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Mineral content of apples stored in refrigeration conditions and controlled atmosphere conditions respectively for 6 months

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Abstract

Fruit quality characteristics such as color, firmness and storage potential have long been known to be related to the concentrations of certain fruit minerals [1]. Fruitlet analysis allows commercial fruit growing, packing and marketing operations to take advantage of these known relationships and increase profit margins by supplying information that can be used to increase fruit quality and reduce storage losses and market claims. Considering the importance of nutrient levels for the success of long term storage, mineral analysis of fruit allows us to determine the concentration of these elements. This paper presents a brief overview of the mineral content of some Romanian apples stored in refrigeration and controlled atmosphere conditions for 6 months.

Keywords: storage, apples, refrigeration conditions, mineral content

1. Introduction

Apple is one of the most important deciduous fruits that shows great success and is widespread all over the world. [2]

One of the goals for any marketing plan is to provide the market with fruit of the highest quality and condition throughout the entire season. Apples must be held in storage for different lengths of time to facilitate an orderly marketing season. Apple quality and maturity must be monitored throughout the storage duration to assure that apples of the highest quality reach the marketplace. [6]

Nutritive effect of the fruits and their importance for food industry depends first of all of their chemical composition. Chemical composition of fruits depends of the type of fruit, species, environmental conditions and processing. Fresh fruits contain high amounts of minerals (0.25-2.10%) in the cellular juice. [3]

During apple cold storage changes occur that may have negative effect on their quality. That implies an increase in costs due to waste and the need of repacking. A large part of the damages are correlated with apples' nutrient content at harvest, but disorders are often seen after storage. [4]

In fruit composition we can find more than 50 chemical elements from Mendeleev table. The most important mineral found in fruits are K, Ca, Mg, Fe, Cu, Mn, Zn, Na etcetera.

In this article the mineral compositions of seven apples varieties from Reghin and Insuratei stored in refrigeration conditions and controlled atmosphere conditions respectively, for six months were determined.

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2. Materials and Method

For the determination of mineral composition in apples we used Romanian apples harvest from Reghin (Starkimson, Golden, Gala, Jonathan) and Insuratei (Fuji, Golden and Pinova). The mineral composition was determined using an atomic absorption spectrophotometer GBC AVANTA. The samples were prepared for analysis and the metallic ions were determined according to the method developed by Bioresources Institute.

Fruit mineral analysis is a difficult topic, because of the abundance of published papers and the often conflicting or inconclusive results. [7] Centro de Pomáceas has found relationships of some of minerals with the incidence of physiological disorders in fruit during storage. The most relevant elements involved have been Ca and its antagonists (Mg and K). Not only a deficit, but also an excess of these nutrients has been associated with diverse symptoms: bitter pit, lenticels breakdown and stem-end splitting. [8]

Calcium is perhaps the most important mineral determining the quality of fruit, particularly in apples because these fruits are stored for long periods of time. [5] A number of apple disorders are associated with low fruit calcium levels. Varieties of apples which are more chilling sensitive (Cox, Jonathan, Spartan, etc.) appear more susceptible to calcium related disorders. Also, increasing the amount of calcium in the fruit reduces the incidence of disorders. In most cases, researchers have been able to find reasonably good correlations between low calcium and disorders. [7] Ca deficiency is responsible for bitter pit; i.e. brown depressions located towards the calyx-end of the fruits. [8]

Given the varieties of apples grown in Romania, researchers have been unable to establish consistent correlations between fruit calcium and fruit quality. Because calcium varies from fruit to fruit, researchers have been unable to determine the specific calcium threshold below which the fruit is at a high risk for disorders or poor quality out of storage. [7]

The calcium content determined in our samples is presented in figure 1. In can be easily observed that the highest calcium amount was found in Gala apples and the lowest, in Jonathan apples respectively.

