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EFFECT OF STORAGE METHOD ON POSTHARVEST QUALITY OF HIGHBUSH BLUEBERRY

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ABSTRACT

Highbush blueberry fruits (*Vaccinium corymbosum* L.) are highly perishable and must be marketed soon after picking. Applying modern techniques of storage, fruit harvested in a particular season, may be consumed months later, preserving decay and quality. Therefore, in order to guarantee a top quality product and to lengthen its shelf-life, it is of primary importance to develop suitable storage techniques. The purpose of this work was to investigate the influence of postharvest method to maintain berry quality. Blueberry samples were stored for 6 weeks in Normal Atmosphere (3°C, 90-95% R.H.) and in Modified Atmosphere (3°C, 90-95% R.H.+0.3 ppm of O_3). During postharvest period firmness was measured with Durofel® instrument and with a Texture Analyzer TAXT2i®. To evaluate berry quality, total soluble solids content, titratable acidity and pH were measured. Little or no quality advantage was evident with the use of ozone on fruit firmness, soluble solid content and acidity. During postharvest storage Normal Atmosphere treatment was more effective to lengthen blueberry shelf-life compared to Modified Atmosphere. These preliminary results showed that ozone treatments seems to be no effective to extend postharvest life of blueberry fruit.

Key words: titratable acidity, bluecrop, Durofel®, R.S.R., Texture Analyzer TaxT2i®

INTRODUCTION

Highbush blueberry culture is increasing in Piedmont Region due to its high market profitability and nutritional value (Bounous *et al.*, 2005). But blueberry is a non-climateric fruit and it must be harvest at full maturity to achieve the maximum quality in relation to flavour and colour. As a consequence, blueberries should be harvested ready to consumption. For this reason cold storage and innovative atmospheres have been used to extend marketing season, reduce losses and increase profitability (Machado *et al.*, 2004, NeSmith *et al.,* 2005).

Ozonation is a new technology that can be used to reduce the decay of fresh fruits and sanitize the produce, but results have been variable (Forney *et al.*, 2001, Palou *et al.,* 2001).

The main characteristics related to the quality of ripe blueberry fruit are texture, flavour and colour. Change in texture is a consequence of the natural process of senescence and also of the atmosphere in which the fruit is stored (Sanford *et al.,* 1991).

The aim of this work was to study how texture and quality attributes of Blueberry fruits changes during 6 weeks of cool storage and to investigate the influence of ozone to maintain berry quality.

MATERIALS AND METHODS

The trial was carried out during the summer of 2004, using the highbush blueberry cultivar Bluecrop. Berries were harvested by hand from commercial plantings situated in Cuneo Province (Piedmont region, north-west of Italy), placed directly into plastic clamshell containers and cold stored under two different storage conditions:

✓ Traditional storage (N.A.): normal atmosphere (3°C, 90-95% of R.H.);

✓ Innovative storage (M.A.): modified atmosphere (3°C, 90-95% of R.H. + 0,30 ± 0,05 ppm O_3). Ozonation was created by AgroCare™ (Grupo Interozone, Cile).

Firmness was evaluated at each picking date and once a week during storage by:

✓ a penetrometer test by Durofel® (Copa Technologie), a dynamometer with a bolt of 3 mm ∅ (0.10 cm^2), on a scale of 1 (soft) to 60 (firm), a rapid nondestructive instrument;

✓ a penetrometer test by TA-XT2i Texture Analyzer® (Stable Micro System) equipped with a 5 Kg loadcell. The probe penetrated 3 mm into the berry at a crosshead speed of 3 mm/s, with P-3mm Dia Cylinder Stainless probe. Force max (N) of penetration was calculated.

For chemical measurements of soluble solid content (°Brix), titratable acidity (meq/l) and pH, 100g samples were weighted and centrifuged (Rotofix 32) at 3000 rpm for 10 min at 20°C. Soluble solid content was measured by placing a few drops of the filtered juice on an digital refractometer PR-32 α (Atago). Titratable acidity and pH were measured by titrating 1:10 diluted juice using 0.1 N NaOH by an automatic titrator (Compact 44-00, Crison).

Data were analyzed using the analysis of variance (ANOVA), Tukey's test HSP was used to determine significant differences among treatment means. Means values were considered significantly different at $P \leq 0.05$. Data was analysed using the program package STATISTICA ver. 7.1 (Statsoft Inc., Tulsa, OK, USA).

RESULTS AND CONCLUSION

As expected, decrease in firmness occurred throughout the storage period regardless of the treatment due to the normal softening of the tissues associated with senescence of the fruit. In particular, M.A. treatment showed significant reduction in the firmness of the berries during postharvest storage period. Data in figure 1 report the results of measurements of force max of penetration (N) by TA-XT2i associated with storage conditions and postharvest weeks. Both sets of data (N.A. and M.A.)

