PROYECTO DiveCropS:
Diversifying Cropping Systems - Traditional knowledge and Innovative approaches
Diversificación de sistemas de cultivos - Conocimientos tradicionales y enfoques innovadores

DAAD

EL ANÁLISIS QUÍMICO COMO MODELO PARA CARACTERIZAR ESPECIES TRADICIONALES: EL CASO DEL TOMATE PLATENSE

CHEMICAL ANALYSIS AS A MODEL FOR CHARACTERIZING TRADITIONAL SPECIES: THE CASE OF TOMATE PLATENSE

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Tomato (Solanum lycopersicum) is one of the most important vegetables worlwide and is the second most widely cosumed vegetable after the potato with an average annual per capita consumption of 12 kg.[1] Moreover, tomato is of nutritional interest. Tomato has been recognized as the most important source of lycopene, a red-colored carotenoid associated with several health benefits. In addition to lycopene, the tomato contains a variety of flavonoids and phenolic acids, that are connected to its antioxidant properties, and can contribute to a healthy diet.[2] Among the minerals, the high potassium content stands out, with concentrations exceeding 2 grams. Potassium together with sodium, calcium, manganese, magnesium, iodine, cupper and zinc, are related with the reduction of the risk of cardiovascular disease. [1]

(1) Ordóñez-Santos, L. E.; Vázquez-Odériz, M. L.; Romero-Rodríguez, M. A. *International Journal of Food Science & Technology* **2011**, *46*, 1561.
(2) Slimestad, R.; Verheul, M. *Journal of the Science of Food and Agriculture* **2009**, *89*, 1255.

Tomate Platense

- Platense tomato is a traditional variety of the horticultural belt of Gran La Plata, recognized for its unique flavor compared to other hybrid varieties. “Tomato with tomato taste”. The samples correspond to a subvariety called "Cosecha Tardía (late harvest)" and were supplied by a local farmer under the concept of organic farmer with irrigation.

Experimental

- The samples (Tomate Platense) were obtained fresh, harvested by the local producer in a farm of his property, located in the horticultural belt near of the La Plata city in February of 2019.
- The crop is free of pesticides but with fertilizer aggregates, mostly obtained from compost.
- The tomatoes were placed in polyethylene bags, clean and new, and transferred to the laboratory, where they remained in a refrigerator until their treatment.
- The samples were washed with distilled water and air dried. The inedible part was removed, and the rest (approximately 3 kg) was homogenized with a domestic grinder.

Experimental

- The resulting tomato pulp was divided into three portions:
  - **PTF**: fresh tomato pulp, for direct analysis.
  - **PTSP**: Powdered dried tomato pulp, obtained after subjecting the pulp to a controlled oven drying process and subsequent grinding to fine powder.
  - **PTC**: frozen tomato pulp, unanalyzed, stored at -18 C for future analysis.

Experimental

- Obtention of calcinated samples:
- For comparison, samples were subjected to calcination prior to the acid digestion. Starting from **PTF** and **PTSP**, the samples were carbonized by heating under a hood and then calcined in muffle at 550 C until constant weight. The C-PTF and C-PTSP were obtained.

Material and Methods

- All chemical were P.A. grade. All the volumetric glass material used was certified material. All reference material for the quantitative analysis are certified.
- Acid digestion samples: Were conduced with concentrated nitric acid of quality for ultratrace analysis.
- Microwave oven for acid digestion: Q-LAB Pro, Questron Technology.
- Determination of elements: By inductively coupled plasma emission spectroscopy with optical detection (ICP-OES).
- Spectrometer: Shimadzu ICPE-9800

Table 1: Mineral content in mg/kg (ppm) of dry weight sample (wet fresh tomato in parenthesis) after microwave assisted acid digestion

	PTF	PTSP	C-PTF	C-PTSP	P-val
K	52075,29 ± 4215,02 (2348.60)	54983,92 ± 4615.83 (2479.77)	56136,93 ± 80,29 (2531.77)	57407,31 ± 1762,12 (2589.07)	*
P	6674,20 ± 384,56 (301.00)	6962,96 ± 185,07 (314.03)	5711,78 ± 253,20 (257.60)	5494,74 ± 466,01 (247.81)	**
Ca	2211,26 ± 124,53 (99.73)	4243,5 ± 355,06 (191.38)	1672,95 ± 113,17 (75.45)	1543,41 ± 145,08 (69.61)	*
Mg	1719,14 ± 112,15 (77.53)	1850,37 ± 3,55 (83.45)	1504,78 ± 86,47 (67.86)	1388,38 ± 96,11 (62.62)	*
Na	1088,08 ± 83,04 (49.07)	1109,72 ± 46,16 (50.05)	2063,03 ± 103,25 (93.04)	2158,14 ± 186,06 (97.33)	*

P-value (ANOVA): * < 0.0001, **= 0.0004

PTF: Fresh tomato pulp; **PTSP**: Powdered dried tomato pulp; **C-PTF**: Ashes from PTF; **C-PTSP**: Ashes from PTSP

