African Journal of Biotechnology Vol. 9(32), pp. 5173-5176, 9 August, 2010
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 ©2010 Academic Journals

Full Length Research Paper

Evaluation of total phenolics, anthocyanins and antioxidant capacity in purple tomatillo (*Physalis ixocarpa*) genotypes

Daniel González-Mendoza[1]* Onecimo Grimaldo-Juárez[1], Roberto Soto-Ortiz, Fernando Escoboza-Garcia[1] and José Francisco Santiguillo Hernández[2]

[1]Instituto de Ciencias Agrícolas -Universidad Autónoma de Baja California, Carretera Delta S/N, Ejido Nuevo León 21705, Baja California México.
[2]Centro Regional Occidente, Universidad Autónoma Chapingo, Chapingo, México.

Accepted 16 July, 2010

Purple tomatillo genotypes were evaluated for their total anthocyanin, phenolic and antioxidant capacity. The result showed that ICTS-UDG-9-224 and ICTS-UDG-9-32 had the highest amount of total phenolic compounds 10.08 and 9.6 mg GAE/g fresh weight in genotypes, respectively, followed by ICTS-UDG-1-1 and ICTS-UDG-2-2 (5.5 and 5.3 mg GAE/g fresh weight), respectively. The highest content of anthocyanins was found in the genotypes ICTS-UDG-9-32 (6.94 mg of pelargonidin 3-glucoside equivalents/g of fresh weight). In contrast, the genotypes ICTS-UDG-9-224 showed lowest values of antocyanins content. On the other hand, for total antioxidant capacity, the 2,2-diphenyl-1-picrylhydrazyl (DPPH) methods showed that genotypes, ICTS-UDG-2-2 and ICTS-UDG-1-1 had the highest antioxidant capacity (approximately 80%) followed by genotypes ICTS-UDG-9-32 (55%) and ICTS-UDG-9-224 (28%), respectively. These results provide useful and important information for researchers in order to increase the antioxidant capacity and functional value of purple tomatillo for the food and nutraceutical industries.

Key word: Antocyanins, purple tomatillos, bioactive compounds, antioxidant capacity.

INTRODUCCION

The production of reactive oxygen species in organisms can have a role in cell communication processes and defense mechanisms. However, excessive production and accumulation of these products can cause a series of biochemical reactions that can generate various disorders on the cells. For example, may oxidize nucleic acid, proteins, lipids or DNA and can initiate a variety of disease processes such as cancer, neurodegenerative disorders, cardiovascular disease and arteriosclerosis (Migliore and Coppedé, 2009). The alternatives to reduce the presence of reactive oxygen species in higher organisms have suggested the consumption of fruits rich in bioactive compounds such as anthocyanins (Salinas-Moreno et al., 2009).

Anthocyanins are plant secondary metabolites, responsible for most of the red, blue and purple pigmentation found in flowers, fruits and leaves (Harborne and Williams, 2000). They are involved in plant resistance against ultraviolet (UV) light and in animal attraction for pollination and seed dissemination (Archetti, 2000; Manetas, 2006). The major sources of anthocyanins in edible plants include the families Vitaceae (grape) and Rosaceae (blackberry, apple, peach, etc.). Other plant families which contain anthocyanin pigments are Solanaceae (tomato and eggplant) and Cruciferae (red cabbage) (Lohachoompol et al., 2004). Among the plants of the Solanaceae family, are the peel tomato (Tomatillo) whose fruits, especially green color, are consumed in different regions of Mexico, USA and Central America

*Corresponding author. E-mail: daniasaf@gmail.com Tel: +52 686 5230079. Fax: +52 686 5230217.

Abbreviations: DPPH, 2,2-Diphenyl-1-picrylhydrazyl; **UV,** ultraviolet; **GAE,** gallic acid equivalent; **RSA,** radical scavenging.

(Mulato-Brito and Peña-Lomeli, 2007). In contrast, consumption of the fruit, purple tomatillo, is limited mainly to the western region of Mexico (Santiaguillo et al., 1994). Therefore, information on the functional properties of this fruit would be helpful in increasing the awareness of the consumers regarding the level of beneficial phyto-chemicals present in this nutritious vegetable.

