



Main Phenotypic and Biochemical Characteristics Recorded at the New 'Andrada' Tomato Variety Obtained at Vegetable Research and Development Station Buzău

Geanina NEGOȘANU*, Costel VÎNĂTORU, Ovidia AGAPIE, Elena BARCANU

Vegetable Research and Development Station, Mesteacănului Street no 23, 120024, Buzău, Romania

*Corresponding author: Geanina NEGOȘANU e-mail: geanina.neacsu11@gmail.com

SHORT COMMUNICATION

Abstract

The Breeding and Biodiversity Laboratory within the Vegetable Research and Development Station Buzău with 11 tomato varieties listed in the Official Catalogue of Cultivated Crops in Romania and a valuable resource of *Solanum lycopersicum* germplasm composed of over 2,000 genotypes, focused its research to obtain tomato varieties for precise use: fresh consumption and industrialization. Starting from a valuable traditional variety ('Inimă de bou' – 'Ox Heart'), the aim was to obtain a new, improved variety of tomato for consumption of fresh fruits, with large, juicy fruits highly appreciated on local market. Research resulted in the approval and patenting of the 'Andrada' tomato variety with distinct genotypic and phenotypic characteristics.

Keywords: biodiversity; breeding; germplasm.

Received: 15 September 2020

Accepted: 01 February 2021


Published: 14 May 2021

DOI:

15835/buasvmcn-hort:2020.0044

INTRODUCTION

Tomatoes are one of the most valuable vegetables from a nutritional point of view due to their very pleasant taste, very varied range of uses and special nutritional value. Tomato domestication experienced a severe genetic bottleneck as the crop was carried from the Andes to Central America and from there to Europe (Vîntor et al. 2019). In Romania 'Inimă de bou', an old traditional variety, was described for the first time in 1955 in the Seed Catalog by M. Dumitrescu. Tomato breeding was a priority for the Vegetable Research and Development Station Buzău to such an extent that, more than 18 commercial varieties of tomatoes were approved in over 60 years of activity. Since 1996, the research within the Breeding and Biodiversity Laboratory has been oriented towards obtaining tomato varieties for precise use, respectively for fresh consumption or industrialization (broth, tomato paste, juice, ketchup) (Vîntor et al. 2016). The laboratory placed special emphasis on the use and capitalization of the native genetic heritage of *Solanum lycopersicum*, thus creating the premises for pursuing objectives such as: yield and quality, dry matter content, balanced acidity, pigmentation, lycopene content, sugar-acidity ratio, and genetic resistance to pathogens. The fruit shape and size are two traits that received the greatest deal of attention when the old populations were being bred and formed. Even today, fruit shape and size along with fruit color are the most important factors for people deciding which tomatoes to buy (Takač et al., 2005). Fruit quality is a combination of visual stimuli such as size, shape and color, and sensory factors such as sugar, acidity and taste. Moreover, the consumers' perception of quality is also heavily influenced by the products' appearance and information like sun-ripe, biological, transgenic, etc. (Bay, 2007). Research on the genetic control of fruit quality traits has been dominated by studies of the ripening process and determination of soluble solid content (Rick and Chetelat,

 © 2021 Authors. The papers published in this journal are licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

1995). Some of the most important changes that occurred during the domestication and improvement of tomato were increased fruit weight and the emergence of variable fruit shapes and colors (Rodriguez, 2011).

The work aims to obtain a new variety of tomato for fresh consumption, with fleshy taste and thin skin that bring back the nostalgia of the tomato taste of the past.