Table 1: Mineral content… continued

	PTF	PTSP	C-PTF	C-PTSP	P-val
Fe	76,13 ± 2,05 (3.43)	271,03 ± 22,37 (12.22)	56,24 ± 4,50 (2.54)	203,58 ± 17,45 (9.18)	*
Si	53,40 ± 3,97 (2.41)	92,77 ± 6,72 (4.18)	727,10 ± 51,88 (32.79)	315,26 ± 10,37 (14.22)	*
Zn	36,21 ± 1,68 (1.63)	51,01 ± 3,24 (2.30)	37,46 ± 2,55 (1.69)	26,43 ± 1,00 (1.19)	*
Al	25,07 ± 1,01 (1.13)	36,66 ± 0,36 (1.65)	42,27 ± 4,09 (1.91)	99,77 ± 7,85 (4.50)	*
Cu	18,42 ± 0,83 (0.83)	28,27 ± 2,07 (1.27)	10,42 ± 0,56 (0.47)	10,70 ± 0,46 (0.48)	*

P-value (ANOVA): * < 0.0001, **= 0.0004

PTF: Fresh tomato pulp; **PTSP**: Powdered dried tomato pulp; **C-PTF**: Ashes from PTF; **C-PTSP**: Ashes from PTSP

Table 1: Mineral content… continued

	PTF	PTSP	C-PTF	C-PTSP	P-val
Mn	11.92 ± 1.03 (0.54).	13.42 ± 0.71 (0.61)	10.43 ± 0.65 (0.47)	9.72 ± 0.76 (0.44)	*
Ni	6,21 ± 0,59 (0.28)	10,12 ± 1,07 (0.46)	2,26 ± 0,23 (0.10)	1,78 ± 0,15 (0.08)	*
Li	3,62 ± 0,38 (0.16)	5,35 ± 0,07 (0.24)	14,67 ± 1,20 (0.66)	11,92 ± 2,05 (0.54)	*
Pb	2,38 ± 0,12 (0.11)	2,87 ± 0,02 (0.13)	0,47 ± 0,03 (0.02)	0,38 ± 0,03 (0.02)	*
Cr	1,29 ± 0,09 (0.06)	14,13 ± 1,32 (0.64)	1,72 ± 0,15 (0.08)	10,46 ± 1,02 (0.47)	*

P-value (ANOVA): * < 0.0001, **= 0.0004

PTF: Fresh tomato pulp; **PTSP**: Powdered dried tomato pulp; **C-PTF**: Ashes from PTF; **C-PTSP**: Ashes from PTSP

Table 1: Mineral content… continued

	PTF	PTSP	C-PTF	C-PTSP	P-val
Mo	0,91 ± 0,06 (0.04)	1,10 ± 0,04 (0.05)	0,81 ± 0,01 (0.04)	0,77 ± 0,02 (0.03)	*
Co	0,59 ± 0,1 (0.03)	2,12 ± 0,15 (0.10)	0,20 ± 0,03 (0.01)	1,55 ± 0,14 (0.07)	*

P-value (ANOVA): * < 0.0001, **= 0.0004
PTF: Fresh tomato pulp; **PTSP**: Powdered dried tomato pulp; **C-PTF**: Ashes from PTF; **C-PTSP**: Ashes from PTSP

Values of **Cd**, in mg/kg, were detected in very low concentrations (wet fresh tomato in parenthesis): **PTF**= 0.08 (0.004), **PTSP**= 0.19 (0.008), **C-PTF**= 0.051 (0.002); and **C-PTSP**< detection limit.

The concentration of minerals after conventional acid digestion is always lower than that obtained after microwave-assisted acid digestion. P, Mg, Na, Si, and Mn, are few affected by the digestion method and their concentrations are reduced only by about 10%. The rest of the elements studied in this work show strong concentration reductions when conventional digestion is used.

Comparison of heavy metals with other hybrid species

		Cd	Pb	Cu	Ni	Zn
Urban [3]		0.41 ± 0.007	9.7 ± 0.001	32.6 ± 2.4	3.1 ± 0.5	3.56 ± 0.99
Rural [3]		0.33 ± 0.05	5.3 ± 0.09	24.12 ± 0.4	0.44 ± 0.08	47.13 ± 0.2
This work		< LD a	0,38 ± 0,03	10,70 ± 0,46	1,78 ± 0,15	26,43 ± 1,00

(3) DEMİREZEN, D.; AKSOY, A. *Journal of Food Quality* **2006**, *29*, 252.

Arsenic as heavy metal in irrigation water

- Arsenic is one of the heavy metals that is present in the underground waters of several regions of Argentina in high concentrations. The irrigation waters used by the producer were analyzed to study their quality.
- Irrigation water (in mg/L): As: 0,0413 ± 0,0045; Cr: 0,0052 ± 0,0006
- In the tomato samples analyzed, the arsenic content is below the detection limit of the equipment (0,02 mg/Kg), therefore it does not represent a health risk.

Conclusions

- This is the first systematic study of oligoelements and mineral contens in our traditional variety of tomato.
- Tomate platense has high content of potassium, phosphorus and calcium and other metals considered beneficial for health.
- Their mineral content is comparable to the values reported for other hybrid species.
- Despite the use of irrigation water with high arsenic contents, this element does not accumulate in the fruit. Tomato Platense is a safe food.

GRACIAS!!