



Composition and antioxidant activity of three Spanish tomato varieties of ecological cultivation: influence of maturation status.

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Tomato (*Solanum lycopersicum*) is rich in essential nutrients and phytochemicals

- vitamins and minerals
- Polyphenols, carotenoids: bioactive compounds with antioxidant activity

Mediterranean countries (Italy, Spain, and Greece) have a rich variety of tomato landraces.



nutritional analysis of the **different tomato varieties**, as well as of their **maturation status**, is an initial and key process that determines its posterior marketing.

In this study, we assayed **three different tomatoe varieties** that exist in **Spain**, the cherry-like tomatoes (variety "**Josefina**" and "**Karelya**"), and the salad tomato types (variety "**Muchamiel**"), in **three different maturation stages**.





- Sensory parameters (weight, size, texture, pH, degree Brix, and color) and nutritional composition (humidity, proteins, lipids, carbohydrates, and minerals) of these varieties were evaluated by several standard assays.
- Carotenoid content was quantified by HPLC coupled to a UV-visible spectrophotometry detector.
- Polyphenol content was quantified using the Folin & Ciocalteu's phenol reagent.
- Antioxidant activity was performed by several common colorimetric or fluorimetric assays:
 - ✓ Ferric reducing antioxidant power (FRAP) assay;
 - ✓ Oxygen radical absorbance capacity (ORAC) assay;
 - ✓ 2,2-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) radical scavenging assay;
 - ✓ 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity assay.
- Two-way ANOVA test, followed by multiple comparisons and Tukey's test correction, was applied using GraphPad Prism 8 (GraphPad Software, San Diego, CA, USA). p -value ≤ 0.05 was considered statistically significant.
- Correlations were analyzed by Pearson's test.

Sensory parameters

	Var. Josefina			Var. Karelya		
	MS1	MS2	MS3	MS1	MS2	MS3
Weight (g)	15.1 ± 2.81 ^a	16.5 ± 3.21 ^b	20.6 ± 4.68 ^c	17.3 ± 2.49 ^a	17.9 ± 1.94 ^a	18.2 ± 2.80 ^a
Size (quatorial gauge, mm)	30.2 ± 2.10 ^a	29.3 ± 1.92 ^b	33.0 ± 2.78 ^c	31.4 ± 2.16 ^a	31.6 ± 1.62 ^a	31.3 ± 1.68 ^a
Texture (N/g)	27.4 ± 2.32 ^a	24.9 ± 4.11 ^a	14.5 ± 6.38 ^b	25.3 ± 3.75 ^a	19.2 ± 2.91 ^b	17.0 ± 1.64 ^b
pH	3.88 ± 0.01 ^a	3.92 ± 0.01 ^b	4.07 ± 0.01 ^c	3.88 ± 0.09 ^a	3.91 ± 0.03 ^a	4.09 ± 0.08 ^b
Degree Brix	5.97 ± 0.10 ^a	6.70 ± 0.06 ^b	7.37 ± 0.08 ^c	6.25 ± 0.05 ^a	6.75 ± 0.05 ^b	8.10 ± 0.09 ^c
Color (Lab)	0.07 ± 0.13 ^a	0.32 ± 0.13 ^b	0.75 ± 0.10 ^c	0.16 ± 0.10 ^a	0.45 ± 0.10 ^b	0.79 ± 0.16 ^c

Maturation stage (MS) of *Solanum lycopersicum*

1 2 3



Var. Josefina



Var. Karelya

cherry-like tomatoes



Var. Muchamiel

salad tomatoes

	Var. Muchamiel		
	MS1	MS2	MS3
Weight (g)	254 ± 74.10 ^{a,b}	258 ± 88.00 ^a	225 ± 79.50 ^b
Size (quatorial gauge, mm)	84.2 ± 10.20 ^a	84.6 ± 12.40 ^a	80.9 ± 12.10 ^b
Texture (N/g)	15.0 ± 3.88 ^a	10.0 ± 1.75 ^b	6.74 ± 1.57 ^c
pH	4.23 ± 0.06 ^a	4.21 ± 0.03 ^a	4.23 ± 0.05 ^a
Degree Brix	3.49 ± 0.14 ^a	3.80 ± 0.12 ^b	4.03 ± 0.09 ^c
Color (Lab)	0.28 ± 0.15 ^a	0.59 ± 0.14 ^b	0.81 ± 0.13 ^c