Thus, the current study was undertaken to determine the content of bioactive compounds such as phenolic compounds, anthocyanins and antioxidant activity present in the fruit pericarp of purple tomatillo.

MATERIALS AND METHODS

Collection of fruits from plant materials

Fresh fruits of four selected purple tomatillo (*Physalys ixocarpa*) genotypes from different regions of Jalisco, Mexico were collected in June 2009 from a cultivated green house at the Institute of Agronomy Sciences of the Autonomous University of Baja, California (UABC). Immediately after harvesting, fruits were frozen and stored at -20℃ until analysis.

Sample preparation

A ground freeze-dried sample of 300 mg of each genotypes were weighted and phenols and anthocyanins were extracted with 3 ml 80% aqueous solution of HCl-methanol (1%) at 4℃ and then homogenates were centrifuged at 3000 rpm for 10 min; super-natants were subjected to further analysis.

Quantitative determination of total phenolic content

The total phenolic content of the crude acidified methanol extract was determined by using a modified Folin-Ciocalteu method with gallic acid (Sigma Chemical Co.) as a standard. Folin Ciocalteu reagent (600 µl, Fluka) was added for methanolic extract solution (120 µl), then 1 N aqueous sodium carbonate solution (360 µl) was added and the tube was vortexed and then incubated for 40 min.

A blue color appeared and the absorbance was measured at 725 nm with a Beckman DU-50 spectrophotometer. All measurements were made in triplicates and the results expressed as milligrams of gallic acid equivalent (GAE) per g of fresh weight.

Anthocyanin extraction and determination

The extracts were freshly prepared from frozen fruit and did not undergo extensive processing or significant browning; a pH differential method for determination anthocyanin content was considered unnecessary. Therefore, the total anthocianin of the acidified methanol extract from 10 selected purple tomatillo (*P. ixocarpa*) genotypes was measured at 535 nm using a Beckman DU-50 spectrophotometer. All measurements were made in triplicates and the results expressed as milligrams of pelargonidin 3-glucoside equivalents per gram of fresh weight.

Determination of DPPH scavenging activity

A methanolic solution (60 µl) of sample extract was added to 1200 µl (0.025 g L-1) of DPPH solution. The mixture was shaken vigorously and allowed to stand at room temperature for 30 min. The absorbance was measured at 517 nm by a spectrophotometer using methanol as a blank. Lower absorbance of the reaction mixture indicates higher free radical scavenging activity. The percentage of 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging (RSA) was calculated using the equation:

$$\%\text{DPPH RSA} = \frac{\text{Initial absorbance - Final absorbance}}{\text{Initial absorbance}} \times 100$$

Statistical analysis

Data were analyzed with analyses of variance (ANOVA), and mean of comparison test (Tukey's α = 0.05) was performed (Statistical Package version 5.5, Statsoft, USA). Significant differences were accepted if $p < 0.05$ and data was expressed as mean ± standard error.

RESULTS AND DISCUSSION

The phenolic compounds (one of the most important antioxidant plant components) are widely investigated on plants and fruits (Djeridane et al., 2006). These com-pounds might interfere in several of the steps that lead to the development of malignant tumors, inactivating carcinogens, inhibiting the expression of mutant genes and the activity of enzymes involved in the activation of procarcinogens and activating enzymatic systems involved in the detoxification of xenobiotics. In the present study, significant variations were observed in the content of total phenolic compounds from different genotypes of selected purple tomatillo genotypes (Figure 1). The maximum values of total phenolic compounds per geno-types were 10.08, 8.34 and 7.31 mg GAE/g fresh weight in genotypes ICTS-UDG-9-224, ICTS-UDG-9-32 and ICTS-UDG-13-52, respectively. While minimum values were recorded from ICTS-UDG-1-1 and ICTS-UDG-2-2 (5.5 and 5.3 mg GAE/g fresh weight, respectively).

On the other hand, the presence of anthocyanins in plant-derived food is very important because their intake in the human diet is associated with protection against coronary heart disease and an improvement in sight. In this study, our results showed that anthocyanin content in purple tomatillo genotypes were slightly different (Figure 2).

