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Comparative analysis of vitamin C content and antioxidant activity of some fruits extracts

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Abstract

In this work was determined ascorbic acid concentration in orange fruits and plums as well as in aqueous, alcoholic and acetonic extracts obtained from them, at the same time evaluating the antioxidant activity of these extracts. Ascorbic acid content was determined by iodometric method and antioxidant activity was quantified by free- radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) method. We notice a rich content of ascorbic acid both in the orange pulp (984,00 mg/100g) and in plums (870,16 mg/100g). Between obtained extracts, those in acetone are the richest in vitamin C, followed by those in water and then the alcoholic extracts. The highest concentration of ascorbic acid was determined in acetonic extracts of orange pulp (52.84 mg/100ml). Lowest content of vitamin C was recorded for alcoholic orange extract (26.42 mg/100ml). Acetonic extract of orange, which has the highest content of ascorbic acid, has the strongest antioxidant activity (the highest reaction speed of DPPH solution in the presence of this extract: v=3.886 μM/s) and the lowest antioxidant activity is for alcoholic extract of orange (v=2.007 μM/s), which presents the lowest concentration of vitamin C.

Keywords: orange, plum, antioxidant activity, ascorbic acid, acetonic extract, alcoholic extract

1. Introduction

Fruits play an important role as protective foods, with therapeutic effects appreciated since antiquity. Today it is known that populations that have a predominantly vegetarian diet show a lower frequency of cardiovascular diseases, cancer, obesity, kidney and liver disease [1,2]. In traditional medicine, largely confirmed by rigorous clinical research, a large number of fruit are recommended for the treatment of gastrointestinal, cardiovascular, nutrition, metabolism. kidney, respiratory, endocrine, central nervous system and dermatological diseases [3,4].

In fruits have been identified many substances having antitumorigen effects: tocopherols, ascorbic acid, glutathione, carotenoids, selenium, zinc, dietary fiber, which act synergistically and effectively in the defense system of the body. Colorful vegetables have stronger antitumor action. A special role in anticancer protection is played by retinoids and carotenoids that block abnormal cell proliferation [5].

Interest in the role of antioxidants in human health has prompted research in the fields of food science and horticulture to assess fruit and vegetable antioxidants [6]. The majority of the antioxidant capacity of a fruit or vegetable may be from compounds such as flavonoids, isoflavones, flavones, anthocyanins, catechins and isocatechins rather than from vitamins C, E or b-carotene [7,8]. Many of these phytochemicals may help to protect cells against the oxidative damage caused by free radicals [9].

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Orange trees (*Citrus sinensis* L.) are widely cultivated in tropical and subtropical climates for the sweet fruit, which is peeled or cut (to avoid the bitter rind) and eaten whole, or processed to extract orange juice, and also for the fragrant peel. Orange fruit is a rich source of vitamins such as vitamin A, B, C, calcium, being a fruit very good for health. Unlike other fruits, orange fruit is superior in terms of calcium. Also it contains sodium, potassium, magnesium, copper, sulfur and chlorine. Thus is a good remineralizing and revitalizing of the body, recommended for all persons regardless of age. Values for 100 g of fruit: water 87.6%, protein 0.7%, fat 0.2%, minerals 0.3%, fibre 0.3%, carbohydrates 10.9%, calcium 26 mg, phosphorus 20 mg, iron 0.3 mg, vitamin C 30 mg [10].

Plums belong to the *Prunus* genus of plants and are relatives of the peach, nectarine and almond. They are all considered "drupes," fruits that have a hard stone pit surrounding their seeds. When plums are dried, they are known as prunes. The fresh version (plums) and the dried version (prunes) of the plant scientifically known as *Prunus domestica* have been the subject of repeated health research for their high content of unique phytonutrients called *neochlorogenic* and *chlorogenic acid*. These substances found in plum and prune are classified as *phenols*, and their function as antioxidants has been well-documented [11].

