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THE INFLUENCE OF STORAGE IN CONTROLLED ATMOSPHERE ON QUALITY INDICATORS OF THREE BLUEBERRIES VARIETIES

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Abstract

The aim of this study was to determine which storage conditions can preserve the blueberry quality (Vaccinium corymbosum L.), stored in three different rooms with controlled atmosphere (CA). For this purpose, three varieties of blueberries, like Coville, Blueray and Chandler were stored and monitored for four months. Quality parameters like: dry matter content (D.M.%), titratable acidity (TA), soluble solids (°Brix), firmness, antioxidant capacity and also content in flavonoids, total polyphenols, total anthocyanins and ascorbic acid was monitored during storage period. The experiment conditions were based on the variation of carbon dioxide (CO_2) as follows: Room 1 (CO_2: 0%, representing the control), Room 2 (CO_2: 5%), and Room 3 (CO_2: 10%). Other common parameters of the experiment were: temperature (t°) 1 °C, oxygen quantity (O_2) 3%, relative humidity (RH) 95%. After four months of storage, observations showed that blueberries from Chandler variety presented better quality parameters compared to blueberries from Coville and Blueray varieties. Moreover, notable differences of physical and biochemical parameters were observed within the same blueberries variety stored in different rooms with controlled atmosphere conditions. Blueberries stored in Room 2 (T: 1°C, O_2: 3%, CO_2: 5%, RH: 95%) and Room 3 (T: 1°C, O_2: 3%, CO_2: 10%, RH: 95%) presented the best quality attributes compared with those stored in the other storage room (control), which would translate to a longer shelf life.

Key words*: blueberries, controlled atmosphere, storage, quality.*

INTRODUCTION

Since the Neolithic, blueberries (*Vaccinium* spp.) were consumed (Wang et al., 2017) at the beginning due to their wonderful taste sweet and sour and after centuries also for their biochemical composition (Wang et al., 2017) and health benefits (Liato et al.,2016). For this reason the production and consumption of blueberries has increased yearly and in recent years, they became one of the most popular horticultural products all over the world, second only after strawberries (Chen et al.,2015). They are sold fresh, processed, and in frozen form for various applications in food retail markets (Yang et al., 2014). Blueberries are appreciated for their taste, their high antioxidant activities, high and rich bioactive level contain of vitamins (C and E) (Liato et al.,2016), anthocyanins (Xu et al., 2016), polyphenolics (Liato et al.,2016), acids, tannins, mineral elements (Xu et al.,2016), chlorogenic acid, procyanidins (Chen et al., 2014) and flavonols (Wang et al., 2017).

Blueberries have antioxidant, anti-inflammatory, antimicrobial, anti-proliferative actions and they can be used in: type 2 diabetes (Shi et al., 2017), diabetic retinopathy (Song et al.,2016), cardiovascular and neuro-vegetative diseases, cancer (Liato et al.,2016), arthritis and obesity (Shi et al.,2017).

Due the increased production of fresh blueberries (Liato et al, 2017) from all over the world, a very important aspect is assuring and maintaining nutritional quality, and microbiological safety during storage and post-harvest sales (Liato et al.,2016).

Liato (2017) suggested that 95% of the blueberries production exhibit fungal contamination. Yang (2014) noticed that fresh blueberries rapidly deteriorate due to water loss and degradation of the fruit, usually caused by

fungi such as: Anthracnose (*Colletotrichum acutatum*), Alternaria (*Alternaria* spp.) and grey mold (*Botrytis cinerea*) (Yang et al., 2014). According to Chen (2015) fresh blueberries are highly perishable and they have between 1 and 8 weeks of shelf life, so it is very important how the methods of harvesting, storage and transport conditions are applied. Varela (2008) studied how long controlled atmosphere storage prolong shelf life of apples, until consumption with the following storage conditions: T=1^{o}C, O_2=2% and CO_2=2%, and the result was 7 months. Also it was observed that the loss of firmness is closely related to changes in cell wall composition and decrease in the total water soluble pectin (Chen et al., 2015). Firmness loss, which seriously reduces the commercial value of blueberries (Xu et al., 2016), can be slowed down by a bioactive, biocompatible and biodegradable polysaccharide such as chitosan (Yang et al., 2014). It acts as a barrier of water vapour to reduce the damage, reducing the loss firmness, decreasing mould growth and extending shelf-life (Yang et al., 2014) of strawberries and blueberries. Fungi can be significantly reduced by limited O_2 and increased CO_2 levels in the package (Yang et al.,2014) and in this way the quality of the texture can be maintained during storage (Chen et al.,2015). However, as Bessemans (2016) observed, the blueberries created storage disorders and an off-flavor by low oxygen content in rooms with controlled atmosphere, but Cortellino (2017) showed that firmness of the apples has been maintained better in low oxigen conditions. Francini (2013) suggests that the content of total phenols in apples had decreased during cold storage.

