grapes. Paris.

O.I.V., 2019 - https://www.oiv.int/en/oiv-life/oiv-2019).

O.I.V., 2020 - https://www.oiv.int/en/the-international-organisation-of-vine-and-wine/2020-oiv-research-grant-program.

Oltenacu, N., Lascăr E. (2015). Capacity of maintaining the apples quality, in fresh condition – case study.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 15, Issue 1: 331-335

Pomohaci, M., Vâşcă-Zamfir D. (2017). Elemente de biostatistică informatică aplicate în floricultură. Editura: Ex Terra Aurum, cap 3: 63-80

Rolle L., Torchio, F., Giacosa, S., & Río Segade, S. (2015). Berry density and size as factors related to the hysicochemical characteristics of Muscat Hamburg table grapes (*Vitis vinifera* L.). *Journal of Food Chemistry*, 173 (2015), 105-113.

Rotaru, L, Vasile, A., Nechita, C.B., Niculaua, M., & Colibaba, C. (2011). Modernizarea tehnologiilor de obținere și valorificare a strugurilor de masă prin implementarea sistemului european de calitate EUREPGAP. Ion Ionescu de la Brad Publishing House, Iași. ISBN 978-973-147-090-0, pp.277.

Saei, A., Tustin D.S., Zamani Z., Talaie A., Hall A.J. (2011). Cropping effects on the loss of apple fruit firmness during storage: The relationship between texture retention and fruit dry matter concentration. *Scientia Horticulturae*, 130: 256-265.

Skupień, K. (2006). Chemical composition of selected cultivars of highbush blueberry fruit (Vaccinium corymbosum L.). *Folia Horticulturae Ann*., 18/2: 47-56.

Stroe, M. (2012). *Ampelografie.* Editura Ceres, Bucureşti, ISBN 978-973-40-0943-5 (COD CNCSIS 236), 182, 184, 187, 194.

Stroe, M., Bejan, C. (2014). The influence of refrigerated storage on quality indicators of valuable varieties of grapes for the table. *Annals of the university of Craiova*, Vol. XIX (LV), 2014, Print ISSN 1453-1275, Cd-Rom ISSN 1453-1275, publishing House Universitaria, pag. 363-368. https://www.cabdirect.org/cabdirect/abstract/20153293515

Stroe, M., Bejan, C., Popescu, C.F. (2016). Research regarding of the technological parameters of some table grape varieties in the experimental field from U.A.S.V.M. Bucharest. *Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture*, vol. 73, no 1, ISSN 1843-5254.

Tahereh, F., Folgado, S.L., Pourbagher-Shahri, A.M., Ashrafizadeh, M., Samarghandian S. (2020). The therapeutic effect of resveratrol: Focusing on the Nrf2 signaling pathway, *Biomedicine & Pharmacotherapy*, Volume 127, 2020, 110234, ISSN 0753-3322, https://doi.org/10.1016/j.biopha.2020.110234.

Ticha, A., Salejda A., Hyšpler R., Matejicek A., Paprstein F., Zadak Z. (2015). Sugar composition of apple cultivars and its relationship to sensory evaluation. *Nauka. Technologia. Jakość*, 4(101): 137-150

Tolić, M., Jurčević I., Krbavčić K., Vahčić N. (2015). Phenolic Content, Antioxidant Capacity and Quality of Chokeberry (Aronia melanocarpa) Products. *Food Technologies and Biotechnologies*, 53(2): 171-179

Tyagi, K., Maoz I., Vinokur Y., Rodov V., Lewinsohn E., Lichter A. (2020). Enhancement of table grape flavor by postharvest application of monoterpenes in modified atmosphere, *Postharvest Biology and Technology*, Volume 159, 2020, 111018, ISSN, 0925-5214,https://doi.org/10.1016/j.postharvbio.2019.111018.

Yoon, K. Y., Woodams E. E., Hang Y.D. (2005). Relationship of acid phosphatase activity and Brix/acid ratio in apples. Lebensm.-Wiss. u.-Technol, 38: 181-183

https://www.vivc.de/index.php?r=site%2Findex

www.eurepgap.org

VEGETABLE GROWING

EX·TERRA·AVRVM