MATERIALS AND METHODS

The Vegetable Research and Development Station (VRDS) Buzău has an impressive collection of over 2,000 accessions. The time frame for determining the phenotypic and biochemical tomato characteristics was between 2019 and 2020, from March until October, during the vegetation period. In this study an attempt was made to rehabilitate some traditional varieties with thin skin and fleshy fruit. As a result, the 'Andrada' variety was obtained after years of research and improvement. The initial breeding material was the tomato variety known as 'Inimă de bou' ('Ox heart') and the breeding method used to obtain this variety was repeated individual selection. Since 2019, it can be found in the Official Catalog of Cultivated Plants. The culture technology used was conventional. Thus, at the beginning of March, the seeds were sown in alveolar pallets of 50 cm³ and the seedling was planted in a protected area after 45 days. The culture scheme used was of 35 cm between plants and 70 cm between rows. The care works consisted in palisading the plants and mechanical and manual hoeing. During the vegetation period, biometric observations and descriptions were made according to UPOV guidelines at 50 – 100 tomato plants

As for the ripe fruit, biochemical determinations were performed such as: the percent of dry matter content using the 200°C fast method at Kern DBS60-3 thermobalance, the total soluble solid content of the ripe fruits measured using a refractometer, total titratable acidity determined using the Titroline 7000 equipment, NaOH 0.1N, titration method, lycopene from tomato samples is extracted into organic solvents and determined spectrophotometrically at 472 and 502 nm wavelengths, sugar-acidity ratio. The following newly genotypes created by the Breeding and Biodiversity Laboratory: 'Măriuca', 'Kristinica', 'Darsirius', 'Florina' were used as control cultivars in order to highlight the biochemical characteristics. These recent creations have been obtained since 2005.

RESULTS AND DISCUSSIONS

In 2019, the tomato variety 'Andrada' was approved and patented as semi-early variety, which can be successfully cultivated in protected areas and fields, in a palisade system. The plant has the following characteristics: undetermined growth with heights over 2 m (it contains the SP⁺ gene), medium vigor, weak anthocyanin coloration on the stem, pubescence at the stem. The fruit is ox heart shaped, very large, red, juicy, with weak luster, easy side, and a small number of seeds located in small seminal lodges. Immature fruits present the U gene, which transmits the characteristic of dark green cover compared to the rest of the fruit, which is lighter green.



Figure 1: (a): 'Andrada' fruit; (b): longitudinal section; (c): cross section

As it can be seen in Table 1, determinations were made for the elite 'Andrada' ('Inimă de bou' – 'Ox heart') plants, measuring the minimum and maximum features from 100 plants, in order to calculate the weighted average value of: plant diameter (PDM), leaf length (LL), leaf width (LW), number of inflorescences per plant (NIP) fruit weight (FW), fruit height (FH), fruit diameter (FD), abscission zone (AZ), peduncle insertion diameter (PID), peduncle clamping diameter (PCD) cap thickness (CT) and number of seminal lodges (NSL). Therefore, the results obtained by examining the tomato plants led to the following observations: the height exceeded 2 m, the lowest value of the plant diameter was 61.50 cm and the highest value was 72.50 cm, while the average value was 67 cm.

The minimum value of the leaf length was 44.40 cm and the maximum value was 45.10 cm, therefore the average value was 44.75 cm. The lowest value of the leaf width was 36.10 cm and the highest was 40.70 cm, thus the average value was 38.40 cm. The smallest value of the inflorescences number per plant, was 12 and the biggest value was 14, so the average value was 13. Regarding the fruits of the 'Andrada' variety, the following measurements were performed on ripe fruit: weight, with the lowest value 280 g and the highest value 396 g, with average value 338 g;

height, where the minimum size was 8 cm and the maximum was 9 cm, with average value 8.50 cm; fruit diameter, with the lowest value 8 cm and the highest value 10 cm, with average value 9 cm; abscission area, with the smallest value 0.32 cm, the biggest value 0.51 cm, and average value 0.42 cm; peduncle insertion diameter, with the lowest value measured of 0.64 cm, the highest value 1.38 cm, and the average value 1.01 cm; peduncle clamping diameter, with the minimum size 0.65 cm, the maximum size 2.78 cm, and the average size calculated 1.72 cm. Regarding cap thickness, the lowest value was 0.45 cm, the highest value was 0.64 cm, so the average value was 0.55 cm. As for the number of seminal lodges, the minimum was 14, the maximum 18, thus the average value was 16. The yield of 'Andrada' plants was calculated by multiplying the average weight by the average number of fruits per plant. The lowest value was 3.19 kg/plant, the highest value was 5.28 kg/plant and the obtained average value was 4.23 kg/plant.