It was observed that the postharvest preservation technologies are applied to reduce damage, prolong shelf life, and keep the nutritional quality of several fruits and vegetables (Liato et al., 2017). Some of postharvest preservation technologies that can be used are: cold room storage, edible coatings, UV irradiation (Xu et al.,2016), packaging in a modified atmosphere (Yang et al.,2014), ozonation, and fumigation of sulphur dioxide (Yang et al.,2014), chlorine dioxide (Xu et al.,2016) (ClO_2 - strong oxidizing and sterilizing power).

The aim of these study was to determine which of the storage conditions of three different rooms with controlled atmosphere (CA), can better preserve the quality of blueberries (*Vaccinium corymbosum* L.).

MATERIALS AND METHODS

Fruits sampling and preparation

In order to accomplish the aim of this study three blueberry varieties (*Vaccinium corymbosum* L.) were used: Coville, Blueray and Chandler. These were acquired in August 2016 from Bilcesti, (Arges, Romania) and were selected by commercial maturity and the same ripening stage of fruits. Blueberries were packed in 250 g perforated trays that were then stored in three rooms with controlled atmosphere conditions from the Research Center for Studies of Food Quality and Agricultural Products - University of Agronomic Sciences and Veterinary Medicine of Bucharest. Temperature (t°) 1°C, oxygen (O_2) 3% and relative humidity (RH%) 95% was the same for all three rooms, but the CO_2 level was different. Thus, in room 1, which represents the control, the CO_2 concentration was 0%, CO_2 concentration in room 2 was 5%, and 10% in room 3 (Rizzolo et al., 2010). The study was conducted in 4 different moments as follows: initial moment (0), after 2, 3 and 4 months of storage in controlled atmosphere (CA). All samples were performed in duplicates.

For total flavonoid, total polyphenol and antiradical activity, the blueberry samples were extracted in 50% ethanol. For total anthocyanin acidified methanol was used (1.0% (v/v) hydrochloric acid in methanol) and for ascorbic acid the samples (5 g each) were extracted in 50 ml 9% metaphosphoric acid (MPA).

Physico-chemical analysis

The ***dry matter and water content*** of the samples were determined by oven drying for 24 hours at 105^{o}C using a UN110 Memmert oven, method used also by Moura (2005), Skupień (2006), Delian (2011), Corollaro (2014), Mureşan (2014), Ticha (2015). To determine the fruit firmness an electronic penetrometer

TR was used, and the results were expressed in kg/cm^2 (Chen, 2015).

Soluble solids were determined from blueberry juice (Yoon, 2005; Saei, 2011; Mureşan, 2014; Oltenacu, 2015), with refractive device Kruss DR301-95 (% Brix). The titratable acidity was determined by titration with 0.1N NaOH to pH 8.1 (DeEll, 1992; Yoon, 2005; Skupień, 2006; Saei, 2011).

Titratable acidity calculation was done using the formula: $\frac{F \times C \times a \times b \times 100}{b \times c}$, where F is the factor NaOH solution 0.1 N (1,002), C = coefficient of correction for citric acid (0.0064), a = quantity of 0.1 N NaOH titrated, b = volume of the extraction solution, c = mass of the sample. For titration with 0.1 N NaOH the automatic titrator TitroLine easy was used. The results were expressed in g citric acid/100g.