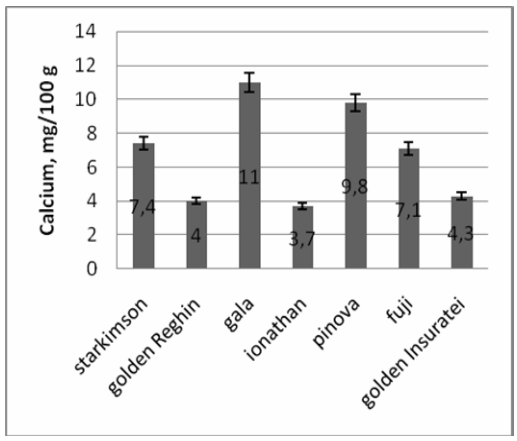

Figure 1. The calcium content of the apples

Kalium is the most representative mineral found in apples. Its presence is important because of the acidic-basic equilibrium in cells maintaining and of the enzymatic activity. [3] In the samples analyzed, the Kalium content varies between 950 and 2900 mg/100 g. (figure 2).

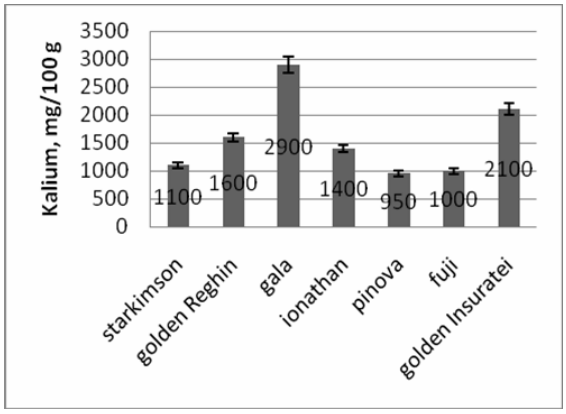

Figure 2. The kalium content of the apples

Sodium is important for the osmotic equillibrium maintaining in living organisms. In the apples analyzed, the sodium content is low, between 2.5 and 3.6 mg/100 g. (figure 3).

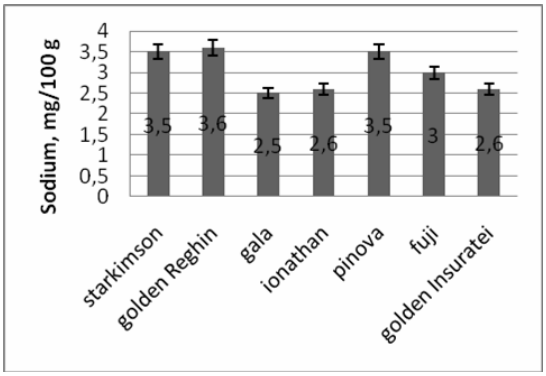

Figure 3. The sodium content of the apples

Magnesium is very important both for humans and plants.

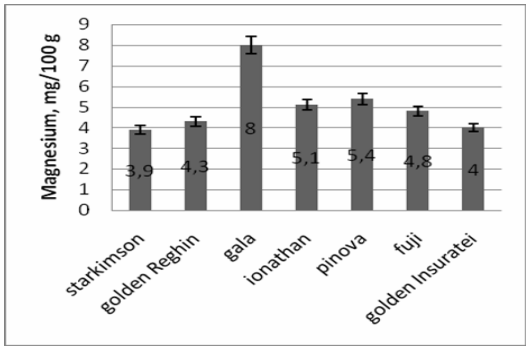

Figure 4. The magnesium content of the apples

Magnesium deficiency produces a distinct yellowing of the leaf tip and margin with characteristic, dark, green arrow tip effect. With severe deficiency, marginal leaf scorch can also occur. [9] The magnesium content of the sample is highest for Gala apples. (figure 4)

Lately, scientist demonstrated that microelements like iron, zinc, manganese, copper are very important for human body. Fruits, and apples, are one of the main sources for these microelements. [3]

Iron participate to substaces exchange in organism. In apples, iron is present too, having 1.8 mg/100g concentration. In our samples the iron amount is lower, between 0.2 and 0.9 mg/100g. (figure 5).

