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# EVALUAREA CALITĂȚII FRUCTELOR LA UNELE SOIURI LOCALE DE MĂR
# ASSESSMENT OF FRUIT QUALITY OF SOME LOCAL APPLES CULTIVARS

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**Abstract**

**The preservation and use of the genetic resources is the basis for the permanent improvement of the cultivated varieties. The objective of this study was to analyze the quality of local Romanian apples cultivars for use as parents in future apple breeding programs. The experiment was conducted during 2020-2022 in apple collection of Research Institute for Fruit Growing Pitești, Romania (ICDP). The study was designed to assess the quality of the apple fruits on fifteen local Romanian cultivars ('Botane', 'Călugăresc', 'Citron de Somcuța', 'Cormose', 'Crețesc', 'Crețesc de Simici', 'Domnesc', 'Muntenești', 'Mohorât', 'Moți', 'Sătmărești', 'Urdoase', 'Verzisoare', 'Zmeurii'). As control cultivar, we used 'Jonathan'. Quality parameters investigated were weight, caliber, total soluble solids, firmness and the color. The results showed that the highest values of the firmness of the fruit were found on 'Verzisoare' variety (83.03 HPE units), the highest values of the total soluble solids (°Brix) were found on 'Urdoase' variety (20.63°Brix). Maximum size has been registered on the 'Crețesc de Simici' (186.67 g) and also caliber (85.4 mm) of fruit was reached at the same cultivar.**

**Cuvinte cheie:** *Malus x domestica*, ameliorare, calitate fruct, soiuri locale.
**Key words:** Malus x domestica, breeding, fruit quality, local cultivars.

## 1. Introduction

The apple is the most popular species, covering large areas on the globe, especially in the temperate climate. The permanent evolution of increasing the apple production and large cultivated surfaces makes the apple culture to have an important place in the world economy of fruits and in human nutrition. Worldwide in the apple breeding there are different objectives, only three of them being with international importance: yielding capacity, fruits quality and genetic resistance to diseases and pests.

Fruit breeding is heavily dependent on the use of genetic resources, old and new cultivars, especially for fruits quality, disease, pest and resistance or tolerance to environmental stress. Besides collecting and preservation of genetic resources, the evaluation for subsequent use in breeding has a great importance. Priority in respect of collecting and preserving should be given to *Malus*, *Pyrus* and some *Prunus* species, which can be crossed unlimitedly with cultivated forms. Therefore the genetic information of wild species can be transferred to cultivated forms (Fischer and Fischer, 2004, Militaru et al, 2015).

In the world are over 10,000 apple cultivars having already been grown, but only a few of them having economic importance. The reason for this situation is the global view of producers regarding the characteristics of the perfect apple cultivar: good appearance, sweet taste, and resistance to harvesting and transport conditions. Unfortunately, the changing climatic conditions strongly influence the contents of fruits in valuable bioactive compounds making the selection process difficult. However, recently, there has been an increase in consumer reluctance to buy products created through selection or genetic modification, leading to a return to old cultivars, which are considered healthier (Slováčková et al, 2023; Szymczak et al, 2024).

Romania has a long tradition in apple growing and production of the apple. Many factors influence the fruits quality, including genetics, soil properties and weather conditions. During the storage time, quality of apples is changing. The old varieties can be found in people's gardens, in small households, being very well adapted to local environmental conditions. It is important to examine the fruits quality of old cultivars, to understand the metabolites and determine their potential beneficial health effects and processing properties of apple fruits. Also, the chemo diversity (aroma and flavour) and sensory and nutritional qualities were found to be higher in old cultivars compared to modern apple cultivars (Donno et al, 2012; Ciese et al, 2015). In recent years, due to the consumer demand for natural, pesticide-free fruits, as healthy as possible, the interest in traditional old apples cultivars has also increased. The market demand creates new tasks for fruit growing sector that can be partially solved by evaluating and reselection of old varieties from the germplasm found. Preservation of unique cultivars should focus on keeping genetic diversity and, not less important, to sustain socio-cultural heritage (Militaru et al, 2016; Meland et al, 2024). The importance in preserving old apple cultivars can also be seen in their significance for improving the nutritional composition of other apple cultivars through innovative cultivation

strategies, and therefore old local apple cultivars could be of great importance in future breeding programs (Duralija et al, 2021).

