

## QUALITY PARAMETERS OF APPLE FRUITS MARKETED IN IAȘI

### PARAMETRI DE CALITATE A FRUCTELOR DE MĂR COMERCIALIZATE ÎN IAȘI

*PATRAȘ Antoanela*<sup>1\*</sup>

\*Corresponding author e-mail: apatras@uaiasi.ro

**Abstract.** Apples are the most consumed fruits in Romania, all over the year. In the present work were studied fruits of 7 apple cultivars (Golden Delicious, Idared, Jonagold, Florina, Jonathan, Starkrimson, Renet) commercialized in 3 open-markets from the city of Iași at the end of April. The main analysed quality parameters were: soluble solids content, acidity, total sugars, sugar/acid ratio. Renet cultivar proved the highest total sugars and soluble solids contents, while Florina, the lowest. The most acid was Idared (Sârca) and the less acid were Starkrimson and Golden Delicious. The best values for sugar/acid ratio (over 75) were obtained by Starkrimson and Golden Delicious, and the smallest ones (less than 33) by Idared (Sârca), followed by Jonathan, Jonagold and Idared (Suceava).

**Key words:** apple fruits, storage, acidity, sugars, sugar/acid ratio

**Rezumat.** Merele sunt cele mai consumate fructe în România, pe toată perioada anului. În prezenta lucrare au fost studiate fructe provenite din 7 soiuri de măr (Golden Delicious, Idared, Jonagold, Florina, Jonathan, Starkrimson, Renet) comercializate în 3 piețe din orașul Iași la sfârșitul lunii aprilie. Principalii parametri de calitate analizați au fost: substanța uscată solubilă, aciditatea, glucidele totale, raportul zaharuri/aciditate. Cel mai mare conținut de glucide totale și substanță uscată solubilă l-a avut soiul Renet, iar cel mai mic, soiul Florina. Soiul cu cea mai mare aciditate a fost: Idared (Sârca), iar cu cea mai mică: Starkrimson și Golden Delicious. Cele mai bune valori pentru raportul zaharuri/aciditate (peste 75) au fost obținute de Starkrimson and Golden Delicious, iar cele mai mici (sub 33) de Idared (Sârca), urmat de Jonathan, Jonagold și Idared (Suceava).

**Cuvinte cheie:** mere, păstrare, aciditate, glucide, raportul zaharuri/aciditate

## INTRODUCTION

Apples are the most popular fruits all over the world, originating from more than 7500 cultivars from different countries and continents. According to the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), the world production of apples was 89.3 million tonnes in 2016, of which 467,259 tonnes produced in Romania.

The important place of apples in the hierarchy of consumers' preference is due to their pleasant taste and to the content in nutrients and bioactive

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<sup>1</sup>University of Agricultural Sciences and Veterinary Medicine of Iasi, Romania

compounds. Their complex composition includes both organic (sugars, carboxylic acids, vitamins, polyphenols, enzymes, phytohormones) and inorganic compounds (containing the elements: N, P, S, and metals Na, K, Fe, Ca, Mg, Zn, Cu). From the organic compounds, very well represented are sugars from all subclasses: monosaccharides – glucose and fructose, oligosaccharides – sucrose, polysaccharides – starch and non-starch (known as fibres) - cellulose, pectic substances. Malic acid is the predominant carboxylic acid (Câmpeanu *et al.*, 2009). From vitamins, the main is vitamin C (ascorbic acid), but apples also contain vitamins A, B1, B2, PP. Phenolic compounds are mainly represented by tannins and flavonoids and they contribute to the fruits' taste, together with sugars, organic acids and some other aroma compounds as 1-butanol-2-methyl-acetate, 2-hexenal and 1-hexanol (Liu *et al.*, 2016; Petkovšek *et al.*, 2009). Very important is also the ratio sugar/acid, whose augmentation increases consumer's acceptance.

The content in different compounds is determined by apple cultivar, pedoclimatic conditions, horticultural practices, harvest period, conditions and duration of storage (Grădinariu and Istrate, 2003). In the case of apples commercialized during late-spring, after more than 6 months of storage, the conditions of preservation and the eventually post-harvest treatments are crucial for the fruits' quality. Usually, when buying, people are choosing apples after their appearance, but it is important the good aspect to correspond to a good taste and aroma and more than that, to an adequate content in nutritious and health-promoting compounds. In the present work were studied some chemical parameters of apple fruits from 7 cultivars commercialized in 3 open-markets from the city of Iași, during the spring season.

## MATERIAL AND METHOD

There were studied fruits of 7 apple cultivars (Golden Delicious, Idared, Jonagold, Florina, Jonathan, Starkrimson, Renet) commercialized at end of April in 3 open-markets from the city of Iași (Nicolina, Alexandru cel Bun, Independenț ei). In the case of Idared cultivar, two samples grown in different locations were analysed: Idared originated from Sârca and Idared from Suceava. After acquisition, all apples were refrigerated at 4 °C and analysed within 2 weeks.