Plums are a very good source of vitamin C. They are also a good source of vitamin A, vitamin K, potassium, and dietary fiber. Mean chemical compositions for all varieties were as follows: moisture, 837.4 g/kg; soluble solids, 155.5 g/kg; titratable acidity, 15.1 g/kg; total sugar, 96.5 g/kg; reducing sugar, 51.9 g/kg; sucrose, 42.4 g/kg; ascorbic acid, 157.9 mg kg^{-1}; protein, 7.5 g kg^{-1}; ash, 5.5 g/kg; sodium 161.53 mg/kg; potassium, 2228.12 mg/kg; calcium, 25.47 mg/kg; iron, 4.70 mg/kg [11,12].

The remedial benefits of consuming plums are many and one of them is that they have a potent antibacterial characteristic. Consumption of plums also helps in rejuvenating the body after undertaking strenuous physical workouts or when someone is enduring mental exhaustion. In addition, plums also enhance the competence of the immune system in combating free radicals, as they have a strong antioxidant impact. Finally, it needs to be mentioned that plums also have cosmetic values, as they improve the condition of the skin [12].

The purpose of this paper is to analyze the correlation between vitamin C content and antioxidant activity of some oranges and plums fruit extracts.

2. Materials and Method

It was used raw materials from the domestic market: orange *Valencia* variety and plums *President* variety. Extracts were obtained from fresh raw materials, chopped fine, of which were weighed by 1 g and then were extracted with 10 ml extraction solvent (distilled water, respectively 96% ethyl alcohol and acetone pa) for 1 hour at room temperature. Extracts thus obtained were filtered and then subjected to various analyzes. For each samples of raw material and extract it was determinated the vitamin C content and for each extract sample was eavaluated the antioxidant activity using the free radical DPPH method.

2.1. Determination of vitamin C

In order to determine the C vitamin content, it was used the adapted iodometric method wich was resented in a previous paper [13].

Quantification of vitamin C content was done according to the relation:

1 ml 0.1 N potassium dichromate is equivalent to 0.008806 g vitamin [14].

All determinations were performed in triplicate, calculating their arithmetic mean.

2.2. Antioxidant activity determination

It was determined the antioxidant activity of aqueous, alcoholic, respectively acetonic extracts obtained from analized fruits: orange- *Valencia* variety and plums- *President* variety, usind the free radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) method.

Materials used were:

- solution 1mM DPPH (2,2-diphenyl-1-picrylhydrazyl – free radical, MP Biomedicals, LLC-Germany, in ethanol);
- ethanol 96% (Merck);
- acetone p.a.;
- distilled water.

For each analyzed fruit extract were taken samples which were diluted with distilled water 1:100, because at lower dilutions fading samples happening instantly. In an stoppered tube were introduced: 0,3 ml diluted sample, 2,6 ml solvent (ethanol) and then 0,3 ml DPPH 1mM solution, after wich this blend was introduced in the spectrophotometer cuvette, for compensation using ethanol, water or acetone. The absorbance at 517 nm and its variation over time was recorded. The records were made with the Perkin Elmer, Lambda 25 spectrophotometer [13].

Based on VIS absorption spectra of the different concentration DPPH solutions (Figure 1.) was obtained calibration curve: *Absorbance* (517 nm) = *f* (*c*, mM) (Figure 2).