The objectives of this paper are the analysis of apple genetic resources and determine the fruits quality of old varieties in comparison with an international cultivar, 'Jonathan'. The best varieties will be selected for use in future apple breeding programs, at Research Institute for Fruit Growing Pitesti, Romania.

## 2. Material and methods

The experiment was located in an apple collection established in 2009, in the Genetic and Breeding Laboratory of the Research Institute for Fruit Growing Pitesti, Romania, with trees grafted on the MM106 rootstock, the planting distance being 4 x 2.5 m. The evaluation was done at the consumption maturation of the fruits for each variety found in the specialized literature. The study was carry out during 2020-2022, on fifteen local Romanian cultivars: 'Botane', 'Călugăresc', 'Citron de Somcuța', 'Cormose', 'Crețesc', 'Crețesc de Simici', 'Domnesc', 'Munteneşti', 'Mohorât', 'Moți', 'Sătmărești', 'Urdoase', 'Verzișoare', 'Zmeurii'. As control, we used as well-known commercial cultivar 'Jonathan'.

Climate and soil conditions are generally very favorable for apple growing. During the three years, the annual temperature values were between 10.7°C and 11.8°C. Regarding precipitation, their amount was lower in 2022 (525.30 mm) (Table 1).

To assess external fruit quality at harvest, ten representative apple fruits of each cultivar were used for physical and chemical analysis by standard methods:

- fruit weight was determined by weighing (g/fruit);
- caliber was determined with a caliber, expressed in mm;
- flesh firmness was measured on two opposite sides of each fruit with HPE non-destructive penetrometer with a 0.5 $cm^2$ measuring device, expressed in HPE units (from 0 - without firmness - to 100 - very hard);
- the total soluble solids (TSS) was measured with refractometer (% Brix);
- external fruit color was determined with a colorimeter Konica Minolta CR 400, based on system CIELAB on both sides of the fruit (L* corresponds to brightness, a* and b* chromaticity coordinates from green to red and from blue to yellow, respectively).

The differences between the evaluated cultivars were assessed using analysis of variance, general linear model procedure (One way ANOVA and Duncan test at $p \leq 0.05$). The cultivars were compared with the control cultivar.

## 3. Results and discussions

The fruits quality is a very important breeding objective, especially since the claims of consumers for very good quality apples are always increasing (Sestras, 2004). According to the statistical analysis of the data, it is observed that for each characteristic studied the variation limits are very large.

According to ECPGR Characterization and Evaluation Descriptors for Apple Genetic Resources (*Malus x domestica*) there are 9 classes for weight and caliber, from extremely small to extremely large. In our study, one variety were included in the small class, 4 in the small to medium class, 7 in the medium class, 2 in the medium to large class and 2 in the large class.

The fruits weight, which positively influences the capitalization, had values between 68.67 g ('Călugăresc' cultivar) and 186.67 g ('Crețesc de Simici' cultivar). The 'Crețesc de Simici' and 'Domnesc' varieties recorded average values of 186.67 g and 174.00 g, exceeding the control 'Jonathan' cv. who had an average of 151.07 g, over the 3 years of study. Regarding the caliber, it varied from 57.37 mm to 85.4 mm. The 'Jonathan' cultivar had a weight of 151.07 g and a caliber of 77.74 mm (Table 2).

The fruits quality depends besides other characteristics also on the flesh firmness. The loss of fruit firmness is a serious problems in postharvest handling old apple cultivars because it resulted in soft and mealy fruit with poor consumers acceptance (De-Ell et al., 2001; Kov and Felf, 2003; Militaru et al, 2016). Regarding the firmness, the average value on the three years of study was between 58.00 ('Jonathan' cv. used as a control) and 83.03 HPE units ('Domnesc' cultivar) (Table 2).

The total soluble solids (TSS) is an index of good quality and increases with the ripening of the fruits. The content of TSS was quite high in most varieties, but the 'Urdoase' cultivar proved to have a very high content, the average value for the years of study being 20.63% Brix. The variety which had a lower content of TSS was 'Verzișoare', 12.03% Brix. The control cultivar registered low values during the 3 years of study, the average value being 13.00% Brix (Table 2; Fig. 1, 2, 3).