The analysed quality parameters were: soluble solids content (SSC), titratable acidity (TA), pH, total sugars (TS), sugar/acid ratio (S/A).

Soluble solids content was measured at 20 °C with a Zeiss refractometer. Fresh juice obtained from studied apples was used. Results were expressed as °Bx.

Titratable acidity was determined according to Savu *et al.* (2000) and results were expressed as g malic acid/100 g fresh weight (FW).

The pH was measured in fresh juice obtained from studied apples with 315i (WTW) pH-meter.

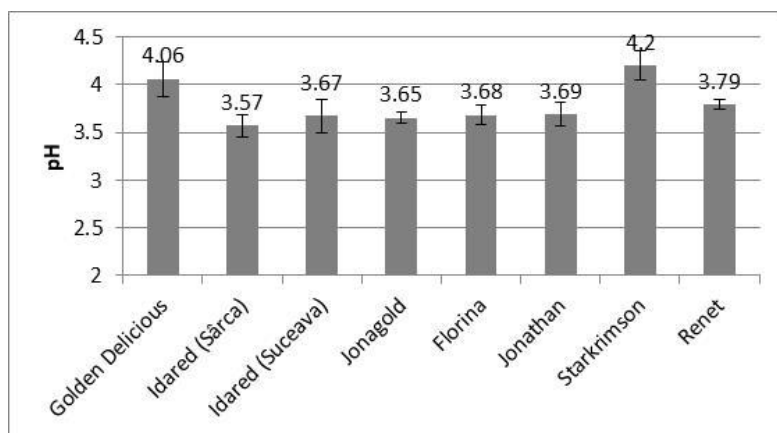
Total sugars were determined according to Savu *et al.* (2000) and results were expressed as g/100 g FW.

Sugar/acid ratio was calculated as the content of total sugars divided by titratable acidity.

All analyses were performed in triplicate and the presented values represent means±SD.

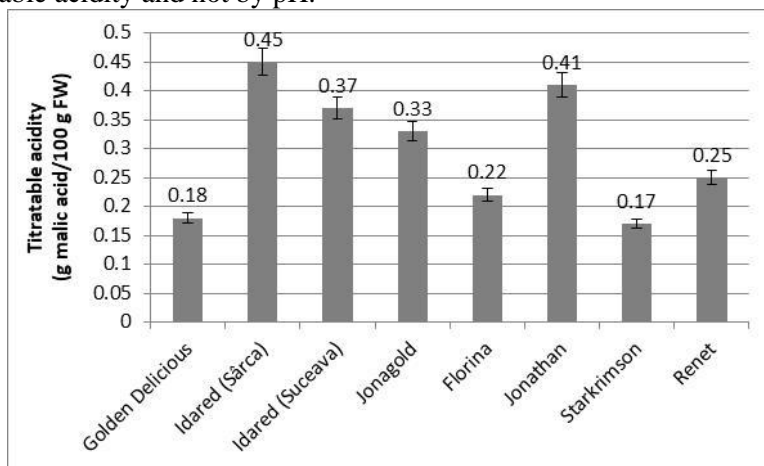
## RESULTS AND DISCUSSIONS

The studied apple samples had the pH in the regular interval, as usually, in apple juices it ranges between 3.0 and up to 4.5. In our case, the obtained pH was more acid for Idared (Sârca and Suceava), Jonagold, Florina, Jonathan and Renet (between 3.57 and 3.79) and less acid for Golden Delicious (4.06) and Starkrimson (4.20) (fig. 1).



**Fig. 1** pH values corresponding to studied apple cultivars

The obtained titratable acidity (fig. 2) was generally well correlated to the pH. Thus, the smallest TA (0.17 g malic acid/100 g FW) was obtained for Starkrimson and corresponds to the highest pH (4.20) and the most important TA (0.45 g malic acid/100 g FW) was for Idared (Sârca) (pH=3.57). The differences between TA and pH are due to the ionization of the organic acids, which are weak acids and are not completely ionized, so total acid content can be better estimated by titratable acidity and not by pH.



**Fig. 2** Titratable acidity of studied apple fruits

The small values of acidity are explained by its gradually decrease during apples' storage, confirmed by other studies. Thus, according to Radu (2012), all studied apple varieties lose acidity during storage, e.g. in Starkrimson the acidity loss was 52% after 6 months of refrigeration. Starkrimson cultivar is characterized by a low acidity even at harvest (0.38 g malic acid/100 g FW), decreasing till April to 0.18 g malic acid/100 g (Radu, 2012). At the beginning of May we obtained 0.17 g malic acid/100 g FW.