The highest content of anthocyanins was found in the genotypes ICTS-UDG-9-32 (6.94 mg of pelargonidin 3-glucoside equivalents / g of fresh weight). In contrast, the genotypes ICTS-UDG-2-2 and ICTS-UDG-1-1 did not show significant difference in antocyanins content. On the other hand, the genotypes ICTS-UDG-9-224 showed the lowest values of antocyanins content (Figure 2). To the best of our knowledge, there are no reports on total phenolic and anthocyanin content from purple tomatillo genotypes, thus preventing a direct comparison. How-ever, our findings are in accordance with those reported on black Soybean Cikuray variety (Astadi et al., 2009) and strawberry (Tulipani et al., 2008). In this sense, we found

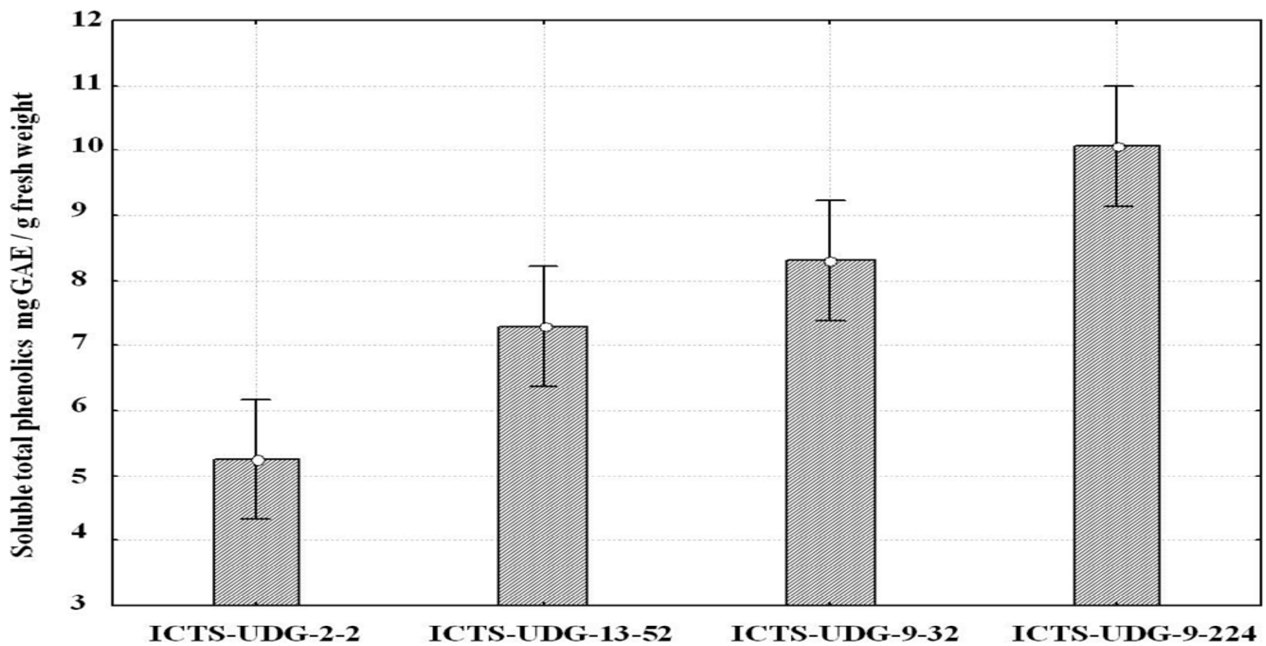

Figure 1. Total soluble compounds phenolics of four different genotypes of purple tomatillo. Means ± standard error; n = 3.