Nutritional composition

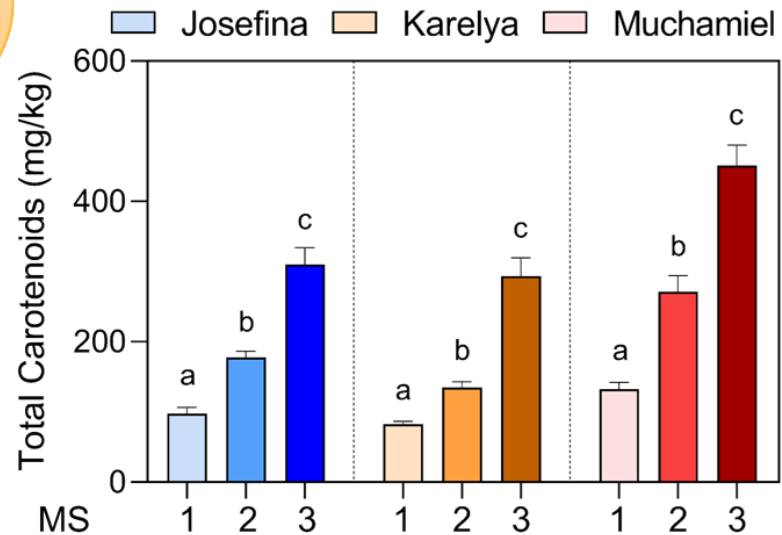
	Var. Josefina			Var. Karelya		
	MS1	MS2	MS3	MS1	MS2	MS3
Humidity (%)	92.90 ± 0.55 ^a	92.40 ± 0.51 ^{a,b}	91.10 ± 1.68 ^b	91.90 ± 0.33 ^a	91.50 ± 0.12 ^b	90.00 ± 0.21 ^c
Proteins (%)	0.19 ± 0.02 ^a	0.18 ± 0.02 ^a	0.20 ± 0.01 ^a	0.20 ± 0.01 ^a	0.23 ± 0.01 ^a	0.27 ± 0.02 ^b
Lipids (%)	0.10 ± 0.02 ^a	0.13 ± 0.02 ^a	0.16 ± 0.02 ^b	0.11 ± 0.02 ^a	0.12 ± 0.01 ^a	0.17 ± 0.03 ^b
Carbohydrates (%)	6.54 ± 0.10 ^a	7.29 ± 0.15 ^b	7.67 ± 0.19 ^b	7.40 ± 0.17 ^a	7.89 ± 0.09 ^b	9.11 ± 0.01 ^c
Minerals (%)	0.23 ± 0.02 ^a	0.22 ± 0.03 ^a	0.24 ± 0.03 ^a	0.38 ± 0.02 ^a	0.40 ± 0.03 ^a	0.46 ± 0.02 ^b

	Var. Muchamiel		
	MS1	MS2	MS3
Humidity (%)	95.50 ± 0.84 ^a	95.70 ± 0.36 ^a	95.30 ± 0.77 ^a
Proteins (%)	0.20 ± 0.02 ^a	0.19 ± 0.02 ^a	0.22 ± 0.03 ^a
Lipids (%)	0.15 ± 0.04 ^a	0.14 ± 0.02 ^a	0.19 ± 0.02 ^b
Carbohydrates (%)	3.70 ± 1.00 ^a	3.56 ± 0.47 ^a	3.91 ± 0.94 ^a
Minerals (%)	0.35 ± 0.08 ^a	0.33 ± 0.02 ^a	0.34 ± 0.02 ^a