Total flavonoid content was determined after an aluminium chloride adapted method (Žilić, 2011; Shen, 2016; Li, 2017). 0.25 ml hydro-alcoholic extract was mixed with 1.25 ml of distilled H_2O and 0.075 ml of a 5% $NaNO_2$, after five minutes 0.075 ml of a 10% solution of $AlCl_3$ was added. After another six minutes 0.5 mL of 1M solution of NaOH was added, the final volume being 2.5 ml. The absorbance was read at wavelength λ = 510 nm. The total flavonoid content was expressed in M/ml in fresh weight.

Total polyphenol content was measured by colorimetric Folin-Ciocateu method after Skupień (2006), Khanizadeh (2008), Delian (2011), Mureşan (2014) and Drogoudi (2016), with some modification. 25 µl of a hydro-alcoholic extract were made up to 2 ml with distilled H_2O. 125 µl Folin - Ciocalteu and 375 µl of Na_2CO_3 (used for an alkaine environment) was added to the mixture. The final volume was 2.5 ml. The wavelength used for mesurements was λ = 750 nm. The total polyphenol content was expressed in M/ml in fresh weight.

Total anthocyanins content was measured with spectrophotometric absorbance at wavelength λ = 540 nm (Bărăscu et al., 2016), after an adapted method. The extracts were filtered under vacuum and completed up to 50 ml volume. The results were calculated using the formula: Total anthocyanins = DO_{540} x F, where DO_{540} is absorbance at wavelength λ = 540 nm and factor F = 11.16. The total anthocyanins content was expressed in mg/100g in fresh weight.

For evaluation of ***antiradical activity*** an indirect DPPH-radical scavenging activity spectrophotometric method was used (Khanizadeh, 2008; Mureşan, 2014; Drogoudi, 2016). 0.5 ml hydro-alcoholic extract was mixed with 1 ml of 0.1 mM DPPH solution. The results were calculated using the formula: AA_{DPPH} (%) = $\frac{A\ control - A\ sample}{A\ control}$ x 100, where $A_{control}$ is absorbing control sample (containing all reagents except extract) and A_{sample} is the sample absorbance. The absorbance was measured at wavelength λ = 515 nm. The evaluation of antiradical activity was expressed in % in fresh weight.

All determinations described above were performed with Specord 210 Plus spectrophotometer.

Ascorbic acid content was determined with HPLC – Agilent Technologies 1200 Series equipment, using an ZORBAX Eclipse XDB-C18 (4.6x50 mm, 1.8µm) column with Rapid Resolution HT and a detector UV-DAD detection wavelength 220/30 nm, reference wavelength 400/100 nm. Mobile phases were A= 99% (ultrapure water with H_2SO_4 up to 2.1 pH) and B= 1% (acetonitrile with 10% A). The samples were filtered through a filter Agilent PTFE 0,2 µm. The injection volume was 2 µl, with 4 min post time, flow rate at 0.5 ml/min at 30 ^oC in column compartment. The samples were analysed in duplicate and were expressed in mg/100g. Ascorbic acid calculation was done using the formula: $\frac{a \times b \times 100}{c}$, where a=ascorbic acid content in mg/ml , b= solution extraction volume (ml) and c= working mass of the sample taken (g).

RESULTS AND DISCUSSIONS

Blueberries fruit quality is assessed by the following indicators: firmness, dry matter, water content, soluble solids and titratable acidity. The quality indicators were different both at harvest and during storage for all the blueberry varieties.

The dry matter and water content of Coville variety had small variations during storage compared to initial moment (0) (Table 1),

observing more fluctuations in the control room (CO_2 - 0%).

The water content and the titratable acidity (TA) had the highest value after three month of storage in the room 2 (CO_2 - 5%).

For Coville variety stored in room 1 (control) the soluble solids content had the maximum value after two months of storage and the dry matter and firmness after three months of storage compared to the other two rooms.