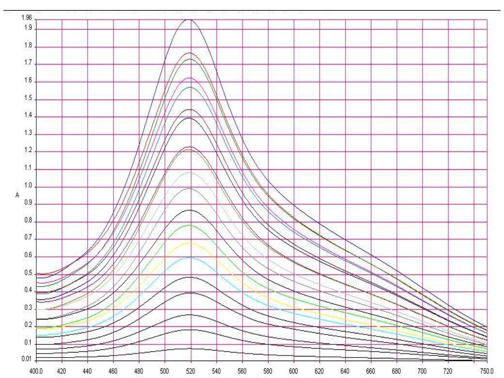

Figure 1. DPPH standard solution VIS spectra

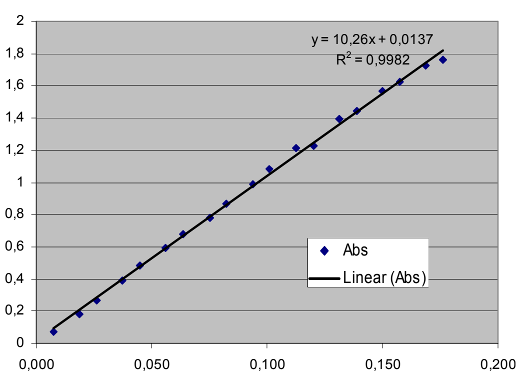

Figure 2. DPPH calibration curve

For quantify the antioxidant activity reaction speed was determined as the ratio between DPPH concentration derived as a function of time, according to equation [15]:

$$v = \Delta c/\Delta t$$

When the reaction speed of the analyzed extract with DPPH solution is greater, the antioxidant activity is better.

3. Results and Discussion

3.1. Vitamin C level

In Tables 1 and 2 (Figures 3 and 4) are the results on vitamin C content of raw materials and extracts.

Table.1. Vitamin C content of raw materials

Sample	Vitamin C content (mg /100g)
Orange pulp	984.00
Plum	870.16

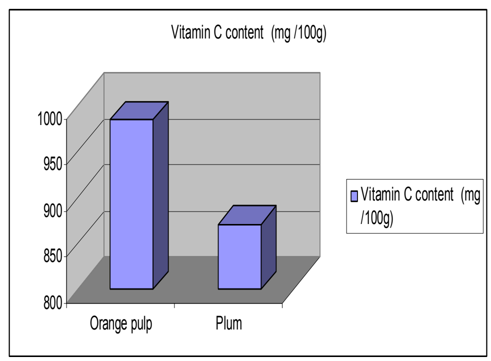

Figure 3. Vitamin C content of raw materials

It notes that orange pulp, *Valencia* variety, is richer in vitamin C (984.00 mg/100g) than plums, *President* variety (870.16 mg/100g). Both fruits presents a high content of vitamin C, according to literature data [10-12].

Table 2. Vitamin C content of fruits extracts

Sample	Sample code	Vitamin C (mg/100ml)
Orange aqueous extract	O.aq.extr	44.03
Orange alcoholic extract	O.alc.extr	26.42
Orange acetonic extract	O.ac.extr	52.84
Plum aqueous extract	P.aq.extr	35.22
Plum alcoholic extract	P.alc.extr	33.29
Plum acetonic extract	P.ac.extr	36.42

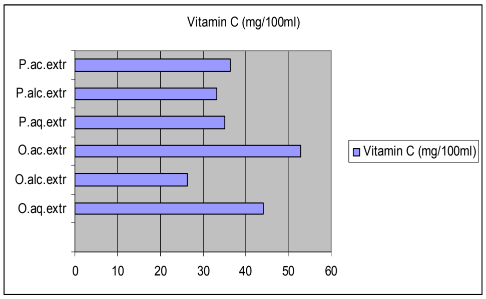

Figure 4. Vitamin C content in fruits extracts

Between obtained extracts is noted that those in acetone are the richest in vitamin C, followed by those in water and then the alcoholic extracts. The highest concentration of ascorbic acid was determined in acetone extracts of orange pulp (52.84 mg/100ml). Lowest content of vitamin C was recorded for alcoholic orange pulp extract (26.42 mg/100ml).

3.2. Antioxidant activity

The results concerning antioxidant activity of the samples, expressed by the average reaction speed of DPPH reaction, in µM/s, are presented in the table 3 (figure 5.). Values were calculated using calibration DPPH curve and Microsoft Excel programme, on basis of the spectrophotometric curves recorded on for each sample (figures 6-11).