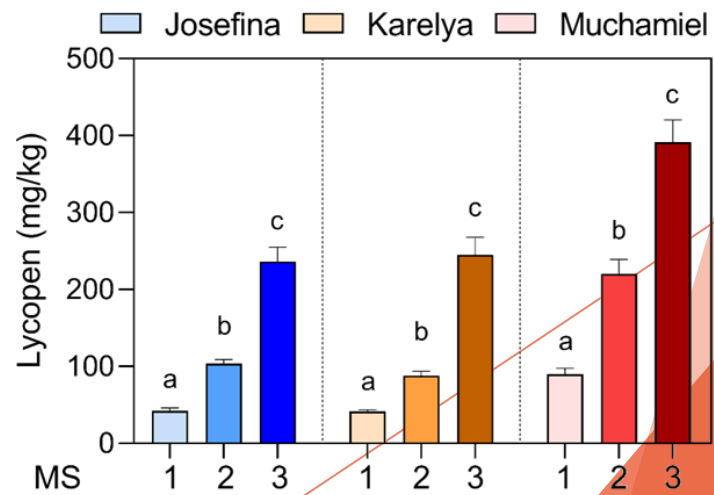
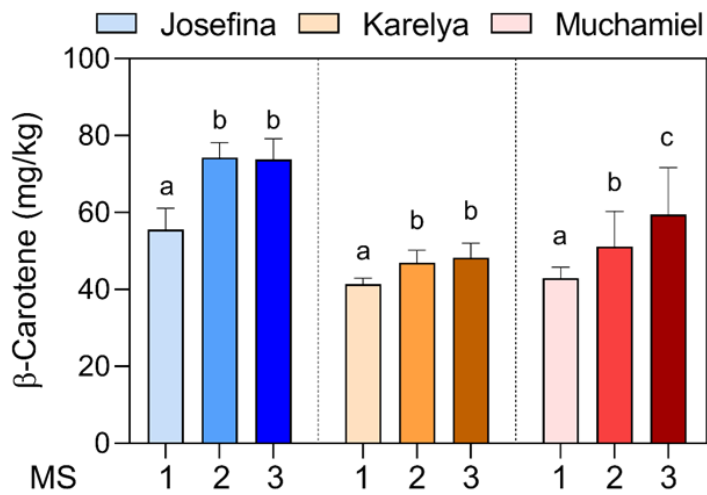
MS: maturation stage

Carotenoid content

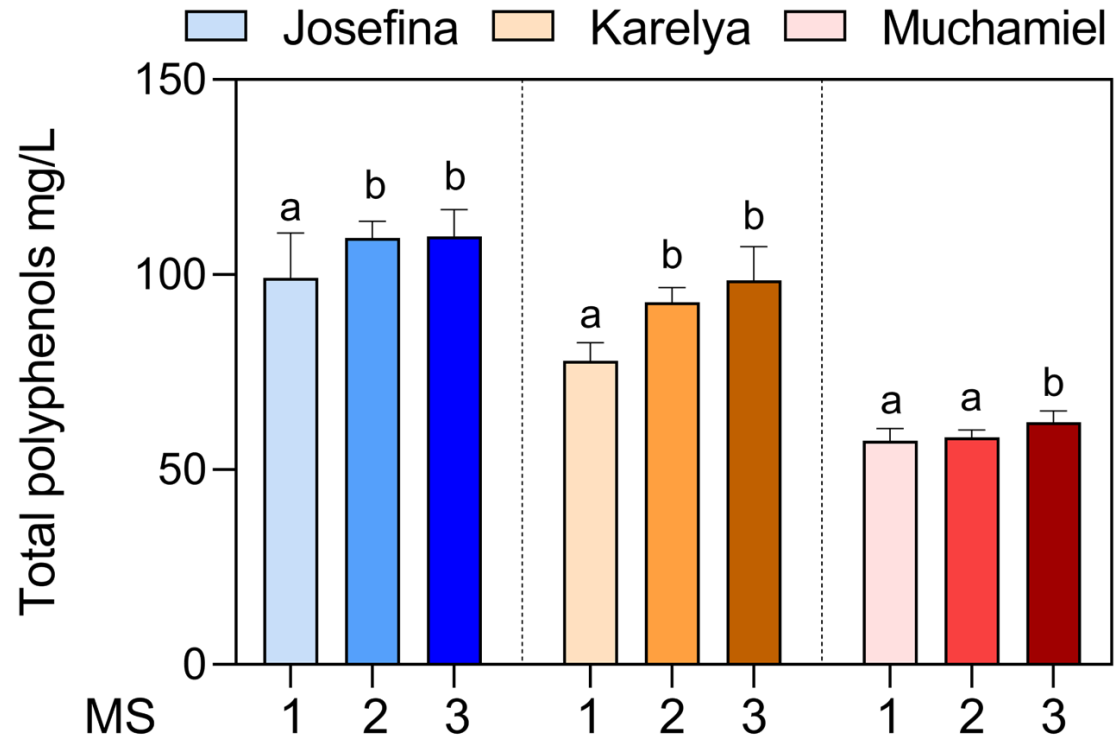
All varieties showed an increase in the carotenoid content throughout the maturation process.



The highest carotenoid content was represented by the lycopene.