Table 1.Variation of firmness and content of: dry matter, water, TA and soluble solids during storage period in CA for Coville variety

Sample	Time of analysis	Dry matter content(D.M.%)	Water content (%)	Titratable acidity (g acid citric/100 g)	Soluble solids (% Brix)	Firmness (kg/cm^2)
Coville	17.08.2016	14.334	85.666	1.016 ± 0.009	10.420 ± 0.751	0.294 ± 0.032
Coville room1	13.10.2016	13.870	86.130	1.087 ± 0.002	11.670 ± 1.063	0.383 ± 0.103
Coville room2	13.10.2016	14.366	85.634	1.061 ± 0.001	11.160 ± 1.251	0.293 ± 0.071
Coville room3	13.10.2016	14.256	85.744	0.889 ± 0.005	9.920 ± 1.396	0.255 ± 0.042
Coville room1	22.11.2016	15.121	84.879	1.136 ± 0.021	10.820 ± 1.434	0.384 ± 0.062
Coville room2	22.11.2016	13.217	86.783	1.302 ± 0.005	10.660 ± 2.219	0.333 ± 0.063
Coville room3	22.11.2016	13.778	86.222	1.092 ± 0.003	9.440 ± 1.608	0.329 ± 0.092
Coville room 1	12.12.2016	14.907	85.093	0.967 ± 0.022	10.470 ± 1.589	0.341 ± 0.074
Coville room 2	12.12.2016	14.794	85.206	1.161 ± 0.001	10.570 ± 1.455	0.257 ± 0.044
Coville room 3	12.12.2016	13.829	86.171	1.105 ± 0.001	10.280 ± 1.605	0.268 ± 0.090

In table 2, for Blueray variety, it has been observed that the content of dry matter and water had some variation during storage in comparison with the initial moment.

Blueray variety stored in rooms 1 and 2 have lost turgidity towards the end of storage period. Titratable acidity (TA) and soluble solids content have different values during storage, compared to initial moment (0). The soluble solids content from room 3 (CO_2 - 10%) and titratable acidity in all 3 rooms registered an increase in comparison with the initial moment (0) (Yang et al., 2014). Also, there was an increase in firmness in room 1 (CO_2 - 0%) after two months of storage. In room 2 and 3 the firmness value was close to the initial moment (0), the maxim firmness of the fruits was recorded after three months of storage.

Table 2.Variation of firmness and content of: dry matter, water, TA and soluble solids during storage period in CA for Blueray variety

Sample	Time of analysis	Dry matter content(D.M.%)	Water content (%)	Titratable acidity (g acid citric/100 g)	Soluble solids (% Brix)	Firmness (kg/cm^2)
Blueray	17.08.2016	11.458	88.542	0.620 ± 0.009	8.400 ± 1.339	0.243± 0.063
Blueray room 1	13.10.2016	12.251	87.749	0.780 ± 0.001	9.370 ± 1.434	0.303± 0.069
Blueray room 2	13.10.2016	11.042	88.958	0.751 ± 0.003	8.430 ± 1.318	0.268± 0.063
Blueray room 3	13.10.2016	11.265	88.735	0.792 ± 0.008	9.120 ± 1.989	0.259± 0.049
Blueray room 1	22.11.2016	13.956	86.044	0.856 ± 0.001	8.688 ± 1.698	0.256± 0.069
Blueray room 2	22.11.2016	13.909	86.091	0.818 ± 0.003	9.040 ± 0.873	0.338 ± 0.075
Blueray room 3	22.11.2016	11.879	88.121	0.705 ± 0.005	10.400 ± 1.268	0.283 ± 0.124

Table 3 shows that the dry matter and water content for Chandler variety had small variations in room 2 and 3 from the initial moment (0) compared with room 1 (control). For control room (CO_2 - 0%) it have noted more fluctuations. Titratable acidity (TA) values were maintained with small variations during storage (Yang et al., 2014).