One of the key factors for the quality of apples is their colour, which is intrinsically linked to the ripening process. Pigmentation can be influenced, among other factors, by climatic factors. If they intensify at the level of stress, the fruit tissues respond by increasing (or ceasing) the production of

coloring (Espley and Jaakola, 2023). For consumers the color is a landmark in the choice of fruits, it offers many benefits from a health point of view.

The skin color, for the brightness variable L*, the variations are medium, both in relation to the multiannual average and for each variety and year (Table 3). In the case of the chromaticity index of a*, the values constantly minus for most varieties are observed quite clearly. The 'Jonathan' cultivar recorded positive values that show the presence of a reddish hue, more pronounced in this variety. Significant differences were noticed in the case of the chromatic indicator b*, for two cultivars: 'Mohorât' (16.95) and 'Jonathan' (12.44) (Table 3).

## 4. Conclusions

Old apple varieties represent an important source of genes for breeding program. Some cultivars are representative for fruit characteristics, such as: weight and caliber ('Cretesc de Simici'), total soluble solids ('Urdoase') and for firmness ('Verzisoare').

The use in breeding programs old valuable varieties can create diversity and even one valuable enough to form the basis for obtaining new varieties. In the present experiment it was observed that although for some characters the variations were small, for others notable differences were found.

Based on this study, the local apple varieties that stood out will be used as parents in future apple quality improvement programs.

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## Tables and Figures

**Table 1. Meteorological parameters registered during 2020-2022**

| Parameters | Year | Month | | | | | | | | | | | | Annual values |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | |
| Temperature (°C) | 2020 | 0,25 | 4,20 | 7,65 | 10,92 | 15,04 | 19,59 | 22,05 | 22,24 | 18,94 | 12,37 | 4,75 | 3,05 | 11,8 |
| | 2021 | 0,54 | 3,01 | 4,12 | 8,59 | 15,60 | 19,32 | 23,48 | 22,40 | 15,57 | 7,95 | 6,67 | 1,63 | 10,7 |
| | 2022 | 0,84 | 3,15 | 3,58 | 10,12 | 16,45 | 21,11 | 22,85 | 22,63 | 15,60 | 11,96 | 7,56 | 2,84 | 11,6 |
| Rainfall (mm) | 2020 | 1,8 | 22,5 | 30 | 21,1 | 104,1 | 166 | 52,00 | 29,8 | 68,2 | 92,7 | 8,8 | 81,9 | 679,10 |
| | 2021 | 73,6 | 12,4 | 67 | 38,4 | 65,4 | 104 | 33,5 | 74,00 | 14,3 | 36,3 | 25,6 | 91,9 | 636,20 |
| | 2022 | 6,4 | 10,8 | 19 | 88 | 72,6 | 25,6 | 25,3 | 142 | 49,6 | 4,3 | 40,8 | 40,4 | 525,30 |