Table 1. Biometric determinations in elite 'Andrada' ('Inimă de bou') plants

Feature	PDM (cm)	LL (cm)	LW (cm)	NIP	FW (g)	FH (cm)	FD (cm)	AZ (cm)	PID (cm)	PCD (cm)	CT (cm)	NSL
Lowest	61.50	44.40	36.10	12.00	280.00	8.00	8.00	0.32	0.64	0.65	0.45	14
Highest	72.50	45.10	40.70	14.00	396.00	9.00	10.00	0.51	1.38	2.78	0.64	18
Average value	67.00	44.75	38.40	13.00	338.00	8.50	9.00	0.42	1.01	1.72	0.55	16

*Note: plant diameter (PDM), leaf length (LL), leaf width (LW), number of inflorescences per plant (NIP) fruit weight (FW), fruit height (FH), fruit diameter (FD), abscission zone (AZ), peduncle insertion diameter (PID), peduncle clamping diameter (PCD) cap thickness (CT), number of seminal lodges (NSL)

In addition, biochemical indicators determined from 'Andrada' tomatoes were compared with other tomato varieties as 'Măriuca', 'Kristinica', 'Darsirius' and 'Florina' (Table 2) concerning percent of dry matter content, percent of total acidity, percent of total sugar content, sugar-acidity ratio, and lycopene expressed in mg/100 g⁻¹. Determinations were performed on 50 plants from the research field of VRDS Buzău, noting that the other four varieties besides 'Andrada' are intended for industrial processing, and were the result of research performed at VRDS Buzău, between 2015 – 2019.

Table 2. Biochemical comparative indicators determined for 'Andrada' fruit and other tomato varieties

Variety	Dry matter content (%)			Total acidity (%)			°Brix			Sugar-acidity (%)			Lycopene mg/100 g ⁻¹		
	Lowest value	Highest value	Average value±SD	Lowest value	Highest value	Average value±SD	Lowest value	Highest value	Average value±SD	Lowest value	Highest value	Average value±SD	Lowest value	Highest value	Average value±SD
Andrada	4.86	5.43	5.15±0.40	0.41	0.45	0.43±0.03	5.83	6.24	6.04±0.29	14.22	13.87	14.04±0.25	8.19	9.08	8.64±0.63
Măriuca	4.88	5.47	5.18±0.42	0.39	0.43	0.41±0.03	2.03	2.85	2.44±0.58	5.21	6.63	5.92±1.01	6.20	6.80	6.50±0.42
Kristinica	4.95	5.56	5.26±0.43	0.36	0.39	0.38±0.02	2.79	3.14	2.97±0.25	7.75	8.05	7.90±0.21	4.90	5.10	5.00±0.14
Darsirius	5.66	5.93	5.80±0.19	0.31	0.35	5.80±0.05	2.97	3.30	3.14±0.23	9.58	8.68	9.13±0.63	5.40	6.60	6.00±0.85
Florina	4.99	5.70	5.35±0.50	0.37	0.40	0.39±0.02	2.74	3.01	2.88±0.19	7.41	7.53	7.17±0.08	7.70	8.65	8.18±0.67