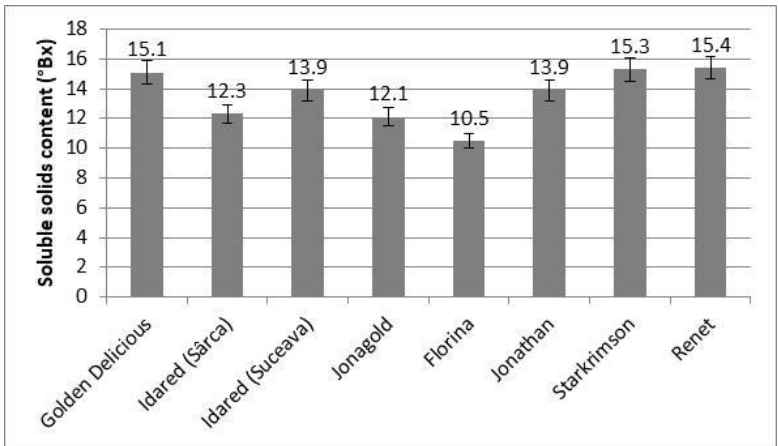


Fig. 3 Soluble solids content of studied apple fruits

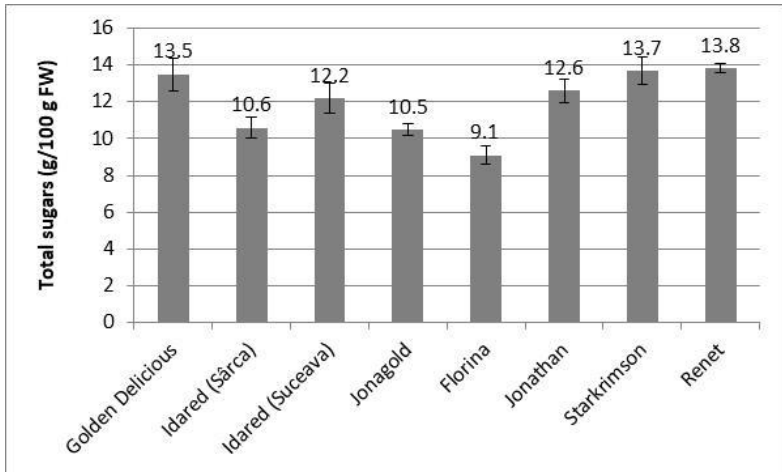
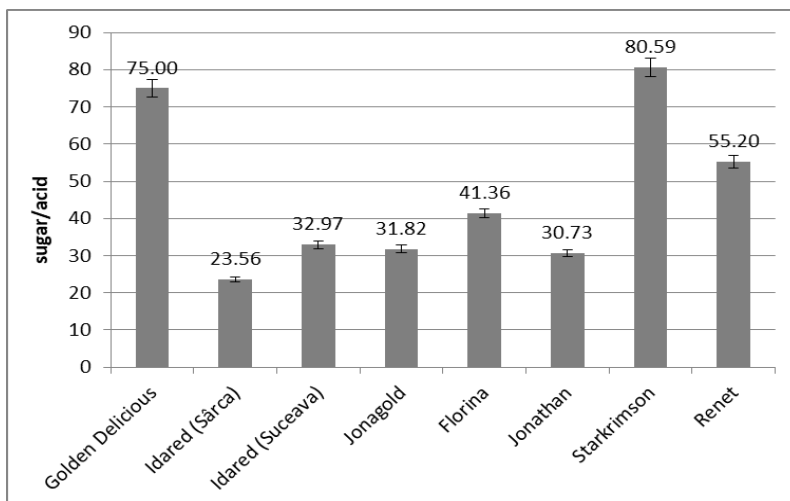


Fig. 4 Total sugars of studied apple fruits

Soluble solids content is a good indicator of sugar content of apples, as it is the major soluble solid in fruits (Nour *et al.*, 2010). Other soluble materials include organic and amino acids, soluble pectins, etc. Soluble solids were between

10.5 °Bx (Florina) and 15.4 °Bx (Renet) (fig. 3). Total sugars had the smallest content also in Florina cultivar (fig. 4). The most important total sugars contents were obtained for Golden Delicious, Starkrimson and Renet.



**Fig. 5** Sugar/acid ratio of studied apple fruits

From all chemical quality parameters, the sugar/acid ratio (S/A) is known as the best indicator for consumer's preference, as it plays an important role in flavour perception. A higher value of sugar/acid ratio generally increases consumer's acceptability. In our case, S/A increases in the order: Idared (Sârca) < Jonathan < Jonagold < Idared (Suceava) < Florina < Renet < Golden Delicious < Starkrimson. These results were confirmed by the organoleptic analyse, as Renet, Golden Delicious and Starkrimson were the top 3 preferred by the tasting team (data not shown). But must be bear in mind that the apple fruits were purchased from open-markets and were stored more than 6 months in conditions that were not the same for all samples.

## CONCLUSIONS

Renet cultivar proved the highest total sugars and soluble solids contents, while Florina, the lowest.

The most acid apple was Idared (Sârca) and the less acid were Starkrimson and Golden Delicious.

The best values for sugar/acid ratio (over 75) were obtained by Starkrimson and Golden Delicious, and the smallest ones (less than 33) for Idared (Sârca), followed by Jonathan, Jonagold and Idared (Suceava).

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