Table 3.Variation of firmness and content of: dry matter, water, TA and soluble solids during storage period in CA for Chandler variety

Sample	Time of analysis	Dry matter content(D.M. %)	Water content (%)	Titratable acidity (TA)(g acid citric/100 g)	Soluble solids (% Brix)	Firmness (kg/cm^2)
Chandler	17.08.2016	12.693	87.307	0.851± 0.009	7.390±1.480	0.079 ± 0.047
Chandler room 1	13.10.2016	13.297	86.703	0.836 ± 0.002	10.050±1.706	0.322 ± 0.037
Chandler room 2	13.10.2016	11.604	88.396	0.909 ± 0.002	10.370±1.113	0.272 ± 0.049
Chandler room 3	13.10.2016	12.413	87.587	0.889 ± 0.005	10.170±1.501	0.274 ± 0.064
Chandler room 1	22.11.2016	13.381	86.619	0.863 ± 0.014	9.560±1.692	0.280 ± 0.035
Chandler room 2	22.11.2016	12.626	87.374	0.833 ± 0.001	10.725±1.320	0.340 ± 0.062
Chandler room 3	22.11.2016	11.352	88.648	0.858 ± 0.003	9.440±1.665	0.315 ± 0.036
Chandler room 1	12.12.2016	11.216	88.784	0.820 ± 0.003	8.750±1.925	0.320 ± 0.049
Chandler room 2	12.12.2016	13.554	86.446	0.857 ± 0.001	9.830±0.953	0.333 ± 0.053
Chandler room 3	12.12.2016	12.686	87.314	0.759 ± 0.001	9.750±0.977	0.278 ± 0.049

A noticeable increase in soluble solids content in all rooms throughout storage can be observed. For the firmness of Chandler variety fruits, an important increase in all rooms throughout the storage period from the initial moment (0) has been observed.

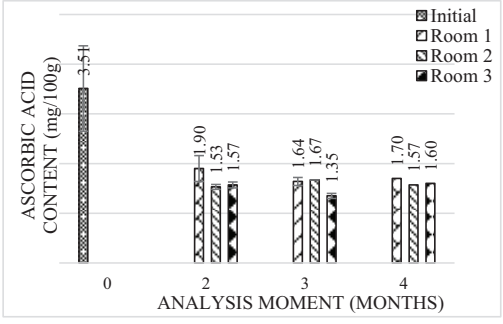

Figure 1. Variation of ascorbic acid content (mg/100g) during storage period in CA for Coville variety where: 0-initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage, 4 - analyses after 4 months of storage

The ascorbic acid content of Coville variety (Figure 1), has declined during storage. Between the three type of storage, there were small differences.

Also at Bluray variety (Figure 2) low values during storage were determined when compared with the initial moment.

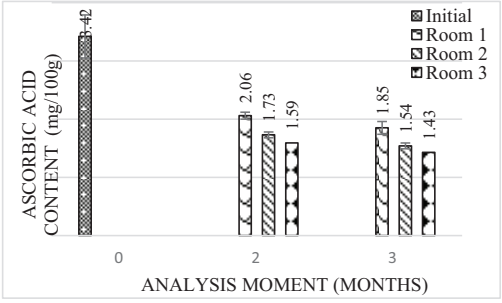

Figure 2. Variation of ascorbic acid content (mg/100g) during storage period in CA for Blueray variety where: 0 - initial moment, 2 – analyses after 2 months of storage, 3- analyses after 3 months of storage

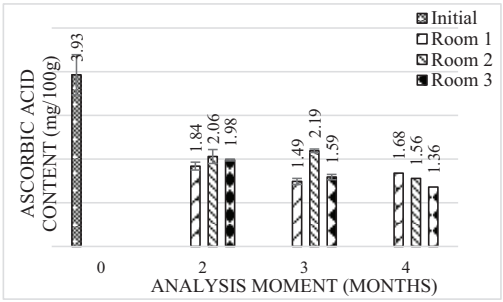

Figure 3. Variation of ascorbic acid content (mg/100g) during storage period in CA for Chandler variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage, 4 - analyses after 4 months of storage

In room 1 (CO_2 - 0%) higher values from all the storage variants were present. At Chandler variety (Figure 3) higher values of ascorbic acid content during the storage in the case of room 2 (CO_2 - 5%) were observed.

Koyuncu (2010) showed that the ascorbic acid content of the fruits progressively drops during storage in cold rooms with T: 1 °C and RH: 95%.

Anthocyanins are water-soluble pigments and belong to flavonoid group. They have a very high antioxidant capacity and are responsible for the color in red-purple fruits.