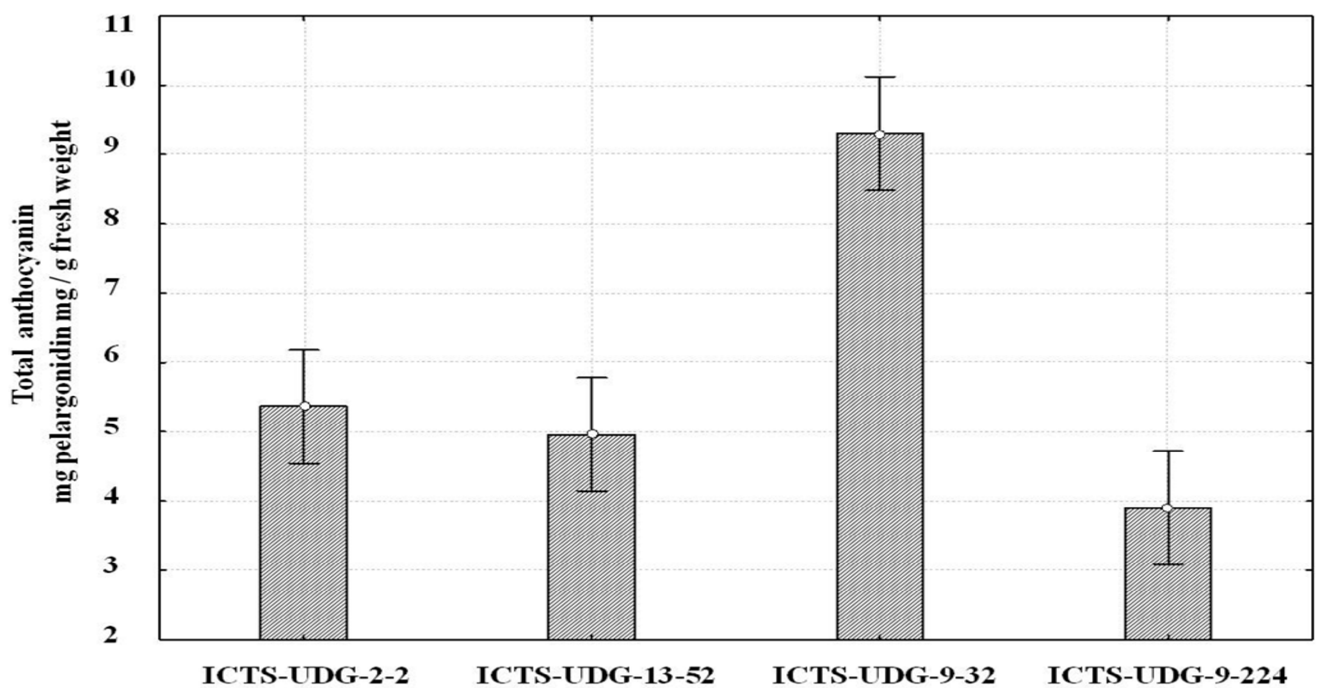

Figure 2. Values of total anthocyanin of four different genotypes of purple tomatillo. Means ± standard error; n = 3.

similar values on phenolic and anthocyanin content. On the other hand, for total antioxidant capacity, the DPPH methods showed that genotypes, ICTS-UDG-2-2 and ICTS-UDG-1-1 had the highest antioxidant capa-city (90% approximately) followed by genotypes ICTS-UDG-9-32 (55%) and ICTS-UDG-9-224 (28%), respectively (Figure 3). Similar values have been observed in different plants such as roselle of *Hibiscus sabdariffa* (Galicia-Flores et al., 2008) and *Camellia sinensis* Linn (Khalaf et al., 2008). Finally, these results provide useful and important information for researchers in order to increase the antioxidant capacity and functional value of purple