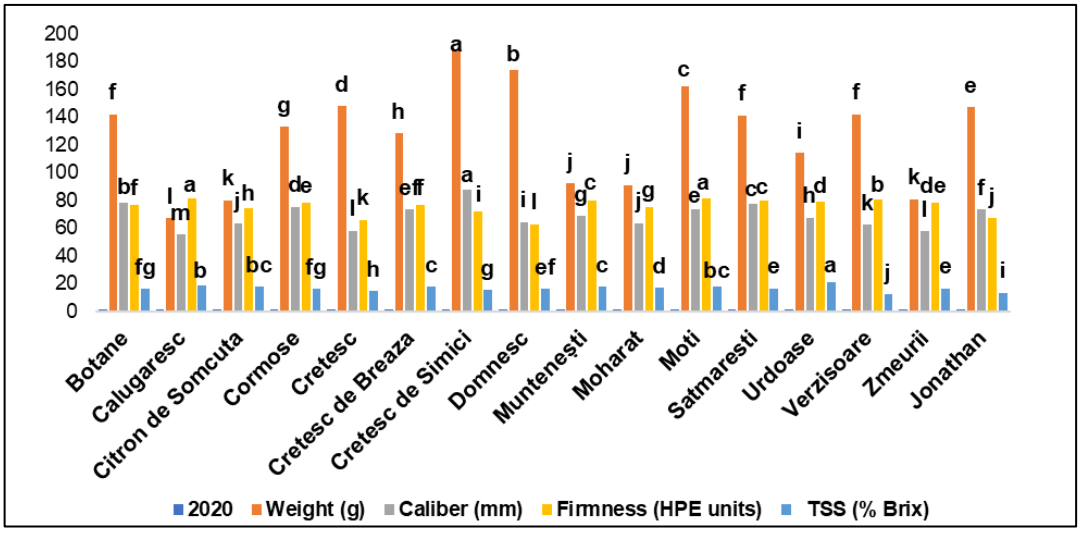


**Fig.1. The main characteristics of apple cultivars studied in 2020**

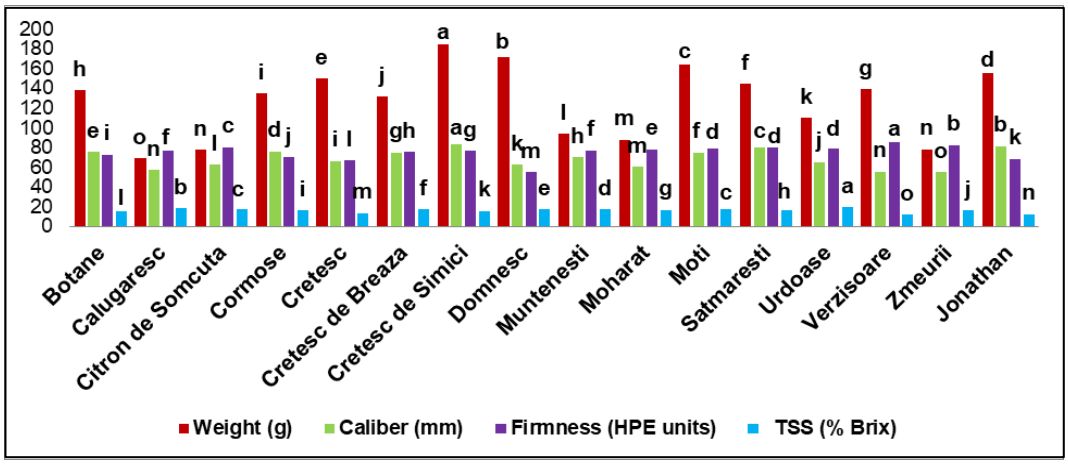


**Fig. 2. The main characteristics of apple cultivars studied in 2021**

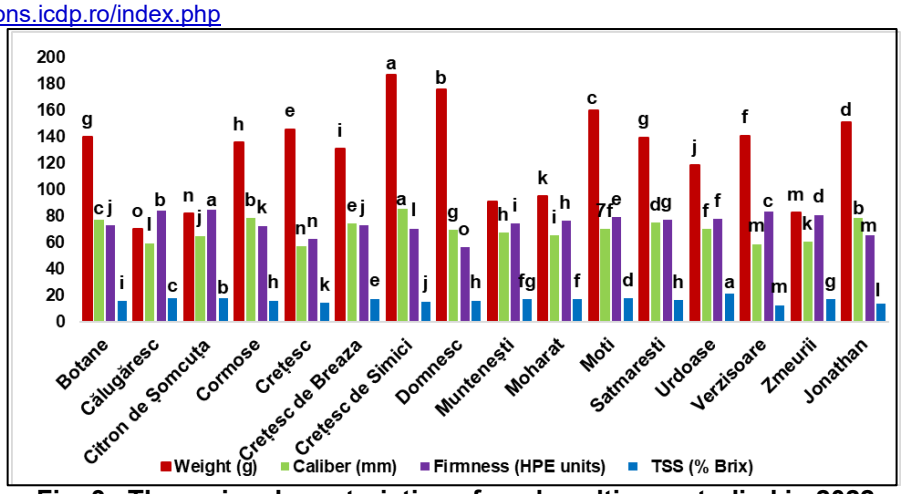


**Fig. 3. The main characteristics of apple cultivars studied in 2022**

**Table 2. The average of main quality characteristics (2020-2022)**

| Cultivar | Weight (g)* | Caliber (mm)* | TSS (%Brix)* | Firmness (HPE units)* |
|---|---|---|---|---|
| Botane | 140±2.00e | 76.87±1.56b | 15.53±0.25g | 74.03±2.05de |
| Calugaresc | 68.67±1.53k | 57.37±2.15g | 18.1±0.2b | 80.97±3.79a |
| Citron de Somcuta | 80±2j | 63.67±1.36ef | 17.8±0.3bc | 79.93±5.22abc |
| Cormose | 134.67±1.53f | 76.7±1.71b | 15.97±0.15fg | 73.63±3.79de |
| Cretesc | 148±2d | 60.43±5.2fg | 13.9±0.44h | 65.08±2.17e |
| Cretesc de Breaza | 130.33±2.08g | 74.27±0.97b | 17.23±0.31cd | 74.93±1.91cde |
| Cretesc de Simici | 186.67±1.53a | 85.4±1.91a | 15.43±0.25g | 72.87±3.04e |
| Domnesc | 174±2b | 65.4±3.68de | 16.4±0.61ef | 58±4.01g |
| Muntenesti | 92.33±1.53i | 68.93±1.31cd | 17.23±0.31cd | 77±2.51bcde |
| Moharat | 91.33±3.51i | 63.03±2.67ef | 16.93±0.12de | 76.67±1.6bcde |
| Moti | 162±2c | 72.9±2.49bc | 17.7±0.2bc | 80.1±1.22abc |
| Satmaresti | 141.73±2.35e | 77.57±2.55b | 16.4±0.3ef | 78.8±1.3abcd |
| Urdoase | 114.37±4.05h | 67.6±2.56de | 20.63±0.99a | 78.6±0.66abcd |
| Verzisoare | 140.67±1.53e | 58.89±3.21fg | 12.03±0.4j | 83.03±2.45abcd |
| Zmeurii | 80.53±2.11j | 57.83±2.65g | 16.37±0.45ef | 80.57±2.22ab |