Note: SD = standard deviation

The average value and the standard deviation were measured and calculated starting with the lowest and the highest values. Dry matter content for 'Andrada' was 4.86 (the lowest value), 5.43 (the highest value) and 5.15 (the average value) ± 0.40 SD. Subsequently, it was revealed by comparative analysis that, for 'Darsirius', this indicator had the highest average value of 5.80 ± 0.19 SD. Total acidity for 'Andrada' was 0.41 (the lowest value) 0.45 (the highest value) and 0.43 (the average value) ± 0.03 SD. It was revealed by comparative analysis that, for 'Darsirius', this indicator had the lowest average value of 0.35 ± 0.05 SD. Total soluble content expressed in °Brix for 'Andrada' was 5.83 (the lowest value), 6.24 (the highest value) and the average value 6.04 ± 0.29 SD. It was revealed by comparative analysis that, for 'Măriuca', this indicator had the lowest average value of 2.44 ± 0.58. The highest average value of sugar-acidity ratio for 'Andrada' was 14.04 ± 0.25 SD. It was revealed by comparative analysis that, for 'Măriuca', this indicator had the lowest average value of 5.92 ± 1.01 SD. Lycopene content for 'Andrada' had the highest value 8.64 ± 0.63 SD mg/100g⁻¹. It was revealed by comparative analysis that, for 'Kristinica', this indicator had the lowest average value of 5.00 ± 0.14 SD mg/100g⁻¹. About 400 chemical compounds are responsible for the tomato taste and aroma, but the soluble solids and acids are key components in the overall flavor intensity (Allen-Stevens, 1979). In this case, 'Andrada' has the highest value of total acidity and also the highest sugar content, consequently the best sugar-acidity ratio. On the opposite side there are tomato varieties such as 'Măriuca', 'Florina', 'Kristinica', 'Darsirius', with industrial destination, with low values sugar-acidity ratios and flavorless. Samples were taken from physiologically mature fruits harvested in the first decade of July, more precisely between July 8-10.

CONCLUSIONS

The research contributed to the consolidation and evaluation of the germplasm base held by the Vegetable Research and Development Station Buzău. The 'Andrada' obtained from 'Inimă de bou' ('Ox Heart') tomato variety with

distinct genotypic and phenotypic characteristics was approved and patented. The value of this variety consists in its special organoleptic qualities, the consumer finding in the 'Andrada' variety the taste and aroma specific to traditional Romanian tomatoes. It is worth mentioning that the special taste is given by the high acidity and sugar content. The fruits are fleshy, have a small number of seeds so they are recommended for fresh consumption in salads, smoothies, juice. Firmness is medium to low, fruits are not woody, and they are juicy, with attractive intense red flesh color. The thin skin can be seen as an advantage because the fruits can be eaten more easily, but at the same time the shelf life is shorter. It is recommended to be cultivated as a kind of niche, with a low storage capacity, but a very good taste, reminiscent of the old tomatoes.

Author Contributions: V.C. Contributed with data and coordinated the analysis tools; A.O. and B. E. Collected the data; N.G. wrote and coordinated the entire paper, Conceived and designed the analysis, Performed the analysis.

Acknowledgments

The work was supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI - UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0850/ contract no 14 PCCDI/2018, within PNCDI III.

Conflicts of Interest

The author declare that they do not have any conflict of interest.

REFERENCES

1. Allen-Stevens M, Kader A, Albright M (1979). Potential for Increasing Tomato Flavor via Increased Sugar and Acid Content, Department of Vegetable Crops, University of California, Davis, CA 95616, *Journal of the American Society for Horticultural Science*. Vol. 104(1): 40-42
2. Bai Y, Lindhout P (2007). Domestication and Breeding of Tomatoes: What have we gained and what can we gain in the future? *Annals of Botany*, Vol. 100(5): 1095-1094
3. Rick C.M, Chetelat R.T, (1995). Utilization of related wild species for tomato improvement, *Acta Horticulturae* 412, 21-38, DOI10.17660/ActaHortic.1995.412.1, <https://doi.org/10.17660/ActaHortic.1995.412.1>
4. Rodriguez G, Munos S, Anderson C, Sim S, Michel A, Causse M, McSpadden B, Francis D, Knaap E Van der (2011). Distribution of SUN, OVATE, LC and FAS in the Tomato Germplasm and the Relationship to Fruit Shape Diversity. *Plant Physiology*, May 2011, Vol.156, pp. 275-285, www.plantphysiol.org
5. Takač A, Gvozdenović D, Gvozdanović-Varga J, Vasić M, Bugarski D (2005). Characteristics of old tomato cultivars. *Natura Montenegrina, Podgorica*.
6. Vînătoru C, Zamfir B, Bratu C (2019). Special vegetable treaty, Alpha MDN Editure, Buzău
7. Vînătoru C, Zamfir B, Bratu C, Lăcătuș V, Cârstea L (2016). New processing tomato varieties obtained at V.R.D.S. Buzău. *Scientific Papers, Series B, Horticulture*, vol. LX: 155-160