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RESEARCH ON THE DYNAMICS OF ORGANIC ACIDS IN APPLES DURING THE STORAGE TIME

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Abstract

Harvesting apples must be carried out at the optimum time, established by a series of quality indicators, among which the malic acid content.

During the storage time, the values of these indicators vary, closely related to the storage conditions. Studying the behaviour of different apple varieties during the storage period allowed the development of specific technologies, in order to limit the quantitative and qualitative loss of fruits.

Key words: apple, total titratable acidity, storage, storage conditions

INTRODUCTION

Organic acids are spread in all fruits and vegetables, being dissolved in free state or combined as salts, esters or glycosides, representing intermediates in carbohydrate, lipid and proteic metabolism and working as hydrogen acceptor or oxidative substrate in the respiration process.

The acid taste is perceived as slightly sour, given to horticultural products by organic acids, represent a major and valued part of organoleptic (sensorial) quality.

Knowing the acidity allows us to better anticipate a product's evolution, from the optimal harvesting, to the end of harnessing, usually taking place after being stored for a certain period.

The fruit maturation takes place during this period, thus reaching species- and variety-related organoleptic qualities.

Total acidity is considered the sum of all component acids of a product, both the compounds with free carboxyl group, as well as those combined with different cations.

Titratable acidity is determined by the presence of free dissociated acids, acid salts, as well as other compunds with acid reaction (phenols, phosphoric acid) and is expressed in grams or milliequivalents of the predominant acid.

Moreover, no organic acid is entirely predominant (100% of the content).

Free acidity is estimated based on pH values.

When it comes to apples, the expression is made in malic acid, which is found both in the free state and as sodium, calcium, potassium and magnesium, etc salts. Studies show a maximum concentration of malic acid before harvesting (70% of the total of organic acids).

The organic acid distribution in horticultural products is, however, uneven.

Research has shown an approximately 1.6 times higher organic acid concentration in central tissues of the apple and, when pressed, the first portions of juice and less acidic than the ones that follow.

Within the same species, the titratable acidity oscillates within a wide range, depending on the variety of fruits.

Thus, are considered aciditc apple varities those with a higher 0.65g of malic acid/100g of product.

These dynamics are also correlated with the pedoclimatic conditions, as well as storage conditions

Thus, higher acidity was recorded during rainy summers or cold areas.

What is more, each variety has its own dynamics of acidity content. In apples we can see an increase up to a maximum value reached right before harvesting. For this reason, the moment of harvesting has an impact on the evolution of titratable acidity during storage.

For the apples which are earlier harvested, the titratatable acidity steadily decreases, in comparison with the ones later harvested.

Storage conditions greatly influence the acidity and the storage duration of the fruits through the atmospheric parameters.

Thus, the storing of different varieties of apples is done with standardization technologies.

The higher storage temperatures cause a decrease of titratable acidity, also depending on the variety.

The atmospheric composition has a great impact on titratable acidity. A controlled atmosphere partially stops the decrease of acidity by inhibating some enzymes involved in the Krebs cycle (Alina, Ardelean, 2019, Radu, I.F., Gherghi A., 1967 Marca, Gh., 1987, Beceanu, D., 1994, 1998, 2000, 2002, 2003, Ceaușescu, I., Iordăchescu, C., 1987, Gherghi, A., et al., 1981, 1983, 1984,1989, 1994, Burzo, I., et. al., 1984, 1986,. Marca, Gh., 2004, Potec, I., et. al., 1983, 1985).

MATERIAL AND METHOD

Research was conducted in 2019 at the Faculty of Environmental Protection, Oradea.

The Golden Delicious apple, a winter variety, was used for the studies. Harvesting took place in early October.

The fruits have a light colored pulp, crunchy and suitable juiciness and a slightly acidic taste and specific aroma.

Fresh fruits as well as those stored for 3 months were included in the study.

The fruits were sorted and those affected by insects, diseases, wounds, blows etc. were excluded when taken to the cellar.

The apples were placed on a wooden shelf, in a single layer, in natural condiitons. A private cellar was selected for this purpose.

Samples were taken on the harvesting day, collected from fruits on trees located at the edge of the row, as well as from the ones in the middle of the row.

Fruits were sampled from various frames belonging to the same tree, with different exposure to light.

Total titratable acidity was determined by neutralization with an alkaline solution in the presence of phenophthalein 1%.

Titration was performed with 0.1N sodium hydroxide solution.

Results are expressed in malic acid, the predominant acid in apples (Table 1).

Table 1

Malic acid content, at harvest, of apples belonging to the Golden Delicious variety

Sample no.	1	2	3	4	5	6	7	8	9	10	Sampl average
Total titratable acidity (malic acid)g/%	0,2	0,2	0,4	0,3	0,3	0,4	0,4	0,4	0,3	0,4	0,3

Table 2

Malic acid content, during storage, of apples belonging to the Golden Delicious variety

Sample no.	1	2	3	4	5	6	7	8	9	10	Sample average
Total titratable acidity (malic acid)g/%	0,1	0,1	0,2	0,2	0,2	0,2	0,2	0,3	0,1	0,2	0,1

RESULTS AND DISSCUSIONS

The results show that the Golden Delicious variety has a lower content of malic acid when harvested (0.3g), and the total titratable acidity decreases after 3 months of storage to 0.1g/% malic acid.

The relative low content of malic acid at harvest is a matter of variety, the Golden Delicious belonging to the group of varieties with a lower acidity.

Furthemore, reduced precipitations were recorded during the vegetation period, even towards the end of it (September-October), contributing to these results.

The malic acid concent decreased by 33% after 3 months in the storage. This has been atributed to intense metabolic activity in the stored fruits, given the climate factors (temperature, humidity, gas composure) that couldn't be controlled.

Maintaining a proper climate for the storage was done only through ventilating the storage room. Due to these factors, the shelf life of apples was limited to 4 months.

After this period, loss of tissue turgidity was recorded and the fruits were affected by storage diseases, thus sorting and placing them for consumption was imposed.

At the same time, the organoleptic properties and the carbohydrate/acidity ratio were affected.

As a result, the fruits lost the variety-specific harmonic taste.

CONCLUSIONS

The following conclusions can be drawn:

1. Lower acidity recorded at harvest is a variety feature, the Golden Delicious one being a less acidic variety.
2. This relatively low acidity is also due to climatic conditions, the year of production having poor rainfall during summer and autumn and high temperatures.
3. The decrease of malic acid after 3 months of storage is due to the storage conditions. The only way to direct the ambiental factors was ventilation in the absence of air conditioning installations.
4. A more intense metabolisation of organic acids was determined by a significant increase in the respiratory activity of the fruits due to the storage conditions.
5. Under the current circumstances, the storage had to be stopped after 4 months due to the modifications the fruits suffered: changes in tissue turgidity, taste properties, different storage diseases (heart and apical rot) and pathophysiologies (scalding and suberification).
6. Further research is recommended regarding the qualitative changes of apples during the storage period.

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