Table 3. Average reaction speed of DPPH in the presence of the analized sample

Sample code	**Dilution**	**v (µM/s)**
O.aq.extr	1:100	3.383
O.alc.extr	1:100	2.007
O.ac.extr	1:100	3.886
P.aq.extr	1:100	2.514
P.alc.extr	1:100	2.449
P.ac.extr	1:100	3.308

It can be seen from the above values, that the acetone extract of orange, which has the highest content of ascorbic acid, has the strongest antioxidant activity (the highest reaction speed of DPPH solution in the presence of this extract: v=3.886 µM/s) and the lowest antioxidant activity is where alcoholic extract of orange (v=2.007 µM/s), which presents the lowest concentration of vitamin C.

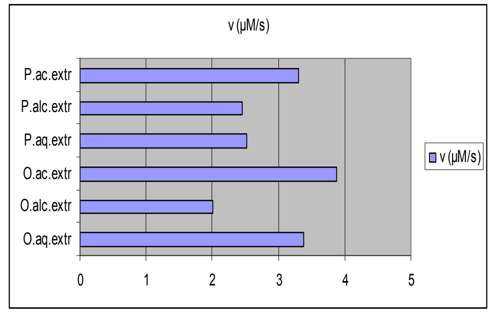

Figure 5. Average reaction speed of DPPH in the presence of the analized sample

Acetone extracts of each type of fruit, which have the highest concentration of ascorbic acid, are those showing the highest antioxidant activity, in all analyzed samples ascertaining the relationship of direct proportionality between the content of vitamin C and antioxidant activity.

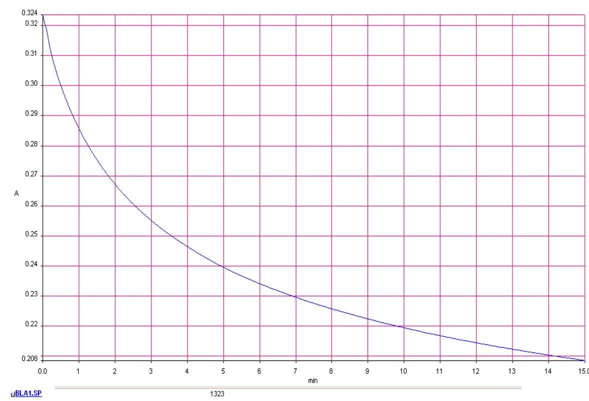

Figure 6. Time variation of the DPPH 1mM solution in the presence of orange pulp aqueous extract diluted 1:100

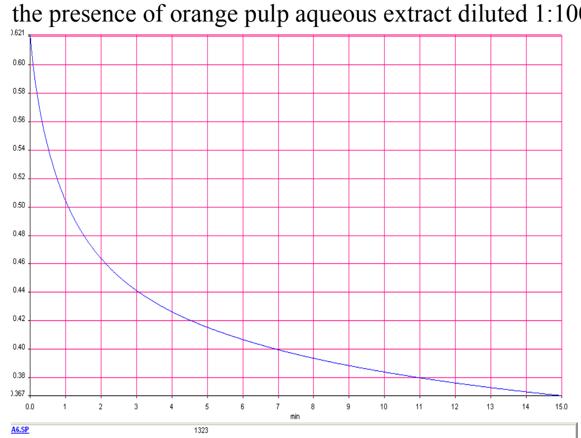

Figure 7. Time variation of the DPPH 1mM solution in the presence of orange pulp alcoholic extract diluted 1:100

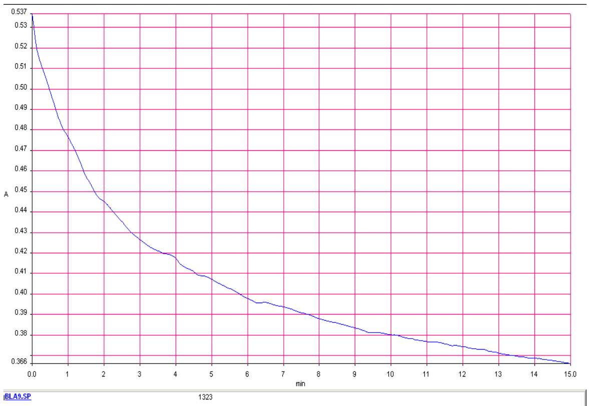

Figure 8. Time variation of the DPPH 1mM solution in the presence of orange pulp acetonic extract diluted 1:100