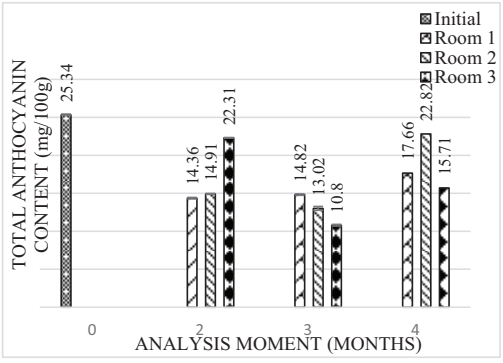

Figure 4. Variation of total anthocyanin content (mg/100g) during storage period in CA for Coville variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage, 4 - analyses after 4 months of storage

The fruits content of anthocyanins can also correlate with the antioxidant capacity (Matityahu, 2016).

Coville variety had the best results regarding total anthocyanins content after four months of storage in the room 2 (CO2 - 5%), while for the fruits stored two months the decrease in anthocyanins was at half comparative to the initial moment (Figure 4).

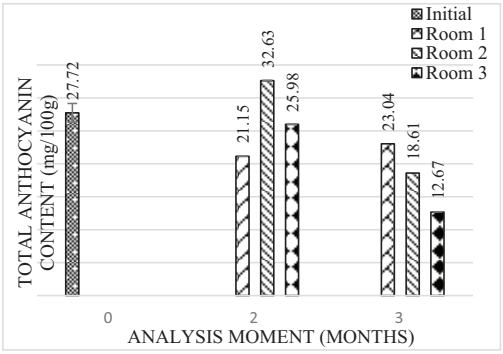

Figure 5. Variation of total anthocyanin content (mg/100g) during storage period in CA for Blueray variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage

After two months of storage in controlled atmosphere from room 2, the total anthocyanins content for Blueray variety registered an increase with 17% compared to the initial moment. After three months of storage, total anthocyanins content value was lower compared to the registered value from the initial moment (Figure 5).

At Chandler variety (Figure 6), the total anthocyanins content increased during storage in room 1 (CO_2 - 0%) having the highest value after two months of storage.

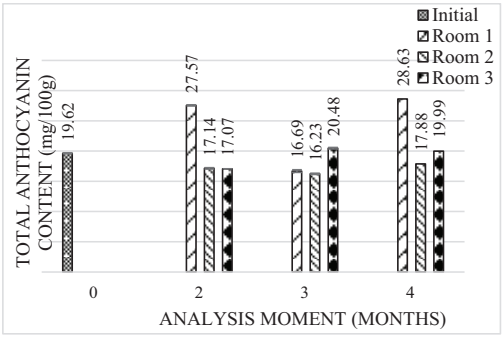

Figure 6. Variation of total anthocyanin content (mg/100g) during storage period in CA for Chandler variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage, 4 - analyses after 4 months of storage

The values of anthocyanins content of the fruits from room 3 were comparable to the ones from the initial moment.

Higher values of the total anthocyanins content towards initial moment, indicate that at low temperatures post-ripening process of fruits continues (Matityahu, 2016). The fruits from rooms with CO_2 had total anthocyanins values content close to the initial moment.

The content of total polyphenols in the blueberries of the 3 varieties studied, increased gradually towards the initial moment throughout storage. At the Coville variety (Figure 7) lower values were observed at the end of the storage in room 3 (CO_2 - 10%) compared to other rooms.

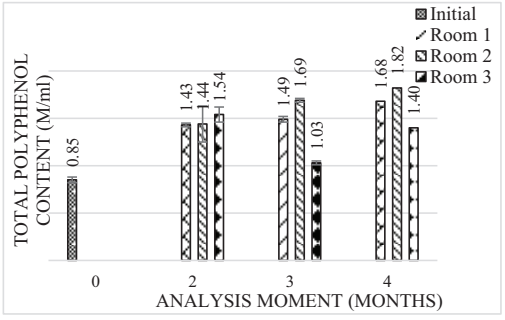

Figure 7. Variation of total polyphenol content during storage period in CA for Coville variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage, 4 - analyses after 4 months of storage

Blueray variety (Figure 8) recorded a lower total polyphenol content in rooms 2 and 3 (with CO_2) compared with the blueberries from room 1 (without CO_2) after 2 and 3 months of storage.