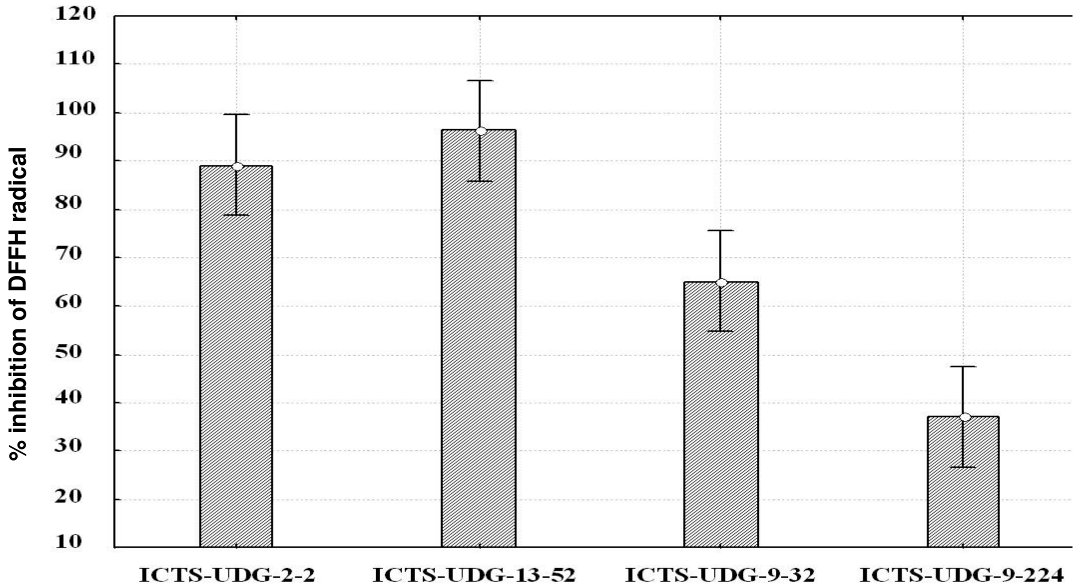

Figure 3. Antioxidant capacity of four different genotypes of purple tomatillo. Means ± standard error. n = 3.

tomatillo for the food and nutraceutical industries.

Conclusion

In the present study, selected purple tomatillo (*P. ixocarpa*) genotypes appear to be good and safe source of antioxidants. The fruits of this plant could be used for direct consumption as salads or as extracts to increase the nutritional value of different foods and diets. Future studies include identification of the remaining antioxidant constituents in the semi purified aqueous fractions and study of the anticancer effects of these aqueous extracts.

ACKNOWLEDGEMENTS

We thank Ph.D. José Sánchez Martínez for excellent technical assistance and Red de Tomate de Cascara for helping us obtain the seeds used in the study and Programa de Mejoramiento del Profesorado (PROMEP) convocatoria 2008, incorporacion de Nuevos Profesores de Tiempo Completo.

REFERENCES

Archetti M (2000). The origin of autumn colours by coevolution. J. Theor. Biol. 205: 625-630

Astadi Ignasius R, Astuti M, Santoso U, Nugraheni P (2009). *In vitro* antioxidant activity of anthocyanins of black soybean seed coat in human low density lipoprotein (LDL). Food Chem. 112:659-663.

Galicia-Flores L, Salinas-Moreno Y, Espinoza-García BM, Sánchez-Feria C (2008). Physicochemical characterization and antioxidant activity of roselle extracts (*Hibiscus sabdariffa* L.) national and imported. Revista Chapingo Serie Horticult. 14: 121-125

Harborne JB, Williams CA (2000). Advances in flavonoid research since 1992. Phytochemistry, 55: 481-504.

Khalaf N A, Shakya AK, Al-Othman A, El-Agbar Z, Farah H (2008). Antioxidant Activity of Some Common Plants Turk. J. Biol. 32: 51-55.

Lohachoompol V, Srzednicki G, Craske J. 2004. The Change of Total Anthocyanins in Blueberries and Their Antioxidant Effect After Drying and Freezing. J. Biomed. Biotechnol. 5: 248-252

Manetas Y (2006). Why some leaves are anthocyanic and why most anthocyanic leaves are red? Flora, 201: 163-177.

Migliore L, Coppedè F (2009).Oxidative Stress and mechanisms of environmental toxicity. Mutat. Res. 31: 73-74.

Mulato-Brito J, Pena-Lomeli A (2007). Germplasm evaluation of tomatillo (*Physalis ixocarpa* Brot.) cropped under Ontario, Canada and Chapingo, Mexico environmental conditions. Vegetable Crops Res. Bull. 66: 117-127.

Salinas-Moreno Y, Almaguer-Vargas G, Peña-Varela G, Ríos-Sánchez R (2009). Ellagic acid and anthocyanin profiles in fruits of raspberry (*Rubus idaeus* L.) in different ripening stages. Revista Chapingo Serie Horticult. 15: 97-101.

Santiaguillo HJF, López RM, Peña AL, Cuevas JASYJ, Sahagún C (1994). Distribución, colecta y conservación de germoplasma de tomate de cáscara (*Physalis ixocarpa* Brot.). Revista Chapingo Serie Horticult. 2: 125-129.

Tulipani S, Mezzetti B, Capocasa F, Bompadre S, Beekwilder J, Ric De Vos CH, Capanoglu E, Bovy A, Battino M (2008). Antioxidants, phenolic compounds, and nutritional quality of different strawberry genotypes. J. Agric. Food Chem. 56: 696-704.