

## Evaluation of antioxidant activity, polyphenols and vitamin C content of some exotic fruits

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### Abstract

The aim of this work was to determine the antioxidant activity (by CUPRAC method), polyphenol content (Folin -Ciocâlteu method) and ascorbic acid (iodometric method) of some exotic fruits: pineapple, kiwi and pomegranate, purchased on the local market. The highest antioxidant capacity had the pomegranate sample (0.290 mM Trolox/l) - even diluted 1:2, compared to other samples, followed by kiwi sample (0.115 mM Trolox/l). The lowest antioxidant activity was recorded in the pineapple sample (0.109 mM Trolox/l). In terms of total polyphenols content, the sample with the highest concentration was pomegranate (0.129 mg gallic acid/l) - diluted 1:2, followed by pineapple (0.072 mg gallic aci /l). The lowest polyphenol content was found in kiwi fruit. The highest content of vitamin C was found in kiwi (91.20 mg/100g), followed by pineapple (45.30 mg/100g).

**Keywords:** pineapple, kiwi, pomegranate, antioxidant activity, CUPRAC method, vitamin C

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### 1. Introduction

Exotic fruits are that which are not native and that are cultivated outside, available at their place of origin. Among the exotic fruit in Romania, they are part and pineapple (*Ananas comosus* L.), kiwi (*Actinidia chinensis* L.) and pomegranate (*Punica granatum* L.). It is known that these fruits are rich in antioxidants and other important phytonutrients for human health [1-3]. In recent decades, growing more and more interest to researchers on the role of antioxidants on human health, also appeared a lot of studies related to the type and effects of antioxidants from fruits and vegetables [4-6].

We know that antioxidants are the substances able to prevent or inhibit oxidation processes in the human body and also in food products. Almost all edible plant products contain antioxidants.

Among antioxidants, polyphenols are the most numerous group and they are present in fruits and vegetables, in their products, leguminous plants, grains, teas, herbs, spices and wines [6-10]. The antioxidant properties of polyphenols are mainly due to their redox properties, which allow them to act as reducing agents, hydrogen donors and singlet oxygen quenchers [11]. As antioxidants, polyphenols prevent oxidation of vitamin C and adrenaline from enzymes containing copper while enhancing effect of vitamin C [7].

Vitamin C (ascorbic acid) is one of the most important vitamin that exist in fruits and vegetables [12]. Vitamin C may protect cell membranes against lipoperoxidation through two mechanisms: (1) directly by intercepting free radicals formed in the aqueous cytosol and (2) indirectly through participation in the regeneration of vitamin E [7].

The aim of this scientific paper was to evaluate the antioxidant activity (using CUPRAC method) and also polyphenol (Folin- Ciocâlțeu method) and vitamin C content in some exotic fruits (kiwi, pineapple, pomegranate) from the Romanian market.

## **2. Materials and methods**

Fruits (kiwi, pineapple, pomegranate) were purchased on the domestic market being analyzed fresh. To determine the antioxidant activity and polyphenols content, from each type of fruit were weighed 2 g and then was comminuted, subsequently subjecting it to extraction with 20 ml 20% ethanol for 2 hours. The filtered samples were subsequently subjected to analysis.

### *2.1. Determination of antioxidant activity*

To determine antioxidant activity of samples was used CUPRAC method that uses as reference substance reagent Trolox- an antioxidant that mimics the structure of vitamin E, but is both fat-soluble and water-soluble [13].

The reagents used in the analysis by this method were: 0.01 M  $\text{CuCl}_2$  solution, neocuproine alcoholic solution of  $7.5 \cdot 10^{-3}$  M, ammonium acetate buffer solution.

Was mixed 1ml cuprous solution with 1 ml neocuproine alcoholic solution and 1 ml of acetate buffer. Over this solution was added 1.1 mL solution containing standard or sample and stirred well. After 30 minutes, was determined the absorbance at 450 nm, using ethanol as reference substance. The molar absorption coefficient for Trolox in the method CUPRAC is:  $\epsilon = 1.67 \cdot 10^4 \text{ l} \cdot \text{mol}^{-1} \cdot \text{cm}^{-1}$

The results were expressed in mmol Trolox/g dry matter.

### *2.2. Determination of polyphenols content*

To determine the total polyphenol content was used Folin-Ciocâlțeu method based on the reducing properties of the phenols to hexavalent molybdenum from the poly-phosphomolybdate [14,15].

The reagents used were as follows: Folin-Ciocâlțeu reagent (FC) 2M diluted 1:10 and 7.5% sodium carbonate solution.