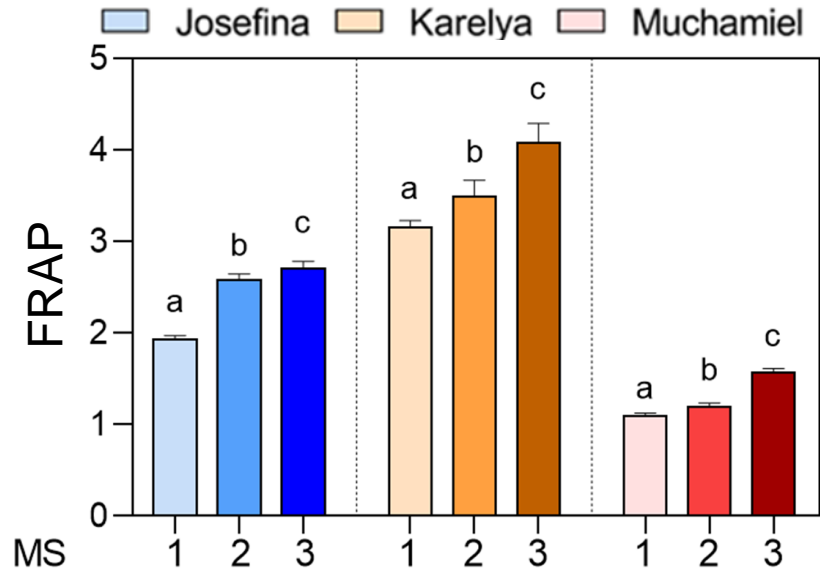


Polyphenols content



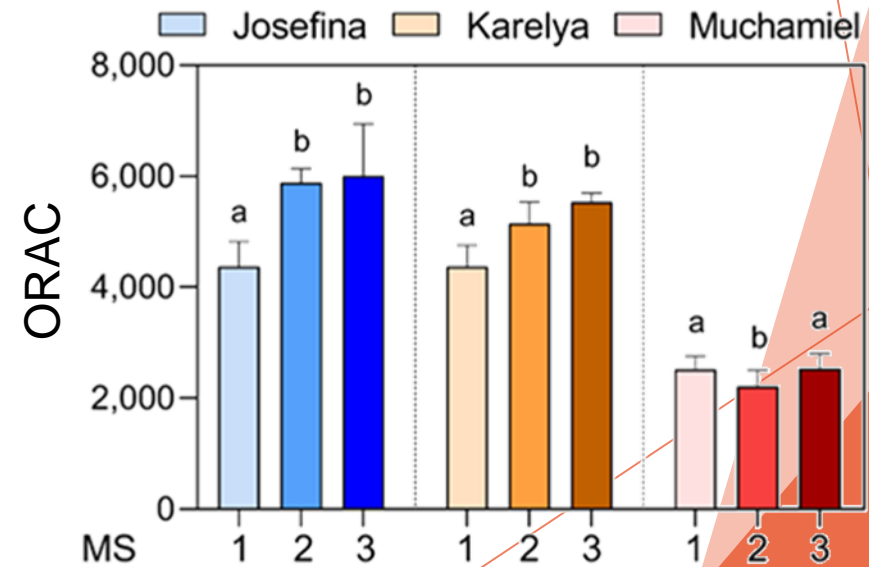
In the last maturation stage, all varieties showed an increase in the polyphenols content.