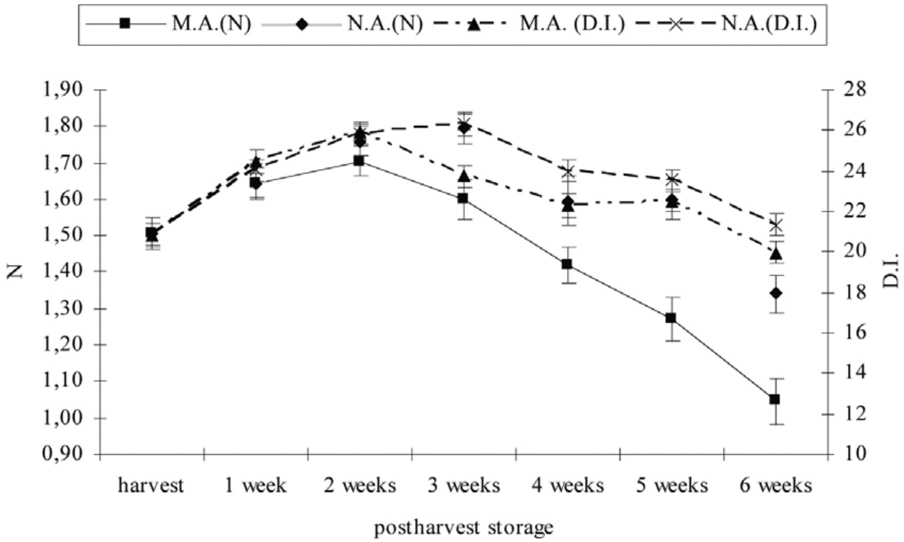

Fig. 1. Fruit firmness as a function of postharvest storage. The figure shows the mean values and the standard error of force max (N) by TA-XT2i and Durofel Index (D.I.) by Durofel instrument. Samples stored in Normal Atmosphere (N.A.) and Modified Atmosphere (M.A.).

shows an apparent rise in force during the first two weeks of storage, but began to fall significantly later in the postharvest weeks. The rate of fall decreased and almost levelled out in the last weeks of storage in particular in the samples stored in N.A.. This trend is probably due to the lost of moisture during the first weeks of postharvest storage due to transpiration and respiration. Similar results are obtained by Durofel Index (fig.1). Wide variability of a same fruit sample, in particular for the firmness measured by TA-XT2i® (fig. 1) is present and it is caused by the higher sensibility of this instrument and the high fruit variability. Probably due to the high fruit variability there are not significant difference ($p<0.05$) for firmness of fruits between the two atmosphere/storage methods. Firmness values covered the range of 0.75 to 2 N for samples stored in M.A., and 0.85 to 2.1 N for N.A.. These results are in disagreement with other experiments (Guzel-Seydim *et al.*, 2004; Machado *et al.*, 2004; Palou *et al.*, 2001) but the effectiveness of ozone may vary significantly depend on treatment concentration, treatment length and produce physiology (Song *et al.*, 2003).

Storage methods evaluated had no detectable effect on chemical parameters. According with Ristow *et al.*, (2004), in general, solid soluble content and titratable acidity were not affected by storage treatment with ozone.

Total soluble solid content increase during postharvest storage, and is higher in the samples stored in M.A. (tab. 1). Statistical testing show no significant differences between the two type of storage methods; only berries stored for five weeks in M.A. were more sweet as compared with other samples (tab.1). Titratable acidity of the blueberries is an indicator of potential storage quality, and decline gradually over the storage period (Spayd *et al.*, 1990).

In this work, only the first week of storage showed significant differences among treatments; in the other weeks of storage, titratable acidity values recorded were decreased similarly in the two storage conditions evaluated. The pH values showed the same tendency, increased corresponding with the slight decline in T.A. during storage in either type of storage method.

Table 1. Effect of storage time and conditions on quality parameters. R.S.R. (°Brix), T.A. (meq/l).

	harvest	*1 week*	*2 weeks*	*3 weeks*	*4 weeks*	*5 weeks*	*6 weeks*
R.S.R.							
N.A.	10.19	9.62n.s.	10.54n.s.	10.17n.s.	10.68n.s.	10.2b	10.69n.s.
M.A.	10.19	9.57n.s.	10.18n.s.	9.88n.s.	11.08n.s.	11.67a	10.97n.s.
T.A.							
N.A.	189.74	163.7a	154.49n.s.	147.46n.s.	119.38n.s.	124.64n.s.	125.75n.s.
M.A.	189.74	141.52b	151.11n.s.	150.45n.s.	124.65n.s.	131.36n.s.	139.29n.s.
pH							
N.A.	2.51	2.57n.s.	2.67a	2.68n.s.	2.76n.s.	2.76n.s.	2.75n.s.
M.A.	2.51	2.58n.s	2.59b	2.69n.s.	2.73n.s.	2.74n.s.	2.74n.s.

Means separated by Tukey's test. Means in columns with different letters are significantly different at $p \leq 0.05$.

Ozone treatment seem to be not effective in preserve blueberry quality and extend postharvest life. There was no detectable effect of ozone on fruit firmness, soluble solid content and acidity. Further investigation of ozone storage may be useful to clarify the actual response on berry quality and also to evaluate the effect of ozone on the development of the most important postharvest pathogens of blueberry.

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