| Jonathan | 151.07±4.2d | 77.74±4.29b | 13±0.53i | 67±1.65f |

**) values in columns that do not have common letters differ significantly for one level of assurance 5% statistic, Duncan test*

**Table 3. The color of the studied apple cultivars, in the Ciel Lab system (2020-2022)**

| Cultivar | L* | a* | b* |
|---|---|---|---|
| Botane | 61.3±0.58ab | -11.78±2.35c | 31.74±0.98abc |
| Calugaresc | 48.55±3.72c | -6.04±6.99c | 22.16±1.99e |
| Citron de Somcuta | 61.8±10.1ab | 1.25±7.5bc | 30.16±5.6abcd |
| Cormose | 57.07±4.13b | -1.54±4.36c | 29.56±2.56abcd |
| Cretesc | 61.75±5.67ab | -2.84±5.27c | 26.75±2.05cde |
| Cretesc de Breaza | 63.63±3.48ab | -11.97±6.81c | 29.62±1.61abcd |
| Cretesc de Simici | 61.54±4.13ab | -6.99±5.61c | 28.55±2.8abcd |
| Domnesc | 61.87±4.62ab | -2.7±4.31c | 27.84±3.29bcd |
| Muntenesti | 57.34±3.36b | -1.56±11.82b | 26.11±2.74f |
| Moharat | 43.29±8.95c | 12.14±10.63c | 16.95±5.3ab |
| Moti | 68.15±0.32a | -7.76±2.62c | 32.95±0.17de |
| Satmaresti | 62.53±0.36ab | -11.45±5.35c | 29.12±1.82abcd |
| Urdoase | 61.77±1.44ab | -2.74±13.71c | 30.93±0.3abcd |
| Verzisoare | 62.15±1.18ab | -6,04±4.36c | 29.65±0.18abcd |
| Zmeurii | 66.46±3.95ab | -8.91±2.65c | 33.38±0.83a |
| Jonathan | 33.86±6.47d | 30.92±5.29a | 12.44±3.67f |

**) values in columns that do not have common letters differ significantly for one level of assurance 5% statistic, Duncan test*

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**Fig. 4. Apple varieties taken in study: a. 'Urdoase', b. 'Botane', c. 'Verzișoare', d. 'Domnesc', e. 'Călugăresc', f. 'Citron de Șomcuța', g. 'Cormoșe'**