Preparation of the calibration curve and the samples was done by mixing 2.5 ml reagent FC diluted 1:10 with 0.5 ml of sample or standard solution of concentration: 0.4- 0.6- 0.8- 0.2- 1.0- 1.2  $\mu\text{M/ml}$  gallic acid. After 10 minutes (time needed to completion of the reduction reaction) were added 2 ml of 7.5% sodium carbonate solution for neutralization and alkanisation of the reaction medium and the formation of reduced poly-phosphomolybdates, colored blue. After approx. 2 hours the absorbance was read at 750 nm. The concentration of polyphenols it was expressed as gallic acid.

### *2.3. Determination of vitamin C content*

The ascorbic acid content of the samples was determined by iodometric method. The principle of this method is the color reaction between starch and I + KI solution. Vitamin C concentration is done with  $\text{K}_2\text{Cr}_2\text{O}_7$  in the presence of KI-starch. Liberated iodine color the starch in blue.

It was weighed at analytical balance a sample of 0.05-0.1 g, was made quantitatively into a titration flask, there were added 10 ml of 2N HCl, diluted to 50 ml with distilled water and triturated. Then was added 1 ml of 1% starch solution (freshly prepared) and 1 ml of 0.1 N KI and then titrated with aqueous 0.1 N  $\text{K}_2\text{Cr}_2\text{O}_7$  to a persistent blue color. The dosage of the vitamin C content was made according to:

1 mL  $\text{K}_2\text{Cr}_2\text{O}_7$  0.1N corresponds to 0.008806 g Vitamin C [16].

## **3. Results and discussions**

### *3.1. Antioxidant activity level*

Using Trolox standard solutions was obtained the calibration curve on the basis of which have been made suitable calculations for the antioxidant activity of exotic fruits analyzed samples.

Pineapple and kiwi samples could be analyzed as such (not necessary for other dilutions) and pomegranate sample had to be diluted 1: 2, being more concentrated in antioxidants.

The results on the antioxidant capacity of a sample of pineapple, pomegranate and kiwi taken in analysis are shown in Figure 1.

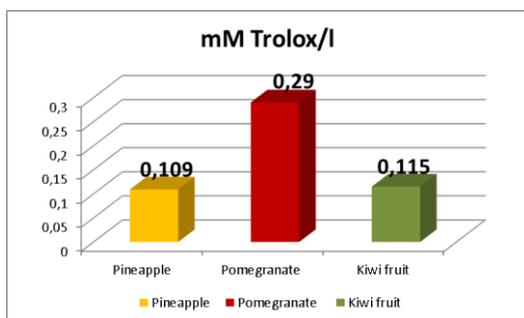


Figure 1. Antioxidant activity of fruits

The values we have obtained experimentally showed that the highest antioxidant capacity presents pomegranate sample (0.290 mM Trolox/l) - even diluted 1:2, compared to other samples, followed by kiwi sample (0.115 mM Trolox/l). The reduced antioxidant activity showed the pineapple sample (0.109 mM Trolox/l).

### 3.2. Total polyphenols content

With the aid of the calibration curve were calculated concentration of polyphenols in samples of exotic fruits. The results of the total polyphenol content of the tested samples are shown in Figure 2.

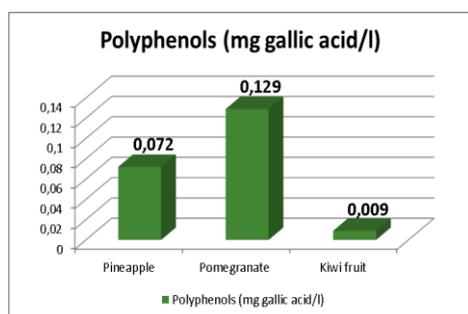


Figure 2. Total polyphenols of fruits

It has been observed that concerning the total polyphenols content the higher concentration was found also in the pomegranate sample (0.129 mg gallic acid/l)- diluted 1:2, followed by the pineapple sample (0.072 mg gallic acid/l).

### 3.3. Vitamin C content

The results on ascorbic acid content of the analyzed samples are given in Figure 3.

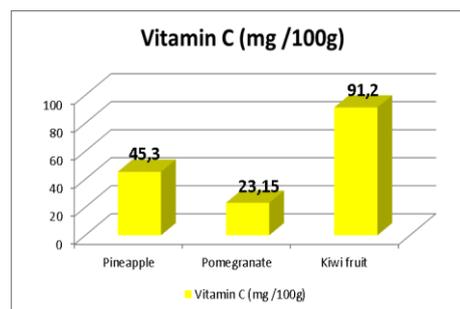


Figure 3. Ascorbic acid content of fruits

The results show that of the three types of exotic fruits analyzed, the highest content of vitamin C was found in kiwi.