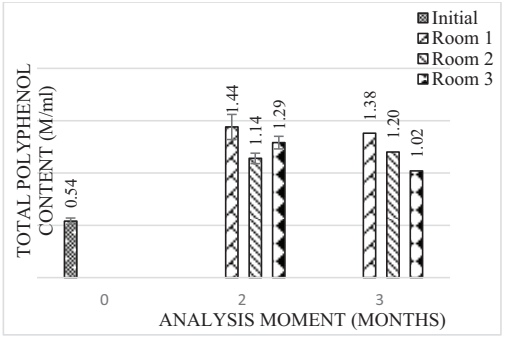

Figure 8. Variation of total polyphenol content during storage periodin CA for Blueray variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage

For Chandler variety (Figure 9) in room 1 (without CO_2) there was a progressive increase of total polyphenol content. Yang G. (2014) suggests that this increase in polyphenol content during storage is a process of maturing fruits which were picked when they were not at fully maturity for consumption.

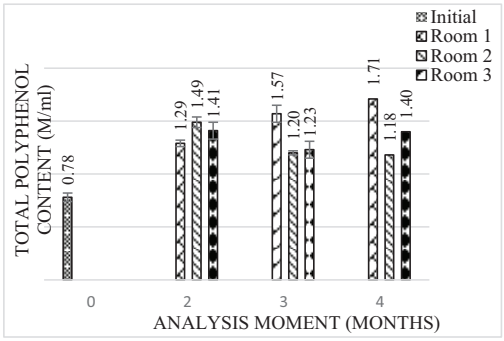

Figure 9. Variation of total polyphenol content during storage period in CA for Chandler variety where: 0 -initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage, 4 - analyses after 4 months of storage

The total flavonoid content of Coville variety (Figure 10) has recorded lower values for all three rooms in 2, 3 and 4 months compared with the value from the initial moment.

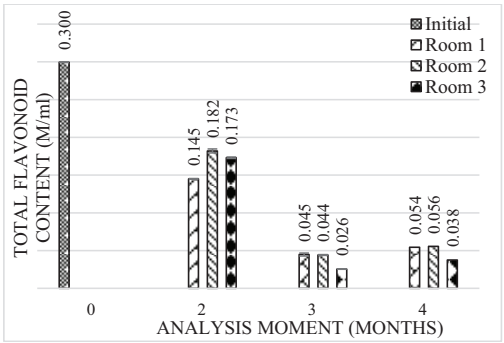

Figure 10. Variation of total flavonoid content during storage period in CA for Coville variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage, 4 - analyses after 4 months of storage

The highest content in flavonoids for Blueray variety (Figure 11) was noticed in room 1 (without CO_2) after two months of storage.

The Chandler variety (Figure 12) maintained the flavonoids content after two months of storage in room 1 (CO2 - 0%) and 2 (CO2 - 5%), and in room 3 (CO2 - 10%) a small decrease of the values was recorded.

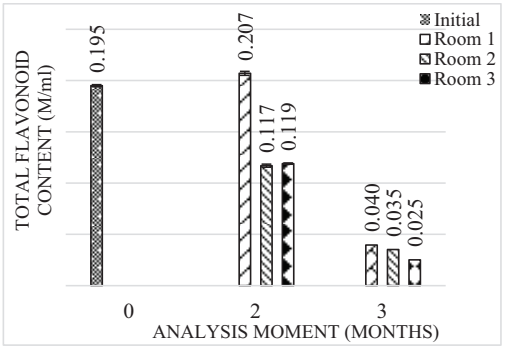

Figure 11. Variation of total flavonoid content during storage period in CA for Blueray variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage

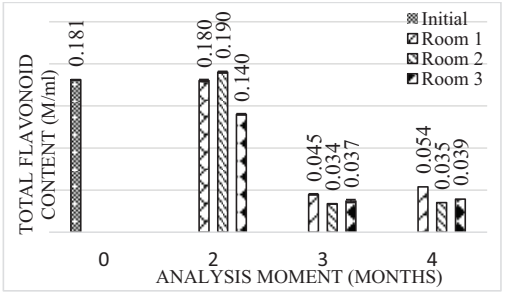

Figure 12. Variation of total flavonoid content during storage period in CA for Chandler variety where: 0 -initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage, 4 - analyses after 4 months of storage

All varieties studied showed an important antioxidant capacity. Coville variety (Figure 13) recorded lower values for antioxidant activity in room 1 (CO_2 - 0%) and room 2 (CO_2 - 5%) after 2 months of storage, compared to the value of the initial moment.