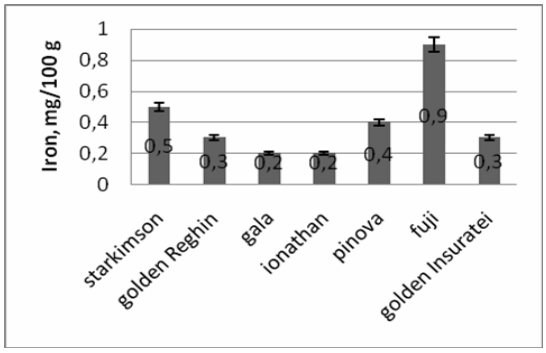

Figure 5. The iron content of the apples

Zinc is the microelement important for chlorophyll synthesis and vitamins synthesis also for glucids and protein metabolism and stimulates enzymatic activity. Zinc deficiency conducts to lower fruit crops and lower fruit quality. [3] Zinc deficiency can result in die back of leaders or shortened internodes and small leaves. Low zinc uptake may reduce tree health and yields even though there are no obvious visual symptoms. [9]

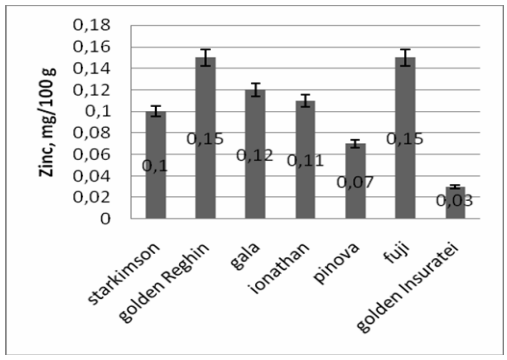

Figure 6. The zinc content of the apples

In the samples analyzed, the zinc content is lower than normal (0.25 mg/100g) as it can be observed in figure 6.

The manganese deficiency is typically seen as pale areas on the leaf between darker green veins. Manganese toxicity may be seen on some trees and fruits. Symptoms may include necrotic spots, or measles, on or under the bark. In the samples analyzed, the manganese content is higher than the data from literature (0.016 mg/100g). (Figure 7)

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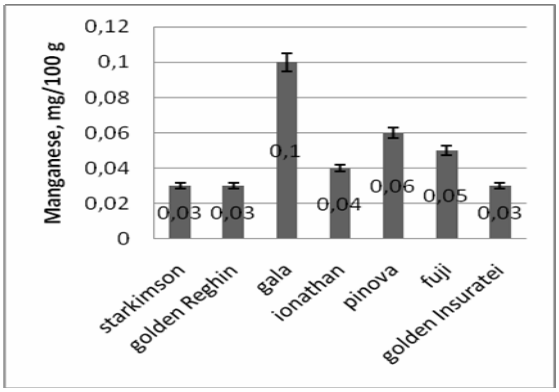

Figure 7. The manganese content of the apples

The copper, lead and cadmium content were also determined, but in the apples analyzed these minerals were not detectable.

4. Conclusion

The mineral content of the fruits analyzed is much lower than the data from literature. This is due to the long storage period of the apples in different storage conditions. The zinc and iron content, as it could be observed, is lower in our samples than the data given by specialty literature. Also, in the analyzed samples the hard metals were not present in detectable amounts.

It couldn't be established the bond between the mineral content and the storage conditions because of the different apples varieties used for analyses.

Acknowledgement

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References

1. Boynton, D. 1954. Apple nutrition. In Childers, N.F. (ed.) Mineral Nutrition of Fruit Crops. Somerset Press, Somerville, NJ. pp.1-78
2. Wolk, W.D., Practical application of fruitlet mineral analysis, 13th Annual Postharvest Conference, march 1997
3. Jamba, A., Carabulea, B, Tehnologia pastrarii si industrializarii produselor horticole, Ed. Cartea Moldovei, Chisinau, 2002
4. Moggia, C., Pereira, M., Apple mineral content vs. quality, Pomaceas – Technical Bulletin, vol. 8, no. 2, march 2008
5. Garcia, M.E., Calcium use in apples: an update, The University of Vermont, presentation
6. Thompson, J., Delicious harvest maturity and storage, 15th Annual Postharvest Conference, March, 1999
7. Kupferman, E., Fruit mineral analysis – an update, Postharvest Pomology Newsletter, no. 6 (2), 1988
8. Moggia, C., Yuri, J.A., Pereira, M., Mineral content of different apple cultivars in relation to fruit quality during storage, ISHS Acta Horticulturae, 721
9. Goldspink, B.H., Sutton, J., Trace elements and magnesium treatments for apple and pear trees, Farmnote, 95/2000