(91.20 mg/100g), followed by pineapple (45.30 mg/100g). High content of ascorbic acid in kiwi (almost 2 times higher than in pineapple), makes the antioxidant activity of this fruit to be higher than for pineapple, although it has a total polyphenol content slightly lower than this. Regarding pomegranate notice that has the lowest levels of vitamin C (23.15 mg/100g) of the three analyzed fruits, but due to its very high concentrations of polyphenols (more than 14 times higher than in kiwi and almost 2 times higher than in pineapple), this fruit shows the highest antioxidant activity of fruits analyzed.

## 4. Conclusions

1. Pomegranate fruit showed the highest antioxidant activity (0.290 mM Trolox/l) followed by kiwi fruit (0.115 mM Trolox/l) and pineapple (0.109 mM Trolox/l).
2. The highest concentration of polyphenols was found also in the pomegranate (0.129 mg gallic acid/l), followed by pineapple (0.072 mg gallic acid/l).
3. Of the three types of exotic fruits analyzed, the highest content of vitamin C was found in kiwi (91.20 mg/100g), followed by pineapple (45.30 mg/100g).
4. Although pomegranate has the lowest levels of vitamin C (23.15 mg/100g) of three fruits analyzed, due to very high concentrations of polyphenols, this fruit shows the highest antioxidant activity of fruits analyzed.

**Compliance with Ethics Requirements.** Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards

## References

1. Chou, H-N., Nee, C-C., Ou, A.S-M., Chou, T-H., Chien, C-C., Characterization of the physico-chemical and antioxidant properties of Taiwanese kiwifruit (*Actinidia setosa*), *Botanical Studies*, **2008**, 49, 215-224.
2. Manasathien, J., Indrapichate, K., Intarapichet, K-O., Antioxidant Activity and Bioefficacy of Pomegranate *Punica granatum* Linn. Peel and Seed Extracts, *Global Journal of Pharmacology*, **2012**, 6(2), 131-141.
3. Haripyaree, A., Guneshwor, K., Damayanti, M., Evaluation of Antioxidant Properties of Phenolics Extracted from *Ananas comosus* L. *Not Sci Biol* , **2010**, 2(2), 68-71.
4. Karadeniz, F., Burdurlu, H.S., Koca, N., Soyer, Y., Antioxidant Activity of Selected Fruits and Vegetables Grown in Turkey, *Turk J Agric For*, **2005**, 29, 297-303.
5. Duda-Chodak, A. Tarko, T., Antioxidant properties of different fruit, seeds and peels, *Acta Sci. Pol., Technol. Aliment.*, **2007**, 6(3), 29-36.
6. Robards K., Prenzler P.D., Tucker G., Swatsitang P., Glover W., Phenolic compounds and their role in oxidative processes in fruits. *Food Chem.* **1999**, **66**, 401-436.
7. Jianu, I., Dumbravă, D., *Factori de protecție alimentari*, Ed. Mirton, Timișoara, 2001.
8. Lima, G.P.P., Vianello, F., Corrêa, C.R., da Silva Campos, R.A., Borguini, M.G., Polyphenols in Fruits and Vegetables and Its Effect on Human Health, *Food and Nutrition Sciences*, **2014**, 5, 1065-1082.
9. Del Rio, D., Rodriguez-Mateos, A., Spencer, J.P.E., Tognolini, M., Borges, G. and Crozier, A., Dietary (poly)phenolics in human health: Structures, bioavailability, and evidence of protective effects against chronic diseases. *Antioxidants & Redox Signaling*, **2012**, 18, 1-73.
10. King, A., Young, G. Characteristics and Occurrence of Phenolic Phytochemicals, *Journal of the American Dietetic Association*, **1999**, 99, 213-218.
11. Rice-Evans, C.A., Miller, N.J. and Paganga, G., Antioxidant Properties of Phenolic Compounds., *Trends in Plant Science*, **1997**, 2, 152-159.
12. Rekha, C., Poornma, G., Manasa, M., Abhipsa, V., Pavithra Devi, J., Vijay Kumar H.T., Prashith Kekuda, T.R., Ascorbic Acid, Total Phenol Content and Antioxidant Activity of Fresh Juices of Four Ripe and Unripe Citrus Fruits, *Chem Sci Trans.*, **2012**, 1(2), 303-310.
13. Apak, R. Güçlü, K. Demirata, B. Özyürek, M. Çelik, S.E. Bektaşoğlu, B. Berker, K.I. Özyurt, D., Comparative Evaluation of Various Total Antioxidant Capacity Assays Applied to Phenolic Compounds with the CUPRAC Assay. *Molecules*, **2007**, 12, 1496-1547.
14. Folin, O. Ciocalteu, V., Tyrosine and tryptophane determination proteins. *Journal of Biological Chemistry*, **1927**, 73, 627-650.
15. Singleton, V.L. Orthofer, R. Lamuela -Raventos, R.M., Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin-Ciocalteu reagent. *Methods in Enzymology*, **1999**, 299, 152-178.