Antioxidant assays

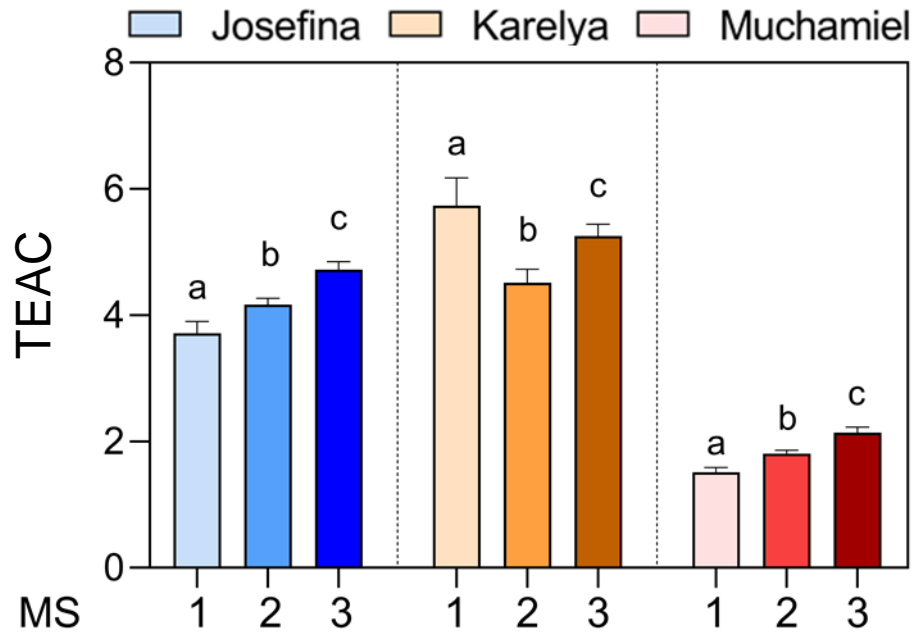


An increase in FRAP values was observed in the second and third maturation stages.

Josefina and *Karelya* varieties showed an increase in the ORAC values in the second and third maturation stages.

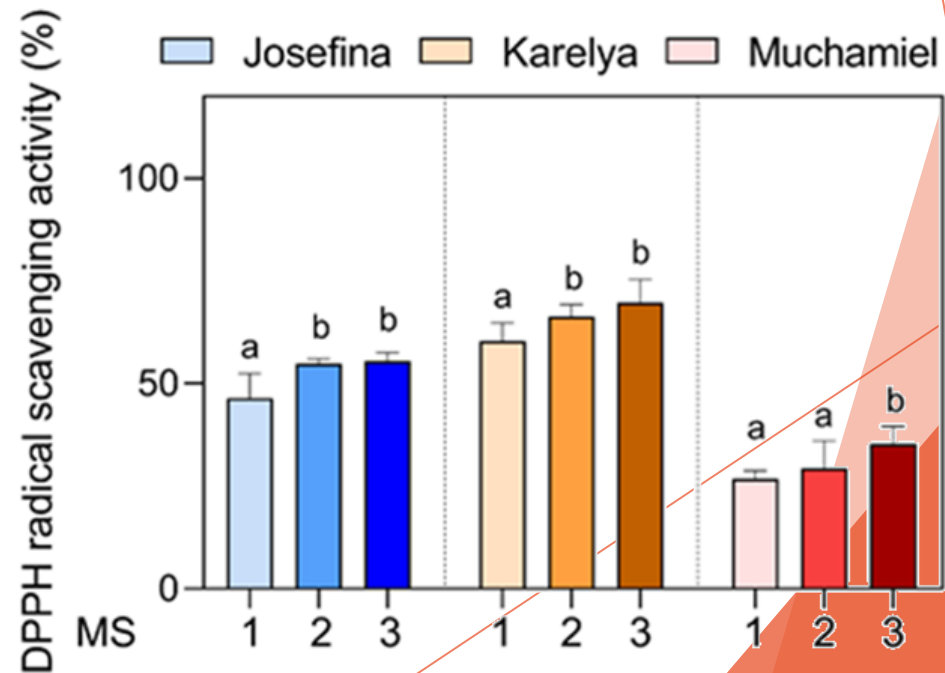


Antioxidant assays



Josefina and Muchamiel showed the highest ABTS levels in the last stage of maturation.

In the last maturation stage, all varieties showed an increase in DPPH radical scavenging activity.



Correlations

Correlation between DPPH radical vs	<i>Josefina</i>		<i>Karelya</i>		<i>Muchamiel</i>	
	r^2	<i>p</i> -value	r^2	<i>p</i> -value	r^2	<i>p</i> -value
Polyphenols	-0.048	0.855	-0.377	0.123	0.225	0.186
Total carotenoids	-0.521	0.026	-0.576	0.012	-0.387	0.032
β -carotene	-0.528	0.029	-0.518	0.028	-0.119	0.489
Lycopene	-0.515	0.029	-0.560	0.016	-0.391	0.030

Polyphenols were not responsible for the increase in antioxidant activity.

By correlation analysis between DPPH radical values and polyphenols and carotenoid content, the increase in antioxidant activity was associated with the rise of carotenoid contents, specifically with the lycopene.

- Carotenoid content increases along the maturation of tomatoes.
- Cherry-like tomatoes have more polyphenols than salad tomatoes.
- The antioxidant activity increase following the maturation of tomatoes.
- Cherry-like tomatoes are more antioxidant than salad tomatoes, at the same weight.
- Lycopene is the principal responsible of the antioxidant activity.

Thanks