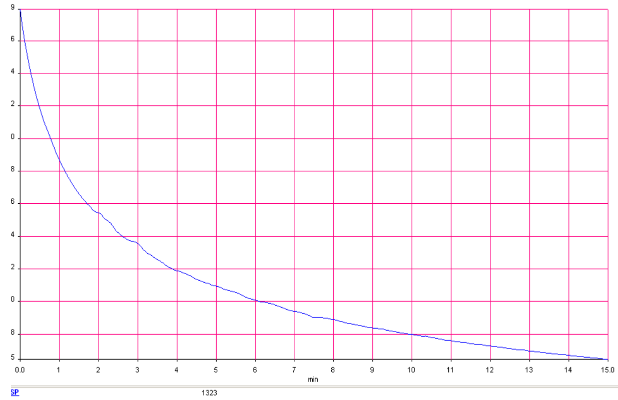

Figure 11. Time variation of the DPPH 1mM solution in the presence plum acetonic extract diluted 1:100

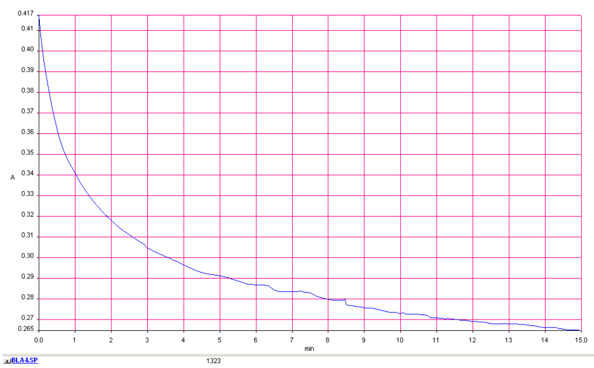

Figure 9. Time variation of the DPPH 1mM solution in the presence of plum aqueous extract diluted 1:100

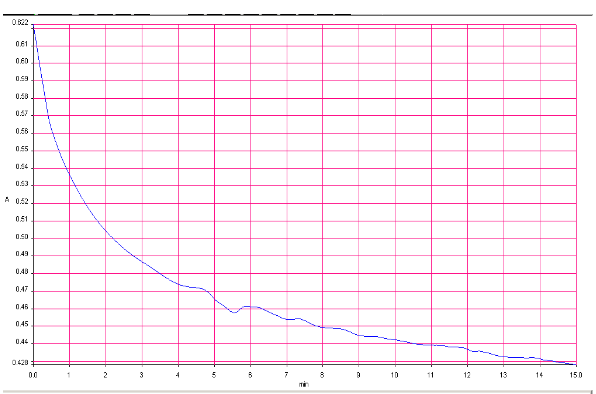

Figure 10. Time variation of the DPPH 1mM solution in the presence plum alcoholic extract diluted 1:100

4. Conclusion

This paper aimed to determine the concentration of ascorbic acid in orange fruits and plums as well as in aqueous, alcoholic and acetonic extracts obtained from them, simultaneously determining the antioxidant activity of these extracts, to establish a correlation. Based on these results we can say that: (1) Ascorbic acid contnt in orange pulp, *Valencia* variety, is slightly higher than that of plums, *President* variety; (2) Between the obtained fruits extracts is noted that those in acetone are the richest in vitamin C, followed by those aqueous and then the alcoholic extracts; (3) Acetone extract of orange pulp, which has the highest content of ascorbic acid, has the strongest antioxidant activity. The lowest antioxidant activity is in the case of alcoholic extract of orange pulp, which presents the lowest concentration of vitamin C; (4) In all analyzed samples was a direct proportional relationship between ascorbic acid content and antioxidant activity.

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