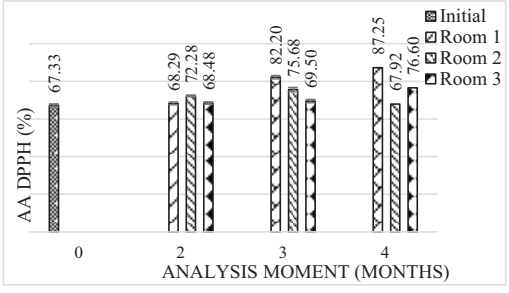

Figure 13. Variation of AA DPPH(%) content during storage period in CA for Coville variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage, 4 - analyses after 4 months of storage

Blueray variety (Figure 14) recorded lower values for the antioxidant activity in all three rooms at 2 and 3 months compared to the value of the initial moment.

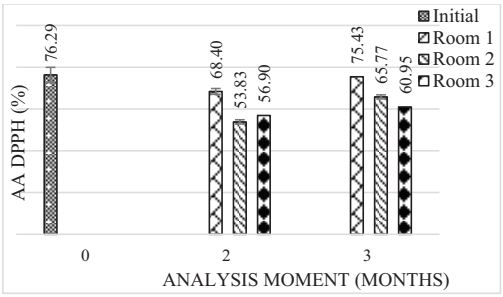

Figure 14. Variation of AA DPPH(%) content during storage period in CA for Blueray variety where: 0 - initial moment, 2 - analyses after 2 months of storage, 3 - analyses after 3 months of storage

Chandler variety (Figure 15) had the strongest antioxidant activity after four months of storage in the room 1 (without CO_2).

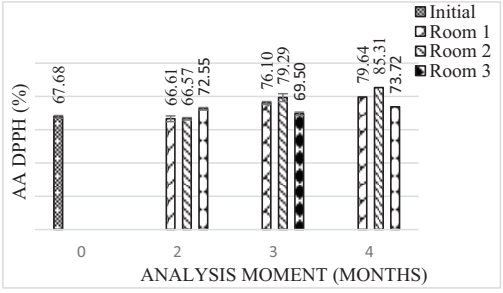

Figure 15. Variation of AA DPPH(%) content during storage period in CA for Chandler variety where: 0 -initial moment, 2 - analyses after 2 months of storage, 3analyses after 3 months of storage, 4 - analyses after 4 months of storage

CONCLUSIONS

The storage in rooms with controlled atmosphere influenced, as expected, fruit quality parameters. It can be noted that all varieties of samples did not have the same level of maturity at harvest, Coville and Blueray varieties being collected at the end of the harvest, while Chandler variety was collected midterm harvest. Because of that, Chandler variety behaved much better during the four months of storage compared to the other two varieties, maintaining much better visual, organoleptic and economical properties.
In the case of antioxidant capacity of Coville and Chandler it was observed that room 3 (CO_2 - 10%) had a slight increase towards the end of the storage period suggesting that metabolic

processes in fruit were slowed down due to higher CO_2 content.

The varieties behaved differently, observing for example the content of ascorbic acid. The Coville and Blueray varietes behaved better in the room without CO_2 while for the variety Chandler observations concluded that it maintained a higher quantity of ascorbic acid in room 2 (CO_2 - 5%).

Following the obtained results, we can specify that the varieties of the same species (blueberry - *Vaccinium corymbosum* L.) requires different storage conditions depending on crop technology applied and harvesting moment.

The post ripening continued in all rooms but was slowed down in rooms 2 and 3 (with CO_2) compared to room 1 (without CO_2). Small differences were observed in flavonoids and ascorbic acid content of the blueberries between the two rooms with CO_2 (room 2: 5% and room 3: 10%).

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